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Private Forest Owners' Social Economic Profiles Weakly Influence Forest Management Conceptualizations

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Abstract: Although several private forest owner studies have dealt with how private forest owners understand forest management, little is known about the determinants of specific forest management concepts. The study expands previous latent variable models of the perception of forest management by European private forest owners by looking at how age, income, education, annual cut, and holding size and type influence specific understandings of forest management. We applied a multiple indicators multiple causes (MIMIC) structural equation model on a representative sample of 754 private forest owners from Slovenia. The MIMIC model confirmed the influence of six covariates on three concepts of forest management: the maintenance concept, the ecosystem-centered concept, and the economics-centered concept. The strongest determinants of perception were education and holding type. The maintenance concept was predominantly associated with less educated older full-time or part-time farmers working on smaller family farms and doing regular cuts. The perception of forest management as an economics-centered activity increased with increased education and dependence on income from intensive cuts. The ecosystem-centered concept was most strongly associated with younger, better-educated owners with smaller holdings and, surprisingly, not to non-farmers but to small-scale family farmers. However, the proportion of the variance of latent variables explained by the six covariates was low, ranging from 2.4% to 5.1%. Taking into account the influence of education and holding type on private forest owners' perception of forest management, by increasing the level of education and raising the proportion of absentee owners in Europe, we expect a shift from the maintenance concept toward either an economics-centered or ecosystem-oriented concept for forest management. Despite the weak influence of private forest owners' social economic profiles on forest management conceptualizations, governments should be aware of the trend and actively seek to prevent the polarization of forest management concepts.

Keywords: family forest owners; forest management concepts; education; family farm; causal indicator model; structural equation modeling

1. Introduction

In many countries, non-industrial private forests prevail. Most non-industrial private forests (hereinafter private forests) are owned by individuals or are family-owned small-scale forests [1]. A variety of names have been given to individuals and families owning these forests to describe the diversity of their attitudes toward forest and forest management (e.g., [2]). Most often, they have been described as multi-objective and multifunctional forest owners, but the terms "passive," "uninterested", or "recreationists" have also been used to describe the type of owners who do not fit the classical definition of a forest owner who undertakes forest management. The widely accepted definition of forest management as planned interventions in forests to meet specific environmental, economic,

social, and cultural objectives seems to be challenged by the behavior of private forest owners [3]. Due to their low level of involvement in silvicultural activities and harvesting, forest owners have often been described as "passive" by policy-makers and forest scientists [2]. However, forest owners frequently claim the opposite; they consider themselves to be active managers, but on their own terms [4]. The discrepancy between the official notion of active forest management and the forest owners' perception of what it means to be active could stem from differences in the understanding of forest management as a theoretical construct.

Several studies have explored the perception of forest management by private forest owners (e.g., [5,6]). Using social representations theory [7], Feliciano et al. [8] compared private forest owners' perceptions of forest management in seven European countries. The social representations theory claims that the beliefs, attitudes, or emotions of a social group are socially specific. Forest management can thus be understood differently by different social groups, but the members of a social group share similar representations. However, since representations are abstract and can only be measured indirectly through latent construct measurement scales, the confirmation of a latent construct requires special methods. A powerful collection of methods that range from regression models for observed variables to multi-level latent variable modeling is structural equation modeling. Using structural equation modeling, Ficko and Bončina [4] confirmed that forest owners in Slovenia conceptualized forest management as a mixture of maintenance and ecosystem-centered and economics-centered management, and that private forest owners considered the maintenance of forests as the main principle in managing the forest. Maintenance emphasizes the continuation of work started by ancestors, ensuring a clean environment in the neighborhood, or just taking care of the forest so it is not left in a state of neglect. Ecosystem-centered management is characterized by making decisions on what, when, and how a particular forest stand should be managed, how the forest should be managed to be sustained for future generations, and how to care for forest health and prevent diseases. Economics-centered forest management considers forest management as capital management and good business opportunities. Their study demonstrated the substantial overlap between forest management representations, particularly between the maintenance concept and the ecosystem-oriented concept. By applying the mean and covariance structures (MACS) model [9], they tested for factor mean differences in a multigroup model consisting of the self-perceived efficient and inefficient forest owners. Häyrinen et al. [10] used confirmatory factor analysis to test the four-dimensional structure of forest owner objectives in Finland. Karppinen and Berghäll [11] used structural equation modeling to test the factors affecting the intention to carry out stand improvement. These rather rigorous models of latent constructs, along with many qualitative studies of forest owner behavior, show that private forest owners understand management as multifunctional and that there are significant differences between private forest owners in their attitudes toward forest management.

However, it remains unclear what factors are associated with the emergence of a certain representation of forest management. The theory of social representations mostly deals with how citizens construct societal and political issues and less with the question of how to explain the collective constructs. However, if we understand how this collective is defined (i.e., by the social structures in which the individual is embedded [12]), then we can expect a correlation between the characteristics of a social collective and the representations that the members of this collective share. However, since there are several levels of collective sharing, and it is not clear how collectively shared social cognitions must be to qualify as social representations, we expect that the explanatory power of structural attributes will be low.

The use of structural attributes to discern one type of forest owner from another has a long history [13]. Social, economic, and demographic conditions at a particular point in time have usually been interpreted holistically and termed as the social economic profile (e.g., [14]). Several private forest owner typologies, in particular the earliest ones developed in the 1980s, have used the social economic profile to explain forest owner management orientation and behavior [2]. Using break-point analysis, Butler et al. [15] showed that the size of forest holdings is highly correlated with forest

management behaviors and timber production objectives. Even variation within established size categories can be substantial [16]. Matilainen and Lähdesmäki [17], for instance, showed substantial variation in attitudes toward forest management, specifically for the group of passive forest owners, where those classified as passive according to the national statistics were not passive at all in relation to forest management.

In addition to theoretical significance, the use of structural attributes for discriminating forest owners according to their understanding of forest management also has practical implications. The use of age, gender, monthly income, education, annual cut, holding size, and the social economic type of a forest holding in explanatory models of attitudes toward a certain concept enables interpretations that are more applicable in practice (e.g., [18,19]). Structural attributes are easy to acquire or are readily accessible in public registers, and can be used to stratify private forests without conducting a survey.

The aim of this study was to contribute to the relatively scarce literature on the influence of the demographic and economic characteristics of private forest owners on their perceptions of forest management. The objectives were to (1) determine which structural attributes could be used to explain the differences in private forest owners' perceptions of forest management, and (2) outline the possible consequences of structural changes in the population of private forest owners for forest management.

2. Materials and Methods

2.1. Study Area and Sampling

The data were collected in Slovenia in September 2013 within the national study of social representations of forest management and efficiency of small-scale forestry. We conducted 3099 telephone interviews with randomly selected private forest owners owning at least 1.0 ha of forestland to achieve 1054 interviews that fit the margin of sampling error of plus or minus 3.0% (Figure 1).

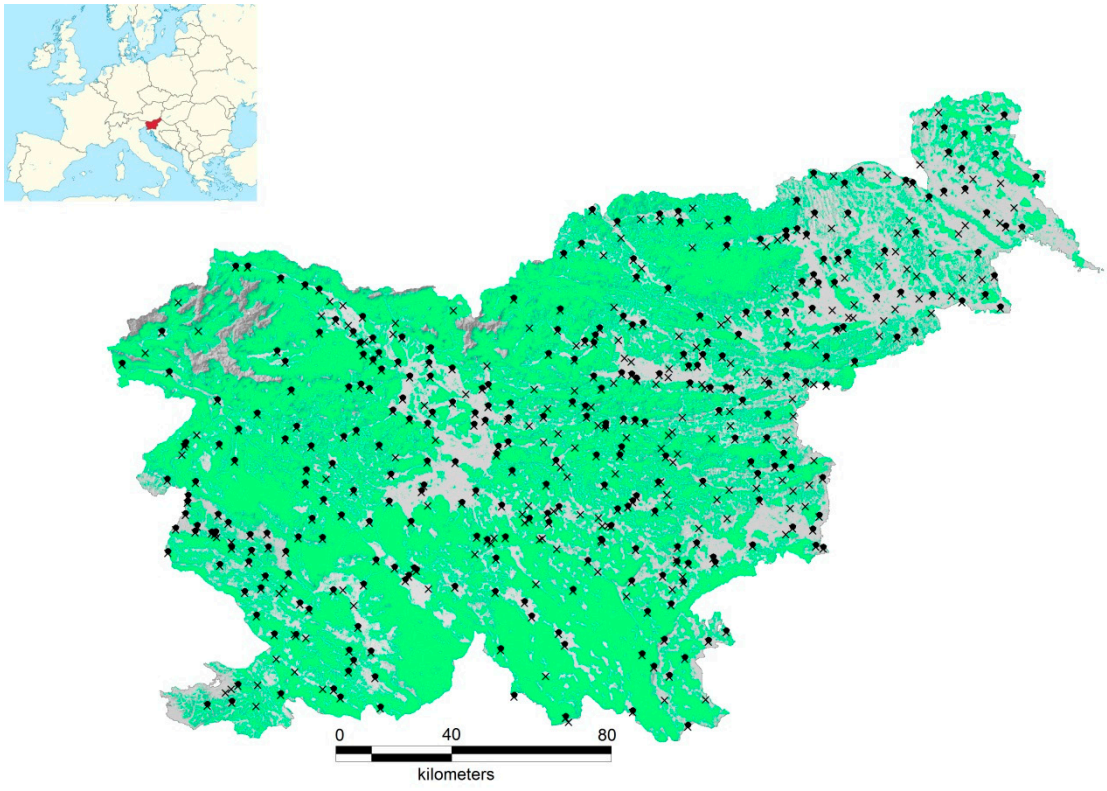

Figure 1. The locations of settlements where the respondents (•) and non-respondents (×) resided. The green color denotes forest cover.

After inspecting the data, 0.19% of values were missing. Where possible, the dataset was completed by data from official registers. After checking graphically that the missing values exhibited a random pattern, we used a multiple imputation technique to replace the rest of the missing values (Table 1). The sample with imputed values thus reached 754. Before further analyses, we used case weights to correct for the slight overrepresentation of owners with smaller properties. The representativeness of the sample was also checked with respect to spatial bias (i.e., by testing the association between the settlements where the respondents and non-respondents came from) and by comparing the socio-demographic variables in the population and the sample. There was no spatial clustering of non-respondents (Cramer's V for the association between the places of residence of respondents and non-respondents = 0.798, $p < 0.01$), and the sample was representative with respect to age (61.1 and 61.4 years for respondents and the population of owners with holdings >1 ha), number of parcels per forest property (13.6. and 12.4) and male/female ratio (1:2.0 in both groups), $p > 0.05$.

Table 1. Structural attributes of private forest owners and forest holdings.

Code	Variable and Type		Variable Definition	Missing Values (Recoded from Official Register (REC), Multiple Imputation (MI))	Mean, Median (Standard Deviation), Range or % Where Applicable
AGE	Age (years)		Calculated from the reported year of birth	1.5% (REC)	61.0, 61.0, (12.4), 84.0
SOC	Socio-economic type of holding (ordinal)	Full-time farmers	None of the active household members (age 15 to 65) employed outside family farm (1)	-	4.4
		Part-time farmers	Combinations of employment (2)	-	30.6
		Elder farmers	All household members older than 65 (3)	-	15.0
		Non farmers	All household members employed outside family farm (4)		50.0
EDU	Formal education level (ordinal)		<8 years (1)	-	2.1
			primary school (2)		12.3
			high school undergraduate (3)		0.5
			vocational school (4)		20.0
			high school graduate (5)		35.9
			higher professional studies (6)		15.8
			college or higher (7)		13.3
AREA	Total forest area of the owner's holding (ha)		Total area of forest land in the holding	15.9% (REC)	4.6, 2.0, (9.9), 167.9
CUT	Mean annual cut in the last decade (m^3 ha^{-1})		Cubic meters harvested according to owner's statement	14.2% (MI)	8.7, 2.5, (22.1), 323.3
INC	Monthly income (ordinal)		No income	13.9% (MI)	23.7
			<500 EUR		48.4
			500–1000		19.5
			1001–2000		3.6
			>2000 EUR		4.8

In the interview, the owners were asked what they understood by forest management. A list of statements defining forest management (q3_1 to q3_19) was provided, and the respondents indicated their level of agreement on a five-point Likert scale (Table 2). The preparation of the statements is described in [5].

Table 2. Statements defining forest management (q3_1 to q3_19) and Spearman's rank correlation with structural attributes (* correlation coefficients significant at the $p < 0.05$ level).

Please Indicate the Level of Agreement with the Following Statements Defining Forest Management with a 5-Point Likert Scale. Forest Management Is ...		**AGE**	**INC**	**EDU**	**CUT**	**AREA**	**SOC**
q3_1	The application of knowledge on how to manage the forest ecosystem	−0.025	0.046	0.170*	0.029	−0.069	−0.039
q3_2	Capital management	−0.025	−0.010	0.077*	0.082*	0.032	0.009
q3_3	Making decisions on what, when and how a particular forest stand should be managed	−0.067	0.051	0.102*	0.102*	−0.030	−0.102*
q3_4	A good business opportunity	0.030	−0.073*	0.045	0.011	0.035	−0.016
q3_5	Taking care of the forest health and disease prevention	−0.035	0.046	0.156*	0.014	−0.048	−0.048
q3_6	Possessing the forest, taking care of the property and borders	0.020	−0.049	−0.009	0.082*	0.010	−0.029
q3_7	Preserving the forestland for future generations	−0.065	0.055	0.041	0.081*	0.015	−0.039
q3_8	Good opportunity to earn additional money or to improve the family budget, as any other side-business opportunity	−0.011	0.025	0.082*	0.075*	0.039	−0.035
q3_9	Leisure and free-time activity in the woods instead of recreation	0.037	0.071	0.050	0.058	−0.025	−0.075*
q3_10	Systematic continuation of the work started by our ancestors	0.009	0.091*	0.079*	0.086*	−0.032	−0.061
q3_11	Mimicking natural processes in the forest and securing natural regeneration	−0.032	0.097*	0.125*	0.103*	−0.025	−0.053
q3_12	About work in the forest, e.g., using a chainsaw and winch, doing forest operations	−0.035	−0.003	−0.041	0.050	−0.013	−0.140*
q3_13	Ensuring regular flow of goods from my forest which I need, such as fuel-wood	−0.058	−0.031	−0.049	0.126*	−0.008	−0.186*
q3_14	Ensuring a clean and natural environment in the neighborhood	0.004	0.080*	0.050	0.091*	−0.061	−0.105*
q3_15	Preserving large-diameter trees and removing low-quality trees	−0.060	0.085*	0.096*	0.096*	−0.064	−0.065
q3_16	A source of subsidies	−0.015	-0.083*	−0.050	0.080*	0.007	−0.051
q3_17	Keeping the forest beautiful exactly the way I like it	−0.031	0.000	−0.043	0.066	−0.066	−0.046
q3_18	Making sure the forest is not left neglected or messy	0.016	−0.025	−0.001	0.084*	−0.060	−0.072*
q3_19	Cutting large-diameter trees when they are ready to be cut	0.005	0.021	0.013	0.111*	−0.050	−0.064

2.2. Causal Indicators of the Conceptualization of Forest Management

The first step in assessing the influence of structural attributes was to establish the baseline model, which was a first-order confirmatory factor analysis (CFA) of the three-factor structure with an oblique rotation of factors, thus allowing for correlation between the concepts (Figure 2). The hypothesis was that forest owners conceptualize forest management in three different ways (i.e., maintenance (MAINT), ecosystem-centered management (EM), and economics-centered management (ECON)) and that these concepts manifest themselves through agreement with the statements from q3_1 to q3_19. The internal-consistency reliability of the three scales for measuring MAINT, EM, and ECON was estimated with McDonald's ω_t and greatest lower bound (GLB) [20]. McDonald's ω_t and GLB are better measures of internal-consistency reliability than Cronbach's α when the assumptions of equal factor loadings of all items in a factorial model and normality are violated, which is almost always the case in factor analyses [21]. The ω_t coefficients and GLBs were 0.865, 0.814, and 0.694, and 0.897, 0.845, and 0.726 for MAIT, EM, and ECON, respectively, which is sufficient. The parameter estimates are reported in Figure 2.

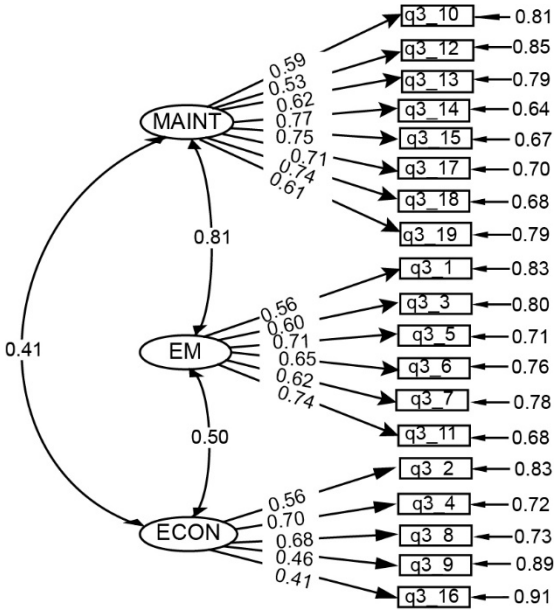

Figure 2. A first-order confirmatory factor analysis of the three-factor structure of forest management. Maintenance forest management (MAINT), ecosystem-centered forest management (EM), and economics-centered management (ECON) correlation. The measured variables and factors are represented with squares and ellipses, respectively. Single-headed arrows indicate the hypothesized causal relationship between two variables; two-headed arrows indicate correlation. Standardized parameters are all significant at $p < 0.05$.

To assess which factors explain the conceptualization of forest management, we used the multiple indicators multiple causes (MIMIC) model [22]. The MIMIC model belongs to structural equation models and can be thought of as a regression with multiple latent variables on the left hand side of the equation and multiple manifest variables on the right hand side. The MIMIC model (Figure 3) consists of two parts: a measurement model and a structural model. In our case, the measurement model was the CFA model described above. As the factors become dependent variables in the MIMIC model and variances or covariances can no longer be estimated [23], each factor in the MIMIC model has a related disturbance term (D) associated with it, which acts as a proxy in carrying its variances and covariances with other factors. The structural model consisted of causal relationships between the covariates and the three forest management concepts (Figure 3).

The MIMIC model can also include direct relationships between the covariates and indicator variables, thus measuring the direct effects of the covariates on the indicator variables, after controlling for the mediating factor. However, testing the direct paths was not in our interest, nor were these relationships significant for the theory of social representations. Testing how the social economic profile of an owner influences agreement with the statements defining forest management after the agreement is controlled for the effect of forest management perception was interesting, if the indicator variables represented a validated multi-item scale for measuring a social construct. In our case, indicator variables q3_1 to q3_19 served merely as variables measuring the three-factor structure of the concept of forest management. Hence, we ignored the direct paths and started building the structural part of the MIMIC model with causal paths pointing only to factors. As covariates, we used the owner's age (AGE), monthly income (INC), education (EDU), annual cut (CUT), holding size (AREA), and the socio-economic type (SOC). Preliminary univariate tests of associations between the 19 indicator variables and social economic variables are available in Table 2.

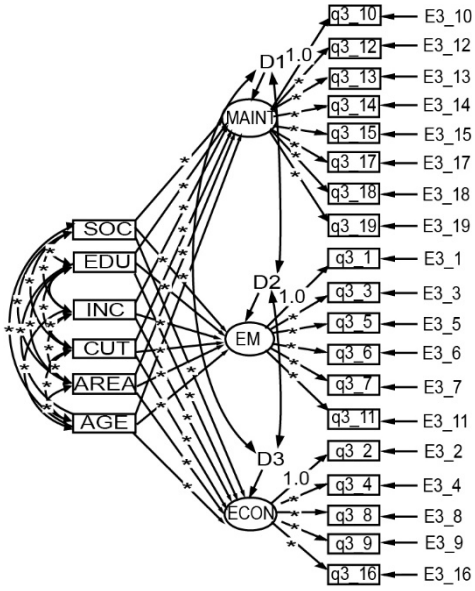

Figure 3. A MIMIC model to test for the effects of a socio-economic type of holding (SOC), formal education (EDU), monthly income (INC), mean annual cut in the last decade (CUT), total forest area of the owner's holding (AREA), and age (AGE) on the three factors representing conceptualizations of forest management (MAINT, EM, ECON). Regression-like error terms are represented with E, disturbance terms associated with factors are represented with D. The parameters to be estimated are denoted with an asterisk (*).

In the estimation of parameters, we used the maximum-likelihood method in EQS 6.2 for Windows software [24]. All tests were based on robust statistics because the assumption of multivariate normality was violated [25,26]. In the goodness-of-fit estimation, we report the following fit indices (an indication of adequate model-data fit is given in parenthesis): the standardized root mean-square residual (the smaller, the better, but SRMR < 0.05 is recommended), the comparative fit index (CFI ≥ 0.90), and the Steiger-Lind root mean squared error of approximation (RMSEA ≤ 0.08). We also report on the Satorra-Betler scaled chi-square (S-B χ^2), the normal theory chi-square (χ^2), and the χ^2/df ratio (2 to 5 indicates an acceptable fit), bearing in mind, however, that large samples tend to inflate the χ^2 statistic.

Since the MIMIC model can be thought of as a general linear model capable of predicting several dependent latent variables as a function of manifest variables, we assessed the possible changes in the perception of forest management in the next two decades given the effect of determinants in the past decades.

3. Results

The structural attributes of forest owners had a minor, but statistically significant influence on the perception of forest management. The proportion of variance of forest management concepts (R^2) explained by the six covariates ranged from 2.4% for the economics-centered management concept to 5.1% for the ecosystem-centered concept (Table 3). The socio-economic type of forest holding (SOC) and education (EDU) were the two variables with the strongest influence. The effect of SOC was significantly negative for all three concepts. This could suggest that the more the owner is disengaged from farming, the more likely their perception of forest management moves away from the current three concepts. However, in the factor analysis, we could not speculate on alternative concepts, as would be the case in linear regression with manifest variables, because we only confirmed the existence of three concepts. Looking at the effect of SOC, we can only say that the maintenance concept is expected to fade out faster than the ecosystem-centered concept and economics-centered concept. The maintenance concept was predominantly associated with less educated (EDU) older (AGE) full-time or part-time farmers (SOC) with smaller holdings (AREA) and intensive cuts (CUT).

In contrast, the economics-centered forest management concept was favored by better-educated (EDU) farmers (SOC) with low off-farm income (INC) and intensive cuts (CUT).

Table 3. Effects of the covariates on three factors representing conceptualizations of forest management, and the correlations between the conceptualizations, estimated with the multiple indicators multiple causes (MIMIC) model. Statistically significant parameters at the 5% level or better are marked with *.

Factor (% of Variance Explained)	Covariates and Factors	Standardized Coefficients (z)
Maintenance-centered management (MAINT) (3.0%)	SOC	−0.142 *
	EDU	0.074 *
	INC	0.021
	CUT	0.044 *
	AREA	−0.095 *
	AGE	−0.028 *
	"Ecosystem-centered management" factor (EM)	0.805 *
	"Economics-centered management" factor (ECON)	0.407 *
Ecosystem-centered management (EM) (5.1%)	SOC	−0.128 *
	EDU	0.193 *
	INC	−0.020
	CUT	−0.009
	AREA	−0.076 *
	AGE	−0.055 *
	"Economics-centered management" factor (ECON)	0.494 *
Economics-centered management (ECON) (2.4%)	SOC	−0.060 *
	EDU	0.146 *
	INC	−0.076 *
	CUT	0.064 *
	AREA	0.009
	AGE	0.008

The effect of education was quite the opposite; it was significantly positive for all three concepts. The strongest influence of education was found for ecosystem-centered forest management ($z = 0.193$, $p < 0.05$). The ecosystem-centered concept was most strongly associated with better educated (EDU) younger owners (AGE) with smaller holdings (AREA) and to the farm-type of holding (SOC). Substantial correlation between the forest management concepts indicates that the maintenance concept and the ecosystem-centered concept have much in common ($r = 0.805$, $p < 0.05$).

Given the low R^2 values, there was a mediocre model fit and significantly worse fit of the MIMIC model when compared to the baseline measurement model (ΔCFI = 0.013, ΔS-B $\chi^2 = 2363$ at df = 96, $p < 0.01$, Table 4), so we concluded that the social economic profile of a forest owner is not a major determinant of forest management perceptions and cannot be used to stratify private forest owners according to their perceptions of forest management.

Table 4. Goodness-of-fit statistics for the MIMIC model. Statistically significant parameters at the 5% level or better are marked with *.

	CFI	χ^2 (df)	S-B χ^2 (df)	RMSEA	SRMR	χ^2/df
Baseline measurement model (CFA)	0.939	954 (149)	9534 (149)	0.289	0.066	6.4
MIMIC model	0.926	1111 (245)	12787 (245)	0.261	0.055	4.5
MIMIC model vs. baseline measurement model	ΔCFI	$\Delta\chi^2$ (Δdf)	ΔS-B χ^2 (Δdf)			
	0.013	157 (96)*	2363 (96)*			

Possible changes in forest management conceptualizations in the future were estimated by the effects of the two most important determinants: socio-economic type and education. Data on the national level (Table 5) showed a fairly linear decrease of the proportion of family farms in private forest ownership in the past decades (adjusted $R^2 = 0.97$, $p < 0.01$), with a magnitude of -0.87% year^{-1}. This implies that the proportion of family farms could fall below 20% in the next two decades to the benefit of other types of private ownership, mostly non farmers. Conversely, education, although partly reconstructed from the general population censuses, seems to be constantly improving, and we expect that in the next 20 years, the majority of private forest owners will at least be high school graduates. Taking into account the current downward trend in family farms and increasing education, we expect a move away from maintenance forest management toward economics-centered or ecosystem-oriented forest management.

Table 5. Estimates of socio-economic types of private forests, forest owner education, and average size of forest holding in the past decades.

Year	Socio-Economic Type of Private Forest Holdings[1]		Education[2] (%)					Average Size of Forest Holding (ha)[3]
	Family Farms (%)	Other Non-Industrial Private Forests (%)	1	2	3	4	5	
1951	95.5	4.5						3.8
1963	79.4	20.6						
1968	69.9	30.1						3.0
1985	59.7	40.3						2.7
1995	57.5	42.5	13.4	44.8	3.0	15.2	3.6	2.3
2000	49.3	50.7	2.0	41.5	28.6	21.0	6.9	2.6
2005	45.1	54.9	1.2	38.2	28.4	22.0	10.3	
2010	39.0	61.0	0.3	34.9	28.2	23.0	13.6	2.8
2013	35.0	65.0	2.1	12.3	20.6	35.9	29.0	

[1] [27,28]. An estimate for 2013 based on this study data. Family farms = Full-time farmers and part-time farmers. Other non-industrial private forests = supplementary farms, elder farmers, and non-farmers). [2] Education: < 8 years (1), primary school (2), vocational school or high school undergraduate (3), high school graduate (4), and higher professional studies or college or higher (5). Data for 1995 recalculated from [29]: p. 103]. Estimates for 2000, 2005, and 2010 were calculated proportional to 5-year changes in the level of education in the general population [30]. [3] [29,31].

4. Discussion

The study showed that the association between the social economic profile of a private forest owner and specific perception of forest management is weak. This result is in line with similar studies investigating the effect of social and demographic factors on human attitudes toward the environment. Fransson and Gärlik [32], for instance, reviewed the environmental psychology literature with regard to correlations between environmental concern and age, social class, gender, income, and other covariates, and found weak and partly contradictory effects. However, the bulk of environmental psychology studies have found consistent effects. Vaske et al. [33], for instance, found the positive influence of education on biocentric value orientations, which means that as education increases, individuals will become more biocentric and more preservation-focused. Our study supports this interpretation, as we found that education had the strongest positive influence on ecosystem-centered forest management. Maintaining the assumption that forest management will continue to be perceived as a mixture of maintenance, care for the ecosystem, and economics, we expect a gradual shift from maintenance management toward ecosystem-centered management. The downward trend in the number of family farms and increasing education of landowners [34–36] suggest that the rest of the developed world will have similar trajectories to that forecast for Slovenia. The noticeable difference, however, is that countries differ in their support for innovative business models and that forest policy might be much more anticipative in certain segments of the forest value chain [37]. On the other hand, we should also be cautious with forecasts. The CFA model may no longer hold true in the future because of new forest

management concepts that are emerging as part of social innovation. This means that predictions can only be made for a short period in which major changes in the structure and content of forest management concepts are not anticipated.

Education also seems to be a plausible explanation for the differences in forest owner perception of forest management from a social psychology perspective. The environmental Kuznets curve theory suggests that once industrial society reaches a turning point in economic development, better education and technological progress increase people's awareness about the importance of caring for the environment. Thus, better educated members of a social collective, be it members of a local community or society in the broader sense, are generally more inclined to biocentric value orientations and favor management concepts related to these values. The effect of education on private forest owners' conceptualization of forest management has also been confirmed in a European study [8], although direct comparison of the results is difficult due to the different methods.

The MIMIC model suggests that the more forest owners become disconnected to family farming (i.e., the higher their score for SOC), the more they disagree with maintenance forest management (MAINT). This is nicely illustrated by univariate analyses of the association of SOC with all of the statements describing the maintenance concept, where all the associations were negative (Table 2): Forest management is about work in the forest (e.g., using a chainsaw and winch, doing forest operations (q3_12), ensuring the regular flow of goods from my forest which I need such as fuel-wood (q3_13), and taking care of the forest so it is not left in a state of neglect (q3_18)). At first glance, it might be confusing that SOC negatively influences all three concepts. However, SOC had the most negative effect on MAINT, which indicates that maintenance forest management is fading more quickly when compared to economics-centered and ecosystem-oriented management. The explanation also seems plausible with respect to the effect of income (INC), which correlated with SOC (r = 0.166*); therefore, the more likely the forest owner is a non-farmer, the higher the off-farm revenues. In turn, this means that well-off individuals are also less likely to be interested in economics-centered forest management because they do not need revenue from the forest [18]. However, we should note that the relationship between income and environmental orientation is often curvilinear [38], which either leads to nonsignificant or very small effects when the non-linear relationship is not properly incorporated in the model. In our model, income was a significant determinant only for the ECON concept, which indicates that income is either of minor importance for explaining forest management conceptualizations or the effect is indeed non-linear.

Mean annual cut in the last decade (CUT) increased support for economics-centered forest management as well as support for maintenance forest management. This means that these two views could become stronger by increasing harvesting intensities. However, looking at the socio-demographic dynamics of private forests after the 1950s (Table 5), we expect the economics-centered forest management concept to gain in prominence over the maintenance concept. Another interesting question is whether CUT is a determinant or an effect of the management concept. In our case, we used it as a determinant, implying that the more the forest owner cuts, the more they will be identified with the economics-centered aspects of forest management. CUT, however, could also be used as an indicator measuring the latent construct ECON. To distinguish causal from effect indicators in structural equation modeling, a tetrad test for causal indicators can be performed [39]. The downside of the test is that it cannot distinguish between equivalent models, and the quality of the test results depends on the quality of the conception of the plausible alternatives [39]. Therefore, the decision on the plausibility of the causal model should not only be based on statistical measures, but primarily on a meaningful hypothesis. Structural equation modeling is a confirmatory technique that relies heavily on the theoretical plausibility of the tested construct.

In studying the human dimensions of forestry, researchers often face the problem of how to measure the effect of various factors on a latent concept. Structural Equation Modeling (SEM) is a powerful group of models that can solve this problem. However, there are several limitations. One of the common problems in SEM is assessing the model fit. None of our models met all the criteria

for sufficient model fit. The RMSEA, which indicates the lack of fit in a model compared to a perfect model, was particularly above the recommended cut-off value (Table 4). This could be due to the few parameters used in our model and consequently lower degrees of freedom and higher value of the non-centrality parameter, which is used in the calculation of the RMSEA, CFI, and χ^2/df ratio [40]. Another drawback of SEM is that it cannot effectively deal with non-linear functions of latent variables. There have been attempts to develop an estimation method for non-linear factor analysis and other types of structural equation models that involve nonlinear relationships [24], but these methods have not commonly been used in empirical research. On the other hand, linearity is usually a good approximation of the effect of a covariate or a latent variable on a construct, particularly when the relationship is monotone. More importantly, a priori nonlinear functional forms are often unknown. A researcher cannot and should not test all possible functional forms because of the confirmatory approach. Nonlinearities in the effect of covariates on a latent variable can be partly accounted for by categorizing covariates into dummy variables and entering them as categoricals. Another drawback of SEM is that models cannot handle interactions, as in linear models and ANOVA. One way to add interactions in the MIMIC model is to create combinations of dummy variables. However, the researcher should first note that adding or dropping parameters based on Lagrange multiplier statistics or the Wald test are meaningless when there is no a priori hypothesis on the effect of the variables and their interactions [39].

The study is a relatively novel application of a SEM test for a causal structure in private forest owner attitudes. Causal models with latent variables retain all of the variability of the latent constructs, which is positive from an information point of view because no variability of the latent construct is lost. Another advantage of modeling with latent variables is that SEM enables the assessment of measurement error, which means that standard measurement scales for a hypothetical construct can be developed and used in longitudinal studies. However, the MIMIC model requires a more stringent hypothesis in comparison to the more common exploratory approach where principal component scores are regressed onto covariates and the ordinary least squares method is used to estimate the regression parameters. This indicates that there is a serious need for more elaborated theoretical foundations for the relationships between private forest owners' values, attitudes, and behavior. SEM can also become a popular methodology in private forest owner research because it can be expanded to spatial modeling (e.g., by the latent spatial lag model or to a Bayesian approach).

5. Conclusions

The social representations theory suggests that the ascribing of meaning to complex phenomena is specific to a social collective. Forest management was expected to differ according to the social economic profile of the forest owner. The study suggests that the social, demographic, and economic characteristics of private forest owners are poor, yet statistically significant, determinants of forest management concepts. The social economic profiles explained only a minor part of the variability in forest management constructs. We found that education and forest holding type were the two most influential determinants. Given the expected dynamics of the social and economic characteristics of private forest owners in the next few decades, we expect greater polarization in the perception of forest management and a gradual move from maintenance forest management toward ecosystem-oriented or economics-centered management.

The perception of forest management as the continuation of work started by ancestors may gradually disappear. White-collar workers, who will be able to conduct forest-related business from the comfort of their homes and commission forest management to third parties, may become a reality if the demand for wood and other bio-based materials increases. Emerging bio-energy markets may additionally increase pressure on forestland and stimulate the relatively inactive woodlot market. Under the pessimistic scenario, this means that young family forest owners will face increasing barriers to buy or lease forest land. Land and renewables will increasingly become the subject of demand and financial speculation, particularly in suburban and rural areas with favorable natural conditions.

The policy pendulum, which in many European countries still points to wood mobilization from private forests, may soon need to swing back toward forest conservation. Countries with proactive forest policies in the field of developing new business and organizational models such as forest leasing service (e.g., [37]), which will be able to recognize the opportunities and threats of these processes to private forests, will have an advantage.

Finally, it seems frustrating that we know a great deal about forest ecosystems but so little about the people owning these lands. Future research should pay greater attention to operationalizing complex social phenomena with advanced models such as generalized spatial structural equation models that can enable spatial modeling of the relationship among the latent variables or multilevel statistical models that take data with a nested structure into consideration. Policy makers should be more aware that the pace of social and economic changes is much faster than that of environmental changes. To monitor the changes in the social part of social-ecological systems, we need systematic data collection on social indicators and verified measurement scales for measuring latent constructs. Part of this information could be collected through national private forest owner surveys, which require stable funding.

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References

1. Schmithüsen, F.; Hirsch, F. *Private Forest Ownership in Europe*; Geneva Timber and Forest Study Papers 26; United Nations, Economic Commission for Europe: Geneva, Switzerland, 2010; Available online: http://www.unece.org/fileadmin/DAM/timber/publications/SP-26.pdf (accessed on 20 May 2015).
2. Ficko, A.; Lidestav, G.; Ní Dhubháin, Á.; Karppinen, H.; Zivojinovic, I.; Westin, K. European private forest owner typologies: A review of methods and use. *For. Policy Econ.* **2019**, *99*, 21–31. [CrossRef]
3. Huff, E.S.; Leahy, J.E.; Kittredge, D.B.; Noblet, C.L.; Weiskittel, A.R. Psychological distance of timber harvesting for private woodland owners. *For. Policy Econ.* **2017**, *81*, 48–56. [CrossRef]
4. Ficko, A.; Boncina, A. Forest owner representation of forest management and perception of resource efficiency: A structural equation modeling study. *Ecol. Soc.* **2015**, *20*, 36. [CrossRef]
5. Steiner Davis, M.L.E.; Fly, J.M. Do You Hear What I Hear: Better Understanding How Forest Management Is Conceptualized and Practiced by Private Forest Landowners. *J. For.* **2010**, *108*, 321–328.
6. Tumpach, C.; Dwivedi, P.; Izlar, R.; Cook, C. Understanding perceptions of stakeholder groups about Forestry Best Management Practices in Georgia. *J. Environ. Manag.* **2018**, *213*, 374–381. [CrossRef] [PubMed]
7. Moscovici, S. *Psychoanalysis. Its Image and Its Public*; Polity Press: Cambridge, UK, 2008.
8. Feliciano, D.; Bouriaud, L.; Brahic, E.; Deuffic, P.; Dobsinska, Z.; Jarsky, V.; Lawrence, A.; Nybakk, E.; Quiroga, S.; Suarez, C.; et al. Understanding private forest owners' conceptualisation of forest management: Evidence from a survey in seven European countries. *J. Rural Stud.* **2017**, *54*, 162–176. [CrossRef]
9. Sörbom, D. A general method for studying differences in factor means and factor structures between groups. *Br. J. Math. Stat. Psychol.* **1974**, *27*, 229–239. [CrossRef]
10. Häyrinen, L.; Mattila, O.; Berghäll, S.; Toppinen, A. Changing objectives of non-industrial private forest ownership: A confirmatory approach to measurement model testing. *Can. J. For. Res.* **2014**, *44*, 290–300. [CrossRef]
11. Karppinen, H.; Berghäll, S. Forest owners' stand improvement decisions: Applying the Theory of Planned Behavior. *For. Policy Econ.* **2015**, *50*, 275–284. [CrossRef]
12. Martin, J.L.; Lee, M.; Wright, J.D. Social Structure. In *International Encyclopedia of the Social & Behavioral Sciences*, 2nd ed.; Elsevier: Oxford, UK, 2015; pp. 713–718.
13. Hatcher, J.E.; Straka, T.J.; Greene, J.L. The Size of Forest Holding/Parcelization Problem in Forestry: A Literature Review. *Resources* **2013**, *2*, 39–57. [CrossRef]

14. Seesholtz, D.; Wickwar, D.; Russell, J.C. *Social and Economic Profile Technical Guide*; Gen. Tech. Rep. WO-74; U.S. Department of Agriculture, Forest Service: Washington, DC, USA, 2006; p. 74.
15. Butler, B.; Caputo, J.; Robillard, A.; Sass, E. Size Matters: The Relevance of Size of Forest Holdings Among Private Forest Ownerships. In Proceedings of the IUFRO 3.08.00 Small-Scale Forestry 2019 Conference Proceedings, Duluth, MN, USA, 8–10 July 2019; University of Minnesota: Duluth, MN, USA, 2019; p. 59.
16. Snyder, S.A.; Butler, B.J.; Markowski-Lindsay, M. Small-Area Family Forest Ownerships in the USA. *Small-Scale For.* **2019**, *18*, 127–147. [CrossRef]
17. Matilainen, A.; Lähdesmäki, M. Passive or Independent? An Empirical Study of Different Reasons Behind Private Forest Owners: Passiveness in Finland. In Proceedings of the IUFRO 3.08.00 Small-scale Forestry 2019 Conference Proceedings, Duluth, MN, USA, 8–10 July 2019; University of Minnesota: Duluth, MN, USA, 2019; p. 42.
18. Hogl, K.; Pregernig, M.; Weiss, G. What is new about new forest owners? A typology of private forest ownership in Austria. *Small–Scale For.* **2005**, *4*, 325–342.
19. Ficko, A.; Boncina, A. Probabilistic typology of management decision making in private forest properties. *For. Policy Econ.* **2013**, *27*, 34–43. [CrossRef]
20. *JASP*; Version 0.10.2; JASP Team: Amsterdam, The Netherlands, 2019.
21. Trizano-Hermosilla, I.; Alvarado, J.M. Best Alternatives to Cronbach's Alpha Reliability in Realistic Conditions: Congeneric and Asymmetrical Measurements. *Front. Psychol.* **2016**, *7*, 769. [CrossRef]
22. Joreskog, K.G.; Goldberger, A.S. Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable. *J. Am. Stat. Assoc.* **1975**, *70*, 631–639.
23. Bryne, B.M. *Structural Equation Modeling with EQS. Basic Concepts, Applications, and Programming*, 2nd ed.; Lawrence Erlbaum Associates, Publishers: Mahwah, NJ, USA, 2006.
24. Bentler, P.M. *EQS 6 Structural Equations Program Manual*; Multivariate Software: Encino, CA, USA, 2006.
25. Satorra, A.; Bentler, P. Corrections to test statistics and standard errors in covariance structure analysis. In *Latent Variables Analysis: Applications for Developmental Research*; Von Eye, A., Clogg, C.C., Eds.; Sage Publications: Thousand Oaks, CA, USA, 1994; pp. 399–419.
26. Sattora, A.; Bentler, P.M. *Scaling Considerations for Chi-Square Statistics in Covariance Structure Analysis (UCLA Statistic Series 2)*; University of California, Department of Psychology: Los Angeles, CA, USA, 1988.
27. Medved, M.; Matijasic, D.; Pisek, R. Private property conditions of Slovenian forests: Preliminary results from 2010. In Proceedings of the IUFRO Conference Proceedings Small-Scale for in a Changing Worlds: Opportunities and Challanges and the Role of Extension and Technology Transfer, Bled, Slovenia, 6–12 June 2010; pp. 457–472. Available online: https://www.iufro.org\T1\guilsinglrightdownload\T1\guilsinglrightfile\T1\guilsinglright30800-et-at-bled10_pdf (accessed on 10 May 2012).
28. Winkler, I. Sedanje stanje in temeljni problem gospodarjenja z zasebnimi gozdovi v SR Sloveniji (Present situation and basic problems in private forest management in SR Slovenia). *Zbornik Gozdarstva Lesarstva* **1976**, *14*, 123–154.
29. Medved, M. Gozdnogospodarske Posledice Posestne Sestave Slovenskih Gozdov (Consequences of Property Structure on Forest Management in Slovenian Small-Scale Private Forests). Ph.D. Thesis, University of Ljubljana, Biotechnical Faculty Ljubljana, Ljubljana, Slovenia, 2000.
30. SURS. Republic of Slovenia Statistical Office. Available online: https://www.stat.si/StatWeb/en (accessed on 30 May 2019).
31. Medved, M. Vključevanje Lastnikov Gozdov v Gozdno Proizvodnjo (Attracting Private Forest Owners into Forest Operations). Master's Thesis, University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia, 28 March 1991.
32. Fransson, N.; Gärling, T. Environmental concern: Conceptual definitions, measurement methods, and research findings. *J. Environ. Psychol.* **1999**, *19*, 369–382. [CrossRef]
33. Vaske, M.P.J.J.; Williams, D.R.; Jonker, S. Demographic Influences on Environmental Value Orientations and Normative Beliefs About National Forest Management. *Soc. Nat. Resour.* **2001**, *14*, 761–776.
34. Karppinen, H. New forest owners and owners-to-be: Apples and oranges? *Small-Scale For.* **2012**, *11*, 15–26. [CrossRef]
35. Butler, S.M.; Butler, B.J.; Markowski-Lindsay, M. Family Forest Owner Characteristics Shaped by Life Cycle, Cohort, and Period Effects. *Small-Scale For.* **2017**, *16*, 1–18. [CrossRef]

36. Côté, M.-A.; Généreux-Tremblay, A.; Gilbert, D.; Gélinas, N. Comparing the profiles, objectives and behaviours of new and longstanding non-industrial private forest owners in Quebec, Canada. *For. Policy Econ.* **2017**, *78*, 116–121. [CrossRef]
37. Laakkonen, A.; Hujala, T.; Pykäläinen, J. Integrating intangible resources enables creating new types of forest services-developing forest leasing value network in Finland. *For. Policy Econ.* **2019**, *99*, 157–168. [CrossRef]
38. Milbrath, L.W. *Environmentalists: Vanguard for a New Society*; State University of New York Press: Albany, NY, USA, 1984.
39. Bollen, K.A.; Ting, K.-F. A tetrad test for causal indicators. *Psychol. Meth.* **2000**, *5*, 3–22. [CrossRef]
40. Ullman, J.B. Structural Equation Modeling: Reviewing the Basics and Moving Forward. *J. Pers. Assess* **2006**, *87*, 35–50. [CrossRef] [PubMed]