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Research Article

The Research on Coordinated Decision-Making Method Tax System Based on Subject Data

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Academically, the research of subject database of tax system aims to set up an efficient, harmonious virtual data application environment. Subject data, in application and management, has been on demand polymerized and autonomously collaborated and has reached a balance between instantaneity and accuracy. This paper defines the connotation and characteristics enterprise informationization, designs a value system of enterprise informationization which is subject database oriented, and builds a model for the import of the subject database of enterprise informationization. Meantime, this paper describes the structure of the subject database based information import model and forges the model's theoretical basis of subject data import in tax system. Using the model can make an analysis on the information of data warehouse, storage information, and tax information to provide decision support for the tax administrators.

1. Introduction

Being in line with China's national economic and social development strategy, the principle of "developing industrialization with information technology and promoting information technology with industrialization" has been a significant approach to achieve a prodigious leap in the development of national economy. Enterprise information does not only serve as an important microfoundation for the national economic and social information, but also a strategic approach to construct an information society. Data is the carrier of information, but the scale effect of big data poses huge challenges to the storage, management, and analysis of data. On one hand, the increasing amount of data often results in increased noise data instead of increased value. On the other hand, traditional data management is in serious need of adjustment so that a balance between instantaneity and accuracy will be kept in the application of big data. Thus, the enterprise information construction falls in the direction of constructing subject databases. The complete value of subject can only be reflected by a multistructure and multilevel coordination. The bottom storage capacity is supported by the file system, based on which we can construct a subject-oriented and integrated database to fulfill the integration, merging, and analysis of enterprise information system data at a higher level.

The tax system is an important pillar for the healthy economic and social development. To be adaptive to the development of enterprise informatization, tax authorities need to move their focus on enterprise information from the microlevel to the macrolevel and to shift the technical perspective to economic perspective so that the continuously changing enterprise informatization and sustainable management mode innovation will be combined. This combination promotes the formation of a research system of the subject data analysis based management of enterprise information. Besides, it enriches and improves the theories and methods in decision-making of enterprise information and performance evaluation.

Academically, the research of subject database of tax system aims to set up an efficient, harmonious virtual data application environment. Started with the optimization of the taxpayer compliance [1–3], this research area focuses on the study of management and application of on-demand polymerization of subject data, autonomous collaboration, and the balance between instantaneity and accuracy. This paper defines the connotation and characteristics of enterprise informatization, designs the value system of a subject

database oriented enterprise informatization, and builds an import model for it. Meantime, this paper describes the structure of the subject database based information import model and forges the theoretical basis of the subject data import model in tax system.

The construction of tax subject data in social network environment is to build the management of a large data system which satisfies the analysis of tax and related topics of the economy of the country. It can also conduct some special analyses such as tax assessment, tax enforcement inspections and checks, and the monitoring of tax revenue. The analyzing structure of the existing tax system is mainly composed of underlying index analysis, perspective analysis, basic tax analysis, custom thematic analysis, and algorithmic analysis of constituting rules [4]. The underlying index analysis indicators include tax analysis, corporate earnings index analysis, tax administration, and macroeconomic analysis. Time analysis, geographic analysis, the state tax unified standard code analysis, and tax industry standards and codes analysis are carried out in perspective analysis. The basic tax analysis includes allowance series analysis, tax household series, invoices series analysis, and audit series analysis. Custom theme analysis involves special analysis, thematic analysis, managing staff platform analysis, and sharing platform analysis. Algorithm rules analysis consists of conventional algorithms, model algorithm, system of rules, and standards that constitute index analysis [5]. Due to differences in management levels, management span, and vertical and horizontal structural relationship of tax authorities, the current four-level tax system analysis has focused on different areas, mainly based on the optimization of both taxation service and tax law enforcement [6]. However, the system internal collaborative function magnitude, collaborative span, and collaborative paths are in need of further consolidation.

The remainder of this paper is organized as follows. In Section 2, we present the corresponding literature review and state the purpose of the research. In Section 3, we develop a collaborative decision-making method of tax system based on subject data. Section 4 provides some concluding remarks.

2. Literature Review

Subject database, first introduced by James Martin, is the brace of data standardization of information resource planning. The subject database, based on data files and application database, is a database in which structure and processing procedure are separated. Also it is the core content of information engineering. The planning process is as follows [7–9]. First, unify data standards and determine the corresponding data. To unify data standards, the unification of the coding standard is the primary concern. Using a unified code, the recoded data will be eliminated. The standards for data entry, storage, and output are unified to satisfy the need of data integration. Then, application data format should be normalized, a unified information management system should be established, and the information processing and output terminals should be unified. Secondly, filter data to construct a standard and consistent database. During the process of database construction, all data need to be classified and standardized. On the basis of standardization, we integrate the data to form a data set whose standard is consistent, normalized, and unified and do not need any data interface. At last we build the subject database. Actually, we manage to integrate the data and the system for the information system whose development is decentralized.

Subject database provides a standard and unified data accessing mode for overall planning of information resources [10]. Additionally, it helps to avoid the decentralized development of information system. It can also provide guidelines for information sharing, promote the data environment reformation, and facilitate the integration of information system. Since the technology model, management, capital model, and credit mode of enterprise information are systematic, there are lots of researches on business innovation model of information technology. Timmers [11] defined the generalized connotation of business model. Wilson-Jeanselme and Reynolds [12] systematically analyzed it in their research. It offers significant foundations for enterprises which aims to implement internet strategy. Domestic enterprise information application is built on the entire socioeconomic information at a relatively low level; therefore, compared with the other countries, there is a big difference in the information application mode of Chinese enterprises.

Tax compliance has become a major research topic in economic psychology. The study of the issue, being approached from various viewpoints, shed light on different aspects of taxpayers' behavior [13]. Lisi [14] indicated that if trust and tax compliance are higher and tax evasion is lower, then the level of taxation can be reduced. Gangl et al. [15] conducted a field experiment on tax compliance, focusing on newly founded firm, and no positive overall effects of close supervision on tax compliance were shown in the results of the experiment. Saad [16] examined taxpayers' views on their level of tax knowledge and the perceived complexity of the income tax system, results of which suggested that taxpayers have inadequate technical knowledge and perceive tax system as a complex. Noga and Arnold [17] indicated that a TDSS can help both experienced and novice tax preparers make better decisions even though the novices cannot perform as well as experienced tax preparers. They concluded that tax compliance is improved with the use of a decision support system. Riahi-Belkaoui [18], who had investigated 30 countries, indicated that, internationally, the tax compliance was positively related to the level of economic freedom. Prinz et al. [19] consider the behaviour of the fellow citizens with respect to taxpaying to be identified. Laura [20] indicated that individuals were more likely to evade when they realized that there were a large number of evaders in the society. Castro and Rizzo [21] found a standard gender effect showing that female participants were less likely to evade taxes than man and that risk aversion negatively affects tax evasion behaviour. Murphy [22] investigated taxpayers who had an enforcement experience with the Australian Taxation Office.

The tax enforcement problems have been studied for many years. Filippin et al. [2] indicated the policy implication: enforcement had a cumulative effect on compliance via

tax morale. Elgin and Solis-Garcia [23] suggested that the enforcement and technological factors might be candidates to account for this relationship. Ordóñez [24] provided the model to Mexico, simulated an improvement of tax enforcement, and found important quantitative gains in output and productivity. Arbex [25] considered tax evasion, a fundamental action associated with taxation. The study also showed that the relationships among different tax enforcement policies, the elasticity of substitution between consumption and leisure, and the elasticity of substitution between formal and informal work were keys to explain formal labor supply. Marhuenda and Ortuño-Ortín [26] proved that, for a large family of penalty functions, the policy was honesty implied regressiveness. This result does not depend on the fact that agents know the true probability of inspection. Vasina [27] analyzed a mathematical model of tax enforcement for the case when the probability of detecting tax evasion was dependent on the inspector's efforts. Xu et al. [28] offered a new insight to policy makers in transforming economies that corporate governance build-up should be multidimensional. Besides, for the traditionally internal governance mechanisms represented by boards of directors and external governance mechanisms represented by takeover markets, tax enforcement was also an important corporate governance mechanism.

However, to the best of our knowledge, in the literature, no work has been done on models which combine tax compliance and tax enforcement. At present, researches on quantifying the degree of taxpayer compliance and tax enforcement have, respectively, made some progress, while there are few researches on collaborative optimization of taxpayer compliance supported by the tax system subject database. Therefore, this research provides the method with the optimization model for the tax administrators to handle the massive tax data in the era of big data.

3. Collaborative Decision-Making Method of Tax System Based on Subject Data

3.1. Decision Model. We can learn that taxpayer compliance consists of tax service and tax law enforcement [1]. Optimized tax service R is the upper target function of tax system decision; its components are function of the state variables which are seen as subfunction of tax service $h(\mu)$ and tax law enforcement $h(\varphi)$. Underlying objective function consists of tax service and tax law enforcement. Depending on the application environment, underlying subfunctions can make linear or nonlinear combination as follows:

$$\begin{aligned}
&\text{Max} \quad \left\{\overline{R}; \mu, \varphi\right\} \\
&\text{s.t.} \quad \left(\overline{R}; \mu, \varphi\right) \in Z \neq \varnothing \\
&\qquad \left\langle H\left(\vec{K}; \overline{R}\right), \overline{R}\right\rangle = 0, \quad H\left(\vec{K}; \overline{R}\right) \geq 0, \ \overline{R} \geq 0 \\
&\qquad \max_{\mu} \quad h\left(\vec{X}, \mu\right), \\
&\qquad \max_{\varphi} \quad g\left(\vec{Z}, \varphi\right) \\
&\qquad \text{s.t.} \quad \mu = \bigcup_{i=1}^{N} \gamma^{i}, \quad \mu \geq \varpi \geq 0 \\
&\qquad\qquad \varphi = \bigcup_{j=1}^{M} \tau^{j}, \quad \varphi \geq \varpi \geq 0,
\end{aligned} \tag{1}$$

where $\overline{R}$ refers to the taxpayer compliance and $\vec{X}$ is a vector set made up of other variables except for tax service μ. Z refers to nonempty set and is a vector set made up of other variables except for taxpayer compliance. The function H takes collaborative design variables as vector value. It is also the output function of tax system analysis. $\vec{Z}$ is a vector set made up of other variables except for tax law enforcement.

In bilevel programming model, upper level parameter is taxpayer compliance; when it transfers to the lower level, we can solve the combination of them and related sections to reflect the upper. Thus we can get the feasible solution for the optimization of upper function. The upper model parameter, taxpayer compliance $\overline{R}$, differs due to the changes of underlying function parameters including tax service and tax law enforcement. In addition, $\overline{R}$ is established on the basis of tax system departments coordination structure c and its level is r. This is the structural attribute for the problem of collaborative decision-making in taxation system. Coordinated structure c and its level r are analytic attributes in the problem of collaborative decision-making in taxation system, coming from the inner of tax system. The entire attribute of it can be made up of μ and together with the adaption to the social status of the external economic environment.

Double planning is a complex optimization problem, while lower planning can be seen as a suboptimization problem with parameters. Moreover, parameter value is determined by the upper planning. Although it is a linear bilevel programming, the problem is also a NP puzzle. The problem, hence, has higher complexity compared with a single plan. The solution to bilevel programming currently can be classified into two categories. The first category is to solve the problems by transformation; the other is to solve the problems directly.

For now, we have three primary solutions to the first type. First, when the underlying function is convex programming, we use KKT prerequisite to transform it to a single planning. Its advantage is that it is equal to the origin issue, and its shortage has some problems that may cause excessive complementary variables which can lead to the excessive scale of issue. Secondly, we can use engineering and technical methods such as Response Surface Methodology and Finite Element Analysis to fit the constituting function of underlying variables. Its strong point lies in its perfect fitting capability for interval made up of continuous variables, while it cannot deal with the discrete variables. Moreover, we can utilize the concept of membership function. The optimization for upper and underlying functions together with decision variables can be transformed into satisfaction function. In that way, a double-layer model can be converted

to a single-layer optimization model. As a result, we can adjust the upper and underlying satisfaction to get the overall optimal solution during the process. Its advantage is that it is different from traditional method based on Stackelberg countermeasure. During the transform process, it adds no complexity. It has relevant inadequate satisfactory solution set; however, the deficiency is that few researches had been made on the solution when the case constraint is not empty in upper planning.

When there is no transformation that can be obtained from the first method, we can consider combining intelligent algorithm to get the solution. In general, we get a set of solutions in the constraint domain of double-layer planning and then solve the underlying problem as taking the solutions as parameters. If the solution we get can satisfies the upper bound, it can be taken as a feasible solution. If not, a new solution would be generated in constraint domain; this procedure repeats until it reaches the maximum number of iterations. We can find the optimal solution from the set of feasible solutions. Its advantage is that the combination with intelligent algorithm can better search the overall optimal solution, while sometimes computational efficiency is too low.

3.2. Decision Method. The basis of collaborative decision-making body is the tax system structure, as the decision-making network of tax system takes analysis bodies of the system as nodes. The network structure, generated by linkage, is caused by the degree of coordination among the decision-making bodies. We discuss the body structure as follows: general administration G_1, provincial administration G_2, PUC administration G_3, county bureau administration G_4, socioeconomic environment G_5, humanities and regional environment G_6, political environment G_7, and enterprises' and citizens' demand intentions of tax service as well as tax law enforcement.

Linkages are built by collaborative decision-making relationships which are generated among bodies. Coordinated operations among bodies are required to conduct subject data supported decision-making behavior. Main network architecture is a completed web, considering the need of the overall network structure's stability and location features of each body, and we define the collaborative decision-making relationships as follows.

Definition 1. Tax system collaborative decision-making relationship is $(\alpha_{ij}, \lambda_{ij}, \theta_{ij})$. α_{ij} refers to the subjective judgment from each subject to assess the importance of each other's decisions; criteria for judging can be seen as Table 1. λ_{ij} refers to the power distance among the each subject. θ_{ij} refers to the similarity of different subjects' intentions. Indeed, $\theta_{ij} = 1 - |G_i - G_j|, i \neq j$.

Definition 2. Administrative distance between collaborative decision-making bodies of tax system refers to the measure unit distance, taking demand intention of tax service as the starting point and general-level development plan as the end. They are in accordance with the current tax laws and related laws and regulations.

Table 1: The importance scale reference of collaborative decision-making relationship among intersubjective tax systems.

l_{ij}	Definition
1	j extremely value the relationship with i's
3	j value the relationship with i's
5	i and j equally value the relationship between them
7	i value the relationship with j's
9	i extremely value the relationship with j's
2; 4; 6; 8	Intermediate cases correspond to two consecutive judgments above

Administrative organization is an organization with longitudinal dependence; that is to say, the collaborative decision-making relationship between general administration and county bureau administration is bidirectional, and the administrative distance is ζ. There is a demand intention of tax service and tax law enforcement from enterprises and citizens and a development intention of social economic and political development. Both the collaborative decision-making relationship between the demand intention and regulatory agencies at all levels and the relationship between the development intention and agencies are bidirectional as well. An arbitrary body's change can bring about an evolution of the entire network structure. Maintaining a positive evolution of the network structure, however, is one of the basic ways to measure the sustainability of the collaborative decision-making effect in a tax system. The data for tax system collaborative decision-making relationship is obtained from subject data.

The subject data based collaborative decision-making method of a tax system is described as follows.

Step 1. We can optimize the taxpayer compliance and its corresponding state variables, tax service, and tax law enforcement via formula (1). Then optimize and calculate the objective function, according to organizational structure between collaborative decision-making bodies; we find longitudinal connection with regard to different subject databases.

Step 2. The network architecture of bodies in the collaborative decision-making of tax systems is established according to the condition of tax bodies that satisfy the main goal of the tax function and collaborative goal constraints.

(1) By measuring the administrative distance between the bodies of collaborative decision-making in tax systems due to Definition 2, we can estimate the relationship between tax system and collaborative decision-making due to Table 1 and Definition 1.

(2) By calculating the similarity of each tax system decision-making bodies, we determine whether the decision-making is sustainable. If it is sustainable, we extract the main structural features of the existing network. If not, the bodies of tax system for collaborative decision-making revise the collaborative decision-making relationship or reoptimize the tax

service and tax law enforcement. Optimizing the objective function, we make lateral connections with subject databases such as cross-regional sibling tax system bodies according to different hierarchies.

(3) Select the appropriate method of determining the weights in connection with the specific condition for collaborative problems.

Step 3. Optimize the subfunctions, the tax service, and tax law enforcement functions. And then we make optimal combinations of them, transferring the optimized state variables to the upper function. If the upper objective function can be further improved, we can repeat Step 3. If not, go to Step 4.

Step 4. Gathering the collaborative decision-making information by appropriate information aggregation operators, we then reach the optimized conclusion.

4. Conclusions

The subject data supported, collaborative decision-making method of tax system systematically analyzes and integrates tax purposes and motivations. It has great meaning for the political, economic, and social developments and the late-developing advantage in the tax system. For now, the analyses of China's collaborative decision-making in tax system were at the stage of theoretical discussion. However, few researches on collaborative decision-making in tax system have been made and there is a gap between theoretical research and its practical application. This paper promotes a subject data supported collaborative decision-making method of the tax system and discusses composition of collaborative decision relationship between the collaborative decision-making bodies. We quantify tax service and tax law enforcement via double- layer planning model and the loop optimization between the vertical and horizontal subjects. Indeed, a specific set method and application procedures are given in this paper.

The subject data supported collaborative decision-making method in the tax system has the following characteristics. First of all, the taxpayer compliance based on vertical structure optimization of tax system enables goal setting of the taxpayer compliance optimization to play a leading role in the lateral tax enforcement and tax service behavior. Moreover, the sustainability of taxpayer compliance optimization is characterized via the evolution direction of the network structure for the multiple decision bodies.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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