







# “Personal income tax management in Ukraine on the game theory basis”

AUTHORS	Olena Tymchenko Yuliia Sybirianska  <a href="https://orcid.org/0000-0003-4075-3560">https://orcid.org/0000-0003-4075-3560</a>  <a href="http://www.researcherid.com/rid/I-9157-2018">http://www.researcherid.com/rid/I-9157-2018</a> Yevheniia Polishchuk  <a href="https://orcid.org/0000-0002-6133-910X">https://orcid.org/0000-0002-6133-910X</a>  <a href="http://www.researcherid.com/rid/J-5444-2018">http://www.researcherid.com/rid/J-5444-2018</a> Nataliia Rudyk  <a href="https://orcid.org/0000-0002-4367-0392">https://orcid.org/0000-0002-4367-0392</a> Volodymyr Korotun
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Olena Tymchenko (Ukraine), Yuliia Sybirianska (Ukraine), Yevheniia Polishchuk (Ukraine), Nataliia Rudyk (Ukraine), Volodymyr Korotun (Ukraine)

## Personal income tax management in Ukraine on the game theory basis

### Abstract

One of the main problems of the fiscal decentralization in Ukraine is the substantiation of the optimal proportion of the personal income tax distribution among the state and different types of local budgets in order to insure the sufficient financial resources for the territorial communities. Since period of the Budget Code adoption, the percentage of the personal income tax paid from salaries to the different levels of budgets has changed three times. However, the methodic of such distribution is not clear. The authors suggest approach of analyzing the logic of the personal income tax distribution on the game theory basis. They consider different ways of making decisions and prove that in all of the analyzed cases the winner was the central government of Ukraine. Such behavior of the central government in making decisions does not meet the goals of the fiscal decentralization reform. The main reason of such situation is that the decisions are made by the state government, but not by the local communities or their representatives. Besides, it is difficult to distribute the expenditures among different types of budgets according to the Governments' competences. The authors suggest some recommendation of the personal income tax distribution in order to ensure benefits for all participants of the game: communities, local governments and central government. But they conclude that the active influence of people on the behavior of the local governments is the basic premise for the scientific research of the PIT optimal distribution.

**Keywords:** fiscal decentralization, personal income tax, game theory, local budgets resources, tax management.

**JEL Classification:** G4, C70, H30, H24.

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### Introduction

The local government reform in Ukraine presupposes the gradual increase of the local authorities' competences. In this case, it is necessary to solve the issues of the financial resources redistribution among the central and local budgets. One of the main resources of the local budgets is a personal income tax, especially paid from salaries (PAYE). Moreover, the sum of the basic and reverse dotation to the local budgets depends on the sum of PIT paid during the previous year. The other significant resources for the local budgets are local taxes (especially land tax and single tax) and excise tax. But in this article, the attention is paid to the PIT and its distribution among the budgets.

In 2001, when the Budget Code of Ukraine was adopted, the local budgets received 100% of PIT from salaries, but at the same time there were different percentage of PIT distribution among different levels of local budgets. The percent of PIT distribution depended on the level of local authority: region, district, city or village. This mechanism was described in the Budget Code (2010). In 2010, according to the Budget Code amendments, 50% of PIT paid to the budget of Kyiv was withdrawn to the State Budget of Ukraine. All the other local budgets continue to receive 100% of the PIT, paid on their territory.

But in 2015, when the fiscal decentralization reform was started, new adjustments to the Budget Code of Ukraine concerning proportion of PIT distribution among local and state budgets took place. According to them, the share of PIT from salaries concentrated in the state budget increased again that was not corresponded with the goals of the fiscal decentralization (Table 1). Logically, if the local authorities' competences increase, financial resources should meet them and also grow. But in fact the tendencies in Ukraine are vice versa.

In official sources, there is not any information in what way the percentages of PIT distribution among the local and state budgets represented in Table 1 were determined.

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Olena Tymchenko, Doctor of Economic Sciences, Professor, Professor of the department of Finance, Kyiv National Economic University named after Vadym Hetman, Ukraine.

Yuliia Sybirianska, Candidate of Economic Sciences, Associate Professor, Associate Professor of the department of Finance, Kyiv National Economic University named after Vadym Hetman, Ukraine.

Yevheniia Polishchuk, Doctor of Economic Sciences, Associate Professor, Professor of the Investment Activity department, Kyiv National Economic University named after Vadym Hetman, Ukraine.

Nataliia Rudyk, Candidate of Economic Sciences, Associate Professor of the department of finance, Kyiv National Economic University named after Vadym Hetman, Ukraine.

Volodymyr Korotun, Candidate of Economic Sciences, Senior Research Fellow, First Deputy Director of the Research Institute of Fiscal Policy, University of State Fiscal Service of Ukraine, Ukraine.

Table 1. Changes in the percentage of PIT distribution among the state and local budgets

1) Coefficients of PIT distribution between the state budget and budget of Kyiv					
Years	Budget of Kyiv	State budget			
2001-2010	100%	0%			
2011-2014	50%	50%			
Since 2015	40%	60%			
2) Coefficients of PIT distribution among budgets of cities of regional significance, regional budgets and state budget					
Years	Budgets of cities of regional significance	Regional budget	State budget		
2001-2010	75%	25%	0%		
2011-2014	75%	25%	0%		
Since 2015	60%	15%	25%		
3) Coefficients of PIT distribution among the local self-government budgets, district, regional and state budgets					
Types of local self-government budgets	Years	Budgets of villages, cities with district status	District budget	Regional budget	State budget
Budgets of villages, cities with district status	2001-2010	25%	50%	25%	0%
	2011-2014	25%	50%	25%	0%
Budgets of villages, cities with district status that are not amalgamated	2015	0%	60%	15%	25%
Budgets of amalgamated communities		60%	0%		

Source: Own results, designed and systematized by authors.

Moreover, the real effects of such reforming are not clear and hardly were estimated by the government authorities.

We can also observe the decline of PIT fiscal role in the tax revenues of the local budgets, especially till 2017 (Table 2).

Table 2. The PIT share in the local budget revenues, %

Years	The PIT share in	
	Tax revenues	Total budget revenues (without official transfers)
2011	73,97	62,54
2012	71,13	60,60
2013	70,82	61,41
2014	71,63	61,88
2015	55,92	45,59
2016	53,76	46,25
2017	55,05	48,22

Source: Calculated by authors on the basis of the State Treasury Service of Ukraine data.

Table 2 shows significant falling of the PIT share in the local budgets revenues right after the fiscal decentralization reform beginning. In 2017, slight increase of the PIT fiscal role in the local budgets was caused by huge increase of minimal salary that have to be paid to employees, but not because of economic reasons.

Therefore, the main goal of our article is to find out the possibility of determining the optimal proportions of PIT distribution among the state and different types of local budgets on the theory game base. We have chosen such methodology because it makes it possible to find the best decision comparing different strategies.

## 1. Literature review

The evolutionary game theory has become of increased interest to social psychologists, sociologists, philosophers and anthropologists – and social scientists in general – as well as economists interested in economic development, and others. In

contrast to the evolutionary game theory presented in biology, the economic game theory leaves its players with choices. In this context, “evolution” is often perceived as cultural evolution refers to changes in beliefs and norms. Among mentioned, a role of a keystone plays biological interpretation of the evolutionary game theory: Hamilton and Trivers (1985) used game theoretical ideas in biology; Smith (1982) and McNamara et al. (2010) introduced game theory to evolutionary biology and population thinking and stated the concept of an evolutionarily stable strategy (ESS) which means finding the balance as the opposite to collapse. The field of evolutionary game theory also was founded by the work of Taylor (1996), Sigmund (2017) and other scientists.

As Diamond (1983) said, in economics the game theory was established by Neuman and Morgenstern and by the late 1960s, it had become

the standard tool to analyze strategic interaction in economics. They built a mathematical basis, for example, for using quantitative models of competition and cooperation between the decision makers, to study human behavior in strategic and economic decisions. Then, Diamond (1984) continued that John Nash created a simple, but important concept in game theory, which is now called Nash equilibrium. John Nash shows that the classical approach to Adam Smith's competition, when everyone is for himself, is not optimal. Strategies are more optimal when everyone tries to do better for themselves, doing better for others. In biology, it is common to single out such models of the organisms' cooperative behavior as symbiosis, competition, and parasitism. And it is simply a way to make a conclusion that wide range of possible situations generates different strategies of interplay among economic units. Today we use the language of game theory to investigate who will win and who will collapse, for example, from not optimal or unsubstantiated the distribution among central and local budgets in Ukraine.

Economists distinguish between two approaches of game theory: non cooperative and cooperative game. The first one take place when the players are not able to make binding agreements about what to do, so they must guess what others will do. Cooperative game theory is a complementary branch of the game theory, which deals with how players divide the spoils after they have made binding agreements. Simply put, we make assumptions about the agents (taxpayers, central and local budget authorities) involved in this game and then we try to figure out what happens when each of them acts to maximize their own expected goals. The agents have to realize that their actions affect each other. And according to the preliminary context, agents may play this game cooperatively (they can work together, coordinating their activities) or non-cooperatively (each agent selfishly maximizes own goals, ignoring any agreements). There is a specific branch of behavioral economics called behavioral game theory that is a part of the evolutionary game theory. It is an approach to economics (Camerer, Loewenstein, Prelec, 2005), which uses psychological regularity to suggest ways to weaken rationality assumptions and extend theory.

The game theory has refined many aspects of economics and finance. Shepsle (political scientist, Harvard University), as well as Professor Diermeier (cited by Kumacheva, 2010; and Shapiro, 2011), reckons state budget negotiations as an example of game theory, regarding a voting process as a

complicated game that follows a logical, analyzable path. Winner of the Nobel Prize in Economics in 1996, William Vickrey investigated the application of the theory for tolls during periods of peak load. The game theory is the most disseminated in corporate finance. The researches by Baker (Harvard Business School) and Wurgler (New York University) are devoted to the reasoning of CFOs' decision to issue shares when a company is overvalued (cited by Martin & Lorek, (017). Bhattacharya's (1979) model of dividends proposed a evolutionary solution to "the dividend puzzle": the system of reasons that causes managerial decision of paying dividends rather than sharing repurchases on the basis of game theory. Game theory methods were also applied to the problems of deadweight costs and smoothing dividends by Miller. and Rock (1985), John and Williams (1985).

Another area that has been significantly changed by the game theoretic models is intermediation. A common case of using game theory in banking concerns with providing insurance to depositors against liquidity shocks. Among others, Diamond, Dybvig (1983) simulated behavior of customers dealing with an issue of choosing liquidity at an intermediate date or at the final date. Another important aspect of banking influenced by game theory is the selection model in which rationing credit is optimal. The paper of Diamond (1984) considers a model of delegated monitoring where banks have an incentive to monitor borrowers because otherwise they will be unable to pay off depositors.

The game theoretical model of interaction between taxpayers and tax authority is quiet popular, especially in the context of tax compliance. It is applied in tax management with classification of behavior of economic agents on a micro (individuals and enterprises) and macro level (the state represented by financial and tax authorities). Vylkovas' (2017) theoretical game model is proposed to discuss how corruption affects environmental policies and taxpayers. Cerquetti and Copier (2016) and Amato and et.al. (2015) convinced that a result of the theoretical game model is the trade-off between different sources of incentives to control corruption, including the ethical sense of the taxpayers. Smales and Thul (2016) determined how the propensity to act illegally is influenced by potential profits rated to penalties, and what level of effort or resources a market supervisor should put into detecting and prosecuting insider traders. Furthermore, the variations of the game theory model, called "principal-to-agent", are often used in the researches

of the tax control. For instance, Kumacheva (2010) inquiries into the question of different cases of the profit functions of players. These functions depend on taxes and penalties that have four cases of the solutions. Each of them searches optimal players' strategies (in order to maximize their income) and the Nash equilibrium. Abraham and Lorek (2017) have developed hypothesis that the positive effect of a stricter compliance norm on tax compliance is larger under collusive tax evasion than under independent tax evasion. Their model shows that the tax compliance norm has a stronger negative effect on the magnitude of collusive tax evasion in comparison with its effect on independent tax evasion.

The list can be enlarged by the very recent articles but even if the theory of games is introduced (apparently) in the practice of tax management of some taxes, the issue of the distribution of personal income tax is a new function for game theory. In this paper, we are the first who look for how interaction between taxpayers and public authorities try to maximize their interest in order to determine the best solution of a source of financing for local budgets through the personal income tax redistribution. The same determines the possible level of independence of local budgets and the effectiveness of the decentralization reform. This research focuses on the above-mentioned experience and fundamental basis.

## 2. Application of game theory to the PIT distribution optimization

In order to apply the game theory to optimize the PIT distribution in Ukraine, we should firstly characterize the subjects of PIT distribution as the participants of the supposed game. The participants are: individual taxpayers, territorial communities, local governments and central government. On the one hand, individual taxpayers as the participants of the game should act according to the tax legislation and pay taxes from their salary or income. On the other hand, individual being a member of certain territorial community (or amalgamated community) receives some kinds of public good and services. At the same time, neither individuals nor territorial communities make decision how much to pay as taxes to the budget and what benefits or public good to receive. Such decision is made even not by local authorities, but by the central government authorities. In this case, the central government decisions may not satisfy the real needs and interests of the territorial communities.

Secondly, we should explain the meaning of gains that could be received in the result of the imaginary

game. Rather often subjects of economic relations focus mostly on the financial aspects, i.e. increase of income means to have a benefit. We suppose that financial benefit should be considered in relation with the results of social and economic development of territorial community, as well as individuals.

Thirdly, we should define possible variants of decisions concerning PIT distribution in relation with mentioned above gains.

There are several types of central government decisions that could have different effects:

Variant 1. All amount of the paid PIT remains in the local budgets and it results in increasing of the received public benefits by individuals-members of community.

Variant 2. All amount of the paid PIT remains in the local budgets, but doesn't result in increasing of the received public benefits by individuals-members of community.

Variant 3. PIT is distributing among the local and state budgets that results both in increasing of budget revenues and benefits received by territorial communities.

Variant 4. PIT is distributing among the local and state budgets that results in increasing of budget revenues, but doesn't change the received public benefits by individuals-members of community.

Variant 5. PIT is distributing among the local and state budgets that results in declining of budget revenues, but the received public benefits by individuals-members of community increase.

Variant 6. PIT is distributing among the local and state budgets and it results in declining both the budget revenues and the benefits received by territorial communities.

Variant 7. All amount of the paid PIT is accumulating in the state budget and it results in reduction of local budgets revenues, but public benefits received by individuals-members of community increase.

Variant 8. All amount of the paid PIT is accumulating in the state budget that results in reduction both local budgets revenues and public benefits received by individuals-members of community.

There should be mentioned, that the final goal could be received only if benefits received by individuals-members of the community increase. The latter could be achieved in the result of applying several of mentioned above variants of PIT distribution (variants 1, 3, 5, 7). Of course, in a short-term period,

increasing of budget revenues could be considered as a positive effect, but in a long run the central and local governments could lose at the next elections because they will not be supported by individuals who are not satisfied with the government policy. In this case the local authorities will suffer because of the results of the central government wrong

decisions concerning PIT distribution. So the question rises about the necessity of the local government participation in making decision on PIT distribution.

Now we should determine the variant, which is currently applied in Ukraine. For this purpose the official data for years 2010-2017 should be analyzed (Table 3).

Table 3. Dynamics of the PIT distribution among the budgets in 2010-2017, in bln UAH and %

Year	Consolidated budget	State budget	Local budgets					
			Total	including				
				Regional budgets, Crimea budget, budgets of Kyiv and Sevastopol	Budgets of cities of regional and republic significance	District budgets	Budgets of villages, cities with rayon status	Amalgamated communities
PIT distribution among the budgets, in bln UAH								
2010	51,0	0,0	51,0	18,3	23,6	5,9	3,2	0,0
2011	60,2	6,2	54,1	18,6	24,9	6,9	3,7	0,0
2012	68,1	7,0	61,1	24,3	24,5	7,9	4,3	0,0
2013	72,2	7,6	64,6	25,9	25,7	8,4	4,5	0,0
2014	75,2	12,6	62,6	24,9	24,4	8,7	4,6	0,0
2015	100,0	45,1	54,9	17,4	24,6	12,9	0,0	0,0
2016	138,8	59,8	79,0	24,9	34,3	18,0	0,0	1,7
2017	185,6	75,0	110,6	n/a	n/a	n/a	n/a	n/a
PIT distribution among the budgets, in % to a total sum of consolidated budget								
2010	100%	0%	100%	35.9%	46.2%	11.6%	6.3%	0%
2011	100%	10%	90%	30.9%	41.3%	11.4%	6.2%	0%
2012	100%	10%	90%	35.7%	36.0%	11.6%	6.3%	0%
2013	100%	10%	90%	35.9%	35.7%	11.7%	6.3%	0%
2014	100%	17%	83%	33.1%	32.4%	11.6%	6.1%	0%
2015	100%	45%	55%	17.4%	24.6%	12.9%	0.0%	0%
2016	100%	43%	57%	17.9%	24.7%	13.0%	0.0%	1.3%
2017	100%	40%	60%	n/a	n/a	n/a	n/a	n/a
Remark. Since 2014, data are without Crimea and temporary occupied territories of the West of Ukraine								

Source: Calculated by authors on the basis of the State Treasury Service of Ukraine data.

Since 2014, data include military fee and some other typed of taxes of physical persons that are paid only to the state budget. All these taxes create tax burden on people, so it is important to understand where these taxes are paid.

From data in Table 3, we can see the dynamics of gradual increase of PIT, which is centralized in the state budget, especially after the reform of decentralization started (since 2014). The sum of PIT, received by local budgets in Ukraine in nominal values during last 8 years is doubled, but we should take into the consideration the influence of different factors on these data, at least inflation. The index of consumption prices increased at 2.4 times during the same period of time. So, real PIT revenues of the local budgets (in prices of 2010) were only 46 bln UAH, which is less than in 2010.

The other problem is unequal distribution of PIT even between different types of local budgets. From Table 3, we can see that the highest share of the PIT received by the regional budgets is

concentrated in regional budgets, budgets of regional significance cities and Kyiv – 75% of PIT received by the local budgets in 2016. So, near 30 thousand of villages and cities with district status received less than 5 bln UAH of PIT in 2010-2014, and in 2015-2017 – any. This tendency is stable during the all period taken into the analysis. We will not discuss the reasons of such situation in this article, because they are obvious. But if we are talking about the amalgamated communities financial capacity, such distribution does not have positive effect on it. So, the amalgamated communities in Ukraine continue to be dependable from the higher-level authorities.

So, in Ukraine we can talk about variants 4 (if we take the nominal values) or 6 (if we take the real values, adjusted on the influence of inflation) of the Government decision about PIT distribution between the budgets. But, when official data show that in all regions of Ukraine since 2011 till 2016, the number of medical beds has declined by

almost 25%, the number of secondary schools decreased by 17%, the average wage in education, health care and social security has been growing at a much slower pace than in Ukraine as a whole, the domestic migration (to the territories with higher salaries and possibilities to be employed) and the emigration from Ukraine increased we can conclude, that the benefits received by territorial communities decline. So, unfortunately, in Ukraine, we have the 6th variant of central government decisions concerning PIT distribution.

### 3. Results

Here the interpretation of the results obtained during the research is made. A comparison is made with the results obtained by other researchers. To substantiate our recommendations the following issues should be considered.

First, we should explain why it is reasonable to distribute the PIT between the state and local budgets in Ukraine. In other words, we should answer the question why the Government decided to centralize the part of PIT. The main reason is the labor migration. The people apply for a job in the big cities and pay PIT from their salaries into the treasury of these cities, but their families continue live in the villages or communities on permanent address and receive public goods and services funding from the budgets of these communities. So, the PIT is not equally distributed among the territories of Ukraine and the Government has to centralize and redistribute part of it for equalizing expenditures on educational, medical, cultural, housing services. We can conclude that the Government decision on centralizing some share of PIT was the result of the amalgamated communities inhabitants' migration behavior.

Second, we consider that for the amalgamated communities inhabitants do not matter from which budget (state or local) the public goods and services are funded if such services and goods satisfy their needs. But if the quality of the public goods and services does not satisfy the amalgamated communities inhabitants the question rises in what way they can change it. Of course, the easiest way is to influence on local government's behavior communicating with it and requiring new decisions. But the standards of most public goods and services are established by the central government in Ukraine and the local government can do nothing to change them. They must provide these standards for people. Moreover these standards have to be provided by the inhabitants of the amalgamated communities

for low salary. The salary rate is established by the central Government and cannot be changed by local government. What is the result of such behavior of the Ukrainian Government? The teachers and medical staff are not motivated to work, applying innovative methods and technologies. Most of them leave their territorial communities and apply for a job in other places. In addition, such behavior of the central government influence on the behavior of the territorial communities' inhabitants discouraging their activeness as citizens. They lose hope that it is really possible to change something and are getting uninitiated.

So, in our game the inhabitants of the amalgamated communities are very passive players. The central and local governments are interested in such passiveness, because they can use budget resources for their enrichment. For example, the local governments can make their own decisions on using of financial resources for reconstructions, renovations of infrastructure objects. It is very convenient way to embezzle the taxpayers' money that in essence is ownership of the amalgamated communities.

We consider that in case of the amalgamated communities inhabitants' passiveness is not reasonable to optimize the proportions of the PIT distribution among the state and local budgets. It will not have resulting in improving the public goods and services. If the central government centralizes more part of the PIT, it will give more money to the local authorities as subventions. If less, the amount of the subventions will be reduced.

For scientific substantiation of the PIT distribution the necessary conditions should be provided:

- ◆ the local authorities have to rethink their mission. They should serve to the amalgamated communities inhabitants and realize that the budget resources are the ownership of the hromada and the local authorities receive the right to manage, but not possess them;
- ◆ the amalgamated communities inhabitants should be more active and require transparency of budget income and expenditures, as well as coordination of decisions with inhabitants of the amalgamated communities;
- ◆ to encourage the activeness of the amalgamated communities inhabitants more competences

- ◆ should be given for the local authorities. They should have rights to pay more in addition to salary rates established by the central government. In this case the PIT that should be paid to the local budgets will be of higher importance for the local governments.

We suggest that:

- ◆ the planned amount of the PIT should be distributed among the state and local budgets according to the currently established proportions, but if the amalgamated communities actually receives the amount of PIT that exceeds its planned amount (in case the planned amount is not less than in the previous year) such extra amount of PIT should be left in the territorial communities' budget;
- ◆ the PIT from the newly created working place salary also should be fully paid to the amalgamated communities budget. The information about allocation of over planned amount of the PIT must be transparent and be

known for amalgamated communities inhabitants. In this case the local governments will be interested in creating new jobs and legalizing salaries.

## Conclusion

Beginning our research we wanted to substantiate the optimal proportions of PIT distribution among the state and local budgets. Based on the game theory and modelling the participants' behavior we tried to realize the correlation between the central and local governments' decisions and the reactions of amalgamated communities' inhabitants in the context of the PIT distributions. As a result, we concluded that in conditions of the amalgamated communities inhabitants' passiveness, it is not reasonable to do this. The active influence of people on the behavior of the local governments is the basic premise for the scientific research of the PIT optimal distribution. To realize the suggested recommendations the order of the horizontal equalization should be changed. It will be the subject of our further researches.

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