UNIVERSITY OF
CAMBRIDGE
Department of Land Economy

Environmental Economy and Policy Research

Discussion Paper Series

How Sustainable are Sustainable Development Programs? The Case of the Sloping Land Conversion Program in China.

by

Dr. Pauline Grosjean	Dr. Andreas Kontoleon[1]

2007

Number: 26.2007

How Sustainable are Sustainable Development Programs? The Case of the Sloping Land Conversion Program in China[1]

Dr. Pauline Grosjean
LERNA, University of Toulouse and European Bank for Reconstruction and Development, grosjeap@ebrd.com.

Dr. Andreas Kontoleon[2]
Department of Land Economy, Cambridge University
ak219@cam.ac.uk

Abstract:

This paper undertakes a direct comprehensive assessment of the long-run sustainability of one the world's largest sustainable development programs, the Slopping Land Conversion Program (SLCP) in China under different plausible post-SLCP scenarios. The analysis is based on farmer contingent behavior post-program land and labor decisions as well as choice experiment data. Our econometric results highlight the main obstacles to the program's sustainability, which include specific shortfalls in program implementation as well as certain institutional constraints such as tenure insecurity, poor land renting rights, limited access to credit and limited land management rights.

Keywords: sustainable development programs, sustainability, recursive probit, choice modeling, Asia, China

[1] We would like to acknowledge the financial support of the China Council for International Cooperation on Environment and Development as well as the assistance of the School of Environmental Sciences of Beijing University in implementing the survey used in this paper. We are also grateful for the comments received by Prof. Jeff Bennett, Dr. Ben Groom, Prof. David Pearce, Prof. Tim Swanson, Prof. Jerry Warford, Prof. Jintao Xu, and Prof. Shiqiu Zhang.
[2] Corresponding author: Dr. Andreas Kontoleon, University of Cambridge, Department of Land Economy, 19 Silver Street, Cambridge CB3 9EP; United Kingdom; Tel: +44 1223 339773; Fax:+44 1223 337130; E-mail: ak219@cam.ac.uk

1. Introduction

There is quite a voluminous and well established theoretical and empirical literature on household behavior in developing countries that describes how market and institutional imperfections drive inefficient allocation choices, which, in turn, are the common factors contributing to both poverty and environmental degradation (De Janvry & Sadoulet, 2005; Groom *et al.,* 2006; Jacoby, 1993; Key *et al.,* 2000). For example, failures in the off-farm labor market (due to institutional factors such as insecure land rights, inability to access credit, high transactions costs or lack of local public goods) prevent households to access income-enhancing off-farm activities and constrains them to oversupply labor on farm. Such constrained, excess on farm labor has been shown to be associated with high levels of forest-land conversion which lead to both economic hardship and to negative environmental externalities (Bowlus & Sicular, 2003; Feng *et al.,* 2004; Groom *et al.,* 2006; Uchida *et al.,* 2005). Similarly, land right imperfections have been shown to undermine land quality investment incentives and provoke land degradation (Carter & Olinto, 2003; Deininger *et al.,* 2003; Feder et al, 1990; Li *et al.,* 1998). This 'diagnosis' has motivated various policy responses that aim at killing two birds with one stone: by addressing the common roots of poverty and environmental degradation, it is anticipated that households will be lifted out of inefficiency traps and steered towards a more sustainable development path. Such policy measures normally provide direct or indirect financial incentives (usually in the forms of subsidies or royalty payments) to local communities in order to induce changes in their land and labor allocation choices and include land set aside and agri-environment programs, community based conservation schemes as well as so called Integrated Conservation and Development Programs (Abbot *et al.,* 2001; Adams *et al.,* 2004; Cernea & Schmidt-Soltau, 2006). Though such 'sustainable development programs' come in various guises they have one common feature: the duration of the financial incentives or subsidies provided is finite as the aim is to induce a structural economic change at the local level such that this 'win-win' objective of poverty alleviation and environmental improvement becomes self-sustainable.

The immediate silver bullet attraction of such programs lead to their proliferation by many aid organizations since the mid 1990's, (Hughes & Flintan, 2001). Given the significant funds and attention that these programs have received, there has been evident interest in investigating to what extent they have been meeting their dual objective of addressing environmental externalities and economic development. This has sprung an extensive empirical policy evaluation literature of such programs. Some of this work has focused on examining the impact of such programs on household income, on household land and labor allocation decisions as well as on the environmental externalities the programs sought to address (Duflo & Kremer, 2003). The data used in these analyses mostly comes from surveys that collect information over household behavior before and during the program. Though these studies provide useful information over the implementation of these programs, they are not particularly useful for assessing their *long-term viability or sustainability*, that is, how participating households will be affected *after* the specific program ends. Such an analysis can be undertaken by using household surveys that include direct contingent behavior questions over household post-program behavior (e.g. Johnson *et al.,* 1997). Further, most evaluation studies provide an assessment of the *gross* policy impact and thus do not adequately discern which particular attributes of a given policy are relatively more effective in generating the desired changes in allocative behavior. They are, thus, not very informative over any auxiliary improving measures that policy makers can adopt *during* the program nor over the optimal design features of a viable and cost effective potential follow-up program *after* the current one expires. Addressing this issue would require a detailed analysis of the impact of individual attributes of a program, which represents an empirical challenge in the absence of sufficient randomization of program attributes among households. In the absence of such data, analysts may use stated preferences choice modeling techniques which are suitable for assessing the relative importance of different program attributes (Louviere *et al.,* 2000).[1]

This paper attempts to address this limitation in the current literature by providing a comprehensive direct assessment of the sustainability of one of the largest sustainable development programs currently under implementation in the developing world, the called Sloping Land

Conversion Program (SLCP) in China, - a program that simultaneously attempts to address rural poverty and externalities from deforestation. Our analysis uses both contingent behavior and choice modeling data obtained from household and village leader surveys undertaken in two provinces in China. The data allows us to assess the program's sustainability under three plausible mutually exclusive post-program scenarios: the case when the current program is renewed in its current form, when the program is terminated altogether and when a new program is introduced. By adopting such a direct *ex ante* assessment of the SLCP, the analysis is able to identify which policy characteristics warrant more attention in the post-SLCP period as well as which households should be targeted so that the dual objective of the program can be attained in a long lasting and cost-effective manner. Further, the use of a choice modeling approach reveals unique evidence on farmers' preferences over land tenure reform currently underway in China.

The paper is organized as follows. Section 2 briefly describes the SLCP and discusses the framework adopted for directly assessing its sustainability using contingent behavior post program land and labor allocation data as well as choice modeling data. Sections 3 and 4 present the econometric framework adopted for analyzing these two types of data as well as the results of the empirical analysis. Section 5 concludes.

2. A framework for a direct assessment of the sustainability of the SLCP

The common lineage of rural poverty and environmental degradation has been particularly well documented in the case of China. Institutional and market failures inherited from central planning policies biased towards industrialization (Wang *et al.,* 2004) have constrained farmers into inefficient production choices, characterized in particular by high land-labor ratios and a low level of agricultural and land savings investments (Jacoby *et al.,* 2001). More specifically, several authors (e.g. Feng *et al.*, 2004; Xu & Cao, 2002) have highlighted the oversupply of on-farm labor and the inaccessibility to off-farm labor market opportunities as major driving factors for both rural poverty as well as the cultivation of marginal, low yield, highly sloped lands. In fact, extensive cultivation of previously forested sloping lands in the upper reaches of the Yangtze, Yellow, Chao

and Bai Rivers has induced severe environmental degradation in the corresponding river-basin in recent years (Hayes & Nadkarni, 2001). At its extreme this culminated in serious flooding and loss of life along the Yangtze River in the summer of 1998 (Uchida *et al.*, 2005; Wang *et al.*, 2004). In 2000, the Chinese government formally introduced the Sloping Land Conversion Program (SLCP), an ambitious ten year program that aims at converting 32 million hectares of sloped land into forest land. The SLCP has a budgetary outlay of over US$30 billion and will affect 60 million households making it one of the largest land-set aside programs in the world (CCICED, 2006; Xu *et al.*, 2006).

The program has the dual objective of curtailing environmental degradation as well as reducing the extent of rural poverty. To this end, it provides participating households a combination of grain, cash and seedlings as compensation for reforesting and maintaining cultivated sloped land in the upper reaches of the major river basins (Xu *et al.*, 2004). SLCP participants receive approximately 100 to 150 kilograms of grain per mu[2] per year and an additional cash subsidy of around ¥20/mu/year[3]. The total value of compensation received lies between ¥200 and ¥300 /mu/year. Compensation levels vary from region to region reflecting differences in the opportunity costs of reforested land. Receipt of SLCP subsidies is conditional on passing regular inspections that the reforested areas are maintained. The duration of the compensation depends on whether the specific sloped plot of land is converted to 'ecological' or to 'commercial' forest. In the former case, land is replanted with trees that serve mainly an ecological function (namely soil retention) while farmers have no rights to the forest products that could be derived from such trees. In this case compensation can be obtained for up to eight years. In the latter case, participants are granted the rights to collect non-timber forest products, so that there is potential for the farmer to replace income lost from reduced cultivation of crops once the trees become productive. Compensation under this case lasts for a shorter period of up to 5 years. A minimum of 80% of the reforested area in any given region must nonetheless consist of ecological forest, reflecting concerns that commercial trees may have sufficiently inferior soil retention characteristics.

Groom *et al.* (2006) present a household production model which shows how, under certain conditions, the provision of the SLCP subsidies may enable participants to reallocate labor towards

more lucrative off-farm activities, and thereby break out of an inefficient equilibrium characterized by on-farm surplus labor and excess forest land conversion. Whether the program is in fact achieving its long term goals is nevertheless not clear. Though there are a few empirical studies that have gained some understanding over the track record of the SLCP during its implementation there is very little appreciation over the long term viability of the program's ecological and developmental aims after the program expires in 2010. Given the limited duration of the program it is important to gain an appreciation of whether the huge budgetary outlay spent will in fact lead to long-lasting and self-sustaining benefits.

Some preliminary evidence from the work by Bennett *et al.* (2004), Groom *et al.* (2006), Uchida *et al.* (2007) and (2005), Xie *et al.* (2005) and Xu & Cao (2005) suggests that the SLCP impact on participating household income levels and on shifts to non-crop related income generating activities (such as off-farm labor or livestock activities) are not sufficient to make a substantial and long lasting change to pre-program production decisions. Further, various program implementation issues that have been observed such as the often involuntary nature of the program, the poor quality and often irregularity of the compensation payments, the inadequate training and support to local farmers in replanting and maintaining trees and the inappropriateness of some of the plots targeted for inclusion in the program have undermined the long term viability of the program (CCICED, 2006; Xu and Cao, 2002). Moreover, the work by Groom *et al.* (2006) indicates that half-way through the current SLCP, market and institutional constraints (primarily incomplete property rights and high transactions costs) still constitute serious impediments to the reallocation of labor towards off-farm activities and thus remain the main contributors to the vicious circle of inefficient production processes, poverty and environmental degradation. However, though the results from the aforementioned studies provide useful information over the implementation of the current SLCP and to some extent some *indirect* evidence over its viability, they provide insufficient direct insights over its long term sustainability. We therefore turn instead to a more *direct* assessment of household behavior, intentions and preferences under the three plausible and mutually exclusive alternative post-SLCP scenarios: where the program will be

renewed in its current form, where the program will be terminated and where a different and new program will be introduced.[4]

Our analysis is based on data obtained from a purposefully designed survey that was implemented in two provinces: Ningxia, situated in northwest China into the middle reaches of the Yellow river, and Guizhou, located in the southwest, on the reaches of the Yangtzee River. Both household and village level data were collected via in person interviews. Household data was collected for both SLCP participants and non participants. In total 286 households in 44 villages were surveyed.[5]

The assessment of the SLCP under the first two polar scenarios (i.e. subsidies renewed and subsidies terminated) was undertaken by analyzing the determinants of responses to contingent behavior questions over household land and labor allocation choices. Focusing on *both* labor and land allocation intentions of participating farmers is essential in order to investigate the sustainability of the SLCP's double ecological and economic objective. Reforested land allocation intentions are the major determinant of the ecological success of the program, while labor allocation choices and in particular the ability to reallocate surplus labor away from farming are essential determinants of rural poverty alleviation. Indeed, the remarkable reduction of poverty in China over the last two decades, falling from 76% to 13% has been largely achieved through increases in rural incomes, which are mainly due to the reallocation of rural labor away from farming towards off-farm activities (De Janvry *et al.*, 2005; Park *et al.*, 2002).

We then used a choice experiment (CE) to analyze the sustainability of the objectives of the SLCP under the third plausible post-program scenario, namely that of a new program being introduced. Respondents were requested to select their preferred policy option from a range of potential hypothetical land set aside policies that differed with respect to the levels assigned to different policy attributes. After a detailed literature review as well as a series of consultations and pilot tests, five policy attributes were selected for the design of the CE. These include two attributes reflecting direct pecuniary benefits accruing from subsidies received and from the revenues obtainable from commercial exploitation of replanted trees. The former of these attributes

('subsidy amount') was expressed in ¥/year/Mu while the latter ('commercial forest') as the percentage of land that each household would be allowed to plant with commercial trees. Two further policy attributes that were included in the CE design were whether a new program would entail enhanced land tenure and exchange rights, which have been widely shown to be essential determinants of agricultural and labor allocation choices in the context of China (Carter & Yao 1999; Jacoby *et al.*, 2002; Li *et al.*, 1998 and 2000; Deininger & Jin 2002, Deininger *et al.*, 2002; Groom *et al.*, 2006). In particular, insecure land rights may discourage households from committing to land quality investments (such as the maintenance of reforested trees) while they may also constrain household members from seeking more profitable off-farm employment opportunities due to the fear of loosing unused land. Therefore it is expected that land tenure and exchange rights should impact upon the likelihood of enrolling into a new SLCP. The former of these rights was proxied by whether or not land *redistribution* on reforested land was permissible ('land tenure') while the latter by whether or not land *renting* restrictions were present ('land renting'). A fifth and final program characteristic reflected the level of household confidence in the implementation of the program. The specific proxy attribute chosen was the degree of assurance offered to households of receiving the program subsidies in a timely and consistent manner ('subsidy assurance'). Our focus group sessions and consultations revealed that many households expressed distrust in the capacity of authorities to provide the promised amount of subsidies. Further, Xu *et al.* (2004) also report that in many regions compensation payments have not been (either completely or partially) delivered to their rightful recipients, due to delays and shortfalls in the payment of compensation. Further, the grain subsidies offered has been often reported to be of very poor quality. Hence, '*subsidy assurance*' was considered to be a major determinant of whether households would be willing to sign up and to comply with a new program. The description of the CE attributes and levels as well as their expected impact on household utility are presented in Table 1. An orthogonal fractional factorial design was used to allow the estimation of all main effects of the attributes (Louviere *et al.*, 2000). The resulting subsets of 32 choice sets were (randomly) blocked into four sets and each household was presented with eight sets. Each choice set presented

respondents with two policy options, each having a 30 year duration, and a third option which corresponded to having no land set aside policy (the current post SLCP status-quo option).

[INSERT TABLE 1 ABOUT HERE]

3. Analysis of post-SCLP intentions of labor and land allocation choices

We first analyze the responses to post-SLCP contingent behavior land and labor decisions under the two polar scenarios where the program is either renewed in its current form or it is altogether abandoned.

3.1. Econometric framework for analyzing land and labor decisions

The dependant variables being modeled here are binary in that the households' were asked whether they intended to increase/maintain or decrease their on-farm labor and their reforested land in the two polar post-SLCP scenarios. In the case where subsidies are renewed 73% of farmers stated that that would sign up to the program and maintain/increase reforested land while 41% stated that they would also decrease their on farm activities. In the other polar case where subsidies were terminated, only 38% of farmers stated that they would continue to maintain their reforested lands while 67% stated that they would increase their farming activities. Econometrically, the likely interdependence of on-farm labor and land allocation decisions can be accounted for in two ways. Firstly, economic theory supports a simultaneous relationship between household labor and land allocation decisions (e.g. see Ahituv & Kimhi, 2005; Feder et al 1990, Huffman & Evenson, 2001).[6] Secondly, factors not accounted for in the non-random (observed) part of the econometric model may be influencing both decisions. This implies that the error terms in the equations of each of these two decisions may also be correlated. Failure to account for possible simultaneity as well as for correlation in unobserved heterogeneity may lead to biased and inconsistent parameter estimates (Greene, 1998). To account for these likely complementarities we employed the bivariate (recursive) simultaneous equation model initially suggested in Maddala (1983). In its more general form the model can be presented using the latent variable approach whereby latent land and labor

post-SLCP decisions are each a function of exogenous explanatory variables as well as of each-other, producing a system of equations of the generic form:

$$y_1^* = \gamma_1 y_2^* + \beta'_1 \mathbf{x}_1 + \varepsilon_1$$
$$y_2^* = \gamma_2 y_1^* + \beta'_2 \mathbf{x}_2 + \varepsilon_2 \qquad \textbf{(1)}$$

Where latent post-SLCP labor (y_1*) and land (y_2*) decisions are determined be each-other and $\mathbf{x_1}$ and $\mathbf{x_2}$ are vectors of explanatory variables while β'_1, β'_1, γ_1, and γ_2 are the corresponding parameter vectors and the ε_1 and ε_2 are the errors terms that may or may not be correlated. There are various formulations of this model based on various censoring mechanisms, on whether or not and in what manner the latent continuous variable y_j^* or its non-latent censored or discrete counterpart, y_j, is observed and on whether the error terms are correlated (Lewbel, 2006). Based on the data generating process in our study, the formulation most relevant in this paper is one where the continuous latent variables are observed in binary form. Further, the simultaneity relationship adopted is based on the work by Groom *et al.* (2006) who use a standard household production model under binding constraints related to land use and production requirements, and show how, for the case of Chinese rural communities affected by the SLCP, household labor allocation decisions are residual upon land allocation decisions, when both the enrolment into the SLCP and the amount of land enrolled are exogenous to each household (a situation that mostly characterize our study sites)[7]. Hence, the nature of the model (in reduced form) that is most relevant for our data would be:

$$y_1 = \delta_1 y_2 + \pi'_1 \mathbf{x}_1 + \upsilon_1 = 1 \text{if } y_1^* > 0$$
$$y_2 = \pi'_2 \mathbf{x}_2 + \upsilon_2 = 1 \text{if } y_2^* > 0 \qquad (2)$$

Where δ_1 is the parameter of the reported binary land allocation decision, y_2, that enters the specification the labor allocation decision, y_1.The parameters π_1 and π_2 correspond to the vector of explanatory variables $\mathbf{x}_1$ and $\mathbf{x}_2$ of each decision and υ_1 and υ_2 are the error terms of each

equation that account for all unobserved heterogeneity that may influence the observance of y_1 and y_2. If factors determining unobserved heterogeneity are correlated then the random variables υ_1 and υ_2 follow a bivariate distribution such that $\upsilon_1, \upsilon_2 \sim$BVN $[(0,0), \sigma_1^2, \sigma_2^2, \rho]$ where σ_1^2 and σ_2^2 are the standard deviations and ρ the correlation coefficient. The above recursive model involving binary dependent variables was estimated via FIML as suggested in Greene (1998).

3.2. Specification of bivariate simultaneous equation model.

The dependent variables consist of binary responses to questions ascertaining household intentions of use of forested land ($LAND_j$) and of on-farm labor allocation (*Labor*) under the two polar post SLCP scenarios ($j=1,2$) where subsidies are simply renewed in their current form and duration ($j=1$) or they are terminated all together ($j=2$). In both scenarios, *Labor* =1 if the household stated that they intended to reduce on-farm activity while $LAND_j$ =1 when the household intended not to reconvert forest back to crop land. Hence, the binary dependent variables have been specified in such a way where equality to one implies household behavior that would promote the sustainability of the impacts of the SLCP.

Explanatory variables that were included in $\mathbf{x}_1$ and $\mathbf{x}_2$ in (2) were determined on the basis of the theoretical framework in Groom *et al.* (2006) as well as on past applied econometric research on farmer land and labor decision in China (e.g. Bowlus & Sicular 2003; Jacoby *et al.*, 2002; Li et al., 2000; Uchida *et al.*, 2005). Firstly, post-SLCP *land* allocation decisions ($LAND_j$) will depend on a comparison of the profitability of alternative land uses and hence the opportunity cost of land (proxied here by its agricultural productivity AGPROD). Secondly, the direct and indirect benefits associated with reforested land will also impact on the land allocation decision. Direct benefits include the direct monetized SLCP income SLCINC, (in the scenario where the program is renewed) and the estimated commercial value of products derived from land reforested under the program (COMVALUE). Indirect benefits refer to positive environmental benefits accruing from improved land quality (such as protection against floods - DFLVAL). Thirdly, the way in which the program is implemented will also impact post-program land decisions. For

example, the quality of the seedlings and grain subsidy received (SGQUALITY), or whether the program provided households with the expertise and know-how of how to plant and manage trees (PLTMNG) may impact the likelihood of a household being willing to maintain its reforested land.

Moreover, as trees are interpreted as an investment in land quality (Deininger & Jin, 2002; Li *et al.*, 2000), traditional determinants of land investment must be included in the specification of (2). Such variables include household characteristics (such as human capital) and land rights, in particular land tenure and exchange rights. Human capital was proxied by several household variables, including average household age (AGE) and different household educational variables, including the education level of the spouse of each household (EDUSPOUSE), which has proven to be a relatively more telling variable for the level of diffusion of social and human capital within a household (Ahituv & Kimhi, 2005). Following Li *et al.* (2000) and Deininger & Jin (2002), tenure security is proxied through village level rating (obtained from the village leader survey) of the likelihood of land reallocations on farmers' land endowments (TENSEC) but also on reforested land enrolled in the program (FORIGHT). The introduction of this variable is justified by the concern raised by farmers during our interviews about the future allocation of land rights over reforested land. The degree of freedom in land transfers (RENTEASE) is assessed through a dummy variable, which takes the value 1 if renting land is not submitted to administrative procedures or prohibited. Lastly, geographical differences are also likely to impact land decisions hence a regional dummy was include such that PROVINCE=1 if the household came from Guizhou and '0' if from Ningxia.

With respect to the determinants of post-program *labor* allocation decisions ($LABOR_j$) in the context of institutional and market imperfections that characterizes rural China, such choices are likely to be constrained by the presence of such failures, and in particular by imperfect land rights and high labor market access transaction costs. Land rights were proxied by the variables defined above (TENSEC, FORRIGHT, RENTEASE) while the indicators for transaction costs included the travel costs to off-farm labor market (TVLCST) and the presence of a local employment centre (EMPLC). We also included the percentage of villagers from each village supplying off-farm labor

(PRCOFFL) in order to capture likely network effects as well as overall village-specific off-farm labor constraints. In addition, more standard variables found in labor supply functions were included in the analysis such as the degree to which a household has diversified its labor into other income generating activities such as livestock production (LIVSTCK), the value of their assets (LNAGMACH), household education (which proxies for off-farm wage) and household average age. Lastly, in accordance with Equation (2), the stated post-SLCP land decision (LAND) was also included as a regressor to account for this particular form of simultaneity between land and labor choices.

3.3. Results of the bivariate simultaneous equation model

Table 2 presents the best-fit results of the recursive bivariate model under the two polar post-SLCP scenarios, namely the business as usual scenario where subsidies are continued and the scenario where subsidies are terminated. These results were derived using a top-to-bottom approach coupled with sequential LR-tests to obtain the most parsimonious specification. Both estimated models display a satisfactory fit to the data with 78% of y_1 and 83% of y_2 responses correctly predicted in the first scenario and correspondingly 82% and 86% in the second scenario. The McKelvey-Zavoina R^2 is 48% and 53% respectively. Also, the correlation coefficient of the error terms of the two decisions is large and highly significant in the scenario where subsidies are renewed but insignificant when subsidies are terminated.[8]

[INSERT TABLE 2 ABOUT HERE]

Due to the non-linear nature of the estimated model, the raw coefficients (shown in column 1) cannot provide an accurate measure of the determinants of the dependent variables. This requires the estimation of the true *marginal effects*. Using the terms of Equation (2) this translates in assessing the impact on the conditional expectation of y_1 and y_2 from a change in an explanatory variable in $\mathbf{x}_1$ and $\mathbf{x}_2$. Note that as we are using a recursive model where y_2 enters as a regressor of y_1, we must calculate the *total* marginal effect of a change in each of the explanatory variables in $\mathbf{x}_1$ and $\mathbf{x}_2$ on the expectation of y_1. This total effect comprises of the *direct* effect of a change in

each variable appearing in $\mathbf{x}_1$ on the expectation of y_1 plus the *indirect* effect of a change in the variables appearing in $\mathbf{x}_2$ on the conditional expectation of y_1 through the presence of y_2 as a regressor of y_1. Marginal effects were calculated as specified in Greene (1996 and 1998) and are presented in columns 3-5 and 9-11 of Table 2 for both post-SLCP scenarios. Asymptotic standard errors of the marginal effects were estimated using the Delta Method.

Examining **Table 2** our results first confirm the unidirectional simultaneity relationship between land and labor allocation decisions discussed above.[9] In fact in both scenarios the LAND variable appears to be associated with the strongest marginal effect. This finding corroborates that the ecological and economic goals of the SLCP are strongly intertwined and jointly affect the sustainability of the SLCP. The remaining marginal effects illustrate the precise factors which contribute to such sustainability.

With respect to the determinants of post SLCP land use decisions, we see that in the case where subsidies are renewed the probability that households will retain the forested lands is mainly determined by the quality of the grain and seedlings (SGQUALITY) received under the current SLCP. This confirms previous observations that shortfalls in the quality of compensation may jeopardize future confidence in any renewed program (Xu *et al.*, 2005). Similarly, whether households were involved and trained in the planting and managing of trees (PLTMNG) also plays a vital role in maintaining reforested lands. The appointment of external teams to plant and manage trees was often used by implementing local authorities in order to divert subsidies away from participating households, a practice that has been received with resentments by local communities (Xu *et al.*, 2004). The quality of program targeting is reflected by the opportunity cost of enrolled land (AGPROD), which also significantly increases the probability of land re-conversion in both scenarios. The effect of the actual subsidy amount (SLCPINC) on the commitment to maintain reforested lands is also important but not to the degree reported in other studies (e.g. Bennett *et al.*, 2004). Instead we find that gaining household support and confidence in the quality of the implementation of the program as well granting a greater degree of autonomy and ability in

managing reforested lands have a relatively larger impact on enhancing adhesion to the SLCP's ecological goals.

In the scenario where subsidies are terminated and no replacement program is instated, the most influential marginal effect on a household's land decision is associated with the expected commercial value of the planted trees (COMVALUE) together with enhanced tenure security over reforested lands (FORRIGHT) as well as having fewer restrictions on renting land (RENTEASE). The policy implications of this finding is clear: the type and quality of trees that is selected for reforestation has to be reassessed while the rights for using these trees must be enhanced in order to increase the likelihood that reforested lands are maintained in the post-SLCP period. Also, these results suggest that ensuring that households make land decisions which internalize environmental externalities in a long last manner requires broader property right reform which includes enhancing rental rights and more secure tenure.

Turning to the determinants of labor allocation intentions we see that household education (as a proxy for the wage rate) as well as agricultural productivity play a prominent role in inducing lower on-farm labor in the post SLCP period under both scenarios. This provides an indication of the internal consistency/validity of our results in that this finding is a basic postulate of economic theory. Focusing next on the differences with respect to the marginal effects between the two scenarios we can discern two main patterns. Firstly, in the business as usual scenario, the important role played by access to a local employment centre (EMPLC) highlights the importance in helping local communities overcome sources of transaction costs in seeking more profitable off-farm employment opportunities. Secondly, the quality of seedlings and grain provided as subsidies (SSGOOD) as well as enhanced involvement in planting and managing reforested lands (PLTMNG) are prominent determinants of labor allocation intentions in the post SLCP business as usual case. This result underlines the importance of proper policy implementation in order to generate wider community confidence in pursuing and committing to alternative development/productive paths that can eventually emancipate households from the current vicious circle of poverty and environmentally harmful production decisions. In contrast, we see that labor

allocation decisions in the post SLCP scenario where subsidies are terminated are (uniquely) influenced by tenure security over a household's land (TENSEC), usage rights over planted trees (FORRIGHT), renting rights (RENTEASE) and labor mobility transactions costs (PRCOFFL and TVLCST). These findings provide evidence that more secure tenure induces households to decrease farming activity, which in turn may likely free labor towards off-farm activities. One explanation for this finding is that insecure tenure induces households to inefficiently over-supply labor on farm as their incentives to engage in off-farm activities are dampened by the increased risk of losing (uncultivated) land in subsequent land reallocations (Yao, 2001). Similarly, the impossibility to sell, mortgage or rent land represents a further obstacle to off-farm labor supply.

The prominence of property rights in the scenario where subsidies are terminated could be attributed to the fact that households associate this scenario with a longer term period. Hence, land rights reform is seen as vital in the long term while policy implementation is more vital in the short term. As the subsidy termination scenario is ultimately the long term scenario that people do expect at some point the need for land right reform becomes an obvious pre-requisite for making the impacts of the SLCP long lasting.

4. Analysis of stated preferences over alternative post-SLCP programs.

We now turn to the assessment of the sustainability of the objectives of the SLCP under the scenario where a new program is introduced by presenting the results from the analysis of the choice experiment data.

4.1. Econometric framework for analyzing choice experiment data.

The econometric model employed was the random parameter logit (RPL) model which allows us to account for preference heterogeneity across households within a random utility modeling framework. (McFadden & Train, 2000). The random utility function with random parameters is given by:

$$U_{jtn} = V_{jtn} + \varepsilon_{jtn} \equiv \beta'_{nk}\mathbf{x}_{jtnk} + \delta'_{k} z_{n}\mathbf{x}_{jtnk} + \varepsilon_{jtn} \qquad (3)$$

Where household n (n=*1…N*) obtains utility *U* from choosing alternative j (j=*A, B, C*) in each of the choice sets *t* (t=1…8) presented to them. The utility is decomposed into a non-random component (*V*) and a stochastic term (ε). In its most simplest form the non-random component is assumed to be a function of the vector of *k* choice specific attributes $\mathbf{x}_{jtnk}$ with corresponding parameters β_{nk} which, due to preference heterogeneity, may vary (randomly) across respondents *n* in accordance to some joint density function with mean β_k and standard deviation σ_k.[10] The household will choose the policy option, *j*, which yields a higher utility compared to any other option in each choice set.[11] In our case the vector $\mathbf{x}_{jtnk}$ includes five attributes (renting, subsidy assurance, land tenure, percentage of commercial forest and subsidy amount) as well as an alternative specific constant (ASC), which takes on the value of 1 when the individual choose a program over the status quo option (choose no program). The ASC captures all other attributes erroneously omitted from $\mathbf{x}_{jtnk}$ and also reflects the utility derived from choosing to participate into the SLCP keeping all other attributes at their status quo levels.

The *sources* of preference heterogeneity can be explored by introducing household specific characteristics, z_n. As these variables do not vary across choices they would drop out of the probability so their inclusion into the model can be made possible by interacting them with the choice varying attributes $\mathbf{x}_{jtnk}$. In our case we interact z_n with the ASC of the model. By including such interaction terms we can examine the household characteristics that affect the likelihood of participation in the new SLCP.[12] Hence, the RPL model specified in (3) will be able to pick up two types of variation in preferences. A systematic *conditional* type of preference heterogeneity, the source of which can be identified in household characteristics, in z_n and a random, unconditional and unobservable type of taste heterogeneity as captured by σ_k of the distribution of each random parameter β_{nk} .

Ultimately the estimation of CE data using the RPL approach provides various unique estimates that are directly relevant to assessing the sustainability of different alternative SLCP

programs. First the model allows us to assess the determinants (program, village and household specific) of choosing alternative SLCP programs. Next we can assess the change in the probability of choosing to enroll into the SCLP as a function of program, village and household specific characteristics. These are the so called 'marginal effects' of each variable in **x** and **z,** that is $\partial \Pr(ASC = 1)/\partial x_k$ and $\partial \Pr(ASC = 1)/\partial z_n$. We can further estimate the entire probability density function for participation into a new SLCP for different subsidy levels. Lastly, we can estimate the marginal consumer surplus (i.e. marginal willingness to accept or implicit price) associated with specific changes in policy characteristics as well as the total consumer surplus (i.e. total willingness to accept) from changes in program profiles from the status quo option of no program. In cases where the parameter of a specific attribute has been found to be random and if we assume that $\beta_{subsidy}$ proxies for the marginal utility of income and is fixed (i.e. non-random), then we can incorporate the information contained in the distribution of that random parameter in the calculation of consumer surplus by following the approach detailed in Hensher *et al.,* (2005) and Train and Weeks (2004) to estimate (via simulations) the expression $MWTA = -\left(\beta_k + \sigma_{nk} \cdot \Phi / \beta_{subsidy}\right)$. Where β_k is the estimate of each random parameter *k*, σ_{nk} its corresponding standard error and Φ the *pdf* of the distribution assumed for each β_k.[13] In the present application marginal willingness to accept (MWTA) is hypothesized to be negative for each of the policy attributes as it represents a measure of the marginal compensating surplus that a household would be willing to forego in order to sign up to a reforestation program that is characterized by an improvement in a particular attribute. On the contrary the implicit price for the ASC parameter is hypothesized to be positive as it would reflect the minimum amount that would need to be provided to each household in order to induce them to sign up to a program that sets all other attributes to their 'less desirable' levels as specified in (3). Lastly, total net WTA or compensating surplus for signing up to different program profiles is given by $TWTA = -\left(\left(V^0 - V^1\right)/\beta_{price}\right)$ and provides an estimate of the minimum bid (or

reservation) price that a farmer would be willing to accept in order to sign up to a particular program that yields utility V^1 as opposed to that obtained from the status quo V^0.

4.2. Specification of random parameter logit model

The parameters of the distribution of the random parameter vector β'_{nk} (i.e. mean and standard deviation) as well as the fixed (non-random) parameter vector of the interaction terms, δ'_k, were recovered via the simulation maximum likelihood routine in LIMDEP based on 1000 Halton draws.[14] Running the full RPL model with large number of draws is particularly time intensive which hinders sufficient and comprehensive exploration of the data. We thus undertook the estimation process in two stages following the recommendation of Hensher, Rose and Greene (2005). In the first stage, we undertook extensive initial exploratory estimation using just 20 draws. This initial stage was used to reveal which attributes were likely to be random, their likely distributional form, as well which household specific variables to include in z_n in order to produce the best fit specification.

The variables that were explored to be included in z_n were selected on the basis of a review of the literature on determinants of farmer participation in agri-environment and land-set aside programs (e.g. Ahituv & Kimhi, 2005; Birol *et al.,* 2005; Cooper, 2003; Johnson *et al.,* 1997; Langpap 2004; Minten, 2003; Parks & Schorr, 1997; Scherr 1995; Vanslembrouck *et al.,* 2002) such as previous participation in the program (SLCP=1) off-farm labor supply in previous period (OFFLAB), education level of spouse (EDUSPOUSE), number of livestock (LIVSTCK), farm size (FARM) and average household age (AGE). In addition, the specification of z_n was guided by the insights derived from the behavioral model presented in Groom *et al.* (2006) which specifically explores the determinants of the allocation decisions of farmers exposed to the SLCP. These variables are common to those used in the analysis of the contingent behavior responses in Equation (2) and include land institutional village level variables such as land tenure security (TENSEC) and ease of renting rights (RENTEASE) but also access to credit (CREDIT ACCESS) and existence of government program providing help for pursuing off-farm employment

opportunities (GOVPRGM) as well individual household level variables that affect off-farm labor opportunities such as distance to nearest large town (DISTANCE) and presence of non-productive elders in the household (ELDERS).

In the second stage of the estimation process we re-ran the RPL with the specifications that were 'short-listed' from the first stage using 100, 300, 500 and 1000 Halton draws. This allowed us to test for the stability of the estimated parameters and then subsequently to choose the most robust best-fit specification. The final results of this estimation procedure are discussed in the next section.

4.3. Results from the choice experiment

Table 3 presents the parameter estimates from the RPL model for the pooled sample as well as for each of the two sampled regions Ningxia and Guizhou. From the adjusted R-square and the Chi-Square statistics we see that the overall fit of the models is satisfactory. The coefficients on the parameters of the choice attribute are significant and have the hypothesized signs (see columns 1, 7 and 13). Further, we see that the data exhibits considerable unconditional taste heterogeneity as signified by the significant standard deviations of the parameters found to be random in each of the three models (see columns 2, 8 and 14 in Table 3). This provides indirect support for the use of the RPL approach as opposed to other approaches for accounting for preference heterogeneity (Hensher *et al.,* 2005). The table also displays the distributional assumptions made for each of the random parameters (see 3rd column in Table 3), with the triangular and normal distributions providing the best fit to the data.

[INSERT TABLE 3 ABOUT HERE]

Turning next to exploring the *sources* of preference heterogeneity, it appears that the pooled model displays a considerably larger number of significant interacted individual characteristics which can partly be explained due to its larger sample size (see columns 1, 7 and 13) in second panel of Table 3). The coefficient associated with 'PROVINCE' is highly significant, justifying the use of the other two region-specific models. Moreover, the determinant factors for participation in

the SLCP are shown to vary across provinces. For example, production variables such as farm size, education and livestock are more significant in Ningxia while institutional reforms such as tenure security, renting rights and access to credit are more important in Guizhou.

The raw coefficients, however, do not provide a clear measure over the relative importance of each of the variables affecting choice. For this we look into the marginal effects of each covariate in **x** and **z** as well as the marginal value of each attribute in **x** (see columns 4, 10, and 16 in Table 3). Both these measures provide valuable policy insights for designing cost-effective and sustainable land set aside policies. The subsidy amount emerges as the most important factor affecting participation in both regions. Increasing the subsidy level by one Yuan would increase the likelihood of participating into the SLCP by 0.1129. Utilizing this estimate, policy makers can explore the likely impacts of plausible discrete changes in the subsidy amount on participation rates (for example an increase of ¥200 would, *ceteris paribus*, entail a 23% increase in the likelihood of participation). Interestingly, the second most important factors affecting participation differs between provinces, with the subsidy assurance being more prominent in Ningxia while land tenure rights in Guizhou. Granting the right to plant commercial trees would (*ceteris paribus*) yield participation rates of 12% and 22% respectively across the two provinces.

As for the marginal effects of variables in household and village characteristics, we see that the most important factor affecting participation in the pooled model is the average off-farm wage. Changing that variable by one standard deviation would increase participation by nearly 16%. Previous participation in the SLCP is also a vital factor, having a higher impact on the likelihood of re-enrolment in Ningxia rather than in Guizhou which is consistent with the considerably higher income impacts from the existing SLCP that have been found in Ningxia (Uchida *et al.*, 2005).

It is also interesting to go beyond 'point' estimates and examine the entire distributions of the probabilities of participating in a new program for different subsidy levels and for different levels of institutional reforms. These distributions were recovered using simulation techniques in LIMDEP. Figure 1 presents these distributions for the pooled sample. The outer distribution depicts the percentage of households rejecting the SLCP at different subsidy levels under the status quo or

'no reforms' scenario. As different reforms are introduced, the density function shifts to the left. The size of the shift depends on the magnitude or relative importance of each reform. Such distributions provide useful decision aiding tools to policy makers concerned with designing sustainable and cost effective land set aside programs. For example, from these distributions we can derive that in order to achieve say a 50% participation rate in the pooled sample, households would need to be offered an average subsidy (keeping all other policy attributes at the status quo levels) of ¥ 370/mu/year. Yet, by introducing land tenure reforms alone the same participation rate can be achieved with approx ¥145 (*ceteris paribus*). Alternatively, we can see that if the authorities were to offer rural households the current levels of compensation (i.e. approx. ¥210 in Ningxia and ¥280 in Guizhou) without any complementary institutional reforms, then participation rates would be 20% in Ningxia and 10% in Guizhou. Such low participation rates raise questions over the long-run viability of the program unless either higher subsidies are offered or additional reforms are introduced.

[INSERT FIGURE 1 ABOUT HERE]

The final set of results that can be derived form the CE and which are relevant for assessing the sustainability of a future land set aside programs relate to measures of consumer surplus. Columns 5, 11, and 17 of Table 3 present measures of the implicit prices or marginal willingness to accept (MWTA) in Yuan per mu per year. We see that the minimum compensation required to participate in the SLCP when no other policy reforms are introduced (i.e. the value of ASC) is ¥429/mu/year. Yet, our results show that significant cost savings could be achieved by changing the attribute levels of the program towards their most 'desirable' level, that is, the level which maximizes respondents' welfare. For example we see that (*ceteris paribus*) introducing tenure security can reduce compensation levels by ¥165/mu/year. This complements the results of Section 3 as well as a vast literature, in that increased tenure security stimulates land savings investments (Jacoby *et al.,* 2002; Li *et al.,* 2000). If the full set of reforms are introduced (i.e. a 'first best' scenario), then the *total net* willingness to accept such a program (for the pooled sample) drops to just ¥12/mu/year which is statistically equal to zero. This brings home the implications for making

such integrated-conservation programs sustainable and self-sufficient: provided institutional and implementation reforms are put into place that address the constraints that bind people into inefficient production decisions, then large cost savings can emerge from implementing integrated-conservation programs.

The analysis further allows policy makers to make more targeted reforms in different provinces as they can prioritize those reforms that have the highest cost-savings implications. In Ningxia, this would entail enhancing the quality and assurances of the implementation of the program (which entail cost savings of around ¥200/mu/year) while in Guizhou, reforms should focus on land rights (savings of ¥179/mu/year) and allowing commercial forests (savings of ¥151/mu/year). Introducing the 'first best' scenario in each of these two regions would entail a total net WTA of ¥136 in Ningxia and ¥35 in Guizhou with only the former of these figures being statically different from zero. These results are in accord with the findings discussed above. It appears that Ningxia farmers (based on their past experience with the SLCP, on current land holdings as well as off-farm land opportunities) would prefer to sign up to a program that would involve subsidizing communities to become foresters. On the contrary the results suggest that households in other regions such as Guizhou would prefer to sign up to a scheme more akin to an agri-environmental program where farmers pursue wider conservation objectives together with direct productive uses of their lands.

Finally, columns 6, 12, and 18 of Table 3 show how the CE approach can yield information over the change in the minimum WTA to participate in the new SLCP for different levels in the variables that appear in the vector of household and village characteristics, **z**. For example, if farmers were to receive the average off-farm wage then (*ceteris paribus*) they would be willing to accept ¥160/mu/year less as compensation. Similarly, an increase in the spouse educational level is associated with a reduction of the household's compensating surplus by ¥75/mu/year, while introducing a government employment program can reduce total net WTA by ¥60 /Mu/year.

5. Concluding remarks

Sustainable development programs in the developing world are often characterized by limited budgets and finite time horizons reflecting both financial constraints and changing priorities in the policy world. These characteristics enhance the need for detailed *ex ante* assessment of the long run viability of the benefits of such programs so that both interim corrective measures can be adopted during the life-span of the current program but also appropriate new policies can be put into place after the termination of the old ones. This paper provided a framework for comprehensive *ex ante* assessment of the long run viability of one of the world's largest sustainable development programs, the SLCP in China, a massive subsidization program that aims at reforesting sloped rural terrain and address rural poverty.

The analysis - based on household and village level survey data obtained from Ningxia and Guizhou provinces – aimed at exploring the viability of the SLCP under the three plausible post-SLCP scenarios: where subsidies are stopped, where they are renewed in their current form and where a new program is instated. The challenge of obtaining *ex ante* information for making such an assessment was overcome by utilizing contingent behavior and choice experiment (stated preference) data. This allowed for a *direct* assessment of the program's sustainability providing, thus, valuable and unique insights that complement those obtained from other *indirect* assessments of the SLCP (Groom *et al.*, 2006; Uchida *et al.*, 2007 and 2005). Our analysis was able to provide the following main conclusions. First, we have shown that the viability of such 'win-win' policies rely in their capacity to address the root causes of household inefficient allocative decisions, which in turn constrain farmers in poverty traps and environmental harmful production practices. In particular, weak and incomplete property rights coupled with high labor mobility transactions-costs that are associated with oversupply of on farm labor emerge as major constraints on the sustainability of the SLCP. Further, the analysis has shown that securing the long run viability of the program's objectives would require policies that target both land *and* labor allocation decisions, as a strong simultaneity relationship between these two variables was found. This result has not been adequately acknowledged by previous research which has focused on examining the

determinants of household land decisions alone. Secondly, in cases where the SLCP is renewed we show that an important determinant of securing high levels of long term community support is the provision of better forestry training to local households as well as enhanced autonomy in managing their reforested trees. Thirdly, in the event that subsidies are not renewed, we have shown that farmers will tend not to reconvert back their reforested lands provided that the expected commercial value of the reforested trees is high. This finding further brings into question the prevailing mindset governing the design of the SLCP which only allows for very limited commercial exploitation of reforested lands. Further, secure property rights (both tenure and forest management rights) were also shown to be important factors in the post-SLCP scenario where subsidies were terminated as they were found to contribute greatly to both securing forest land and freeing surplus labor away from farming on slopped lands. As inevitably subsidies will be terminated at some point in the future, the importance of such institutional reforms for the success of current sustainable development programs becomes even more evident. Fourthly, in the scenario where a new SLCP program is offered we find that the likelihood of re-enrolment is affected not just by the subsidy amount but also by the implementation assurances offered to farmers, by the average off farm wage they can expect to earn as well as by further land tenure reforms. Hence, specific policy interventions that alleviating constraints and transactions costs associated with off-farm employment (e.g. educating spouses, creating employment centers, reducing local travel costs, enhancing access to credit) coupled with wider institutional reforms (e.g. land tenure, land renting and land management reforms) may increase the participation rates for a given level of subsidies or similarly may reduce the minimum compensation levels required to be offered to farmers for a given participation rate. Hence, we display how specific social interventions and institutional reforms can provide wider social external benefits in the form of considerable cost-savings in the implementation of a major sustainable development program, which in turn contribute towards its long term viability as funds can be spread across a longer time horizon. Fifth, the CE results shed unprecedented insights on Chinese farmer preferences over tenure reform and how these preferences impact upon the viability of the SLCP. Though there is some work on the determinants

of past or current forest land tenure arrangements in China (e.g. Brandt *et al.,* 2004; Xiao-Yuan, 1996; Xu, 2006) there is hardly any systematic research on actual farmer's preferences for such arrangements. The current analysis shows that farmers display a strong aversion for land redistribution and favor the development of more secure land rental rights. This is an interesting contribution to the debate over institutional reform in China. Indeed, an obstacle to individualization of land rights is the fear that it might undermine the function of land as a social safety net and insurance mechanism (Burgess, 2001). For that reason, a key concern of Chinese policy makers preoccupied with land tenure reform has been that, even though it may be associated with economic and environmental benefits, a deepening of land property rights privatization would be opposed by a majority of the rural population. Our analysis shows that this is not the case and thereby contradicts a significant literature, which may now be outdated, that has found household opinion to be strongly in favor of land redistribution (Kung, 1995; Kung and Liu, 1997; Liu *et al.*, 1998). Sixth, our CE analysis shows that a sustainable design of a land conversion program requires a more flexible approach that takes under account regional heterogeneities. To date the discussion (both within policy and academic circles) over how to achieve efficient (i.e. welfare enhancing) and cost-effective targeting has mainly focused on how to determine different levels of subsidies across regions. Though this is important, our analysis displays that the long run sustainability of the SLCP would also require a further degree of flexibility that allows for different *developmental paths* across regions depending on local preferences as well as institutional and socioeconomic conditions. For example, our results show that a viable SLCP program in Ningxia would be one where households are provided assured subsidies to become professional foresters. By contrast households in Guizhou would be willing to maintain reforested lands even if hardly any direct subsidies are offered provided that they receive enhanced tenure and renting rights over their reforested lands as well as improved usages rights that would allow for the uninhibited selection and management of planted tree types as well as their full commercial exploitation.

Finally, our paper displays the relative merits of using a framework that relies on contingent and stated behavior data for assessing the long run viability of sustainable development programs.

Areas for further consideration and research include the combination (fusing) of revealed (actual) and hypothetical data as well as using experimental economic techniques where participants are placed in a more controlled setting. Given the interest and financial commitments made towards sustainable development programs we feel that such further detailed *ex ante* analyses are warranted.

6. References

Abbot, Joanne . O. , David H. L. Thomas, Anne A. Gardner, Sama E. Neba & Mbony W. Khen (2001). Understanding the links between conservation and development in the Bamenda Highlands, Cameroon. *World Development*, 29 (7). 1115-1136.

Adams, W. M., R. Aveling, D. Brockington, B. Dickson, J. Elliott, J. Hutton, D. Roe, B. Vira & W. Wolmer (2004). Biodiversity conservation and the eradication of poverty. *Science,* 306 (5699), 1146-1149.

Ahituv, A. & A. Kimhi (2005). The joint dynamics of off-farm employment and the level of farm activity. Working Paper, The Hebrew University of Jerusalem.

Asfaw, A., von Braun, J., & Klasen, S. (2004). How big is crowding-out effect of user fees in the rural areas of Ethiopia? Implications for equity and resource mobilization. *World Development*, 32(12), 2065–2081.

Bennett, J., Z. Lei, D. Guangcui, X. Chen, Z. Jincheng, L. Dan, L. Yongwei & W. Xuehong, A review of the program for conversion of cropland to forests and grassland. Research Report No. 2, Australian Centre for International Agricultural Research (ACIAR). 2004.

Birol, E. A. Kontoleon & M. Smale (2005) Farmer demand for agricultural biodiversity in Hungary's transition economy: a choice experiment approach. in Smale, M. (Ed) *Valuing Crop Genetic Biodiversity on Farms during Economic Change*, CAB International, Wallingford, UK.

Bowlus, A. & T. Sicular, (2003). Moving towards markets? labor allocation in rural china. *Journal of Development Economics*, 71(2), 561-583.

Brandt, L., S. Rozelle & M.A. Turner (2004). Local government behavior and property right formation in rural China. *Journal of Institutional and Theoretical Economics*, 160(4), 627-662.

Burgess, R. (2001). 'Land and Welfare', Theory and evidence from China. Working paper, LSE.

Carter, M. & Y. Yao (1999). Specialization without regret: transfer rights, agricultural productivity and investment in an industrializing economy. World Bank Policy Research Working Paper, No. 2202.

Carter, M. & P. Olinto (2003). Getting institutions right for whom? credit constraints and the impact of property rights on the quantity and composition of investment. *American Journal of Agricultural Economics*, 85(1), 173-186.

CCICED (2006). Assessing the impacts of the Sloping Land Conversion Program on local community welfare. China Council for International Cooperation on environment and Development.

Cernea, M & K. Schmidt-Soltau (2006). Poverty risks and national parks: policy issues in conservation and resettlement, World Development, 34 (10), 1808–1830.

Cooper, J (2003). A joint framework for analysis of agri-environmental payment programs, *American Journal of Agricultural Economics*, 85(4), 976-978.

De Janvry, A., & E. Sadoulet (2005). Progress in the modeling of rural households' behavior under market failures. in Janvry, A., and R. Kambur, *Poverty, Inequality and Development*, Kluwer publishing, chapter 8, 2005.

De Janvry, A., E. Sadoulet, & N. Zhu (2005). The role of non-farm income in reducing rural poverty and inequality in China. Working Paper, Department of Agricultural & Resource Economics, UC Berkeley.

Deininger, K. & S. Jin (2002). The impact of property rights on households' investment incentives, risk coping and policy preferences. World Bank Policy Research Paper 2931.

Deininger, K., S. Jin, B. Adenew, S. Gebre-Selassie & B. Negra (2003). Tenure security and land related investment, evidence from Ethiopia. World Bank Policy Working Paper No. 2991.

Duflo, E. & M. Kremer (2003). Use of randomization in the evaluation of development effectiveness. |Paper prepared for the World Bank Operations Evaluation Department Conference on Evaluation and Development Effectiveness. Washington, D.C., 15-16 July, 2003.

Feder, Gershon Lawrence J. Lau, Justin Y. Lin, Xiaopeng Luo (1990). The relationship between credit and productivity in Chinese agriculture: a microeconomic model of disequilibrium. *American Journal of Agricultural Economics*, 72(5), 1151-1157.

Feng, Z., Y. Yang, Y. Zhang, P. Zhang, & Y. Li (2004). Grain for green policy and its impact on grain supply in west China. *Land Use Policy*, 22(3), 301-312.

Greene, W. (1996). Marginal effects in the bivariate probit model. Working Paper Number *96–11*, Department of Economics. Stern School of Business, New York University.

Greene W. (1998). Gender economic courses in liberal arts colleges: further results, *Journal of Economic Education*, 29(4), 291-300.

Groom, B, P. Grosjean, A. Kontoleon, T. Swanson & S. Zhang (2006). Relaxing rural constraints: a 'win-win' policy for poverty and environment in china? BIOECON Conference, Kings College, Sep. 2006

Hayes, A. and M.V. Nadkarni (2001). Poverty, environment and development: studies of four countries in the Asia Pacific Region. Bangkok, UNESCO Asia and Pacific Regional Bureau for Education.

Hensher,D. J. Rose and W. Greene *Applied choice analysis*, Cambridge, Cambridge University Press, 2005.

Hope, R.A. (12006) Evaluating Water policy scenarios against the priorities of the rural poor. World Development. 34 (1), 167–179,

Hughes, R. & F. Flintan (2001). Integrating conservation and development experience: a review and bibliography of the ICDP literature. Report for the International Institute for Environment and Development.

Huffman, W & and R. Evenson (2001). Structural and productivity change in US agriculture, 1950-1982, *Agricultural Economics,* 24, 127-147.

Jacoby, H. (1993). Shadow wages and peasant family labor supply: an econometric application to the Peruvian Sierra, *The Review of Economic Studies*, 60(4), 903- 921.

Jacoby, H., G. Li & S. Rozelle (2002). Hazards of expropriation, tenure insecurity and investment in rural china, *The American Economic Review*, 95(5), 1420-1447.

Johnson, P., S. Misra, & T. Ervin, (1997). A qualitative choice analysis of factors influencing post-CRP land use decisions, *Journal of Agricultural and Applied Economics,* 29(1), 163-173.

Key, N., E. Sadoulet & A. De Janvry (2000). Transactions costs and agricultural household supply response, *American Journal of Agricultural Economics*, 82(2). 245-59.

Kung, J. K. (1995). Equal entitlement versus tenure security under a regime of collective property rights: peasants' preference for institutions in post-reform Chinese agriculture. *Journal of Comparative Economics*, 21(1), 82-111.

Kung, J. K. & S. Liu (1997). Farmers' preferences regarding ownership and land tenure in post-Mao China: Unexpected Evidence from Eight Counties. *The China Journal*, 38, 33-63.

Langpap, C. (2004). Conservation incentives programs for endangered species: an analysis of landowner participation. *Land Economics,* 80, 375–388.

Lewbel, A. (2007). Coherence and completeness of structural models containing a dummy endogenous variable, *International Economic Review,* forthcoming

Li, G., S. Rozelle & J. Huang (2000). Land rights, farmer investment incentives, and agricultural production in China, *ARE Working Papers*, No. 00-024, Department of Agricultural & Resource Economics, UCD.

Li, G., S. Rozelle and L. Brandt, (1998). Tenure, land rights and farmer investment incentives in China. *Agricultural Economics,* 19, 63-71.

Liu, S., M. Carter & Y. Yao (1998). Dimensions and diversity of property rights in rural China: dilemmas on the road to further reform, *World Development,* 26(10), 1789-1806.

Louviere, Jordan J. David A. Hensher and Joffre D. Swait, Stated choice methods: analysis and applications. Cambridge, Cambridge University Press, 2000

Maddala, G.S. *Limited-dependent and qualitative variables in econometrics,* New York, Macmillan, 1983.

McFadden, D & K. Train (2000). Mixed MNL models for discrete choice response, *Applied Econometrics*, 15(5), 447-470.

Minten, Bart, (2003) Compensation and Cost of Conservation Payments for Biodiversity. Cornell Food and Nutrition Policy Program Working Paper No. 142.

Park, A., S. Wang & G. Wu (2002). Regional poverty targeting in China. *Journal of Public Economics*, 86(1), 123-153.

Parks, Peter J. & Schorr, James P. (1997). Sustaining open space benefits in the Northeast: an evaluation of the conservation reserve program, *Journal of Environmental Economics and Management*, 32(1), 85-94.

Scherr, Sara J. (1995). Economic factors in farmer adoption of agro-forestry: Patterns observed in Western Kenya, *World Development*, 23(5). 787-804.

Soule, Meredith J, Tegene, Abebayehu & Wiebe, Keith D, (2000). Land tenure and the adoption of conservation practices. *American Journal of Agricultural Economics*, 82(4). 993-1005.

Tai, Hsing-Sheng (2007). Development through conservation: an institutional analysis of indigenous community-based conservation in Taiwan. *World Development, In Press*

Train, K. & Weeks, M., (2005) Discrete choice models in preference space and willingness-to pay space, in Applications of Simulation Methods in Environmental and Resource Economics, Scarpa, R & A. Alberini (Eds.). Springer, 2005.

Uchida, E., J. Xu & S. Rozelle (2005). Cost effectiveness and sustainability of china conservation set aside program. *Land Economics*, 81 (2), 247-264.

Uchida, Emi, Jintao Xu, Zhigang Xu and Scott Rozelle (2007). Are the poor benefiting from China's land conservation program? *Environmental and Development Economics,* forthcoming.

Vanslembrouck. I., G. Van Huylenbroeck & W. Verbeke (2002). Determinants of the willingness of belgian farmers to participate in agri-environmental measures. *Journal of Agricultural Economics,* 53 (3), 489-511.

Wang, X. H. Han & J. Bennett (2004). China's land use management. australian center for international agricultural research project : ADP/2002/021.

Xiao-Yuan, D. (1996). Two-tier land tenure system and sustained economic growth in post-1978 rural China. *World Development,* 24(5), 915-928.

Xie, C., J. Zhao, D. Liang, J. Bennett, L. Zhang, G. Dai & X.Wang (2005). livelihood impacts of cropland to forest and grassland project. Australian Center or International Agricultural Research Project: ADP/2002/021.

Xu, J. (2006). Understanding forest tenure reform in China. Paper Presented in 8th BioEcon Conference, Kings College Cambridge.

Xu, J., & Y. Cao. (2002). The Sustainability of converting the land for forestry and pasture. *International Economic Review*, 3(4), 56-60.

Xu, J., M. Bennett, R. Tao & J. Xu (2004). China's Sloping Land Conversion Program four years on: current situation, pending issues. *International Forestry Review*, 6(3). 317-326.

Xu, Z. J. Xu, X, Deng, J, Huang, E. Uchida & S. Rozselle (2006). Grain for green versus grain: conflict between food security and conservation set-aside in China, *World Development*, 34 (1), 130–148.

Yao, Y. (2001). Egalitarian land distribution and labor migration in rural China. Working Paper Series, China Center for Economic Research.

Table 1. Choice experiment attribute description

Attribute Description	Attribute Levels	Expected impact on utility
Land renting rights	= 1 if land rights permitted/no obstacles	+
Subsidy Assurance	= 1 if assured	+
Land Redistribution	= 1 if prohibited	+
Percentage of commercial forest	100%, 80%, 50%, 20%, 0%	+
Subsidy amount (¥/Mu/year)	800, 500, 400, 300, 200, 100	+

Figure 1 PDF of households rejecting the SLCP at different subsidy levels and for different reforms.

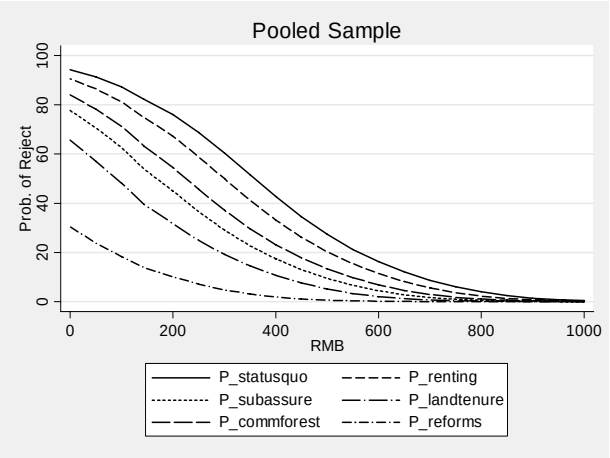

Table 2. Simultaneous equation model of post-SLCP land and labor allocation choices

	1	2	3	4	5	6	7	8	9	10	11	12
	Subsidies Renewed Scenario						Subsidies Not Renewed Scenario					
	Coef.	SE	Marginal Effects			St Error	Coef.	SE	Marginal Effects			St Error
			Direct	Indirect	Total				Direct	Indirect	Total	
Labor Equation: LABOURj=1 when reduce on-farm activity												
Constant	-0.650	0.521***	-	-	-	-	-2.630	0.617***	-	-	-	-
LAND (=1 if not reconvert forest back to crop land)	0.390	0.193***	0.559	-	0.559	0.095***	1.470	0.602***	0.512		0.512	0.154***
SLCPINC (SLCP income in (¥/mu/year)	-	-	-	0.737	0.737	0.644	-	-	-	-	-	-
COMVALUE (HH assessment of commercial value of SLCP trees; 1-5)	-	-	-	-	-	-	-	-	-	-0.891	-0.891	0.637
SGQUALITY (=1 if seed and grain received is of good quality)	-	-	-	0.325	0.325	0.111***	-	-	-	-	-	-
PLTMNG (=1 if HH plant and managed trees itself)	-	-	-	0.319	0.319	0.109***	-	-	-	-	-	-
DFLVAL (=1 if value of SLCP against floods is high)	-	-	-	-	-	-	0.430	0.246**	0.159	0.015	0.174	0.147
LIVSTCK (numbers of livestock heads)	0.070	0.022***	0.012	-	0.012	0.008*	-	-	-	-	-	-
AGE (Average age per HH)	-0.020	0.014*	-0.004	-0.002	-0.006	0.004*	-	-		0.347	0.347	0.362
EDUSPOUSE (=1 if spouse has received some schooling)	0.960	0.240***	0.177	0.066	0.243	0.097**	0.720	0.362**	0.281		0.281	0.134***
AGPROD (Agric. Productivity (yield/Mu))	-	-	-	-0.166	-0.166	0.088**	-	-	-	-0.385	0.385	0.201
LNAGMACH (value of agricultural machinery in ¥ - logs)	-	-	-	-	-	-	0.090	0.053**	0.024	0.013	0.037	0.023*
EMPLC (1= if local employment centre)	0.650	0.235***	0.263	-	0.263	0.109***	-	-	-	-	-	-
PRCOFFL (% of villagers supplying off farm labor)	-	-	-	-	-	-	0.001	0.001**	0.001	-	0.001	0.000**
TVLCST (Travel cost to nearest town in ¥)	-0.100	0.057**	-0.025	-	-0.025	0.017*	-0.200	0.107**	-0.079	-	-0.079	0.042**
TENSEC (=1 if secure tenure over land endowment)	-	-	-	-	-	-	1.030	0.487***	0.397	-	0.397	0.160***
FORRIGHT (=1 if tenure rights to planted trees secure)	-	-	-	-	-	-	1.060	0.410***	0.381	0.019	0.401	0.128***
RENTEASE (=1 if renting land freely allowed)	-	-	-	-	-	-	0.640	0.358**	0.218	0.032	0.250	0.152*
PROVINCE (=1 Guizhou)	-	-	-	0.138	0.138	0.074**	-	-	-	-0.127	-0.127	0.984
Land Equation: LANDj=1 when not reconvert forest back to crop land												
Constant	-1.220	0.736*	-	-	-	-	-7.010	2.065***	-	-	-	-
SLCPINC (SLCP income)	0.000	0.000***	0.0002	-	0.0002	0.0001*	-	-	-	-	-	-
COMVALUE (HH assessment of commercial value of SLCP trees; 1-5)	-	-	-	-	-	-	1.390	0.445***	0.4712		0.4712	0.1556***
SGQUALITY (=1 if seed and grain received is of good quality)	1.720	0.336***	0.631	-	0.631	0.136***	-	-	-	-	-	-
PLTMNG (=1 if HH plant and managed trees itself)	1.460	0.283***	0.619	-	0.619	0.106***	-	-	-	-	-	-
DFLVAL (=1 if value of SLCP against floods is high)	-	-	-	-	-	-	1.850	0.732***	0.2691		0.2691	0.1845
AGPROD (Agric. Productivity (yield/Mu))	0.000	0.000***	-0.0016	-	-0.0016	0.0004**	-0.004	0.001***	-0.0016		-0.0016	0.0004*
LNAGMACH (Value of agricultural machinery in ¥ (logs))	-	-	-	-	-	-	0.002	0.001***	0.0008		0.0008	0.0003
AGE (Average age per HH)	-0.030	0.019*	-0.012	-	-0.012	0.007*	-0.060	0.032*	-0.02		-0.02	0.0123
FORRIGHT (=1 if tenure rights to SLCP trees secure)	-	-	-	-	-	-	3.560	0.874***	0.78		0.78	0.2859***
RENTEASE (=1 if renting land freely allowed)	-	-	-	-	-	-	3.230	0.996***	0.8698		0.8698	0.3848***
EDUSPOUSE (=1 if spouse has received some schooling)	1.060	0.313***	0.412	-	0.412	0.134***	-	-	-	-	-	-
PROVINCE (=1 Guizhou)	0.570	0.277**	0.209	-	0.209	0.128*	1.990	0.918***	0.2791		0.2791	0.1133***
RHO(1,2) Correlation Coefficient	0.800	0.153***	-	-	-	-	-0.070	0.996	-	-	-	-
	N=286; LL function=-97.15468 McKelvey-Zavoina R^2 = 48%						N=286; LL function = -79.67141 McKelvey-Zavoina R^2 = 53%					

Notes: Significance level: ***1% , **5%, *10%

Table 3. Random parameters logit model with conditional heterogeneity

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	POOLED						**NINGXIA**						**GUIZHOU**					
Choice parameters	Coef.	Stand. Dev.[a]	Dist.	ME[b]	MWTA[c]	ΔWTA[d]	Coef.	Stand. Dev.[a]	Dist.	ME[b]	MWTA[c]	ΔWTA[d]	Coef.	Stand. Dev.[a]	Dist.	ME[b]	MWTA[c]	ΔWTA[d]
ASC	-2.7535***	3.9706***	~N	-	429.313***	-	-2.146***	3.659***	~N	-	471.772***	-	-3.273***	2.538***	~N	-	423.7255***	-
	(1.1971)	(0.3047)			(38.839)	-	(0.700)	(0.278)			(35.168)	-	(0.637)	(0.221)			(42.193)	-
Subsidy assurance	0.7911***	3.0647***	~T	7.17	-112.59***	-	0.751***	1.683***	~T	18.45	-199.524***	-	0.120*	1.317***	~T	6.34	-17.828	-
	(0.0893)	(0.2241)			(13.363)	-	(0.073)	(0.215)			(15.378)	-	(0.077)	(0.200)			(12.112)	-
Land Tenure	1.1368***	1.2344***	~N	10.52	-164.916***	-	0.364***	0.578***	~T	9.33	-21.45**	-	1.429***	0.892***	~T	25.64	-178.796***	-
	(0.0849)	(0.0979)			(13.676)	-	(0.060)	(0.166)			(12.285)	-	(0.093)	(0.179)			(16.212)	-
Commercial Forest (%)	0.0169***	0.0192***	~N	0.17	-1.122***	-	0.017***	-		0.12	-0.89484***	-	0.021***	-		0.22	-1.509***	-
	(0.0027)	(0.0027)			(0.250)	-	(0.003)				(0.234)	-	(0.004)				(0.277)	-
Renting rights	0.2506***	-		3.00	-28.287***	-	0.346***	-		4.09	-25.545***	-	0.219**	0.424***	~N	5.83	-41.11**	-
	(0.0573)				(10.638)	-	(0.067)				(11.202)	-	(0.087)	(0.096)			(11.979)	-
Subsidy amount (¥/mu/year)	0.0127***	-		0.11		-	0.010***	-		0.16		-	0.013***	-		0.19		-
	(0.0006)						(0.001)						(0.001)					
Heterogeneity in mean (interacted with ASC)[e]																		
PROVINCE (=1 Guizhou)	-1.1856***	-		-8.49		87.082	-	-		-			-	-		-		
	(0.5391)																	
SLCP	1.3740***	-		7.34		-114.453	1.590***	-		25.78		-140.673	1.080	-		13.61		-51.309
(=1 if enrolled in old SCLP)	(0.4880)						(0.390)						(0.314)					
TENSEC	0.9133***	-		6.42		-78.182	-	-		-			1.246	-		25.77		-64.041
(=1 if land secure)	(0.3996)												(0.361)					
RENTEASE	0.5869*	-		4.48		-52.483	-	-		-			0.745	-		4.55		-25.527
(=1 if renting allowed)	(0.3532)												(0.354)					
CREDIT ACCESS	0.9402**	-		5.41		-67.763	-	-		-			0.943	-		19.94		-56.070
(=1 if credit institution nearby)	(0.4739)												(0.312)					
GOVPRGM	0.6737*	-		5.66		-59.313	-	-		-				-		-		
(=1 empl. prgm exists.)	(0.4155)																	
DISTANCE	-0.0764**	-		-0.55[f]		8.713	-0.206**	-		-0.01[f]		42.497		-		-		
(distance from town in klm)	(0.0439)						(0.102)											
ELDERS	-0.6261*	-		-5.57		43.031	-	-		-			-0.765			-11.14		90.606
(=1 if elderly in household)	(0.3610)												(0.286)					
FARMSIZE	0.0552***	-		3.74[f]		-76.747	0.077***`	`-		7.77[f]		-115.453	-	-		-		
(farm size in mu)	(0.0202)						(0.014)											
AVOFFWAGE	0.0005***	-		15.94[f]		-159.299	-	-		-			-	-		-		
(average village off-farm wage)	(0.0002)																	
OFFLABOUR	0.0021***	-		6.98[f]		-53.229	-	-		-			-	-		-		
(hours of off-farm labor)	(0.0007)																	
EDUSPOUSE	0.8850**	-		4.74		-75.955	0.800***	-		12.12		-131.974	-	-		-		
(=1 if spouse has schooling)	(0.4246)						(0.282)											
LIVESTOCK	0.0961**	-		3.22[f]		-40.790	0.092**	-		1.35[f]		-42.239	0.072	-		4.67[f]		-62.582
(no. of livestock)	(0.0507)						(0.043)						(0.038)					
AGE	-0.0387***	-		-2.19[f]		86.137	-0.038***	-		-6.23[f]		126.689	-	-		-		
(average HH age)	(0.0154)						(0.012)											
	N=2288	R (Halton draws)=1000					N=1240	R (Halton draws)=1000					N=1048;	R (Halton draws)=1000				
	R^2-Adj=0.330	Log likelihood =-1627.974					R^2-Adj =0.411	Log likelihood =-784.4359					R^2-Adj =0.459	Log likelihood =-600.518				
	χ^2=1632.877	Prob(χ^2>χ^2_α)= 0.000					χ^2=1080.981	Prob(χ^2>χ^2_α)= 0.000					χ^2=1037.936	Prob(χ^2>χ^2_α)= 0.000				

Notes: All parentheses denote standard errors; Significance levels defined as ***1% , **5%, *10%; [a] Derived standard deviations of random parameters; [b] Marginal effects; [c] Marginal WTA estimates in (¥/mu/year); [d] Change in min WTA to participate in new SLCP for changes in socioeconomic variables (¥/mu/year). For continuous variables this is estimated for their mean values. For binary variables this is estimated when variable=1; [e] Variables in 2004 levels as reported in survey; [f] Marginal effects of continuous variables evaluated for a change equal to one standard deviation of the variable.

NOTES

[1] Examples of choice experiment techniques applied to policy evaluation in developing countries include Asfaw *et al.* (2004), Birol *et al.* (2005), Hope (2006) and Scarpa (2003). The present application is the first such application to be conducted in China.

[2] 1mu=1/15hactare

[3] The current exchange rate for one Chinese Yuan is approximately ¥1 =US$0.13.

[4] Beyond adopting this direct assessment approach, our analysis also improves upon the aforementioned studies in that we examined both participants and non SLCP participants , we undertook our study at a much later time in the lifespan of the SLCP (and not in its first couple of years where opinions about the programme are less clear), we explored *both* land and labour allocation decisions and we undertook a systematic exploration of household preferences with respect to the programme by using a choice modelling approach.

[5] The survey was part of wider project that was completed in 2006. Further details on the surveys can be obtained in CCICED (2006).

[6] Using the same data set Groom *et al.* (2006) employed a multi-output distance function approach to estimate a trans-log production function in the two main outputs (wheat and potatoes) against land, household labor and fertilizer. The cross partial of land and labor was found to be positive and significant at the 5% level which lends initial support for the simultaneity assumption evoked for the contingent behavior land and labor responses analyzed here.

[7] The aforementioned model consists of a household behavioral model where production choices are subject to a land use constraint, given the absence of rental and exchange markets, and to a production requirement constraint. The production requirements may be due to subsistence constraints, imposition of production quotas by local authorities, or the necessity of maintaining production on land in order to avoid land confiscation when tenure is insecure. Under these conditions, allocation decisions are dictated by the production requirement constraint, and labor allocation decision becomes residual (Groom *et al.*, 2006).

[8] The finding that rho=0 in the second specification does not invalidate the use of the recursive model. The correlation coefficient measures the correlation between the outcomes after the influence of the included factors. For the LABOR equation these factors include *LAND* which as discussed below is the single most important determinant of the LABOR.

[9] For reasons of statistical completeness we also explored specifications where the simultaneity was reversed (i.e. the labor decision determined the land decision and not vice versa). In both polar post-SLCP scenarios this form of simultaneity was rejected.

[10] Not all parameters in β_{nk} are necessarily random but may instead be fixed. In this case, standard deviation of that parameter will be zero and all behavioral information of that attribute is captured by its (fixed) mean β_k .

[11] By specifying the distributional form of each of the likely random parameters and by assuming that ε is iid distributed extreme value type 1 independent of **x** and **z**, the probability of choosing the option j in each of the eight choice occasions can be estimated as a mixed logit model using a maximum simulated likelihood approach (McFadden & Train 2000; Hensher *et al.* 2005).

[12] Other interaction terms with specific attribute could be included but their interpretation is less informative in this context.

[13] This relationship is estimated by simulating the population probability density from which each random parameter and subsequently producing a distribution of MWTA.

[14] In order to identify the parameters the scale parameter, μ^n , of the mixed logit was normalized to one. Moreover, categorical attributes were effects coded and possible correlation amongst multiple choices made by the same household was accounted for by utilizing the panel data specification of the RPL. Not accounting for this possible correlation would violate the IID assumption. Possible reasons for this correlation include the commonality of household characteristics that are invariant across choice sets for each household as well as the specific sequencing of choice sets that can lead to effects (unaccounted for in the estimation process) such as learning, inertia, and strategic responses (Hensher *et. al.,* 2005).