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Research Article

Analysis of Urban Residents' Willingness to Pay for Forest Ecological Services Based on the Multilayer Linear Model

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This study takes 8 cities in Shaanxi province as the research object and uses the multilayer linear model specifically for nested structure data to introduce the urban macroexplanatory variables on the basis of individual level of residents and influence the willingness of urban residents to pay for forest ecological services. The factors are analyzed in multiple layers to find out the prediction effect on ecological payment, and on this basis, corresponding countermeasures and suggestions are put forward. The results show that regional differences have a significant impact on residents' willingness to pay for forest ecological services; individual characteristics and regional characteristics can independently have a significant impact on residents' willingness to pay; after introducing macrolevel variables, individual-level environmental awareness and per capita income, five variables, such as education level, place of residence, and age, have significant predictive effects on residents' willingness to pay; among them, the interaction between consumer price index and environmental awareness is the largest, followed by the interaction between consumer price index and age. Per capita social security is the interaction between expenditure and environmental awareness. Finally, that is the interaction between the per capita social security expenditure and age and the interaction between the average salary of employees and the monthly per capita income.

1. Introduction

China has experienced rapid urbanization in the past 30 years. It is predicted that 75.8% of Chinese people will live in cities by 2050, and the total urban population will exceed 900 million (United Nations, Department of Economic and Social Affairs, Population Division, 2014). In this process, the utilization of construction land and resources in the urban center and its surrounding areas will increase day by day. At the same time, people's demand for good quality of life and healthy urban environment will also increase. In the process of urbanization and the construction of ecological civilization city, the concepts of green city, ecological city, or sponge city began to appear and attracted much attention [1]. Although the specific contents are still controversial, they all have one thing in common, that is, increasing urban blue-green infrastructure and improving urban ecosystem services. The forest ecosystem not only directly provides people with production and living goods such as wood, flowers, seedlings, and food but also meets the needs of residents for urban environment and provides nonphysical ecosystem services, such as reducing the urban heat island effect, fixing CO_2, adapting to climate change, purifying air, reducing noise, purifying water source, and maintaining biodiversity. These nonphysical ecological services have a potential economic value and play an important role in improving the well-being of urban residents and promoting sustainable urban development [2].

With the acceleration of China's urbanization process, the deterioration of urban ecological environment is becoming more and more obvious. The social ecosystem service function is being seriously damaged, and some ecological functions are declining or even lost, such as the intensification of water ecological crisis, serious grassland degradation, and frequent natural disasters, which have created great obstacles to the development of economy and society and the improvement of people's living standards.

With the development of economy and the improvement of urban residents' living standards, residents have an increasingly strong desire to improve the urban ecological environment. Ecological demand has become the first demand of residents for environmental construction, and forest protection and afforestation are recognized as one of the most effective solutions by all sectors of society. Because forest production and management behavior have strong positive externalities, it can absorb dust, reduce noise, absorb carbon dioxide, and adjust urban climate, so as to greatly improve the quality of life of urban residents in all aspects of clothing, food, housing, and transportation, which will inevitably lead to strong willingness of urban residents to pay. At the same time, a good natural ecosystem provides material production and ecological services for social and economic development, promotes the social and economic system to obtain additional benefits, and also generates a certain opportunity cost. In order to maintain the sustainability of this value and obtain benefits, the social and economic system should give feedback to the ecosystem providing services, that is, to establish accounts for ecological construction and environmental protection through ecosystem service payment, so as to further promote the benign development of the ecosystem, which is also the essence of compensating the ecological benefits of forest. Moreover, the willingness and quantity of residents to pay are not only the embodiment of income level but also the embodiment of residents' subjective evaluation of infrastructure services and convenience in the forest ecosystem, as well as noneconomic factors such as willingness to obtain services again. To some extent, it also reflects the deviation of people's understanding of forest ecosystem leisure and entertainment services and payment behavior, as well as the fluke of free riding.

In view of this, based on the theories of forest ecological services and marketization of public services and taking the residents' willingness to pay for forest ecological services from the perspective of voluntary compensation as the starting point, this study constructs a multilevel statistical model of urban residents' willingness to pay for forest ecological services under different urban economic development levels in the region. Differential analysis on the interaction between urban economic development level and individual characteristics of residents on the willingness to pay for forest ecological services organically combine the objectivity of ecological service value with the subjectivity of residents' willingness to pay, consider the ecological consumption market existing in public welfare forest areas and economically developed areas as a system, and connect the development of forest areas with economically developed cities. Create favorable environmental conditions for urban residents to participate in the ecological construction of public welfare forest areas, strive to reveal the law of the interaction between regional economic and social development and resources and environment, and make the forest ecosystem an open system, so that the forest area can obtain the funds needed for development from the economically developed areas outside the system and provide excellent ecological services to the surrounding areas. This will help fundamentally solve the shortage of ecological benefit compensation funds, help residents in beneficiary areas to participate in forest ecological construction in public welfare forest areas, and more help to supplement and improve the ways to realize the value of forest ecological services in public welfare forest areas.

2. Literature Review and Research Design

Willingness to pay (WTP) is the word that comes from neoclassical economics, proposed by Hicks in 1941, mainly used in the measurement of consumer surplus in the principle of neoclassical economics, that is, consumer surplus = willingness to pay – actual pay. Kim. JY et al. believed that the key process of market transactions is that buyers and sellers find a price that is satisfactory to both parties, that is, price discovery. The willingness of residents to pay actually reflects their participatory pricing strategy for voluntary payment of products in the virtual trading market. American economist Mankiw believes that the willingness to pay is the highest price tW that the buyer pays for an item. Balderas Torres et al. [3] argued that the willingness to pay survey of beneficiaries can evaluate the monetary value of public environmental resources, but needs to be supplemented by an assessment of the owners of the provided ecological resources and services. Amimejad et al. [4] applied the CVM survey to study the value of forests in northern Iran in order to estimate the economic value of nonmarket transactions. Winans et al. [5] showed that residents have certain preferences and payments in order to change the status quo. Willingness (generally using income tax) and compensation policies should take into account environmental and social benefits. Social motivation is related to the benefits of public goods, not to the benefits of the goods themselves, and social motivation is related to the willingness to pay. The willingness to pay has nothing to do with its sense of responsibility for contributing to the cause of public welfare. The moral awareness of the environment and the motives of altruism are also related to the willingness to pay, and the willingness to pay is also related to the motivations for survival and personal use value. It has not been found that the willingness to pay is related to the individual's perceived level of ethical obligation to contribute to charity.

At present, domestic scholars' research on willingness to pay mainly focuses on the ecological compensation research field of ecosystem service functions such as wetlands, forests, farmland, and grassland basins, the field of ecological compensation for resource protection and development, and the willingness to pay for ecological products. The methods of virtual market value assessment (CVM), logistic regression, and probit regression analysis are used to quantitatively study the willingness and ability of urban residents to participate in the construction of ecological services. Among them, Li et al. [6] analyzed the factors influencing the subjective willingness of urban residents to participate in forest ecological construction. It shows that when residents are dissatisfied with the benefits of ecological services as forest ecosystem service consumers, they will have a high

degree of legality for forest ecological services. And attention, satisfaction, and subjective will have a high positive impact. While maintaining high attention and attention, as consumers of ecological services strive to maximize the satisfaction of the living environment, they will certainly do willing to buy enough to improve the benefits of ecological services. Shi and Zhao [7] used the selective model of orthogonal experimental design to evaluate the full value of urban residents' ecosystem service functions in the Jiuhe River Basin. In addition, the research on willingness to pay has made a breakthrough progress in the manufacturing field. From the perspective of cognitive geography, the mechanism of the merchant's own brand influence strategy on the purchaser's brand premium willingness is clarified. Zhao and Wang [8] and others found that China's ecological compensation pays less attention to regional differences, the compensation standard fails to reflect the real cost of farmers, there are problems such as insufficient compensation or compensation for areas that can provide ecological services without compensation, and the utilization efficiency of compensation funds is low. On the basis of optimizing the selection of compensation areas, it is proposed to divide the level of compensation areas and calculate the compensation standards at different levels. Dai and Zhao [9] and others took the grassland ecosystem of Gannan Tibetan Autonomous Prefecture as an example to carry out the study on the regional selection of ecological compensation with villages and towns as the research unit. Zhang et al. [10] and others put forward the concept of "geographical factor endowment equivalent," which quantifies and makes explicit the role of geographical factor endowment hidden behind regional socioeconomic development, and can be used as the spatial distribution standard of regional social and ecological compensation on a large scale (such as countries). Some other studies are indirectly related to the spatial level of ecological compensation, such as the research on ecosystem service function, spatial distribution of ecological assets, ecological location quotient, and main functional areas. Although they are not directly aimed at ecological compensation, they are related to the spatial differentiation of ecological compensation elements in terms of substantive content. Compensation has a certain relationship with the flow direction or spatial system.

It is not difficult to find out that with the general application of CVM assessment methods in various fields and the in-depth study of the willingness to pay, scholars began to use the willingness to measure the results to reflect the value assessment of ecological resources and ecosystem services. And the assessment of payment preferences and the use of research results to develop a variety of compensation standards, for the government's decision-making, effectively played a guiding significance. However, the related research on the willingness to pay, whether it is the analysis of the influencing factors or the value assessment, is limited to the study of the influencing factors of the individual level of the residents. The study of the macroeconomic variables of regional development into the factors affecting the willingness to pay has not been found [11]. This study attempts to use the multilayer linear model to incorporate it into the study of the factors affecting the willingness to pay to determine its variant components. To this end, this study proposes the following research questions. (1) What is the impact of different regional socioeconomic characteristics on residents' willingness to pay for forest ecological services? (2) If there is any impact, what are the regional differences in factors affecting the willingness of residents to pay for forest ecological services? (3) After controlling the influence of other factors, especially the characteristics of individual residents, what is the impact of regional differences on the willingness of residents to pay for forest ecological services?

3. Data and Methods

3.1. Data Source. The data used in this study were derived from random sampling conducted by different scale cities in Shaanxi province in September 2017, including the northern Shaanxi region (Yan'an City, Yulin City), Guanzhong district (Xi'an City, Xianyang City, Weinan City, and Baoji City). There are 8 cities in southern Shaanxi (Hanzhong City and Ankang City), among which the northern Shaanxi and southern Shaanxi areas are direct benefit areas of forest ecological services, and the Guanzhong area is an indirect benefit area for forest ecological services. Each city is randomly selected according to the PPS method. The community then decides the number of individual samples in each community. A total of 2,300 questionnaires are distributed, allowing the testees to complete the test papers in a voluntary manner, with a response time of approximately 15 minutes. Excluding the invalid questionnaire and the unrecovered questionnaire, 2120 valid data were obtained, and the overall effective rate was 92.17%.

3.2. Variable Selection

3.2.1. Interpreted Variables. This work will study the influencing factors of the willingness to pay for forest ecological services in different regions, so the willingness of residents in different regions to pay for forest ecological services is taken as the explanatory variable. For the surveyed areas, the residents' willingness to pay for forest ecological services is divided into willingness and unwillingness. If residents are willing to pay for the forest ecological services they enjoy, regardless of the degree of payment, the explanatory variables are assigned: 1; conversely, if the resident is unwilling to pay for the forest ecological service enjoyed, the explanatory variable is assigned a value of zero [12].

3.2.2. Explanatory Variables. This study focuses on the impact of regional differences on urban residents' willingness to pay for forest ecological services, so the economic and social development representing regional differences is taken as the main explanatory variable. The variables that reflect regional economic development include consumer price index, per capita GDP, and average wage of urban workers. The variables reflecting the regional social development are the per capita social security expenditure and the proportion of education practitioners.

3.2.3. Control Variables. Besides the regional differences that this study focuses on, there are also some other important factors affecting residents' willingness to pay for forest ecological services, especially residents' individual characteristics. The final decision to pay for forest ecological services is made by individual residents, and the individual characteristics of residents obviously have an important impact on their willingness to pay. Through field research, this study selects the individual characteristic variables of residents, including gender, age, education level, monthly income, residence, environmental awareness, and so on. Here, the gender variable is assigned, "1" = "male," "0" = "female." According to the principle of equidistance or order in statistics, the variables such as age, education level, monthly income, and residence are assigned and coded. Urban residents' awareness of environmental protection is coded according to Li Kezhi's 5-point scoring scale. These variables reflecting residents' individual characteristics are not the purpose of this study, but they have an important impact on residents' willingness to pay for forest ecological services. Therefore, it is necessary to include individual characteristic independent variables as control variables in the analysis of the model. Related variable definitions and descriptive statistics are given in Table 1 [13].

3.3. Model Construction. Generally speaking, if the sample data of the research object have the characteristics of internality and nesting, the general linear model is affected by the similarity data of different levels, and the interpretation effect is poor. For example, from a macroperspective, in areas with different levels of economic development, socioeconomic characteristics such as per capita consumer price index, average wage level of employees, and per capita GDP are different. From the microscopic point of view, individual socioeconomic characteristics such as family income level, gender, and age of individual residents belong to different levels from macroeconomic indicators. Individuals are nested in regions, and for such data with nested structure, there are generally 3 methods for dealing with traditional regression models: the first is to analyze only the influence of individual level factors while ignoring the overall level factors [14]. This method is too simple and biased, which easily leads to the fallacy of reductionism. The second method is to summarize the individual level features to the overall level, abandon the individual characteristics of the residents, and only build models at the macrolevel for analysis, which will lead to ecological fallacy. The third method is to take into account the micro and macrolevels and assign the overall characteristics of the society to the individual level of the residents, so that each research unit includes the characteristics of the residents and the social characteristics, which in turn leads to the nonindependence of the error items, resulting in statistical errors. Therefore, it is necessary to use a multilayer linear model specifically for this kind of data with nested structure for analysis [15].

The multilayer linear model is produced to solve the limitations of traditional statistical methods such as regression analysis in dealing with multilayer nested data. It is a set of cutting-edge theories and methods of social science data analysis in the world. Its advantages are reflected in two aspects: one is to solve the problem of data nesting; the other is to introduce new methods for tracking research or repeated measurement research. Traditional linear models such as ANOVA or regression analysis can only analyze the problems involving one layer of data, but cannot comprehensively analyze the problems involving two or more layers of data, and the multilayer linear model provides an effective statistical method to solve these problems [16]. The parameter estimation method of the multilayer linear model is similar to the method of twice regression in concept; however, their statistical estimation and verification methods are different, and the parameter estimation method of the multilayer linear model is more stable. Therefore, the application range of the multilayer model is also quite wide. Compared with the traditional methods for processing multivariate repeated measurement data, this model has low requirements for data, can clearly represent the changes of individuals in the first level, and can explain individuals by defining the random variation of the first level and the second level. The complex changes over time and the impact of higher-level variables on individual growth can be considered. The principle is to divide the variation of dependent variables into intragroup individual differences and intergroup differences of different groups, so as to reveal the effects of individuals and groups on dependent variables, respectively. In the process of processing hierarchical data, the multilayer linear model first establishes the regression equation with the characteristic variables of the individual level, takes the intercept and slope in the equation as dependent variables, and takes the overall level characteristics as independent variables to establish the macroscopic level equation for quadratic regression, so as to reflect the influence of independent variables of different levels on dependent variables. Generally, the influence of socioeconomic characteristic indicator M at the overall level on the indicator X at the individual level can be expressed by a linear equation as follows:

$$\text{Overall level}: Y_{ij} = \beta_{0j} + \beta_{ij}X_{ij} + \mu_{ij}, \tag{1}$$

$$\text{Individual level}: \beta_{0j} = \gamma_{00} + \gamma_{01}M_j + \upsilon_{0j}, \tag{2}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}M_j + \upsilon_{1j}. \tag{3}$$

The combination of the above 3 formulas is called a multilayer linear model (formula (1)). The regression model represents the individual level (individual level), that is, the relationship between the explanatory variable and the explanatory variable of the individual level, and the regression model of formula (2) and formula (3) represents the overall level (the overall level). V_{0j} and V_{1j} represent the error terms of the overall hierarchical regression analysis. It can be seen that the regression analysis of the individual-level regression analysis and the slope term as the dependent variable are for higher-order regression analysis, rather than the individual-level dependent variable data which are low. The parameters of the order regression analysis are explained rather than the

Table 1: Related variable definitions and descriptive statistics.

Variable name	Variable definitions	Mean	St.d
Willingness to pay for forest ecosystem services	1 = willing, 0 = unwilling	0.43	0.51
Regional characteristics			
CPI	Changes in household purchases of consumer goods and services during the year	101.2	99.5
Per capita GDP	per capita GDP during the year (ten thousand yuan)	4.79	4.11
Average wage of urban workers	Average wage level of urban workers in the region (ten thousand yuan)	6.74	5.29
Per capita social security expenditure	Per capita social security expenditure in the region (ten thousand yuan)	0.31	0.35
Proportion of education practitioners	Proportion of education practitioners in the region (%)	2.67	2.74
Individual characteristics			
Gender	1 = male, 0 = female	0.51	0.52
Age	1 = 22 years old and below, 2 = 22–60 years old, 3 = 60 years old and above	2.51	2.53
Education level	1 = Elementary school and below, 2 = middle school, 3 = college and above	2.89	2.90
Monthly income status	1 = 2000 and below, 2 = 2000–5000, 3 = 5000 and above	2.19	2.35
Place of residence	1 = Central Shaanxi, 2 = Northern Shaanxi, 3 = Southern Shaanxi	1.87	2.11
Environmental awareness	1 = well, 2 = better, 3 = general, 4 = poor, 5 = very poor	3.71	3.83

interpretation of the dependent variable. The "fixed effect" in the results refers to the regression coefficient ("intercept and slope of the average"), and the "random effect" refers to the residual variance (the "specific" part of different groups and individuals).The above equations are integrated to obtain a multilayer linear regression full model equation:

$$Y_{ij} = \gamma_{00} + \gamma_{10}X_{1j} + \gamma_{01}M_j + \gamma_{11}M_jX_{ij} + \upsilon_{0j} + \upsilon_{1j}X_{ij} + \mu_{ij}. \tag{4}$$

In the model, r_{00} is the intercept of the overall layer interpretation of the individual layer intercept term, r_{01} is the slope of the interpretation of the individual layer intercept term by the overall layer explanatory variable, which indicates the direct influence of the overall level explanatory variable on the dependent variable, r_{10} is the intercept of the individual layer's interpretation of the individual layer slope term is the influence of the individual level explanatory variable on the dependent variable, r_{11} is the slope of the overall layer explanatory variable explaining the individual layer slope term, reflecting the adjustment effect of the cross-layer interaction. Here, the individual characteristic variables belong to the individual level of the residents, the regional differences belong to the overall level, and the individual levels are nested at the overall level. If the traditional regression method is chosen, the homogeneity of the variance and the independence of the individual cannot be met, and even the statistical fallacy can be caused. Therefore, this study adopts a multilayer linear model to solve a series of problems caused by nested structure and is also more in line with the actual research.

The willingness of urban residents to pay for forest ecological services is affected by regional socioeconomic characteristics. Therefore, it can be assumed that different urban residents have different regression models for the willingness to pay for forest ecological services, and each simple regression model has its own slope and intercept, and the choices of different cities are random [17], so the slope and intercept can be assumed as a sample of the overall group slope and intercept of each city's residents' participation. The following assumptions are made:

Hypothesis H0: it is assumed that both the attribute characteristics at the individual level and the attribute characteristics at the macrolevel have an impact on the ecological payment willingness of urban residents, but they play a different role in different ways and degrees, with obvious stratification characteristics.

Hypothesis H1: it is assumed that variables such as per capita social security expenditure, per capita consumer price index, and average wage of employees reflecting regional characteristics at the macrolevel have a significant impact on urban residents' ecological willingness to pay, which can affect residents' choice behavior of willingness to pay

Hypothesis H2: it is assumed that variables such as environmental awareness, age, education level, place of residence, and monthly family income at the individual level reflect residents' individual level have a significant impact on their willingness to pay, which can strengthen or weaken the impact of macrocharacteristic variables

4. Empirical and Analytical

Since social and economic factors have a certain impact on the payment of residents, it is necessary to examine the impact of the city's social and economic indicators (per capita consumer price index, average wages of employees, and per capita security expenditures in various regions) [18]. In general, the more indicators that measure the dependent variable, the more stable the structure of the dependent variable, and the easier it is to converge on the model parameter estimates. Therefore, the abovementioned cross-level variables are introduced to perform multilayer linear model estimation across layers.

4.1. Zero Model Analysis. The zero model is also called the one-way ANOVA of random effects. It does not include any independent variables. It only uses the residents' willingness

to pay for forest ecological services as the result variable of the whole study, that is, the dependent variable. The purpose is to decompose the residents' willingness to pay into residents. The individual and regional total two-level variance, calculate the percentage of regional variation, and test whether residents' willingness to pay for forest ecological services has regional level variation. If the variation between regions is significant, it is necessary to establish multilayer linearity. The model is analyzed to show the impact of regional characteristics on residents' willingness to pay. Its complete model can be expressed as model 1, and the calculation results are given in Table 2.

In the zero model, the variance of the dependent variable is decomposed into two parts: the variance between the groups and the variance within the group. The equation between the groups reflects the variation of the overall level. The variance between the groups reflects the variation of the individual level. The cross-level correlation coefficient of residents' willingness to pay for forest ecological services, i.e., ICC = intergroup equation/(intergroup equation-+ intragroup equation) = 0.1432, and the results are significant, indicating that the variation result of residents' willingness to pay is 14.32%, subjected to the overall level variable. The impact, therefore, is necessary to analyze and determine the variation components by multilevel statistical analysis methods, assuming H0 is verified.

4.2. Random Effects Model Analysis. On the basis of the zero model, the individual characteristics and the overall characteristics are included in the model to analyze the influence of each level of independent variables on the willingness to pay. Among them, the second model is the random intercept model, the individual level model has no independent variables, and the overall level is added to the relevant independent variables and is set as a random effect, which is mainly used to test whether the effect of the overall level independent variable on the willingness to pay is significant. Model 3 is also the intercept model. Taking the residents' willingness to pay as the dependent variable, the explanatory variables representing the individual characteristics of the residents are included in the first layer of the model, and a two-level random effect regression model that does not include the urban level explanatory variables is established. It is used to examine the impact of individual interpretation variables on the willingness to pay and whether there is a difference in the regional level of this effect. The complete model is expressed as follows:

$$\begin{aligned} Y_{ij} &= \mu_{ij} + \gamma_{00} + \gamma_{01} M_j + \upsilon_{0j} \ (\text{model 2}), \\ Y_{ij} &= \beta_{ij} X_{ij} + \mu_{\text{ij}} + \gamma_{00} + \upsilon_{0j} \ (\text{model 3}). \end{aligned} \tag{5}$$

The calculation results are as given in Table 3.

From the results of model 2, it can be seen that the three variables of consumer price index, per capita social security expenditure, and average employee wages are significant at the level of 0.05 and have positive effects, indicating consumer price index, per capita social security expenditure, and employee wages. The higher the level, the stronger the willingness of residents to pay for forest ecological services. The two variables of per capita GDP and education practitioners have no significant impact on the willingness to pay. In the random effect part, the model 2 is larger than the model 1, and the variation of the overall level is greatly reduced from 0.1432 to 0.1022 and the decrease is 28.6%, indicating that the overall level independent variable in the model explains 28.6% of the variance of the overall payment willingness of residents. Therefore, the inclusion of the overall level of independent variables in the model can greatly improve the ability of residents to explain their willingness to pay. Assume that H1 is verified.

Table 2: One-way analysis of variance of willingness to pay.

	Variance	df	X^2	P
Intergroup variation r_{00}	0.56761	67	486.3	≤0.001
Intragroup variation σ^2	3.39548			

From the results of model 3, it can be seen that the regression coefficients of education, monthly income, and environmental awareness are 0.0572, 0.1343, and 0.8159, respectively, indicating a significant positive impact on willingness to pay. The regression coefficients of gender, age, and place of residence are all negative, indicating a negative effect on the willingness to pay. It can be seen from the results of random effects that the variance of gender is the smallest, the P value is not significant, and the coefficient is relatively small, indicating that the influence of gender on regional differences is relatively small. The P values of the other 5 variables were significant, indicating that they varied significantly between regions. Among them, the degree of education, monthly income, and environmental awareness are large, indicating that the importance of the difference between the regions is large, and the impact on residents' willingness to pay is also greater. In summary, the individual characteristics of residents have a significant impact on the willingness to pay. The good educational level, income level, environmental awareness, age, and place of residence have significant P values, which have a significant predictive effect on residents' willingness to pay and can promote. The increase in residents' willingness to pay, the impact of gender is relatively small. Assume that H2 is verified.

4.3. Full-Model Analysis. The above zero model and random effect model are benchmark models that only consider individual characteristics or overall characteristics. Now, the individual characteristics and the overall characteristics are simultaneously included in the two-layer model, and the residents' willingness to pay for forest ecological services is established as the dependent variable and the individual social economy of the residents. The characteristic variable, the urban socioeconomic development characteristic variable, the full-model regression equation of the independent variable, given in equation (4), which is called model 4 (where the per capita GDP, the proportion of educated employees, and the age that have little effect on the willingness of residents to pay) is eliminated. The calculation results are given in Table 4.

Table 3: Analysis of random effects of willingness to pay.

Model	Effect		Variable													
			Difference		Regional characteristics						Individual characteristics					
			Between groups	Within groups	Intercept	CPI	Per capita GDP	Proportion of education practitioners	Per capita social security expenditure	Average wage of urban workers	Gender	Years	Education level	Monthly income status	Place of residence	Environmental awareness
2	Fixed	Col			3.0822	0.1529	0.5127	−0.6041	0.0268	0.1376						
		P			≤0.001	0.015	0.682	0.931	0.015	0.024						
	Random	σ^2	0.1022	2.5411												
		P	≤0.001													
3	Fixed	Col			2.4135						−0.1814	−0.0531	0.0572	0.1343	−0.1086	0.8159
		P			≤0.001						0.112	0.038	0.042	0.037	0.024	≤0.001
	Random	σ^2	0.1269	2.7532							0.0041	0.0556	0.2068	0.1144	0.0692	0.3811
		P	≤0.001								0.123	0.046	0.034	0.019	0.026	0.008

Table 4: Impact of urban level variables on urban residents' willingness to pay.

Independent variable	Fixed effect				Random effect	
	Estimated value	SE	t	P	Variance	X^2
β_0					0.04932	14.677
Intercept γ_{00}	2.434256	0.087131	27.162	≤0.001		
CPI	−0.153227	0.103141	−1.432	0.217		
Employee salary	0.000013	0.000011	1.515	0.191		
Safeguard expenditure	0.000214	0.000344	0.532	0.599		
β_1					0.01923	6.92311
Years γ_{10}	−0.03189	0.063121	−0.481	0.637		
CPI	−0.08712	0.070651	−1.245	0.029		
Employee salary	0.000040	0.000070	0.625	0.564		
Safeguard expenditure	0.000391	0.000241	1.581	0.019		
β_2					0.02731	12.252
Monthly income γ_{20}	0.138321	0.068014	2.045	0.012		
CPI	−0.027432	0.078331	−0.361	0.731		
Employee salary	0.000009	0.000008	0.951	0.041		
Safeguard expenditure	0.000021	0.000271	0.075	0.931		
β_3					0.02316	9.615
Education level γ_{30}	0.064131	0.034127	1.932	0.051		
CPI	−0.09312	0.082651	−1.119	0.034		
Employee salary	0.000030	0.000060	0.513	0.651		
Safeguard expenditure	0.000511	0.000221	1.472	0.031		
β_4					0.02374	8.419
Place of residence γ_{40}	−0.114279	0.096134	−1.125	0.335		
CPI	−0.028272	0.090111	−0.321	0.771		
Employee salary	−0.000008	0.000018	−0.423	0.692		
Safeguard expenditure	−0.000156	0.000322	−0.477	0.671		
β_5					0.25851	22.135
Environmental awareness γ_{50}	0.841223	0.198161	4.221	0.019		
CPI	−0.387153	0.239276	−1.631	0.019		
Employee salary	0.000036	0.000025	1.482	0.023		
Safeguard expenditure	0.001657	0.000823	1.912	0.014		

Bring relevant statistical data and get the general formula of the regression equation of residents' willingness to participate in forest ecological construction.

From the regression results of Table 4 and model, it can be seen that after adding the city level explanatory variables (per capita consumer price index, per capita security expenditure, and average employee wages), the degree of education has a marginal significant predictive effect on the slope of urban residents' willingness to pay, and the city level explanatory variables have no significant predictive effect on the intercept of urban residents' willingness to pay. The individual level explanatory variable age added to the city level explanatory variable per capita consumer price index and per capita protection expenditure has a significant predictive effect on the slope of the dependent variable, but there is no significant predictive effect on the slope of the dependent variable after joining the average salary of the employee. After the variables, the place of residence also has no significant predictive effect on the willingness of urban residents to pay; after adding the average wage level of employees, the monthly income variable of the family has a significant predictive effect; after adding the urban level explanatory variables, all variables of environmental awareness have significant predictive effects. It can be seen that the urban residents' willingness to pay is subjected to the environmental awareness of the urban residents and the individual socioeconomic characteristics of the residents and is also restricted by the characteristic variables of the urban economic development level of the residents. There is no significant predictive effect on the willingness to pay in the individual level explanatory variables. The interaction of the per capita consumer price index, the average salary of employees, and the per capita security expenditure in the urban level explanatory variables is on the horizontal explanatory variables of residents and residents. There is a significant predictive effect on willingness to pay. Therefore, accept the original theoretical assumptions.

5. Conclusions and Policy Recommendations

On the basis of extracting the socioeconomic data of the forest ecological service benefit areas, this study selects the multilayer linear model to measure the willingness of urban residents to pay for forest ecological services in different regions and conduct multivariable and nested cross-layer interaction analysis. The conclusions of the study are as follows. (1) The results of the zero model show that there is a significant difference in the willingness to pay for forest ecological services between different regions. The 14.32% variation of residents' willingness to pay is due to differences in regional socioeconomic characteristics, and regional differences are willing to pay. There is a significant impact, so

it is necessary to use a multilayer model for research. (2) The random effects model verifies that both individual and regional features can independently have a significant impact on willingness to pay. (3) The results of the full model show that there is a significant difference in the willingness to pay among urban residents in the same region. At the same time, after joining the urban explanatory variables, the 5 variables of age, income, education level, place of residence, and environmental awareness at the individual level are residents have a significant predictive effect on the willingness to pay for forest ecological services, reaching a significant level. It has a significant predictive effect on the willingness of urban residents to pay. It is ranked according to the contribution rate as environmental awareness, per capita income, education level, place of residence, and age. After the regional level variables are included, the interaction order is the consumer price index. The interaction of environmental awareness is the biggest, followed by the interaction between consumer price index and age. Once again, per capita social security interacts with expenditure and environmental awareness. Finally, the interaction between per capita social security expenditure and age, average employee wages, and monthly per capita. The interaction of income.

In view of this, according to the influencing factors and levels of urban residents' ability to pay, in order to further promote the willingness of urban residents to pay for forest ecological services, the author believes that on the one hand, the government should actively promote the income level of residents and enhance the willingness to pay for agriculture. According to the study, the income level of residents is positively changing with their willingness to pay. The level of economics in different regions also stimulates the same direction of change in residents' willingness to pay. Therefore, accelerating regional economic development and raising the income level of urban residents is the fundamental way to enhance their willingness to pay for agriculture. At the same time, according to the difference in residents' income, enrich the way in which residents participate in the payment of ecological services, and the government will guide them to give certain subsidies or incentives. It is important to distinguish the willingness of residents to pay for different income levels and increase their enthusiasm for ecological payment. significance. On the other hand, the government should strengthen publicity and raise residents' awareness of environmental protection. The above analysis of the factors affecting the willingness to pay for ecology shows that there is a significant correlation between income, education level, and age and their ability to pay. This is mainly because the above factors are closely related to people's environmental awareness, and the correlation coefficient of age is negative. With the increase of age, people's willingness to pay for ecology will gradually decline; with the increase of income and the improvement of education level, people's awareness of environmental protection will continue to strengthen, thus enhancing their willingness to pay. Therefore, increasing environmental protection publicity and improving national quality and environmental awareness are important social conditions for promoting urban ecological environment construction and improvement.

At the same time, according to the partial effect of independent variables, policy makers should enhance residents' willingness to purchase forest ecosystem services in the following priority order: improve residents' satisfaction with environmental governance > improve residents' trust in government departments > shorten the psychological distance between residents and forests > enhance residents' sense of possession of forests. Through the innovation of the ecological environment governance system, let residents share the achievements of forest environmental improvement, so as to improve residents' satisfaction with ecological services. Improve residents' trust in government departments by improving the efficiency and strength of government departments in dealing with environmental damage events. By accelerating the reform of the forest ecological carbon property right system, increasing the disclosure and publicity of forest ecological environment information, and encouraging residents to participate in forest environmental protection public welfare activities, residents' psychological ownership of forests can be improved.

In addition, the government should also change the traditional concept of "tragedy of the commons." In reality, in the values of a considerable number of people, the forest ecological service is considered to be free public goods and should be obtained free of charge. Therefore, it is unwilling to provide ecological services. Make a payment. In order to cultivate the willingness to pay for ecological services, this concept must be changed. In practice, it is necessary to implement differential pricing of ecosystem services. When determining the ecological compensation standard of forest ecological services, relevant departments should adjust measures to local conditions rather than one size fits all. Diversified payment methods should be designed according to the differences of residents' payment preferences. For positive response groups, we can not only consider collecting ecosystem service value compensation from them in the form of environmental protection tax but also initiate the establishment of relevant public welfare funds to receive donations from residents. For real zero response groups and protest response groups, policymakers should not only know the meaning but also give it benefit. With the help of green financial system innovation, we can launch a paid payment model for people with zero payment or low willingness to pay, so as to stimulate residents' enthusiasm to participate in ecosystem service payment. Policy makers can also encourage social capital to issue green bonds or green stocks to residents in the region to raise the required funds, so that residents can enjoy the benefits of protecting the forest ecological environment while participating in the payment of ecosystem services.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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