An Empirical Analysis of the Tax Inspection and Law Enforcement Risk of Changchun Taxation Bureau in the Era of Big Data

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Abstract. In this paper, we develop the static and dynamic non-cooperative game models based on the basic assumptions, and analyze them separately. It is concluded that the main factors affecting the overall benefit of the tax inspection department are the tax loss, the inspection cost and the fine of the inspection department. Combined with the specific situation of Jilin Province, it is the conclusion that the inspection ability of the tax inspection department of Changchun Taxation Bureau is increasing year by year, the inspection cost is lower than the national level, and the punishment for illegal behaviors is not enough.

Keywords: Big data Era · Tax inspection · Game theory

1 Application of the Game Model Between Tax Authorities and Taxpayers

The relationship between tax authorities and taxpayers is both opposite and unified, and using the game model can better analyze the relationship between tax authorities and taxpayers. In a narrow sense, the relationship between tax inspection and taxpayers is opposite and it is impossible to reach a binding agreement, that is, the interest relationship between them is also relative, and both parties pursue the goal of maximizing their own interests under the condition of mutual influence of interests. Therefore, the relationship between Changchun tax authorities and taxpayers is more applicable to the non-cooperative game theory model, and the contradiction between tax inspection and taxpayers mainly lies in the "check" part, so this model is established in the process of "check" [1].

1.1 Basic Assumptions of the Model

The establishment of a non-cooperative game model means that the relationship between tax inspectors and taxpayers is completely opposite, and there is no intermediate or cooperative relationship. In addition, since this game model cannot completely correspond to the actual situation of tax inspection in Changchun, it is necessary to assume some

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premises based on the above reasons, and that the model should be established and further analyzed under these premises:

Firstly, the two parties participating in the game are tax inspection and law enforcement personnel and taxpayers respectively.

Secondly, both tax inspectors and taxpayers are economic rational people. In the game process, both players will pursue benefit maximization under the condition of considering risks. Generally speaking, the goal of tax inspectors is to maximize tax revenue, while the goal of taxpayers is to pay as little as much tax as possible.

Thirdly, tax inspectors only have two choices: "inspection" and "no inspection", while taxpayers only have two choices: "illegal" and "no illegal".

Forthly, tax inspectors can only find out that taxpayers are breaking the law through tax inspection.

Fifthly, tax inspectors shall not be affected by other factors in the inspection process [2].

Based on the above assumptions, non-cooperative game models of both sides can be established.

1.2 Model Construction

The tax payable by the taxpayer shall be TD (Tax Due); The actual tax paid by the taxpayer is TP (Tax Paid); The tax payable by a taxpayer is greater than or equal to the tax actually paid by the taxpayer, approach TD $\geq$ TP, The difference between the tax payable by the taxpayer and the actual tax actually paid by the taxpayer is the illegal amount or the amount of tax lost; The intensity of the fine imposed by tax inspectors on taxpayers for breaking the law is: $\alpha > 0$; The inspection cost of inspecting taxpayers by tax inspectors is IC (In s pection Co s t); The illegal co s t of the taxpayer is ic (illegal co s t); The probability of tax inspectors conducting tax inspections is p, The probability of tax inspectors not to carry out tax inspection is 1-p; The probability of a taxpayer breaking the law is q, The probability of taxpayers not breaking the law is 1-q; The probability of inspection seized by tax inspectors is r, The probability of not seized is 1-r.

Construction of the Static Non-cooperative Game Model. According to the above conditions, Table 1 is shown below.

Table 1. Table of the mutual selection results of the static non-cooperative game model.

Game subject		Tax inspectors	
		check (p)	No inspection (1-p)
taxpayer	break the law (q)	-TP -α *(TD -TP)-ic, TP + α * (TD -TP)-IC	-TP -ic, TP
	Non-illegal (1-q)	-TD, TD -IC	-TD, TD

The Construction of a Dynamic Non-Uncooperative Game Model. Because in the actual situation is the first taxpayer to break the law, and then the tax inspectors for tax

inspection [3]. In the process of tax inspection, taxpayers do not know when they will be tax inspection, and tax inspectors do not know whether the taxpayer is illegal. According to the above conditions, it is shown in Table 2 below.

Table 2. Table of dynamic non-cooperative game model.

Game subject		Tax inspectors		
		check (p)		No inspection (1-p)
taxpayer	break the law (q)	hunt down and seize (r)	Not seized (1-r)	
		-TP -α * (TD -TP)-ic, TP + α * (TD -TP)-IC	-TP -ic, TP -IC	-TP -ic, TP
	Non-illegal (1-q)	-TD, TD -IC		-TD, TD

2 Model-Based Risk Analysis of Tax Inspection and Law Enforcement in Changchun City

According to the above static non-cooperative game model, the dual selection result table and the dynamic non-cooperative game model, the two models, the static game model and the dynamic game model, are analyzed.

2.1 Static Non-cooperative Game Analysis

According to the above conditions, if the probability that the tax inspector conducts a tax inspection is p, the expected income that the tax inspector chooses the inspection is:

$$p * [TP + \alpha * (TD - TP) - IC] + (1 - p) * (TD - IC) \tag{1}$$

The expected benefits of tax inspectors choosing not to inspect are:

$$p * TP + (1 - p) * (TD) \tag{2}$$

According to the Nash equilibrium theory, it can be concluded that when p * [TP + * (TD-TP) -IC] + (1-p) * (TD-IC) = p * TP + (1-p) * (TD):

$$P' = IC/(1 + \alpha) * (TD - TP) \tag{3}$$

If the probability that the taxpayer violates the law is q, the expected income that the taxpayer chooses the violation is:

$$q * [-TP - \alpha * (TD - TP) - ic] + (1 - q) * (-TD) \tag{4}$$

The expected income of taxpayers taxpayer chooses not to be illegal is:

$$p * (-TD) + (1 - p) * (-TD) \tag{5}$$

When q * [-TP- * (TD-TP) -ic] + (1-q) * (-TD) = p * (-TD) + (1-p) * (-TD):

$$q\text{`} = (TD - TP - ic)/(TD - TP) * (\alpha + 1) \quad (6)$$

Therefore, it can be concluded that the mixed Nash equilibrium of the static nonco-operative game model is achieved when the probability of (TD-TP-ic)/(TD-TP) * (+ 1) and the tax inspectors conducts the tax audit with the probability of IC/(1 +) * (TD-TP).

When q < (TD-TP-ic)/(TD-TP-ic/(TD-TP) * (+ 1); when q > (TD-TP-ic)/(TD-TP) * (+ 1), and when q = (TD-TP-T P-i c)/(T D-T P) * (+ 1).

When p < IC/(1 +) * (TD-TP), the best choice for tax inspectors is not to audit; when p > IC/(1 +) * (TD-TP); when p = IC/(1 +) * (TD-TP).

Therefore, it can be concluded that the probability of taxpayers choosing to break the law or not is related to the inspection cost of tax inspectors, the illegal cost of taxpayer, the amount of tax paid by taxpayers and the fine intensity of tax inspection and law enforcement personnel to taxpayers breaking the law.

2.2 Analysis of Dynamic Non-cooperative Game

According to the above conditions, if it is assumed that the probability of the tax inspector inspecting and seizing it is r, then the taxpayer's selection scheme is Y1 = (Y11, Y12), among Y11That the taxpayer chooses illegal, Y12The taxpayer chooses not to be illegal. The choice scheme of the tax inspectors is Y2 = (Y21, Y22), among Y21It means that the tax inspectors choose the inspection, Y22Says that the tax inspectors chose not to check.TEiFor the taxpayer total expenditure (= -taxpayer total benefit), TBiFor the total benefit of the tax inspectors [4].

When the taxpayer chooses not to break the law and the tax inspector chooses not to inspect, the choice is (Y11, Y12) Down, the corresponding to (L1, E1) = (TD, TD).

When the taxpayer chooses not to break the law, and the tax inspector chooses to inspect, that is, the choice is (Y12, Y21) Down, the corresponding to (L2, E2) = (TD, TD -IC).

When the taxpayer chooses to break the law and the tax inspector chooses not to inspect, the choice is (Y11, Y22) Down, the corresponding to (L3, E3) = (TP + ic, TP).

When the taxpayer chooses to break the law, and the tax inspector chooses to inspect, the choice is (Y11, Y21) Next: If the tax inspector finds the taxpayer breaking the law, the corresponding (L4, E4) = [TP + * (TD-TP) + ic, TP + * (TD-TP) -IC]; if tax inspectors cannot detect taxpayer violations, the corresponding (L5, E5) = (TP + ic, TP -IC).

Then we can get non-cooperative game payments for taxpayer expectations of r * [TP + * (TD-TP) + ic] + (1-r) * (TP + ic) and tax inspectors' expectations of r * [TP + * (TD-TP) -IC] + (1-r) * (TP-IC) as shown in Table3.

According to the expected utility theory of non-cooperative game, we can know that when the taxpayer chooses the total illegal expenditure, the taxpayer will choose to be illegal; when the taxpayer chooses the total illegal expenditure, the taxpayer will choose not to be illegal. When the total benefit of the tax inspectors to choose the inspection is greater, the tax inspectors will choose not to inspect, and the tax inspectors will choose not to inspect. The Nash equilibria of the available game are as follows:

Table 3. Analysis table of Dynamic non-cooperative Game Model.

Game subject		Tax inspectors	
taxpayer	break the law (q)	check (p)	No inspection (1-p)
		r *[TP + α * (TD -TP) + ic] + (1-r) * (TP + ic), r *[TP + α * (TD -TP) -IC] + (1-r) * (TP -IC)	TP + ic,TP
	Non-illegal (1-q)	TD,TD -IC	TD,TD

When r * [TP + * (TD-TP) -IC] + (1-r) * (TP-IC) = TP, the solution is given:

$$IC = r * (1 + \alpha) * (TD - TP) \tag{7}$$

Therefore, when the audit cost of tax inspectors is IC > r * (1 +) * (TD-TP), r * [TP + * (TD-TP) -IC] + (1-r) * (TP-IC) > TP for taxpayers, and the T > T-IC; when the tax inspectors choose not to audit, TD > TP + ic, so the taxpayer should choose illegal, and there is a unique Nash equilibrium (Y11, Y22).

When the inspection cost of tax inspectors is IC < r * (1 +) * (TD-TP), there is no Nash equilibrium, and the mixed strategy equilibrium of both sides needs to be solved. For taxpayers, the aim is to minimize the total expenditure, namely, F (p, q, r) = (1-p) * [(1-q) * TD + q * TD] + p * {(1-q) * (TP + ic)} + q * {r * [TD + * (TD-TP) + ic] + (1-r) * (TP + ic)}} then F (p, q, r) Seek guidance, can get F (p, q, r) ' = -TD + TP + ic + q * r * (1 +) * (TD-TP) = 0, solved to:

$$q' = (TD - TP - ic)/r * (1 + \alpha) * (TD - TP) \tag{8}$$

That is, if the probability of tax inspectors choosing inspection is less than q ', then the taxpayer will choose to break the law, if the probability of tax inspectors choosing inspection is greater than q ', then the taxpayer will choose not to break the law, if the probability of tax inspectors choosing inspection is equal to q ', the taxpayer can choose whether to be illegal or not.

For tax inspectors, the purpose is to maximize the overall benefit, namely F (p, q, r) = (1-q) * [(1-p) * TD + p * TP] + q * {(1-p) * (TD-IC)} + p * {r * [TD + * (TD-TP) -IC] + (1-r) * (TP-IC)}} to obtain the minimum value of F (p, q, r) Seek guidance, can get F (p, q, r) ' = -IC + p * r * (1 +) * (TD-TP) = 0, solved to:

$$p' = IC/r * (1 + \alpha) * (TD - TP) \tag{9}$$

That is, when the probability of the taxpayer choosing to break the law is less than the p ', the tax inspectors should choose to inspect; otherwise, the taxpayer should choose not to inspect. When the probability is equal to the p ', they can choose the inspection or not.

3 Analysis of the Basic Conclusion of the Model

As it is difficult to find the tax audit data for 2018–2020, so the text selects the data in the 2015–2018 tax audit Yearbook, namely the data of 2014–2017. Moreover, it is also difficult to find the inspection data of the tax inspection department of Changchun

Taxation Bureau. However, Changchun city is the provincial capital of Jilin Province, and its various indicators, such as tax revenue, the supplementary tax amount and the number of people set, account for a large and highly representative proportion. Therefore, according to the tax inspection data of Jilin Province in 2014–2017, the tax inspection data of Changchun city in 2014–2017 is estimated, so as to study the specific situation and risks of the tax inspection department of Changchun Tax Bureau. According to the analysis results of the above static non-cooperative game model and the dynamic non-cooperative game model and the relevant data of Jilin Province, the conclusions can be drawn.

3.1 The Inspection and Subsidy Capacity of Changchun Tax Department Has Been Improved year by year

The inspection and compensation ability of the tax department of Changchun has improved year by year, so the risk of tax inspection and law enforcement brought by the insufficient inspection ability is low. According to the above game model analysis, it can be learned that the total benefit of the tax inspection department is affected by the difference between the tax payable by the taxpayer and the amount actually paid by the taxpayer, namely TD-TP, also referred to as tax loss [5]. The greater the difference between the tax payable by the taxpayer and the amount actually paid by the taxpayer, the stronger the necessity for the tax inspection department to choose inspection; the smaller the difference between the tax payable by the taxpayer and the actual amount paid by the taxpayer, the weaker the necessity for the tax inspection department to choose inspection. Therefore, the inspection and compensation ability of the tax inspection department of Changchun city is increasing year by year, as shown in Table 4.

It can be seen that the tax revenue of the tax inspection department of Changchun Taxation Bureau from 2014 to 2017 was 32.03 billion yuan, 30.00 billion yuan, 30.99 billion yuan and 34.01 billion yuan respectively. There was no obvious rule in the tax revenue change in the four years, and the difference was less than 2 billion yuan. The total number of direct inspection and organization enterprise self-inspection and compensation income increased year by year from 2014 to 2016, and decreased in 2017. However, as the tax revenue of Changchun city in 2017 decreased compared with 2016, the decline in the total number and compensation income of direct inspection and organization enterprises can be explained. From 2014 to 2017, the difference between the inspection and subsidy income and the storage trend decreased year by year, and in 2016 and 2017, all the storage revenues were realized. It can be concluded that although the tax loss of Changchun city in increasing year by year, means that the Changchun city tax inspection department still can operate space, but the tax inspection department inspection ability is increasing, so Changchun city tax bureau tax inspection department face due to the lack of ability and risk is smaller, but also can't completely relax.

Table 4. Table of Changchun Tax Inspection Department

		a particular year							
		2014	2015	2016	2017	2014	2015	2016	2017
		Jilin Province				Changchun City			
Tax revenue (RMB 100 million)		884.40	867.10	872.95	853.95	320.30	300.00	309.90	340.10
						36.22%	34.60%	35.50%	39.83%
Tax inspection and compensation situation	Total number of direct inspection and organized enterprise self-inspection (households)	4044	6873	6959	5525	1465	2378	2470	2200
	Check the income (100 million)	29.20	38.43	44.85	36.58	10.58	13.30	15.92	14.57
	Warehousing (100 million yuan)	27.37	38.34	44.85	36.58	9.91	13.26	15.92	14.57
	The difference between checking income and warehousing (RMB 100 million)					0.67	0.04	0	0

Data source: China Tax Inspection Yearbook 2014–2017 data.

3.2 The Tax Inspection Cost of Changchun Taxation Bureau is Lower than the National Level

The tax inspection cost of Changchun Tax Bureau is lower than the national level, and the tax inspection risk brought by the inspection cost is relatively small. Based on the above analysis results of the above static non-cooperative game model and the dynamic non-cooperative game model, the inspection cost of the tax inspection department is obtained, that is, the IC is positively correlated with the probability of the taxpayer choosing the law. When the inspection cost of the tax inspection department increases, the higher the probability of breaking the law, the lower the probability of choosing against the tax inspection department, the lower the probability of the taxpayer choosing the law, and the higher the probability of choosing not breaking the law.

Therefore, the study of the specific situation of tax inspection of Changchun Tax Bureau in Jilin Province needs to study its inspection cost. Generally speaking, the inspection cost mainly includes two aspects. One is the fixed cost, and the other is the non-fixed cost. Fixed costs mainly include the expenses incurred by the tax inspection department of the tax bureau in its daily work, including the wages and salaries of the staff, the water and electricity charges generated in its daily work, and the necessary office supplies such as computers, paper and pens in their daily work. Fixed costs are generally not easily affected by other factors. Non-fixed costs include time cost, information cost,

risk cost, etc. This paper mainly represents the time cost of the tax inspection department of Changchun Taxation Bureau, Jilin Province by the number of inspections per capita, so as to reflect its non-fixed cost, as shown in Table 5.

Table 5. The Comparison Table of Changchun City and the National Tax Inspection Situation

nationwide	a particular year			
	2014	2015	2016	2017
Direct inspection and organization of enterprise self-inspection total number (ten thousand households)	5.95	12.38	11.82	15.81
Number of personnel (person)	82334	80154	79239	79158
Number of inspections per capita (ten thousand households)	0.7	1.5	1.5	2.0
Jilin Province	a particular year			
	2014	2015	2016	2017
Total number of direct inspection and organized enterprise self-inspection(households)	1465	2378	2470	2200
Number of personnel (person)	814	705	776	848
Inspection quantity per capita (household)	1.8	3.4	3.2	2.6

It can be concluded that between 2014 and 2017, the per capita number of inspections in China was 7,000,15,000,15,000 and 20,000, respectively, and the per capita number of inspections in Jilin Province was 18,000,34,000,32,000 and 26,000, respectively. Both the national per capita inspections and the provincial per capita inspections were increasing year by year, with the per capita inspections in Jilin Province decreasing in 2017 and higher than the national levels in 2014–2017.

With the reform of the collection and management system and the merger of the national tax bureau and the local tax bureau, the fixed cost of the tax inspection department of the Changchun Tax Bureau in Jilin Province will also be reduced. Therefore, it can be concluded that the inspection cost of the tax inspection department of Changchun Taxation Bureau is lower and lower than the national level. Therefore, it can also be concluded that the tax inspection department of Changchun Taxation Bureau is faced with less law enforcement risk brought by the inspection cost, but it can not be ignored.

3.3 The Tax Inspection Department of Changchun Taxation Bureau Does not Punish Taxpayers Enough for Illegal Behaviours Enough

The tax inspection department of Changchun Taxation Bureau does not punish taxpayers enough for illegal acts, which brings risks to the tax inspection and law enforcement in Changchun. According to the above game model analysis, it can be known that the punishment intensity of the tax inspection department on taxpayers' illegal behavior is

negatively related to the probability of taxpayers choosing illegal behavior. When the greater the fine of the tax inspection department, the lower the probability of taxpayers choosing not breaking the law, the higher the probability of choosing not breaking the law, the higher the probability, the lower the probability of choosing not breaking the law. Among the major illegal cases investigated and dealt with in Changchun in the first half of 2020, most of them received administrative penalties of 500,000 yuan, but the amount of money involved in these illegal and criminal cases is very different, which makes the tax inspection department of Changchun Taxation Bureau not punish enough for taxpayers who choose illegal cases to form a deterrent effect. Therefore, it is necessary to pay attention to the law enforcement risk risks caused by the insufficient punishment for illegal acts.

By establishing a game model between tax authorities and taxpayers, and analyzing the static non cooperative game and dynamic non cooperative game between Changchun tax authorities and taxpayers, it is concluded that the inspection subsidy capacity of Changchun tax authorities has been improved year by year, the tax inspection cost of Changchun tax bureau is lower than the national level, and the tax inspection department of Changchun tax bureau has not adequately punished taxpayers for illegal acts.

References

1. Olaoye, C.O., Ekundayo, A.T.: Effects of tax audit on tax compliance and remittance of tax revenue in ekiti state. Open J. Account. **8**(1) (2019)
2. Blaufus, K., Schndube, J., Wielenbergs, R.: Strategic interactions between tax and statutory auditors and different information regimes:Implications for tax audit efficiency. arqus Discussion Papers in Quantitative Tax Research (2020)
3. Battiston, P., Duncan, D., Gamba, S., Santoro, A.: Audit publicity and tax compliance:a natural experiment. The Scandinavian J. Econ. **122**(1) (2020)
4. Guangqiang, L., Yisihong, Z.: The internal mechanism and Countermeasures of big data driven Tax Governance. Tax Res. **2018**(04), 114–119 (2018)
5. Huan, H.: A feasible path to control tax inspection risks in the big data era. Econ. Res. Refer. **2018**(30), 26–27 (2018)