An Economic Assessment of the Influence of Changed Property Rights on Forest Management[1]

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Abstract

Shrift towards private ownership in forestry recourses in transition countries of Central and Eastern Europe promotes forest values and their development in diversified ways. In this paper, we provide a general equilibrium model assisting in estimation of forest management practices in the regional level by comparing different ownership structures and public policy measures.

The model is applied for the county of Banská Bystrica in Slovakia. The results provide an integrated tool identifying possibilities to address strategic development at the regional level that relates to the improvement of local well-being and sustainability applicable in other regions with diversified forest ownership structure.

Keywords: *forestry, property rights, ownership, transition countries, Slovakia*

JEL Classification: C68, Q15, Q23

Introduction

Forests play an important role both in the economic development of regions and nations. Apart from providing timber, additional values such as wildlife habitat, watershed protection, or natural areas for recreation can be recognized

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(Carlsson, 1999). Unfortunately, the allocation of different function of forests between competing uses becomes more and more difficult as society's demand for all uses have increased (Dore and Guevara, 2000). Despite the importance of these non-timber products, the assessment of forest management activities is often focused only on the optimal harvesting of forest stands. Thus, the focus of the present paper is on the management of forests providing both timber and non--timber products in economies in transition of Central and Eastern Europe (CEE).

In these countries, weak political support, lack of financial resources and administrative capacities are likely to negatively affect environmental quality. Eventually, there is the possibility of a breakdown of the environmental resource base, caused by rapidly increasing waste production by households, the break-up of established systems of land use control, water resources and forestry management leading, for example, to uncontrolled urban development on previous agricultural land (Pavlínek and Pickles, 2004). On the regional level, the evidence of these trends is the increasing degree of both legal and illegal cutting, a side-effect of the more complex coordination between the different stakeholders (Kluvánková-Oravská, 2004).

A related issue particularly important for the transition countries of Central and Eastern Europe is the gradual privatization of the former publicly owned forests. In general, there is a lack of comprehensive assessment of the impacts of changed ownership regime over forests in transition countries. However, there are examples that post-communist transformation has also resulted in new dangers of reckless exploitation. Privatization of forests and uncertainties over ownership rights and cutting regulations have led new private owners to cut their newly acquired forests for profit, ignoring environmental consequences and, in some cases, established legal codes (Pavlínek and Pickles, 2004; Pickles et al., 2002). We argue that the supply of non-timber products can be linked to the ownership structure of forests: recreational and other existence and option values are provided to a higher extent under public than under private ownership. Ultimately, the reason for this difference is the public good character of these services. Therefore, it is of key interest to investigate if new property rights regimes imply changes in forest management and to propose alternative policies able to address the adverse environmental effects.

The purpose of this paper is to improve the understanding and to provide a methodological approach for assessing the impact of the different property regimes on forest management. Therefore, we analyze the changes in the utility of households related to the ownership and imposed taxes on the forestry sector by means of a static, two-sector Computable General Equilibrium (CGE) model, since the CGE approach permits prices of inputs to vary with respect to changes in output prices and, thus, allows to capture the behavior of economic agents (Gunning and Keyzer, 1993; Patriquin et al., 2003). We model households' utility derived from a composite consumption good and non-timber products under different forest property rights regimes. In the case of public ownership, we assume that the authority is aware of the households' interest in non-timber products and to avoid the cutting of the forest. In case of a private forest, the owner does not take account of the non-timber values and thus imposes a negative externality on the households. We thus determine the tax rate necessary to internalize this loss in forest values.

The economy used as a case study in this paper is a small-scale economy in the county of Banská Bystrica in Slovak Republic. By parameterizing our model for this county, we assess the current activities of the forestry industry, identifying key linkages between different ownership structures in forest management and estimate the value of forest industry output, and industry employment in Banská Bystrica. The results of the research could be used to provide assessment of possible policies that can tackle a negative affect of restored private ownership structure.

The paper is organized as follows. First, the inclusion of an externality due to a diminished forest stock into the household's utility maximization problem is discussed. Afterwards, different property rights regimes for the forest sector are discussed as well as their implications for the profit maximization problem of the forest owner. Then, the impact of households' higher preference for non-timber products and an increase in the forest stock are investigated. In a final section, implications, shortcomings and possible extensions of the model are discussed.

1. Methodological Approach

With the aim to keep the property rights regimes in forestry in the centre of our approach, two sectors will be distinguished, that is the forest product and a composite good (all other goods). Both goods are produced from the four inputs of capital, labor, land, and timber, assuming constant returns to scale.[2] Households are described by a representative consumer who derives utility from consumption and disutility from a reduction in the forest stock, which can be interpreted as a decrease in non-timber values. Disposable income of the households consists of wages, capital income and land rent. While the model builds on (Bergman, 1990) and therefore will only be discussed briefly, two major changes can be observed. First, utility is dependent on the remaining forest stock after cutting. Second, property rights are defined by a scale parameter, which can take any value between zero and one.

[2] The selection of input is based on Lantz and Yigezu (2002).

Non-timber benefits are modeled by the value of the remaining forest stand, denoted by $\mu \cdot F$. Let M be the forest stand if no tree is cut. Then, the remaining forest stand is defined by $F = (M - X_1)/M$ where X_1 stands for the output in sector 1 (forestry). Thus, when assuming a Cobb-Douglas utility function with constant returns to scale, utility is defined by:

$$U(C_1, C_2, F) = C_1^{\,b} C_2^{\,1-b} e^{\mu \times F}, \quad \mu < 0 \tag{1}$$

As seen from this utility function, overall utility is inversely related to the size of the remaining forest. In other words, if the forest is not cut ($X_1 = 0$), the household's utility is equal to $U(C_1, C_2, F) = C_1^{\,b} C_2^{\,1-b}$. On the other hand, if a positive value is cut, the factor $e^{\mu \times F}$ will be smaller than one.

To assign a value to non-timber benefits, it is convenient to derive the households' marginal willingness to pay for cutting one unit less of the forest. With respect to that, one has to rephrase the dual to the utility maximization problem, which is an expenditure-minimizing problem subject to a utility constraint. Solving this problem gives the following expenditure function:

$$E(P_1, P_2, U) = B \times P_1^b \times P_2^{1-b} \times U \times e^{-\mu \times F}, \quad where \quad B = b^{-b}(1-b)^{b-1} \tag{2}$$

Accordingly, the households' marginal willingness to pay to avoid an incremental decrease in F is

$$\frac{\partial E(P_1, P_2, U)}{\partial F} = -\mu \times B \times P_1^b \times P_2^{1-b} \times U \times e^{-\mu \times F} \tag{3}$$

The second major extension refers to the inclusion of property rights. Under private forest ownership, the damage of the forest output on the representative household is not considered at all, while public ownership implies that these benefits are taken fully into account by means of the marginal willingness to pay (MWTP) stated by the consumer in order to avoid this impact. If the forest industry is taxed at a tax rate equal to this MWTP, it is forced to take account of non-timber benefits, too. Property rights and taxes are modeled by dummy variables, denoted by m and t, respectively:

$$property\ rights \begin{cases} t_{1,2} = m_{1,2} = 0 & in\ case\ of\ private\ property \\ t_{1,2} = m_2 = 0,\ m_1 = 1 & in\ case\ of\ public\ property \\ t_1 = 1,\ m_{1,2} = t_2 = 0 & in\ case\ of\ private\ property\ with\ tax \end{cases} \tag{4}$$

Accordingly, the supply of firm i is determined by

$$P_i + t.TAX_{yield} = \frac{\partial \phi_i\left(W, R, V, X_i\right)}{\partial X_i} - m.MWTP \quad (5)$$

where $MWTP = \frac{\partial E\left(P_1, P_2, U\right)}{\partial F}\frac{\partial F}{\partial X_1} < 0$, $TAX_{yield} = -MWTP > 0$, and where W stands for the wage rate, R for the rental price of capital, V for the land rent. The cost function is denoted by ϕ. Thus, if the forest sector is in private ownership, we have, as in the standard model that price equals marginal cost. Under public ownership, however, the firm has to bear an extra cost, which is just equal to the marginal willingness to pay of the household. In the third case, a tax drives a wedge between marginal costs and price such that the private forest industry behaves just as under public ownership. Yield tax revenues are transferred to the households and therefore increase disposable income. The remaining equations refer to market clearing of all input and output markets.

2. Case Study: The Forest Industry in Banská Bystrica County

Forest covers an estimated 74% of the total land area of county Banská Bystrica, which represents some 91% of all forestry and woodland found in Slovak Republic. The county has nearly 1,132,986 hectares of woodland, of which private woodland constitutes more than 70% of the forests, but the majority of them is still managed by a state owned company. Banská Bystrica is the county with the second largest abandonment of agricultural land that reaches approx. 15.6% of total agricultural land (Green Report, 2002).

Table 1

Description of the Base-line Scenario for Banská Bystrica County (2001)

Variables	Unit	Base value (2001)
Output in forest sector, X_1	mil. SKK	10.135
Output in composite sector, X_2	mil. SKK	104.445
Labor in forest sector, L_1	Persons	14.823
Labor in comparison sector, L_2	Persons	227.321
Capital in forest sector, K_1	mil. SKK	18.324
Capital in comparison sector, K_2	mil. SKK	34,986.792
Size of forest stock, M	1000 m^3	394*
Land in comparison sector, D	ha	379.915
Wage in forest sector, W_1	SKK	9.456
Wage in comparison sector, W_2	SKK	11.385
Rental rate of land/ha, V	SKK/ha	10.452
Income of household, Y	mil. SKK	73.176

*This level of stock is estimated as a level needed for maintaining sustainable forestry (Green Report, 2002).

Note: elasticity estimates are the average elasticity of 8 European countries including EU and non-EU members (Schwarzbauer, Brooks and Baudin, 1995).

Source: Bizikova (2004); Green Report (2002); Slovak Statistical Office (2002a, 2002b).

The parameters of the utility and production function are set as follows. The elasticity of substitution in the utility function is $b = 0.365$, output elasticity of labor in the forest sector is set at $\alpha_1 = 0.69$, and in the composite sector at $\alpha_2 = 0.31$. The following simulations are derived with GAMS (General Algebraic Modeling System).

3. Implication of Different the Forest Ownership Regimes

In the model, the ownership structure is grasped by the MWTP dummy and the private forest owner is maximizing the profit from cutting the forest. On the other hand, if the forest is in public ownership, the aim is not only to maximize profits but also to take account of the negative impact of cutting on the utility of the representative household. In majority of the cases including transition countries, the most realistic option is so called 'mixed' ownership that assumes partly privately owned forest and partly publicly.

By comparing these three cases, it can be seen that the price of sector 1 (forestry) increases the more the forest is in public ownership. Correspondingly, the output of sector 1 is falling. The reverse effects can be recognized in sector 2. Overall, the income of household is increasing when one moves from private to public ownership. When we move from private ownership to different magnitude of public ownership, the output of the forestry sector is decreasing.

Finally, in column 4 and 5 of the Table 2, the outputs under private and mixed ownership are taxed according to a rate equal to the marginal willingness to pay to avoid an additional unit of destruction of the forest on behalf of the households. Not surprisingly, in either case the resulting prices and quantities are just the same as in the public ownership case. In the following, we use the public ownership case (third column) as reference case.

Table 2

Impact of Ownership Structure

Ownership types*	**Private**	**Mixed**	**Public**	**Private**	**Mixed**
m_l (if MWTP considered > 0)	0	0.5	1	0	0.5
t_l (if tax imposed > 0)	0	0	0	1	0.5
Output sector 1 (Forestry), X_l	1	0.988	0.95	0.95	0.95
Output sector 2 (Other goods), X_2	1	1.005	1.006	1.006	1.006
Income of household, Y	1	1.01	1.02	1.02	1.02
Price of good 1, P_l	1.00	1.02	1.03	1.03	1.03
Price of good 2, P_2	1.00	1.00	0.999	0.999	0.999
Tax rate	0	0	0	0.044	0.022

*$\mu = -0.01$

Source: Model calculation.

4. The Preference for Non-timber Products by Households

In order to investigate the impact of an exogenous increase in the preference for non-timber products, we increase the value of μ (in absolute terms). The larger this parameter, the smaller will be both the scaling factor $e^{\mu.M}$ and the resulting utility level. Table 3 gives the result for different cases of μ where its value is increasing from left to right, and $\mu = -0.1$ constitutes the base-line level used in Table 1.

A larger value of μ implies a smaller output in forestry (sector 1) and a larger one for the composite good (sector 2). Accordingly, price 1 falls and price 2 increases. Because the forest sector is assumed to be labor intensive and its demand for labor is falling, the wage rate is declining. This then affects the decline in the remaining forest stock (see bottom row), which implies an increasing MWTP to avoid an additional unit of cutting the forest. In line with this is also the increase in disposable income.

The MWTP increases with the absolute value of μ. In the case of a more environmentally conscious household (as depicted by a $|\mu|$ larger than 0.1) the price of the forest product increases by up to roughly 40%, resulting in a very negative impact on consumption possibilities and utility. Therefore, this negative impact on utility dominates the positive effect of a reduced output in sector 1 on the remaining forest stock M.

Moreover, forest sector output decreases from 98.8% to 89.3%, depending on the applied value of μ. These reductions cause a downward pressure on forest sector's wages (up to –9.9%) and on rental rates.

Table 3

The Impact of the Preference Parameter for Non-timber Benefits (Simulations for Public Ownership)

Non-timber preference parameter, μ	–0.05	–0.1	–0.3	–0.707
Output sector 1 (Forestry), X_1	0.988	0.95	0.91	0.893
Output sector 2 (Other goods), X_2	0.006	0.006	0.008	0.011
Labor in forest sector, L_1	0.099	0.082	0.063	0.039
Labor in comp. sector, L_2	0.001	0.001	0.001	0.001
Land in comp. sector, D	0.009	0.003	0.015	0.021
Wage in forest sector, W_1	0.099	0.096	0.094	0.091
Rental rate of land/ha, V	0.01	0.009	0.007	0.003
Income of household, Y	1.01	1.02	1.022	1.03
Price of good 1, P_1	1.01	1.02	1.03	1.041
Price of good 2, P_2	1.00	0.999	0.998	0.998
Marginal WTP, $MWTP(X_1)$	–0.03	–0.09	–0.19	–0.45
Remaining forest proportion, F	0.902	0.905	0.909	0.918

Source: Model calculation.

Reductions in the wage and rental rate of capital in the forest sector in the model simulation imply that labor and capital move out of the sector and into other sectors of the economy. In this case, the composite sector experiences an increase in output, labor and land. Overall, the county experiences a significant reduction in total output, labor, and capital in the region.

5. Dependency on the Size of Exogenous Forest Stock

Due to factors exogenous to the model, such as extreme weather events, the forest stock M could be destroyed. In that case, keeping the cutting rate at a high level could lead to extinction of the forest. Therefore, the household's utility is reduced by a larger negative externality (as measured indirectly by the remaining forest stock).

As illustrated in Table 4, a decrease in M leads to an increase in the $MWTP$, as well as in disposable income due to the transfers to the household in compensation for the reduction in non-timber benefits.

Table 4

The Impact of the Size of the Forest Stock (Simulations for Public Ownership)

Reference forest stock, M	400*	1000	3000
Output sector 1 (Forestry), X_1	0.96	0.99	0.999
Output sector 2 (Other goods), X_2	1.005	1.002	0.999
Labor in forest sector, L_1	0.07	0.99	0.99
Labor in comp. sector, L_2	0.002	0.001	0.001
Land in comp. sector, D	1.062	1.031	1.001
Wage in forest sector, W_1	0.959	0.999	0.999
Rental rate of land/ha, V	0.009	0.011	0.021
Income of household, Y	1.026	1.02	0.999
Wage rate, W	0.94	0.98	0.99
Price of good 1, P_1	1.08	1.03	1.01
Price of good 2, P_2	0.999	0.999	0.999
Marginal WTP, $MWTP(X_1)$	–0.122	–0.027	–0.011
Remaining forest proportion, F	0.812	0.941	0.98

*Only moderate increase compared to baseline level of the forest stock.

Source: Model calculation.

On the other hand, and beyond the results gained by our simulations, afforestation will enlarge social benefits: primarily to agriculture, because of soil protection and hydrological forest functions, but also in a broader sense, e.g. concerning climate change mitigation. Due to market failures, however, these social gains from afforestation (external benefits) will not be achieved, and welfare maximization conditions therefore will not be met without government regulation (Nijnik and Bizikova, 2006). The main reason is the discrepancy in the distribution of benefits and costs from forestry development. The establishment of forest plantations is executed in the forest sector, while the soil protection benefits, for instance, accrue to agriculture (Kooten, Binkley and Delcourt, 1995; Nijnik and Bizikova, 2006). Therefore, if the forest stock is increasing, i.e. afforestation measures are adapted, the *MWTP* falls to virtually zero and therefore transfers from the government do not increase disposable income.

Conclusions

In this paper, we addressed the pressing needs in transition countries that call for the development of a new approach to forest management planning in order to fit a wider range of forest sites together with specific requirements of various owners (Kluvánková-Oravská, 2004). As long as land remains fragmented, there is an absence of long-term investments and appropriate incentives for tree-planting activities, as well as whilst government subsidies to encourage sustainable behavior on the part of new land owners are continuously decreasing, the expansion of intensive economic activities will keep threatening forest sustainability.

The present model is an attempt to analyze the impact of different forest ownership structures on the economic performance of the forest sector and composite sectors, as well as their influence on the utility of the households. Moreover, the sectoral changes as a consequence of the tax imposed under different property regimes are included in the paper. The preferences of the households for the remaining forest were grasped by means of their willingness to pay in order to avoid the cutting of an additional unit of the forest.

The simplifications made in the model setup influence the results and their implications for forest management. One important basic assumption is the substitutability of natural and manmade capital, which allows any shift from one sort of capital to another. Secondly, the inclusion of forest resources in a static CGE model is not able to describe the dynamics of both forest growth and its development, including also the occurrence of extreme events such as floods, storms etc. Moreover, an important role for the condition of the forests plays the forest management activities implemented. In our model, the imposed tax influenced the production of the forestry sector without tackling implied changes in management activities, which could have a significant impact on the future development of a forest.

This development will be probably significantly influenced by consolidation of the EU sustainability regime and implementation of principles of sustainable management of natural resources. Addressing problems such as climate change, urban sprawl, soil sealing and habitats protection requires the integration of environmental concerns into other policies to achieve a significant decoupling of economic development on the one hand, and environmental degradation and resource consumption on the other (Homeyer, 2004).

But to explore the success of sustainable forest management very much depends on the success of institutional transformation. Since the capacity to generate a simultaneous change in a whole range of political, economic and social institutions is limited, it is vital to find a feasible time-path for step-wise reforms, which do not unhinge the macroeconomic balance (Eggertsson, 1994). The institutional framework "able to handle such a dramatic change in property rights" has to acknowledge that overall privatization of forests meanwhile might be finished in some transition economies (Biziková, 2004; Carlsson, 1999), whilst an excessive forest privatization might be also unnecessary in some other.

Finally, it is necessary to include diversification between households, for instance by distinguishing groups according to differences in their dependence on the forestry sector. Both agriculture and forestry are in the transition process, and resource extraction especially of timber, as the major source of employment in many rural areas, is undergoing painful transitions from predominantly agrarian rural economies (Beckmann and Dissing, 2004; Nijnik and Biziková, 2006). These changes are experienced by rural societies in transition countries of Europe states over a matter of years rather than decades or centuries. Moreover, while the outcomes of the model simulation provide valuable guidelines for the policy development, they need to be adequately adapted to the context of the transition process in the countries.

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