International Journal of Business and Management Invention (IJBMI)
ISSN (Online): 2319-8028, ISSN (Print):2319-801X
www.ijbmi.org || Volume 10 Issue 4 Ser. I || April 2021 || PP 01-07

Evolutionary Game Analysis of Transfer Pricing: Based On the Perspective of Multinational Companies and Tax Authorities

Xiao Jian
Shanghai University, Shanghai

ABSTRACT: *Multinational companies doing tax avoidance illegally by transfer pricing seriously encroaches national tax base and harms the healthy development of investment environment. This paper is to explore the dynamic game about anti-tax avoidance and tax avoidance in tax authorities and multinational companies' angles, which is based on evolutionary game's analysis. We find an interesting phenomenon: when tax authorities have to afford large funds to get multinational companies' information about transfer pricing due to the strong concealment of these information, the authorities' inspection rate about tax avoidance by transfer pricing will decrease, even to zero, and multinational companies will continue to do tax avoidance by transfer pricing until 100%. Therefore, it's important to improve tax authorities' ability to getting information efficiently. Refining the scope of transfer pricing standards through industry, keeping close touch with other countries, seizing the opportunity of construction of digital economy tax framework and building a professional international tax analysis team can solve the problem properly.*
KEYWORDS*: Transfer Pricing; Anti-tax Avoidance; Evolutionary Game*

Date of Submission: 29-03-2021 Date of Acceptance: 12-04-2021

I. INTRODUCTION

With the development of economic globalization, transfer pricing, which is concealed and difficult to measure, becomes a serious issue for China. It provides great opportunity to multinational companies to avoid tax liabilities illegally. Related party transactions from foreign-invested companies in China accounted for 42.6% of the import and export trade(GACC,2018). More than half of foreign-invested companies enjoy tax incentives granted by local governments on the one hand, and on the other hand transfer the profits to other lower tax rate districts. What's more, the actions from many large multinational companies have also confirmed the abuse of transfer pricing. GlaxoSmithKline, UK, fined US$3.5 billion by the US government for transfer pricing issues in 2000. Starbucks was under investigation by using supply chain to shift profits in 2012. The local media exposed the fact that the American technology Apple had been using intangible assets for transfer pricing and transferring most of its profits to Ireland in 2018. As a conclusion, it's a common problem that multinational companies conduct improper tax avoidance through transfer pricing. This problem has led to a serious loss of national tax revenue and has brought a huge threat to the healthy development of the investment environment.

In order to cope with the challenges from transfer pricing, State Taxation Administration in China began to fixed the transfer pricing framework in 1991. This Constructing plan includes transfer pricing's definition for related party transaction, transfer pricing species, scopes and so on. And now, it has been determined basically. However, it's just theoretical level not Practice level. In this framework, how transfer pricing affect the relationship between tax authorities and multinational companies? What decisions tax authorities and multinational companies will make in real life? Different scholars explore these questions in different angles. Some previous research has explored the tax avoidance in multinational companies. Borkowski S. C.(1992)[1] pointed out that taxation, host country income tax rate and the Simplicity of transfer pricing could affect the methods to transfer pricing significantly, and the prices of highly differentiated commodities are easier to be manipulated by companies(Bernard et al,2006; Cristea and Nguyen,2016)[2][3]. What's more, Fan(2017)[4] proved that the fundamental purpose of transfer pricing is to do the tax avoidance by the angle of intangible assets. Other researches concentrate on the anti-avoidance perspective of tax authorities. Mao(2017)[5] started with the EU's anti-tax avoidance action, pointed out the current situation of "stopping the symptoms but not the root cause" of the current domestic anti-tax avoidance, and emphasized the importance of cooperation between governments in anti-tax avoidance. Marques and Pinho(2016)[6] and Rossing(2017)[7] proved that a strict anti-tax avoidance system can effectively control the behavior of tax avoidance. Zhou(2019)[8] used the "whistleblower" system to suppress tax avoidance.

Most of the literature starts from the perspective of case analysis to analyze the behavior of corporate transfer pricing and explore the development of anti-tax avoidance systems. However, they haven't understood what kind of game between tax authorities and multinational companies on transfer pricing issues, and whether

there will be an strategy equilibrium in the process of the game. In order to analyze how tax authorities and multinational companies to deal with transfer pricing issues, and explore the solution for transfer pricing essentially. This paper will give the policy advice on how to improve transfer pricing rules implementation efficiency by knowing the behavior choices between tax authorities and multinational companies in micro level, which is based on evolutionary game analysis.

II. EVOLUTIONARY GAME ANALYSIS OF TRANSFER PRICING BETWEEN TAX AUTHORITIES AND MULTINATIONAL COMPANIES

2.1 Research design

The evolutionary game process of enterprise transfer pricing involves two major game players under objective conditions: Multinational companies and tax authorities. In order to design the evolutionary game model, I arranges the subjects, behaviors, relevant parameters, assumptions and return matrix of the evolutionary game, then builds and analyzes the evolutionary game model on this basis. In the evolutionary game process, if a multinational enterprise sets a specific price for its own multinational affiliates to conduct related transactions for the purpose of tax avoidance when conducting transnational related party transactions, it will be regarded as using transfer pricing for tax avoidance(TPTA), otherwise there is no TPTA. When the tax authority conducts a tax inspection on a multinational company, it is regarded as random inspections(RI), otherwise it is not conducted. These behaviors can be combined in pairs, and resulting in four situations:

S1: Multinational companies are conducting TPTA and tax authorities are doing RI in the same time.

S2: Tax authorities don't do RI but multinational companies are conducing TPTA.

S3: Multinational companies don't conduct TPTA but tax authorities are doing RI.

S4: Tax authorities are doing RI but multinational companies don't conduct TPTA.

the strategy matrix of multinational companies and tax authorities is shown in Table 1.

Table 1: strategy matrix of multinational companies and tax authorities

Player		***Multinational companies***	
		TPTA	***No TPTA***
Tax Authorities	***RI***	(RI, TPTA)	(RI, No TPTA)
	No RI	(No RI, TPTA)	(No RI, No TPTA)

In these situations, when tax authorities conduct RI, it needs human and materials resources to get the companies information. These costs we defined as a. When the tax authorities regard the companies' behaviors as TPTA, the fines that the companies should give to tax authorities we defined as b. If multinational companies are too lucky to be found the TPTA behaviors, the incomes that companies get we defined as c. Specific parameters are shown in Table 2.

Table 2: parameters

Value	***means***	***Effect factors***
a	Cost for RI	National GDP, policy and supervision
b	Fine	Government punishment, the public's law awareness
c	Income from TPTA	The legal awareness of the enterprise and the Strictness of the national policies

The evolutionary game assumes that the players in the game have bounded rationality, and that both sides of the game complete their decision-making choices in the process of continuous learning. We have these three assumptions:

A1: Both multinational companies and tax authorities are bounded rationality. Tax authorities don't have enough information about multinational companies' operations. But each time tax authorities conduct a RI, they can find companies' TPTA behaviors.

A2: Tax authorities will do RI with a probability of $x(0 \le x \le 1)$. Multinational companies will conduct TPTA with a probability of $y(0 \le y \le 1)$. This paper mainly explores the relationship between the cost RI and the benefits from TPTA without considering the impact of other factors.

A3: There must be costs in the RI process and the fines are positive, which means $a > 0, b > 0$. Multinational companies must conduct TPTA under fully consideration, which means $c > 0$.

There can be a game income matrix about tax evasion and governance between tax authorities and multinational companies which can provide complete value information about four situations:

S1(RI, TPTA): The cost from RI is a. When doing a RI and find the TPTA behaviors, tax authorities confiscate all incomes c from TPTA and get fine b. The total incomes for tax authorities is$(b - a + c)$, and the total incomes for multinational companies is $(-b - c)$.

S2(No RI, TPTA): Tax authorities don't do the RI but multinational companies are conducing TPTA. Tax authorities will loss the revenue c, so the total incomes is $-c$. Multinational companies will get the incomes c from TPTA, and the total incomes is c.

S3(RI, No TPTA): Tax authorities spend cost a but don't find TPTA behaviors. The total incomes for tax authorities is $-a$, and the total incomes for multinational companies is 0.

S4(No RI, No TPTA): Neither tax authorities nor multinational companies have any behaviors. The total incomes for tax authorities is 0, and the total incomes for multinational companies is 0.

Income Matrix of Tax Authorities and Multinational Companies are shown in Table 3.

Table 3: Income Matrix of Tax Authorities and Multinational Companies

Player		***Multinational companies***	
		$\boldsymbol{y}$	$\boldsymbol{1-y}$
Tax Authorities	$\boldsymbol{x}$	$(b-a+c,-b-c)$	$(-a,0)$
	$\boldsymbol{1-x}$	$(-c,c)$	(0,0)

After obtaining the income matrix, according to the income matrix of tax authorities and multinational companies in Table 3, through pairwise combination, four kinds of strategic expected income are generated:

① When tax authorities do the RI strategy, the multinational companies' expected income from TPTA $w_1 = (b+c)y - a$;

② When tax authorities don't do the RI strategy, the multinational companies' expected income from TPTA $w_2 = -cy$;

③ When multinational companies conduct the TPTA strategy, the tax authorities' expected income from RI $w_3 = bxy - ax - cy + 2xy$;

④ When multinational companies don't conduct the TPTA strategy, the tax authorities' expected income from RI $w_4 = 0$.

The weighted average income of tax authorities $W_1 = bxy - ax - cy + 2cxy$; The weighted average income of multinational companies $W_2 = -bxy + cy - 2cxy$.

2.2 Replicated dynamic equation

Replicated dynamic equation should be used to reflect the speeds and directions of the learning evolution of tax authorities and multinational companies.

Replicated dynamic equation about proportion x of tax authorities doing RI as shown in (1):

$$f_{(x,y)_1} = dx/dt = x(w_1 - W_1) = x(1-x)[(b+2c)y - a] \quad (1)$$

Replicated dynamic equation about proportion y of multinational companies conducting TPTA as shown in (2):

$$f_{(x,y)_2} = dy/dt = y(w_3 - W_3) = y(1-y)[c - x(b+2c)] \quad (2)$$

When $f_{(x,y)_1}$ and $f_{(x,y)_2}$ is 0, game players won't learn any more, they'll reach a relatively table equilibrium state and contributes to five equilibrium points which can be obtained as below:

$$B_1 = (0,0), B_2 = (0,1), B_3 = (1,0), B_4 = (1,1), B_5 = (c/(b+2c), a/(b+2c))$$

2.3 Stability analysis of the equilibrium

According to Friedman (1998), only if the equilibrium point is the point obtained by the replicated dynamic equations. To figure out the stability of the five equilibrium points, we calculate the Jacobian matrix J as shown in (3).

$$J = \begin{bmatrix} \frac{\partial 1}{\partial x} & \frac{\partial 1}{\partial y} \\ \frac{\partial 2}{\partial x} & \frac{\partial 2}{\partial y} \end{bmatrix} = \begin{bmatrix} h_1 & h_2 \\ h_3 & h_4 \end{bmatrix} = \begin{bmatrix} (1-2x)[(b+2c)y - a] & x(1-x)(b+2c) \\ -y(1-y)(2b+c) & (1-2y)[c - x(b+2c)] \end{bmatrix} \quad (3)$$

When $\det(J) = h_1h_4 - h_2h_3 > 0, tr(J) = h_1 + h_4 < 0$, there will be evolutionarily stable strategy point(ESS) which will contribute to a long-term stable relationship between multinational companies and tax authorities. The detailed for $\det(J)$ and $tr(J)$ as shown in (4) and (5).

$$det(J) = (1-2x)[(b+2c)y - a](1-2y)[c - x(b+2c)] + y(1-y)(2b+c)x(1-x)(b+2c)$$
$$tr(J) = (1-2x)[(b+2c)y - a] + (1-2y)[c - x(b+2c)]$$

Substitute B_1 to B_5 into $\det(J)$ and $tr(J)$, the results as shown in table 4.

Table 4: Results of $\det(J)$ and $tr(J)$

Equilibrium Points	$det(J)$	*Result*	$tr(J)$	*Result*
$B1 = (0,0)$	$-ac$	<0	$c - a$	uncertain
$B2 = (0,1)$	$c[a - (b + 2c)]$	uncertain	$b - (a + c)$	uncertain
$B3 = (1,0)$	$-a(b + c)$	<0	$a - (b + c)$	uncertain
$B4 = (1,1)$	$(b + c)[a - (b + 2c)]$	uncertain	$a - c$	uncertain

We can find that the cost of RI by tax authorities has a great influence on TPTA, and the environmental constraints which constructed by the evolutionary game model need to be supported by tax authorities' fines and income from TPTA. Therefore, there are two possible scenarios for the tripartite evolutionary game model.

Scenario 1: Compare a and b or c individually. When $c > a, c < a, b > a$ *or* $b < a$ within a certain fluctuation range, the probability of RI by tax authorities and the probability of companies conducting TPTA are repeated. Multinational companies will decrease the rate of TPTA under the increasing rate of RI. With the decreasing rate of TPTA, tax authorities will decrease the rate of RI subsequently to save costs. After discovering the decreasing rate of TPTA, multinational companies will increase the rate of TPTA subsequently to obtain more profits. However, the illegal behaviors will be discovered soon and tax authorities will restart to increase the rate of RI subsequently. Through this continuous repetition, a large number of saddle points(SP) and unstable points(UP) will be generated, but no ESS. The detailed as shown in Table 5. We assign values to verify the conclusion. Set the initial point(0.5,0.5), and use the MATLAB to do the simulation analysis to get fig.1 and fig 2, which can find that tax authorities and multinational companies will play repeated games but they fail to reach the balance of the game.

Table 5: Results of Strategic combination

Point	$c > a$			$c < a$			$b > a$			$b < a$		
	Det	*Tr*	*Result*	*Det*	*Tr*	*Result*	*Det*	*Tr*	*Result*	*Det*	*Tr*	*Result*
$B_1 = (0,0)$	<0	>0	UP	<0	<0	SP	<0	Uncertain	SP	<0	Uncertain	SP
$B_2 = (0,1)$	<0	>0	UP	Uncertain	Uncertain	UP	<0	>0	UP	Uncertain	Uncertain	UP
$B_3 = (1,0)$	<0	<0	SP	<0	Uncertain	SP	<0	<0	SP	<0	Uncertain	SP
$B_4 = (1,1)$	<0	<0	SP	Uncertain	>0	SP	<0	Uncertain	SP	Uncertain	Uncertain	UP

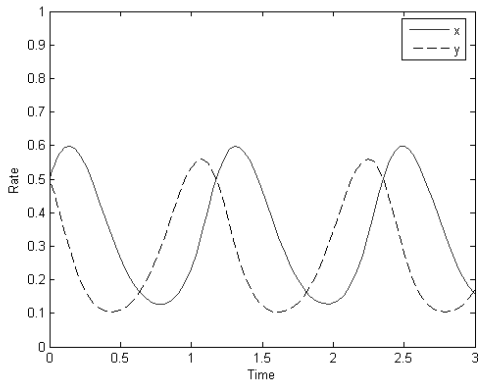

Fig.1 evolutionary process of $c > a$ and $b > a$

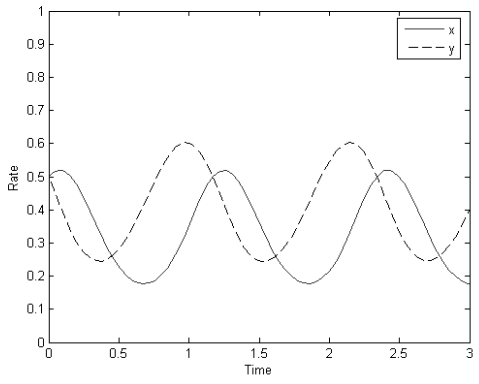

Fig.2 evolutionary process of $c < a$ and $b < a$

Scenario 2: Compare a with b and c. When $b + 2c < a$, $B_2 = (0,1)$(No RI, TPTA) is the ESS. When the costs of RI is more than twice the sum of the income from TPTA plus the fines, the probability of RI by tax authorities will decrease to zero year by year, while the probability of RI by multinational companies will increase year by year, eventually reaching 100%, ESS appears. And then use the MATLAB to do the simulation analysis to get fig.3 and fig 4. When $b + 2c > a$, no ESS; but $b + 2c < a$, both sides will achieve balance eventually after several years of game fluctuations by setting the initial point from (0.1,0.1) to (0.9,0.9).

Table 6: Results of Strategic combination

Point	$b+2c>a$			$b+2c<a$		
	Det	*Tr*	*Result*	*Det*	*Tr*	*Result*
$B1=(0,0)$	<0	Uncertain	SP	<0	<0	SP
$B2=(0,1)$	<0	Uncertain	SP	>0	<0	ESS
$B3=(1,0)$	<0	Uncertain	SP	<0	>0	UP
$B4=(1,1)$	<0	Uncertain	SP	>0	>0	UP

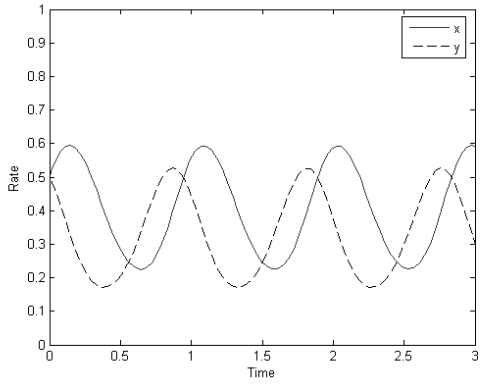

Fig.3 evolutionary process of $b+2c>a$

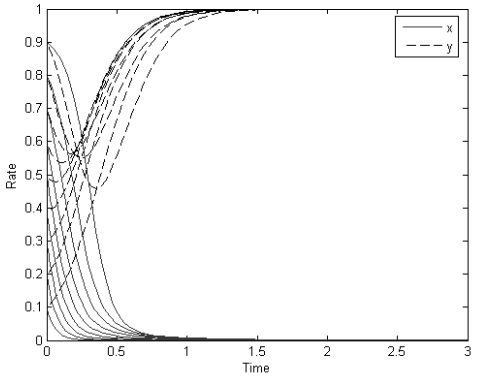

Fig.4 evolutionary process of $b+2c<a$

Companies and tax authorities will are generally in a state of repeated games according to the stability analysis and the numerical simulation results. However, when tax authorities have to invest a lot of money which is greater than the fines plus twice the scale of TPTA to obtain corporate information due to the concealment of information, the probability x of RI will gradually decrease to zero, which means no more RI for anti-tax avoidance activities. Tax authorities need to use a variety of methods and channels to complete RI at a high cost. Therefore, tax authorities will gradually reduce this "laborious" matter, and the frequency of RI on transfer pricing will decrease, which results in the higher probability y(even to one) of TPTA. It means multinational companies will have been using transfer pricing to avoid tax duties.

Regarding to the only evolutionary game balance point described above, firstly, excessive RI costs are the direct cause of the appearances of ESS, and the strictness and implementation of policies will directly affect the frequency and cost of RI. The faster the economic development, the more likely it is to increase the cost of RI because the economic development cannot match with the system update temporarily. Therefore, how to keep the balance between system and development is a matter worth considering. Secondly, transfer pricing is a neutral term. Multinational companies are more or less able to conduct transfer pricing, but how to control the "degree" of transfer pricing is closely related to the company's awareness of law-abiding and the country's policies. Finally, when the public's awareness of law-abiding is weak and begins to test the edge of the law, multinational companies try to get profit from improper transfer pricing. Due to the uniqueness of most of the commodities traded by the affiliates of multinational companies and the concealment of transaction information, there is no sufficient information. Therefore, it's difficult for tax authorities to compare and supervise these illegal behaviors which results in the inefficiency of tax authorities' supervision. whether the "degree" of transfer pricing or the awareness of law-abiding is inseparable from the regulatory policies of the tax authorities and the transfer pricing system. The issuance of policies and regulations is to allow work to be carried out in an orderly manner, which can ensure overall work efficiency. All in all, it's essential to improve the efficiency of tax authorities' abilities to access to companies' information.

III. ADVICE

In order to improve the efficiency of information obtained by tax authorities, reduce the negative impact of transfer pricing and cultivate multinational companies' awe of the host country's legal system and the good habit of paying taxes according to law, at the same time, reduce the cost of RI of tax authorities, in view of the current situations, combined with the results of evolutionary game, relevant regulatory policies and institutional background, we have the following suggestions:

(1)Improve country's international taxation legislation and standards[9], and refine the scope of transfer pricing standards by industry. Since the 18th National Congress of the Communist Party of China, Secretary General Xi Jinping has made important speeches on international taxation work many times. From the clear creation of an upgraded version of international taxation in the new era in 2013, to the six major international

tax standards proposed in 2014, and the establishment of the Shanghai International Tax Service Center in 2016, during this development process, China's transfer pricing tax system has gradually taken shape. In the process of related business, multinational companies can register the annual related business transaction report form, and refer to the "Special Tax Investigation Adjustment and Mutual Agreement Procedure Management Measures". However, the scope of my country's transfer pricing standards is only classified according to the nature of the transaction, not matching the industry, which may reduce the efficiency of the docking work. Therefore, it's possible to refine the scope of transfer pricing standards by industry, and then summarize the practical feedback of each industry to arrive at a universal standard for the industry. Different types of companies have different transfer pricing procedures and arrangements. For example, for the pharmaceutical industry that involves too many intangible assets and requires the profit split method to determine the value of intangible assets, you can have a special transfer pricing procedure and tax personnel for efficient docking; while the physical industry with an active market for goods can slightly simplify the corresponding transfer pricing Registration procedure. In this way, the work efficiency of the tax authorities will be improved from the perspective of legislation, and the China's international taxation content of transfer pricing will be enriched.

(2)Maintain close tax communication with countries around the world to fully grasp companies commodities transactions information[10]. In terms of international tax information communication, China signed a multilateral tax collection and management mutual assistance treaty in August 2013, signed a multilateral agreement on the automatic exchange of tax-related information on financial accounts in December 2015, and signed a tax treaty implementation in June 2017. What's more, China has officially signed 107 double taxation agreements to prevent tax base erosion and profit transfer multilateral conventions in December 2018. Regarding international taxation, whether in the past or future, China has always been adhering to an open and cooperative mentality, and fully communicated with countries around the world. However, with the advancement of the national "One Belt One Road" and other internationalization strategies, differences in taxation systems and tax collection and administration among countries, taxation legalization and transparency especially in some developing countries such as Myanmar and Cambodia which don't have clear provisions on international tax anti-avoidance clauses and will provide some multinational companies with a "hotbed" for TPTA. Therefore, fully understand the tax systems of other countries through on-site inspections, and establish tax cooperation agencies between countries to coordinate taxation work of all parties are suitable methods to deal with such differences.

(3)Follow the development of the times and grasp the taxation framework construction in the digital economy era. The development of science and technology has brought opportunities and challenges to traditional international taxation. As a member of the G20, China has successively proposed more than 1,000 position statements, opinions and suggestions such as "modification of tax rules for the digital economy" and "taxation of profits in places where economic activities occur and value creation", which incorporate concepts with characteristics of developing countries into the BEPS. In this digital economy era, production and operation are becoming diversified, and many transactions such as marketing intangible assets cannot be qualitative through the principle of independent transactions. Therefore, we can deeply explore and construct a tax management framework for the new era of digitalization on the basis of improving the traditional international tax collection rules. Digital economic profits without entity attribution can be quantified and measured by indicators such as customer participation distribute profits and divided by profit split method. Seize the opportunities and beware of new TPTA.

(4)Build professional international tax analysis teams to face the ever-changing international environment. The State Administration of Taxation of the People's Republic of China began an international talent training strategy: establishing a talent training working group and long-term and effective cooperation mechanisms with foreign universities, OECD and other institutions in October 2017. In 2019, the tax authorities have set up "Belt and Road" tax colleges in Beijing and Yangzhou to meet the challenges brought from "One Belt One Road". Since tax authorities and multinational companies will be in a state of repeated games in terms of TPTA, only the professional ability of tax personnel can be guaranteed to deal with various situations encountered in international taxation. What's more, tax authorities need to pay attention to the performance appraisals of talent training and beware of the phenomenon of "talking on paper".

REFERENCE

[1]. Borkowski S., Organizational and international factors affecting multinational transfer pricing[J]. Advances in International Accounting, 1992, 5:173-192.
[2]. Bernard, Andrew B., Jensen, J. Bradford, and Schott, Peter K. "Transfer Pricing by U.S.-Based Multinational Firms." Social Science Electronic Publishing (2006).
[3]. Anca, et al. "Transfer Pricing by Multinational Firms: New Evidence from Foreign Firm Ownerships." American Economic Journal: Economic Policy (2016).
[4]. Fan Yong and Hou Jingyu. Research on Anti-Tax Avoidance of Intangible Assets Cross-border Trade[J]. Taxation Research,2017(01):66-70.
[5]. Mao Xiaofei. The Dilemma of Competition Law Regulating Transnational Tax Avoidance and Its Solution: Enlightenment from EU

Anti-Tax Avoidance Action[J].Jiangxi Social Sciences,2017,37(11):196-203.
[6]. Marques, Mário, and Carlos Pinho. "Is transfer pricing strictness deterring profit shifting within multinationals? Empirical evidence from Europe." Accounting and Business Research 46.7 (2016): 703-730.
[7]. Rossing, Christian Plesner, Martine Cools, and Carsten Rohde. "International transfer pricing in multinational enterprises." Journal of Accounting Education 39 (2017): 55-67.
[8]. Ou Yangying,Zhou Xingyao.Evolutionary Game Analysis of Enterprise Taxation Behavior Based on "Whistleblower"[J].Taxation Research,2019(03):86-90.
[9]. Xu, Jiayang, et al. "Evolutionary game on government regulation and green supply chain decision-making." Energies 13.3 (2020): 620.
[10]. Chen Zhenlin,Wang Wenju. The Evolutionary Game Analysis of Government and Polluting Enterprises under Environmental Tax System[J]. Management Review,2017,29(05):226-236.

Xiao Jian, "Evolutionary Game Analysis of Transfer Pricing: Based On the Perspective of Multinational Companies and Tax Authorities." *International Journal of Business and Management Invention (IJBMI)*, vol. 10(04), 2021, pp. 01-07. Journal DOI- 10.35629/8028