

# When should households be compensated for constraints on their property rights? A decision-making framework for Chinese land-use policy

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## Abstract

Competing uses of land mean that regulations aimed at biodiversity conservation often conflict with the land-use rights of rural households. Early reports suggest that this has occurred with the introduction of the Natural Forest Protection Programme (NFPP), a Chinese programme involving a ban on logging in natural forests. This paper investigates whether households should be compensated for infringements on property rights, drawing on institutional economics literature on regulation. We distinguish between cases where regulation solves local collective action problems and increases the welfare of those affected, and those where regulation involves a redistribution of rights from one group to another. We apply this to the NFPP by estimating the net welfare impacts, using household level stated preference data with econometric techniques that explicitly account for zero and negative values of the dependent variable. We find that the ban on logging does not affect the net welfare of the affected forest communities. This indicates that the losses resulting from the restrictions on property rights are offset by the benefits from restrictions on other local households. We also find evidence that a partial reduction in logging would be welfare increasing, indicating that the NFPP is to some extent addressing local collective action problems in forest areas.

## 1 INTRODUCTION

Conservation programmes often act by placing restrictions on the way that individuals, households or firms use land that they hold rights to<sup>1</sup>. When this occurs there are frequently calls for compensation to be paid for the full or partial loss of property rights. In developed countries, in the context of the debate on ‘regulatory takings’, there is much disagreement about whether compensation should be paid or not (a key example relates to the US Endangered Species Act, see(e.g. Innes, Polasky et al. 1998; Polasky and Doremus 1998; Meltz 2005). However, when similar programmes in developing countries are considered, there is a greater presumption in favour of compensation. This may be on equity grounds, either from a development (Cernea 2003; Kanbur 2003) or conservation (James, Gaston et al. 1999) point of view. Alternatively, the argument for compensation may be put forward on efficiency grounds (Ferraro and Kramer 1997). We argue that compensation is not necessarily appropriate simply because property rights have been infringed by a

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<sup>1</sup> These may be formal or informal rights.

regulatory intervention. Instead the case for compensation will vary according to the purpose and impacts of the intervention.

In contrast to the literature discussed above, we do not assume that individuals are necessarily made worse off as a result of regulation that limits their activities. The reason for this is that regulation may in certain cases be viewed as a solution to a collective action problem (Vatn 2005), rather than only as a cost imposed on private agents. From this viewpoint, regulation may not be solely an infringement of property rights, but in fact may limit some rights while protecting others (Commons 1931). Where free-riding exists, individuals may prefer to constrain their own behaviour through regulation if it means that others are similarly constrained (Mueller 2003). For example, if an externality is reciprocal, regulation can increase the welfare of everyone because although individuals are prevented from activities that create externalities, others are also prevented from imposing those same externalities on them (Bromley 1991).

Following this institutional economics literature, we address the question of whether compensation should be paid when regulation infringes formal or informal property rights. We propose that compensation should be paid where a regulation redistributes rights from one group to another. However, it is not justified if a particular regulation is solving a collective action problem within a community and therefore simultaneously limiting rights and providing new rights in the form of freedom from negative externalities imposed by others.

We use this framework to explore the case for compensation for the Natural Forest Protection Programme (NFPP), a Chinese conservation programme involving a ban on logging in natural forests. The programme is understood to have infringed the property rights of rural collectives and households in forest areas, and there have been widespread calls for those affected to be compensated for their losses (Shen 2001; Miao and West 2004; Su 2004). One of the questions relating to the NFPP is why the central government would follow the introduction of the Household Responsibility System - a policy of granting property rights to individual households - with a policy that effectively takes those rights away. We argue that it may either be because the individual use of the forest land led to collective action problems, reducing net social welfare for forest-based communities; or because although the rights were used optimally as far as individual households

were concerned, there were unexpected negative effects on downstream households. Each of these has different implications for compensation. Beyond the NFPP, the question of compensation is highly relevant to the current situation in China more generally, as property rights are rapidly evolving and becoming more individualised (Brandt, Huang et al. 2002), and there is an increasing need for new legal and institutional frameworks (Ding 2007).

We compare two alternative scenarios, based on the costs and benefits to households of timber harvesting. In the first, the logging ban alters the distribution of property rights away from forest-based households, who are no longer permitted to harvest timber, in favour of downstream households, who benefit from improved environmental services. In the second scenario, the logging ban is welfare improving for forest-based households and regulation is only required if institutional failure at the local level prevents the collective action needed for all households to voluntarily reduce their harvests. Using data on the amount that forest-based households are willing to pay to avoid the logging ban element of the NFPP, we estimate whether the net welfare impacts on households are positive or negative. We find that faced with a full ban on logging, such as in the NFPP, forest-based households do not experience significant welfare changes. This would suggest that the local benefits of the regulation provide implicit compensation for the loss of the rights to harvest timber. We also find that households expect to experience net welfare gains from a partial ban on logging, in which a limited amount of timber may be cut for household use. This indicates that to some extent the NFPP is addressing a local collective action problem as well as providing benefits to downstream households.

The Chinese government is currently facing demands for compensation for a range of interventions. Some of these constitute physical takings of rural land, for the purposes of urban development or dam construction, however, they are now extending to cases such as the NFPP where regulations limit property rights without removing them completely. In addition to this, there is a widespread view that where conservation programmes restrict property rights in developing countries more generally, compensation should necessarily be paid to the communities affected. This paper shows that in cases such as these, there is not one universal answer for the question of whether compensation should be paid for regulations that

infringe property rights, but that instead it is necessary to look in more detail at the type of regulation and its impact on particular communities.

## 2 COMPENSATION FOR REGULATION

### *2.1 Purpose of regulation*

The question of whether compensation should be paid to communities affected by conservation programmes can be looked at from various perspectives. Within the Law and Economics literature, there is ongoing debate about whether compensation should be paid for ‘regulatory takings’, where there is no appropriation of title, or physical occupation of property, but restrictions on the use of property may be sufficiently severe to amount to the same thing (Miceli and Segerson 1999; Meltz 2005). In legal terms, there is a clear distinction between physical takings, for which compensation must generally by law be paid, and regulatory takings, for which compensation is generally not paid (Calandrillo 2003). However, in practical terms, regulatory takings lie on a continuum between non-compensable regulations and compensable physical takings (Miceli and Segerson 1999). In this paper, we attempt to distinguish between a compensable regulatory taking and a non-compensable regulation.

In the context of developed countries there is no clear consensus about whether or when compensation should be paid. However, in the context of conservation programmes in developing countries the necessity for compensation is rarely questioned<sup>2</sup>. Within the conservation literature, there is often an assumption that compensation should be paid when programmes are introduced in developing countries on straightforward ‘fairness’ grounds, given that those affected are in many cases poor rural households with few alternative opportunities (James, Gaston et al. 1999; Brockington and Schmidt-Soltau 2004). Among resource economists, there is a greater focus on the importance of compensation for the creation of positive incentives, either in the context of creation of protected areas, (Kramer 1996; Ferraro and Kramer 1997) or payments for

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<sup>2</sup> One exception to this is Bulte and Rondeau (2005), who argue that compensation should not always be paid in conservation programmes on the grounds that it can create perverse incentives.

environmental services as an alternative to regulation (Pagiola, Bishop et al. 2002). However, in either case, it is assumed that a conservation programme that places limits on how a community can exercise any formal or informal property rights they previously held must only impose costs on that community. If this assumption is not made automatically, but rather tested empirically for individual situations as in this paper, the appropriateness of compensation can no longer be presumed.

The proposition that restrictions to property rights may not necessarily lead to losses for those affected is based on an institutional view of regulation. The argument that compensation should be paid when regulation infringes property rights relates to the idea of regulation as a constraint on economic activity. However, as pointed out by Commons (1931), although any collective control that prohibits something will have a negative effect on one person, at the same time it will positively affect another. This is because although it prevents an individual carrying out certain actions that may hurt others, it also prevents others from performing the same actions that may hurt the individual. For example, if a community was deciding whether to allow certain types of building, say above a particular height, any individual may prefer to build a higher building for themselves, but could still prefer that everyone was prevented from doing so (Vatn 2005). On this basis, regulations can both constrain and liberate: individuals are constrained from acting as they choose, but liberated from the external effects of others acting in the same way (Bromley 1989).

Hobbes (1651), describes the enforcement of laws by the higher authority of the state as a welfare improving alternative to the chaotic 'state of nature' that would otherwise exist. In more recent times, difficulties in solving global environmental problems, such as climate change, illustrate the losses that can occur in the absence of any higher authority with the ability to enforce regulations. The underlying problem in both cases is one of free-riding. The role of state intervention in solving collective action problems resulting from free riding or from difficulties in coordination has been widely analysed. Mueller (2003) shows how individuals may choose to constrain their own behaviour through a 'constitutional contract' in order to solve the Prisoners' Dilemma created by the incentives to steal from one another in the absence of protection for property rights. In this instance, all are better off if property rights are enforced and those who steal are

punished. Similarly, Buchanan (1968) uses the concept of the Prisoners' Dilemma to describe how centralisation and coercion may be required to solve the problem of public goods.

Some individuals will be against such intervention if they are losing rights or privileges, however, in the case of an externality the affected individual has no choice but to accept it unless they can pay the property owner to stop it (Vatn 2005). If the state regulates, the property owner is coerced into behaving in a particular way, but if it does not, those affected by his or her actions are coerced into accepting them (Bromley 1989). In other words, the state is involved in either case because it has to sanction and protect the property rights represented by the status quo even if there is no institutional change (Bromley 1991).

In this paper, we use these concepts about the potential impacts of regulation on rights of individuals or communities as the basis for deciding whether compensation should be paid when a conservation programme appears to limit such rights<sup>3</sup>. We highlight two scenarios: in the first, a regulation is necessary to solve a collective action problem and therefore those affected both lose and gain rights, but are left better off overall; in the second, regulation involves a redistribution of rights from one group to another – in this situation the regulated group are left worse off overall. Using the case of the NFPP, where forest-based households are prevented from harvesting timber on their forest land, as our illustrative example, the first scenario can be modelled as a standard 'Prisoners' Dilemma'.

**Table 1: Payoff structure with free-riding**

		Forest-based households	
		Harvest	Not Harvest
Other households	Harvest	-50, -10	10, -20
	Not Harvest	-60, 50	0,0

The payoff structure shows the preferences of each type of household for each outcome. We can see that the Nash equilibrium will be (Harvest, Harvest), but both households would be better off with an outcome of (Not Harvest, Not Harvest). If this type of collective action problem is the reason why regulation is necessary, then compensation is not required because there is already an implicit transfer in the form of

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<sup>3</sup> We focus on the implications for conservation programmes, but the results could also be applied to a wide range of other regulatory interventions.

mutual welfare gains. While the property rights of each household may have been restricted by the regulation, they also benefit from the limitations placed on the property rights of their neighbours. Even in the absence of compensation, we would expect households to support such a regulation.<sup>4</sup>

However, as an alternative, it may be that the non-cooperative harvest levels are optimal at the village as well as the household level. In this case, a regulation to limit harvests will make the forest-based households worse off. This could occur where there are heterogeneous groups within the wider society, for example, downstream households who do not benefit directly from harvesting, but who experience the external costs of the activity; and households in forest areas who benefit from harvesting timber, and may or may not experience external costs. In this case, the former group would only benefit from limits to harvesting, while the latter would experience both costs and benefits, and may be worse off overall. In this situation, we would not observe a ‘Prisoners’ Dilemma’ game, but instead, the payoff matrix would be as follows:

**Table 2: Payoff structure with asymmetry**

		Forest-based households	
		Harvest	Not Harvest
Other households	Harvest	-50, 20	10, -20
	Not Harvest	-60, 50	0, 0

As in the Prisoners’ Dilemma setting, all households would prefer to harvest timber than to unilaterally reduce harvests. However, in this scenario, while the downstream households would prefer a situation where all households reduced their harvests, the forest-based households would be better off with an outcome where they were allowed to continue to harvest timber even if that meant that others were allowed to as well. In this case, the Nash equilibrium will again be privately optimal harvesting, but a reduction in harvests by all

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<sup>4</sup> If there was thought to be the possibility of compensation, households who did in fact support the programme might not truthfully reveal their preferences as they could potentially gain from declaring that they did not support it.

is no longer a Pareto improvement as the households in forest areas will be made worse off. The welfare maximising situation will depend on the relative costs and benefits of each outcome.<sup>5</sup>

In summary, to decide whether compensation should be paid for regulations that limit private property rights, we distinguish between two situations: the first takes the form of a prisoner's dilemma in which all would be better off if they could solve a free-riding problem; and the second is one in which one group would be better off if everyone reduced harvesting, but the other group would not be because they would have lower welfare relative to the initial situation, even if all households cooperate. These two situations have different implications with regard to the appropriate policy solution. Where free-riding is preventing cooperation, the possibility of compensation can further increase the incentives to continue harvesting. Furthermore, payment of compensation is not justified, as the regulation moves all households to an improved situation in terms of their own welfare. Where cooperation is prevented by heterogeneity in costs and benefits, compensation no longer has perverse incentive effects, and can result in a Pareto improvement<sup>6</sup>.

One point to bear in mind is that although there is a clear theoretical difference between these two cases, they may be difficult to distinguish in reality, and may interact with each other. This is because while asymmetry of costs and benefits is the basis for non-cooperation due to heterogeneity, it also increases incentives for free-riding. A household with relatively high costs of cooperation and relatively low benefits clearly has more to lose from cooperating and less to potentially gain, which means that, other things being equal, they will be more likely to free-ride than another household with lower costs and higher benefits. This will be the case even if they would experience an improvement in welfare if everyone cooperates. The result of this is that a situation where a household would benefit from cooperation, but chooses to free-ride, will appear very similar to a situation where they do not benefit from cooperation. Furthermore, as the degree of asymmetry increases, the likelihood of free-riding increases at the same time as the likelihood that the household will never voluntarily cooperate, regardless of free-riding.

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<sup>5</sup> We assume for the purposes of this paper that the regulation does increase total welfare, otherwise it would not be introduced at all.

<sup>6</sup> This has been shown in the context of international environmental agreements by Swanson (1994), Wilman (1998) and Barrett (2004)



## ***2.2 Implications for compensation***

Despite the result of non-cooperation in the Prisoners' Dilemma context, it is well known that in many circumstances this outcome can in fact be overcome. Where cooperation is prevented by free-riding we would expect that over time, in the small stable communities that we are focussing on, there would ultimately be some form of collective agreement. This might occur as a result of repeated interactions (Axelrod 1984), or the development of local institutions to enforce cooperation (Ostrom 1990). However, if cooperation is prevented by asymmetry of costs and benefits, achieving voluntary agreement is less likely because it requires redistribution from one group to another. We would expect that local collective action problems might be solved by groups of households or local levels of government, while redistribution between groups would more often require central government intervention. This would suggest that in many countries, national level regulations are likely to be required mainly for addressing distributional issues rather than local collective action problems. However, there are indications that in the Chinese case, local collective action problems are not being solved at the local level so that in the absence of action by the central government, households are acting independently and in their own interest.

It would seem surprising that in rural China, where until recently all activity was carried out collectively, village level collective action should prove to be difficult. However, in interviews with village leaders, Nee and Sijin (1990) found that, in over half of villages they visited, collective institutions collapsed entirely after decollectivisation. Village leaders were left uncertain about their role with relation to individual household property rights, leading to a decline in public works and collective activity. Since then, some have begun to develop new ways of promoting the interest of the village as a whole, while others have been slower to do so. Other studies of village governance have found that, although there is variation by individual, the majority of village leaders focus on the implementation of policies on behalf of higher levels of government rather than taking action on their own initiative to improve the overall welfare of the village (Rozelle and Li 1998). However, there is some indication that this is changing with the election of leaders and village committee members by the villagers themselves (Zhang, Fan et al. 2004).

In the case of the NFPP, we are interested in whether the programme is a regulatory taking, involving a redistribution of property rights in the national interest, or whether government intervention is only necessary because local institutions are not functioning effectively. In the latter case, compensation for restrictions on property rights would not be justified as households are already effectively compensated through the equivalent restrictions on the rights of their neighbours.

### ***2.3 Empirical application***

In the rest of the paper, we apply the concepts discussed in this section to the question of whether there should be compensation for households restricted by the NFPP. This is done *ex post*, using contingent valuation data on how forest-based households have been, or believe they would have been, affected by the programme. At the survey stage, we used stated preference techniques to elicit values for the total welfare impacts of the NFPP on households. In this paper we use this information to estimate average net welfare impacts of the programme across the forest communities. If net impacts are positive, then the benefits to households of restrictions placed on their neighbours must outweigh the negative impacts of the restrictions that they face themselves. We can therefore assume that in the absence of the programme, there exist local, unsolved collective action problems, otherwise the community would voluntarily have moved to this position of higher welfare. In this situation, payment of compensation is not justified because the community both loses the right to harvest and gains freedom from the impacts of harvesting by others. If the net impacts are negative, the forest-based communities would not have voluntarily introduced the ban on logging. In this case we assume that the NFPP is a regulation that has been imposed on forest-based households for the benefit of other communities, and for which they bear the costs. There would then be a much stronger argument in favour of compensation for the losses experienced, due to the transfer of rights from one group to another.

Alternatives to considering the impact on welfare would be to look at income impacts or changes in land values. We have not used income impacts on the grounds that these only pick up part of the total impacts of the logging ban on forest-based households. They do not identify non-monetary effects, which may be positive (such as reduced soil erosion, more attractive local surroundings etc) or negative (e.g. that

off-farm employment may involve leaving the village). In addition to this, much of the agricultural and forest production by households is for consumption within that household, so it is not marketed.

In developed countries, the use of changes in land values is common when assessing the impacts of a regulation in the context of compensation demands (Miceli and Segerson 1999). However, in the case of China, households do not hold full ownership rights to forest land, and are limited in the extent to which they can sell or lease the rights they do hold, which means that a functioning land market does not exist (Brandt, Huang et al. 2002). Furthermore, even in other developing countries where land markets do exist, if those markets function imperfectly, land prices may not capture all the non-monetary costs and benefits that we are focusing on.

An additional reason for the use of hypothetical welfare values to estimate the impacts of the NFPP is that as well as assessing the impacts of the full ban on logging, we also ask households about the potential welfare impacts of a partial ban on logging, in which limited harvesting is permitted for non-commercial use. We are interested in this because although the NFPP was initially implemented as a complete ban on logging, over time it has been relaxed in some places (Xu, Katsigris et al. 2002). In addition, the original programme was intended to last for 10 years, so it is due to end in 2010. Estimation of the likely welfare effects of a partial ban allows us to consider potential policy options for the future as well as look at the impacts of the current programme.

## **4 CASE STUDY - NFPP**

### ***4.1 Description of programme***

The Natural Forest Protection Programme (NFPP) was introduced by the Chinese government in 2000 as it became increasingly apparent that overharvesting of timber was creating environmental problems. The NFPP applies to 17 provinces and autonomous regions in the upper reaches of the Yangtze River and

the upper and middle reaches of the Yellow River. These provinces contain 69% of the total natural forest area in China (CCICED 2005).

The objectives of the programme are: to restore natural forests in ecologically sensitive areas, protecting and enhancing biodiversity; to plant forests for soil and water protection; to increase timber production in forest plantations to meet national demands for timber and contribute to economic development of rural areas; and to protect existing natural forests from excessive cutting (Zhang, Shao et al. 2000). These objectives are being pursued with the use of, firstly, a ban on logging in natural forests across many parts of the country; and secondly, measures to encourage the development of new plantation forests which should increase timber supplies while reducing pressure on natural forests. These activities have been supported with funds from the Chinese government, directed specifically at afforestation and forest protection, and compensation or pensions for unemployed state forest workers (Xu, Katsigris et al. 2002).

This programme is the largest of its kind in the world, and therefore there has been considerable interest in its impacts. In the most significant study so far, Xu et al (2002) found that while there have been positive impacts on forest cover, there have been certain negative effects such as losses in employment in the state forest sector; reductions in local government finances; and losses of employment and income for households dependent on the state and collective forest sectors. Others have similarly concluded that the NFPP has had environmental benefits, but that these have come at the expense of household incomes and the security of rights to forest land (Shen 2001; Xu 2002; Miao and West 2004; Su 2004). These findings are of concern because improving living standards in rural areas is one of the objectives of current forest policy. As the areas where the NFPP has been applied include the poorest provinces of China, if it reduces incomes in these areas it will exacerbate rural poverty. In addition, if households have no alternative income generating opportunities then enforcement and monitoring costs of the ban are likely to be high.

## ***4.2 Data Collection***

The data for this study come from a face-to-face survey of 285 households and 33 village leaders in Guizhou Province in southern China, which was carried out by the Department of Environmental

Economics at the University of Beijing as part of a joint project that was completed in May 2006. The households were selected from 40 villages in three counties in Qiandongnan District. In two of the counties, Liping and Jinping, the NFPP was introduced in 2000. The third county, Congjiang, was the only county in Qiandongnan District where the NFPP was not implemented. All three counties are important forest areas, where the main source of local government income has been from forest activities. However, although the climate and soils are conducive to forest growth, there have been problems of resource depletion with the results that the size of logged timber has decreased over time and available forest areas for logging have become more remote.

The NFPP in Qiandongnan started in 1998 in four pilot counties, and was then officially implemented in the majority of the district in 2000. In the five years since the implementation of the programme, forest cover has increased from 40.7% in 1995 to 49.37% in 2000; and according to estimates of forest officials, it has now reached over 55%, with significant improvements to forest ecology.

## **5 EMPIRICAL ANALYSIS**

### ***5.1 Econometric models***

In order to determine whether the NFPP is something that the affected households would have chosen if they could be assured that others would not free-ride, or whether it is a regulation that has been imposed on them for the benefit of other communities, we estimate the net impact of the programme on average welfare. As part of the household survey described in section 4, households were asked to state their maximum willingness to pay to avoid the ban on logging. Many households stated that they were not willing to pay anything. When questioned further, many of these respondents said that it was because the ban actually increased their welfare. Within the following analysis, we assume that those with positive WTP to avoid the ban experience negative welfare impacts as a result of the ban. Those with zero WTP may either experience positive welfare impacts or be indifferent to the ban; however, we assume that those who are

indifferent give ‘true’ zero responses, while those who experience positive welfare impacts have negative WTP where that is allowed for in the econometric models used.

In general, studies valuing the provision of environmental and other public goods assume only positive WTP (Bateman, Carson et al. 2002), however we follow Kristrom (1997), Clinch and Murphy (2001), and MacMillan *et al* (2001), in accounting for the possibility that respondents may experience either positive or negative welfare effects as a result of the provision of public goods. Kristrom (1997), Bohara *et al* (2001), and Nahuelhual-Munoz *et al* (2004) have all shown that there can be significant differences between estimates of WTP using strictly non-negative values and estimates that use distributional assumptions which allow for censored negative values. In order to account for a positive probability mass at zero, we estimate the model using both a standard Tobit model, and Cragg’s (1971) more general ‘double hurdle model’, in which the probability of a zero observation is independent of the value of that observation if it is positive<sup>7</sup>. The double hurdle model has two parts as follows: the first part is a participation equation, involving the indicator variable  $d$ , where  $d=1$  if  $z>0$  and  $d=0$  if  $z \leq 0$ :

$$d = z' \gamma + v \quad \text{eq. 1}$$

The second part is the WTP equation:

$$\begin{aligned} y^* &= x' \beta + u \\ y &= x' \beta + u && \text{if } z > 0 \text{ and } y^* \geq 0 \\ y &= 0 && \text{otherwise} \end{aligned} \quad \text{eq. 2}$$

To address potential non-normality and heteroscedasticity, we also re-estimate the model with an Inverse-Hyperbolic Sine transformation of the dependent variable (Johnson 1949) and with a parameterised variance<sup>8</sup>. To ensure further robustness against specification errors, we also use the semi-parametric Censored Least Absolute Deviations model (Powell 1984). It is not possible to estimate  $E(y^* | x)$  with this type of semi-

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<sup>7</sup> The hurdle model has more widely used in the analysis of household expenditure and consumption (e.g. Yen and Jones (1997); Jones (1987); Carroll et al (2005)), but there have been a number of applications to WTP such as Clinch and Murphy (2001); Martinez-Espineira (2006); and Yen *et al* (1997).

<sup>8</sup> We use the Inverse-Hyperbolic Sine transformation on the grounds that it allows negative values of the dependent variable (Burbidge et al 1998)

parametric censored model, but we can estimate the conditional median as long as the median of the error term is observable.

## 5.2 Descriptive statistics

Each of the respondents was initially offered a choice of a full ban on logging lasting 10 years; or no ban on logging, but an increase in local taxes to pay for environmental projects instead. Those who chose to pay to avoid the ban were then asked the maximum amount they would be willing to pay in Chinese RMB per mu<sup>9</sup> per year. A payment card was used for this in accordance with standard recommended practice for contingent valuation (Bateman, Carson et al. 2002), as it provides a balance between the minimisation of potential biases and maximisation of the information obtained from each respondent. The payment card contained values from 5RMB to 3000RMB. The respondents were then asked the same questions with regard to a partial ban on logging, in which limited harvesting would be permitted for household use<sup>10</sup>. The results of these questions are shown in Table 3 and Table 4.

When asked whether they would be willing to pay to avoid a ban on logging, more than 40% were unwilling to pay anything to avoid a full ban, and over half were unwilling to pay anything to avoid a partial ban.

Table 3: Whether households are willing to pay to avoid ban

	WTP: FULL BAN		WTP: PARTIAL BAN	
	Number	%	Number	%
<b>'Yes'</b>	53	58.2	35	48
<b>'No'</b>	38	41.8	38	52
<b>Total</b>	91	100	73	100

'Yes' means the respondent is WTP some amount

'No' means the respondent is not willing to pay any amount to avoid the ban

When we look at the amounts that households were willing to pay to avoid the ban, the results show that the mean values for WTP are all significantly greater than zero. Median values are lower than mean values, and in the case of the partial ban, the median WTP across the whole sample is zero. WTP to avoid the

<sup>9</sup> 1 mu = 1/15 hectare

<sup>10</sup> Respondents were informed at the start that they would be asked about these two separate aspects in order to avoid biases resulting from the ordering of the questions (Bateman et al 2004)

partial ban is generally lower than to avoid the full ban. On average, households in our sample have 38 mu of forest land, so that the total mean WTP to avoid the full ban is around 1000RMB, and the median is 380RMB per year. Total mean WTP to avoid a partial ban would be 400RMB per year. These values can be compared with average annual total incomes of around 10,000RMB.

**Table 4: Average WTP to avoid a logging ban**

	<b>WTP FULL BAN</b>		<b>WTP PARTIAL BAN</b>	
	All respondents	Positive responses	All respondents	Positive responses
Mean	25.89	44.45	10.53	41
Standard deviation	49.27	57.96	22.07	40.74
Significantly different from zero at 5% <sup>2</sup>	Yes	Yes	Yes	Yes
Median	10	30	0	30

All values in RMB per mu per year

In addition to asking maximum WTP for those who indicated that they were willing to pay some amount, we also asked the respondents who said they were not willing to pay anything to explain why. The answers are presented in Table 5, which shows that most of the respondents who chose not to state their WTP value did so because of their views on the NFPP rather than because of their views about the payment mechanism. This is supported by the fact that almost two thirds of those who were not willing to accept compensation for the logging ban because they wished to use the forest, were willing to accept a partial ban which would allow a limited amount of timber to be harvested.

**Table 5: Reasons for zero WTP (number of respondents)**

	<b>FULL BAN</b>	<b>PARTIAL BAN</b>
I don't want to pay any tax	3	6
NFPP not a problem	17	19
NFPP is a good thing	16	20



### ***5.3 Econometric analysis***

Based on responses presented in Section 5.2, it was clear that the zero responses needed to be modelled explicitly, or in a sufficiently flexible manner. We also concluded that it was necessary to allow for the fact that some of the zero responses to the WTP questions in the survey may in fact represent households that are in favour of keeping the ban, in other words, those with negative values for WTP.

We estimate average values of WTP (mean and median) using the alternative specifications discussed in Section 5.1. We compare the standard Tobit model with Tobit and Hurdle models with IHS transformation of the dependent variable and parameterisation of the variance as appropriate, and also with the CLAD model. The transformed Tobit and Hurdle models are estimated by maximum likelihood, and the CLAD estimation was carried out using Jolliffe *et al's* (2000) procedure. The latter model could not be estimated for WTP to avoid the partial ban because the median lies below the censoring point of the dependent variable. The explanatory variables used fall in three different categories: basic household and village characteristics; involvement of the household in forest-related activities; and variables relating to the institutional context within which the household is operating. In order to select variables that were significant in this context, we drew upon previous studies on household behaviour in rural China, such as Jacoby *et al* (2002) and Zhang *et al* (2004).

### ***5.4 Determinants of WTP***

The results of the models estimated for WTP to avoid the full and partial logging bans are presented in Table 6 and Table 7. The variables included in each model vary because we have presented the results of the best-fit specification for each one, based on comparison of log-likelihood functions. In terms of the determinants of WTP, we find that the different specifications give quite consistent results.

Table 6: Determinants of WTP to avoid full ban on logging

	TOBIT	IHS TOBIT	IHS HURDLE		CLAD
			participation	WTP	
Log likelihood	-310.79	-295.07	-282.52		-
$\chi^2$ statistic	35.67	21.15	20.46		-
Observations	91	91	91		91 initial/ 60 final
Total household income (RMB/year)	.0012 (.00049)**	.00054 (.00021)**	.000022 (.00001)**	6.34*10 <sup>-06</sup> (.000015)	.00082 (.0015)***
Estimated value of family house (RMB)	-.0015 (.00047)***	-.00051 (.0002)***	-.000018 (9.74*10 <sup>-06</sup> )*	-.000011 (.000025)	-.0007 (.0018)***
Proportion of adults in the household with more than primary education	40.75 (27.17)	-	-	-	-2.45 (52.96)
Dummy for NFPP county (1=in NFPP)	-	-	-	-	-15.11 (62.2)*
Income from non-timber forest products (RMB/year)	-	-	-	-.000065 (.00016)	-
Perceived security of forest land tenure (1=secure to 5=insecure)	8.41 (5.66)	-	-	.089 (.21)	.21 (30.84)
Area of collective forest land per head in village (mu)	3.9 (2.12)*	4.97 (2.7)*	.16 (.13)	-	-
Area of agricultural land held by household (mu)	-	-	-	.017 (.045)	-2.4 (8.68)*
Proportion of respondents in same township who are WTP to avoid ban	108.9 (35.78)***	46.42 (15.98)***	3.47 (.90)***	-	39.05 (95.22)***
Dummy for whether village leader elected (1=elected; 0=appointed)	-52.55 (16.93)***	-23.8 (7.91)***	-.72 (.35)**	-.33 (.78)	-10.37 (41.23)*
Variance:					
Area of agricultural land held by household (mu)	-	.077 (.032)**	-	-	-
IHS transformation	-	-.026 (.0082)***	2.28 (5.36)	-	-

Table 7: Determinants of WTP to avoid partial ban on logging

	TOBIT	IHS TOBIT	HURDLE MODEL	
			participation	WTP
Log likelihood	-197.96	-192.57	-188.64	
$\chi^2$ statistic	31.2	18.24	17.08	
Observations	91	91	91	
Total household income (RMB/year)	.00065 (.00033)*	-.00024 (.00043)	.000012 (.000013)	.00066 (.00063)
Estimated value of family house (RMB)	-.00051 (.00035)	-	-	.00012 (.00019)

Dummy variable for livestock ownership (1=livestock)	24.72 (11.4)**	9.74 (6.99)	.33 (.46)	14.87 (6.44)**
Dummy for NFPP county (1=in NFPP)	-11.67 (10.36)	-11.21 (6.34)*	-.7 (.42)*	-
Income from timber (RMB/year)	-.032 (.023)	-	-.0008 (.00072)	-
Area of agricultural land held by household (mu)				-.69 (1.48)
Area of agricultural land held by household (mu)	-	-	-	-1.38 (.83)*
Area of jointly managed forest land held by household (mu)	-	-	-	.2 (.19)
Proportion of respondents in same township who are WTP to avoid ban	88.09 (29.05)***	55.3 (17.3)***	4.68 (1.39)***	-
Dummy for presence of shareholding land in village (1=present)	-33.87 (19.15)*	-18.87 (12.27)	-1.47 (.68)**	-
Dummy for whether village committee elected (1=elected; 0=appointed)	-24.86 (12.03)**	-13.69 (6.92)**	-	-
Dummy for whether village leader elected (1=elected; 0=appointed)	-38.0 (23.99)	-	-	-
<b>Variance:</b>				
Total household income (RMB/year)	-	.000022 (.000013)*	.000047 (.000016)***	
Dummy for NFPP county (1=in NFPP)	-	-	-	
IHS transformation	-	-.023 (.013)*	-	

When we look at the determinants of WTP to avoid a full or partial logging ban, we find that income and wealth variables are significant for the case of the full ban, but not the partial ban. Income is positively related to WTP to avoid the full ban, which conforms to the predictions of economic theory, based on decreasing marginal utility of money. However, if income is controlled for, wealthier households are WTP less to avoid the full ban, which is likely to be because they have a greater range of economic alternatives than poorer households.

Variables representing forest activity are largely insignificant as determinants of WTP to avoid either the full or partial bans. However, there is some indication that the area of collective land in the village is positively related to WTP to avoid the full ban, but negatively related to WTP to avoid the partial ban. The proposed ban was described as lasting for ten years, so households with their own private forest land would

expect to realise the gains from timber growth over that period. In contrast, there may be more uncertainty about the use of collective forest land after the 10 year period. This suggests that whereas households oppose losing all access to collective forest land under the full ban, they support controls over the use of collective land so that others are limited in the extent to which they can cut timber. For the partial ban in particular, whether the household has already experienced the NFPP has a negative and significant effect on WTP. This suggests that those who have experienced the ban are more aware of its benefits or have already begun to overcome some of the costs.

When we look at the institutional variables, we find a number of strong effects across all the models. Firstly, household WTP is positively correlated with whether other households in the same township are willing to pay to avoid the logging ban. This indicates that institutional factors which are not picked up by the other variables included in the model are important in determining individual household views about the logging ban. We cannot say exactly what those institutional factors are, but the conditions for local collective action would be expected to vary more between townships than within them, which provides a plausible source of variation in household attitudes towards the logging ban.

We also find that the election of the village committee (as opposed to appointment by higher levels of government) is negatively related to WTP. Rozelle (1994) and Zhang et al (2002) find that elected village leaders or village committees act more in the interest of village households (compared to the interest of higher levels of government), and provide higher levels of public goods. Given this, we would expect an elected village committee to be more likely to address local collective action problems resulting from overharvesting in the absence of the national level ban. This could have been displayed as greater support for the ban from those households that had unsolved local problems, but instead the results suggest that those who are more likely to have already had local restrictions on harvesting are less opposed to the national level ban. This may be because they are more aware of the benefits or because the additional effects will not be too large.

For the partial ban, we find that households in villages with shareholding land are less opposed to the restriction. Shareholding land is one method that the village leader or village committee can use to reconcile

individual property rights to forest land with collective management because although households have rights to the income from the land, decisions about how it is used are made at the village level. This supports the view that in villages where harvesting may have already been restricted, households are less concerned about being affected by the logging ban.

### ***5.5 Expected WTP***

Table 8 shows the conditional mean and median values of predicted WTP estimated from the different models. We also include the summary statistics for comparison. All the models show positive estimates of mean and median WTP to avoid the full ban on logging. The results from the basic summary statistics and the IHS Tobit model are significantly different from zero. However, the results of the Tobit, IHS Hurdle and CLAD models are not. As the IHS hurdle and CLAD models are more flexible than the others, we conclude that on average, there are no significant welfare changes as a result of a full logging ban. The models that allow estimation of the results from the partial ban all indicate negative and significant mean and median values of WTP.

**Table 8: Average WTP to avoid the logging ban – best-fit specifications**

		MEAN (SD)	SIGNIFICANT?	MEDIAN
Summary statistics	Full ban	25.89 (49.27)	Yes	10
	Partial ban	10.53 (22.07)	Yes	0
Tobit	Full ban	0.44 (46.3)	No	2.11
	Partial ban	-19.10 (33.38)	Yes	-16.78
IHS Tobit	Full ban	15.95 (49.58)	Yes	11.7
	Partial ban	-10.25 (21.20)	Yes	-9.27
IHS Hurdle	Full ban	1.55 (7.96)	No	0.21
Hurdle	Partial ban	-0.33 (1.29)	Yes	-0.07
CLAD	Full ban	-	No	5.51 (93.98)
	Partial ban	-	-	-

When we compare the parametric and semi-parametric results to the summary statistics, we find that the former tend to be lower. This is to be expected as where we have made distributional assumptions, we have allowed for negative values of the dependent variable, which reduces the net value. In the case of the partial ban, this is more pronounced as the summary statistics cannot be negative, whereas when we assume a distribution across all possible values of the dependent variable we find that average WTP to avoid the partial ban is less than zero. There are also greater differences between the mean and median values when they are estimated directly from the data than when any of the parametric or semi-parametric models are used.

Overall, what we find is that on average, household WTP to avoid a full ban on logging is greater than zero but not significant. Average household WTP to avoid a partial ban on logging, in which limited amounts of timber can be cut for own use, is significantly less than zero. This indicates that households do not experience or anticipate net welfare changes as a result of a full ban on logging, but anticipate a welfare gain from a partial ban. Based on the framework described in Section 3, we would conclude that as the full logging ban does not increase the welfare of the forest communities, they would not have voluntarily stopped harvesting timber in the absence of the regulation. However, they do not require compensation either because the losses they experience as a result of the prohibition on timber harvesting are offset by the environmental gains for the local community. This, along with the negative results for the partial ban, suggests that the forest-based households were experiencing a collective action problem to some degree. In the absence of free-riding, we would have expected to observe a reduction in timber harvesting by all households, even if not complete cessation.

## 6 CONCLUSION

Our theoretical framework distinguished between two alternative regulatory scenarios. In the first, regulation is solving a local collective action problem. In the absence of any government intervention, it is possible that the relevant community could have solved this problem themselves, as it would have been in their interest to do so. However, the incentives for individuals to free-ride can often prevent cooperation.

Furthermore, we argue that due to the recent introduction of individual property rights to agricultural and forest land, local institutions for solving collective action problems arising from individual households exercising their private property rights are less developed in China than elsewhere, increasing the need for national level intervention. Within this scenario, regulation may reduce the rights of individuals over their property, but that loss is non-compensable because there is already implicit compensation due to the reduction in external costs for the whole community. In other words, each individual gains more from the restrictions on the rights of others than they lose as a result of the restriction placed on themselves. The second scenario is more familiar from debates over regulatory takings. It occurs where individuals experience losses in property rights that they would not have voluntarily chosen, even if free-riding could have been avoided. In this scenario, asymmetry in the distribution of costs and benefits means that one group bears the costs of the regulation, while a separate group experiences the benefits. In this situation, we can argue for compensation to the former group.

Much of the existing literature on the NFPP has stated that households in collective forest areas should be compensated because they have lost the rights to cut the timber on their forest land. We argue that the loss of rights is not a sufficient condition for the payment of compensation. Instead, it is also necessary to consider whether the environmental benefits of the logging ban are experienced solely by downstream households or whether they are also important for the households in forest areas. If the external costs of timber harvesting were affecting the forest-based households, free-riding could mean that a voluntary reduction in harvesting would not be observed even if it would increase the welfare of the whole community. In this case, regulation would be a solution to the collective action problem and would not require compensation. In this paper, we tested this additional condition of whether the NFPP was a solution to an existing collective action problem in forest areas or whether regulation involved a redistribution of rights from forest-based households to those located in downstream areas.

We estimated the average welfare impacts of the NFPP on forest-based households to determine whether they were positive or negative. We found that the net effect on households' welfare of a complete logging ban was negative but not significant. This implies that although the households might not have

voluntarily introduced a ban on the basis of the local impacts, they have received implicit compensation for losses in land-use rights, in the form of local environmental benefits that offset the welfare impacts of those losses. In addition, we found that when we proposed a partial logging ban, where households would be permitted to harvest very limited quantities of timber for their own use only, the expected net welfare impacts were positive. This indicates that although a full ban would not be voluntarily chosen by forest households, there does appear to have been some degree of overharvesting at the local level. We conclude that in the absence of free-riding, harvesting levels would have been lower than they in fact were, and that some intervention to reduce harvesting would be welfare improving for those affected.

In relation to the question of compensation for regulatory interventions more generally, we conclude that where collective action problems are not being addressed at the local level, central government regulation may be necessary to achieve local Pareto improvements. In countries where private property rights are long established, regulation is more likely to be used primarily for redistributive purposes, and compensation may therefore be justified. However, where the institutions for voluntary agreement between individuals about the use of private property are less developed, certain regulations will be welfare improving for all affected. In these cases, compensation for limitations placed on property rights is no longer justifiable.



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