Modelling Titanic and Clash of Clans Games: Theoretical Definition and Application in Current Social Systems

Modelování her typu Titanic a Souboj klanů: teoretické vymezení a aplikace v současných sociálních systémech

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Abstract
This article develops research into Titanic games and the associated concepts anchored in game theory. It defines the conditions under which a Titanic game transitions into a Clash of Clans game and discusses the degree of punishment and its consequences for the nature of the game and the positions of the individual players. The game is analysed in significant detail, clearly showing what happens when different strategies are chosen. At the same time, the article also looks at the context of social policy and social systems, where the application of the analysed games is very beneficial, and points to the example of the situation in the Czech health insurance system between 2000 and 2010. The identification of the proposed concepts and their possible existence in socio-economic reality enables us to substantially better see what games are being played or can be played, and as such to gain an understanding of what is happening. The article shows the differences between Titanic and Clash of Clans games and their possible application in current social systems.

Keywords
game theory, social systems, cooperative games, non-cooperative games

JEL codes
D01, I10, D74

Abstrakt
Tento článek rozvíjí výzkum her typu Titanic a souvisejících konceptů ukotvených v teorii her. Definuje podmínky, za nichž hra typu Titanic přechází ve hru Souboj klanů. Diskutuje míru trestání a její důsledky na charakter hry a pozici jednotlivých hráčů. Analýza hry je provedena do značného detailu a jasně ukazuje, co se stane, když jsou zvoleny odlišné strategie. Současně článek obsahuje kontext sociální politiky a sociálních systémů, kde je aplikace analyzovaných her vysoce vhodná a ukazuje příklad situace v českém systému zdravotního pojištění mezi roky 2000–2010. Pomocí rozpoznání navrhovaných konceptů a jejich možné existence v socioekonomické realitě můžeme podstatně lépe vidět, jaké hry se hrají či mohou být hrány a tím porozumět tomu, o co jde. Článek ukazuje rozdíly mezi hrami typu Titanic a Souboj klanů a jejich možnou aplikaci v současných sociálních systémech.

Klíčová slova
teorie her, sociální systémy, kooperativní hry, nekooperativní hry

Introduction

Almost every citizen is currently aware of the escalation in socio-economic problems and contradictions, despite the fact that the economy currently finds itself in an upward phase of the economic cycle. However, we do not always want to admit and consider the consequences this may have for us. It is therefore no coincidence that comparisons are frequently made between the situation in which we find ourselves and the threat to which the passengers on the ship *Titanic* were exposed. At the same time, our ship is the space in which we are living along with the other members of Czech society.

The significance of the theory lies in the fact that it can use abstractions working with a high level of generalisation and identify principles which are common to the monitored phenomena and events. This applies both in the case of natural phenomena and during the analysis of social development. Game theory is a highly effective tool in this area. The comparison of the situation on the Titanic with contemporary events in society using a suitable theoretical model directly suggests the use of game theory. This enables us to better understand how people make decisions and the logic of current events. The game mechanisms and the relations between the described types of games are of direct practical significance within the context of social policy.

The goal of this article is to develop a theoretical model of Titanic-type games in connection with the behavioural strategies of the individual players and to show under what conditions they morph into a Clash of Clans game. As such, we can demonstrate the close connection between them and the methods of transition between asymmetric Titanic-type games and symmetric Clash of Clans games. A secondary goal involves the application of the analysed games to the reality of social systems, supplemented with an empirical example from the development of Czech healthcare system.

The article seeks answers to the following research questions:

- What are the main differences between Titanic-type and Clash of Clans games?
- How do the players' strategies and the degree of punishment influence the appearance of individual games?
- Is it possible to use the created models to explain the apparently nonsensical behaviour of people in certain situations?
- Which mechanisms influence the position and behaviour of the players in the individual types of games?
- Where can we see the playing of these games in social systems?
- Which strategies are optimal for universally available social systems (for example, healthcare and pensions)?

1 Theoretical-methodological background and literature review

The key starting point for this research is a critical analysis of an article (Mertl & Valenčík, 2017) which presents the results of the first phase of research into Titanic games. In doing so, we have used the general methodological principle which states that if we wish to create a good theoretical model of reality based on exact tools, we should endeavour to reveal whatever is elementary in the given area. We will show that the model proposed in the article (Mertl & Valenčík, 2017) is not elementary, but for all that, it contains a path which can lead to the detection of that which is fundamental, elementary and therefore most common in the given area.

The concept of the welfare state (Titmuss, 1958) and the social models associated with it (Esping-Andersen, 1990) constitute a further starting point for modelling Titanic games. These models show how the patterns of division in society might work. We would emphasise the fact that this does not involve an automatic preference for redistribution. On the contrary, the liberal social model, for example, minimises redistribution. The universalistic social model works with a greater degree of redistribution, but recognises the market division of resources as being primary. The performance-related (conservative) model builds on performance that can be measured by the market as the basis for redistribution. It prefers to provide for citizens and their families with reference to said performance (for example, social insurance) and only sees any other redistribution as necessary and "responsible" solidarity with a tighter group of the needy. The choice of social model has a substantial influence on the form of individual social policy areas (Krebs, 2015).

The given issue also has a macro-economic dimension in connection with economic growth (Gignano, 2014), (Coyle, 2017). It is apparent that social system dynamics cannot be approximated using only the maximisation of profit for individuals, because, as we will show, certain strategies lead with certainty to a weakening or even the elimination of selected social groups or to the escalation of social conflicts (Gould & Hijzen, 2017). At the same time, this changes the environment of the "game", and the selection of the individual strategies not only depends on individual preferences, but also on what game is being played, the attitudes of the other players and what is rewarded in society and what is punished (Myerson, 1991).

Game theory is an independent discipline focussing on a wide spectrum of decision-making situations (Osborne, 2004). It is therefore suitable for analysing social systems and for generalising observed phenomena (Meliers & Birnabou, 1983).
We have simplified the model of a Titanic-type game to the form of a non-cooperative game with an inconstant sum which can be expressed using the matrix 2x2 (two players, of which each has two strategies). We will describe the probability of the rescue function when choosing cooperative and non-cooperative strategies, for which we will also use suitable original graph depictions which increase the intuitive comprehensibility of the model (set of models) and which play an important role during the interpretation of the results achieved using the model and its gradual expansion.

The theoretical model of a Titanic game is based on the fact that the players have two basic strategies:

1. Cooperative: to try to achieve the rescue of the greatest possible number of people through cooperation.
2. Non-cooperative: to limit the option of rescue for the others in order to increase the chance of rescue for the chosen few (we will continue to use the phrase "chosen few" in this sense).

The name "Titanic" is somewhat symbolic. The different variants of the complex of Titanic-type games cannot be directly identified with what happened during the catastrophe on the ship *Titanic*, even though what took place there (or each of the versions of what took place there) is one type of the complex of Titanic games. We have proceeded from this simple definition which can be further expanded. Furthermore, in this article, we will use just the simplified name "Titanic game", although as we have explained, we are talking about the whole complex of such games that have the specific Titanic-type attributes.

The area of application of Titanic game models is very wide. In particular, their application to current social reality on both a local and a global scale suggests itself. The process of wealth divergence, i.e. the growth in wealth differences ("the rich getting richer, while the poor get poorer") has achieved dimensions never seen before in history, and it is still accelerating. Economic and social segregation is increasing; since approximately the beginning of the millennium there has been a turn in developments, whereby vertical mobility is being limited instead of equal opportunities for social advancement being gradually created. The question as to whether this involves the playing of several game variants which belong to the complex of Titanic games is an apt one.

It is well-known from the theoretical roots of social policy that each social system can only function in the long run if it meets certain conditions. The level of the secondary redistribution through the tax system of the resources distributed primarily by the market is especially significant in this regard. At present, this ranges from approximately 30% to 50% of GDP depending on the social model (OECD, 2017). However, it has been shown that not even this high level of redistribution necessarily resolves the problems of arising segregation for two main reasons.

Firstly, this redistribution has to date been focused primarily on labour incomes, which are not the only source of income and wealth under the conditions of globalisation and developed capitalism. A number of studies (Piketty, 2014) and statistical analyses (IMF, 2015), including those associated with the last financial crisis, have confirmed that the process of the "rich getting richer and the poor getting poorer" is deepening. For example, a mere 0.7% of the world's population owns wealth in excess of 1,000,000 USD per person, which accounts for 45.6% of the world's wealth (Credit Suisse, 2016). The "trickle-down effect", i.e. the idea that wealth trickles down the chain (Canto, Joines, & Laffer, 1983), does not work or has only had a partial effect, and the capital markets tend to be divorced from the real economy. This leads to the interruption of the basic conditions for the rational functioning of the market economy (Engliš, 1932) and the creation of mortgage bubbles, the accumulation of toxic assets, the failure of banking systems and the other negative phenomena which have reduced citizens' trust in the market economy in the sense of the realistic opportunity of making a living in it and securing one's existence, reproduction and a dignified standard of living. This may result in the situation where a life based on work income may lose its popularity, and where this is risky and less lucrative than earnings from other factors (rent, the share market, etc.) which are also less encumbered by payments into public budgets (Akerlof, 1976). This involves the general question of the adjustment of tax systems and social security systems and not just the secondary problem of "indirect labour costs".

The question of different sources of income and their links to the way the economy functions is understood as being highly current in contemporary economic theory. It is said that income inequality fails to generate positive motivation, especially if it is driven by rent-seeking and incomes from capital and land (Stiglitz, 2012). Statistics document the trends in income differentiation in the long period from 1980 to 2010, i.e. that it is mainly the high-earning social groups which can have capital earnings and that low-income groups do not participate in this to any significant extent. In 1980, the 90% of the poorer citizens in the USA had 37.921% of the capital income, 9% of the middle class had 30.347% and 1% of the richest citizens had 31.732%, whereas in 2010 these ratios were already 90% – 22.911%, 90–99% – 23.047%, 1% – 54.042% (Bivens, 2014). A significant study by the IMF (IMF, 2015) shows that income differentiation has reached a level where the share of low-income individuals in the overall wealth is stagnating or has fallen slightly while they have maintained their (low) absolute standard of living, whereas the relative share of high-income individuals is rising with the current concentration of wealth within a narrow spectrum of the population (Stiglitz, 2011). This mechanism ensures economically that funds are available for the modest financial flows to low-income individuals. From a social point of view, however, the problems around the motivation to be active, the loss of functionality in a number of traditional means-tested social support tools and mainly the replacement of productive mechanisms of social interaction (including work, family and community links) thanks to simple right redistribution come into play (Murray, 2008).

Secondly, the described redistribution blocks investments in the human capital of individuals to a certain extent, when the "self-supporting" schemes which are necessary from the point of view of motivation to undertake economic activity and the remuneration of desirable behaviour are not created by the mere redistribution of wealth. Universally accessible schemes, financed from taxes and other compulsory payments, have an irreplaceable role in social systems. Nevertheless, it is possible to supplement their basic universal pillars with additions which provide specific functions and enable the necessary conditions and opportunities for individual social groups to be set, within the framework of a multiple-pillar concept.

To define this using the language of game theory: the question arises as to whether games are being played in which some players are willing to sacrifice (including in the physical sense) part of society (possibly including the majority of citizens) for their own survival and the maintenance of their positions. It is possible to come across certain such indications or attempts. A good model and the theoretical apparatus associated with it may assist us in recognising attempts at playing Titanic games in time so that we can respond to these attempts.

2 A critical analysis of the existing Titanic game model

An article (Mertl & Valenčík, 2017) proposes the original payoff matrix presented in Figure 1.

Figure 1: The original matrix for a Titanic game

		Player B (other persons)		
		cooperate	do not cooperate	
			do not accept	accept
Player A (one person)	cooperates	Aa1 : Ba1	Aa2 : Ba2	Aa3 : Ba3
	does not cooperate	Ab1 : Bb1	Ab2 : Bb2	Ab3 : Bb3

Source: Mertl & Valenčík, 2017

The payoffs in the individual cells of the matrix are the payoffs stated using the probability of the rescue of one of the players (A), if they choose a cooperative or non-cooperative strategy, and the payoffs of each other player (in the same values), if a cooperative or non-cooperative strategy is applied, followed by whether these players will or will not accept player A among them in the case of the adoption of a non-cooperative strategy.

This payoff matrix is a good starting point. The article describes some inequalities which must be met in order for the values in the matrix to comply with a real situation. Despite this, the proposed scheme has some "structural" inadequacies:

- in the case of the payoffs for each non-cooperating player, it is necessary to reckon with the average payoff of both those who cooperate and those who do not cooperate, whereby it depends on the numbers of cooperating or non-cooperating players as to which strategy is applied. The corresponding values are therefore difficult to interpret;
- the choice of strategy by player B should be independent of the choice of player A from a mathematical point of view (if we are also to interpret the alternatives as a function in the sense that we assign a functional value, i.e. to the payoff for player B, to each variable, i.e. the strategy of player A). This is, of course, not the case. The fact as to whether any of the strategies is applied in the group of all the players also depends on the decision of player A.

However, when formulating the inequalities that must be met, the article formulates a number of important observations which point the way to how to extricate oneself from the theoretical difficulties and how to eliminate the inadequacies in the payoff scheme. We will look at this in the following section.

2.1 The theoretical basis for setting the values of the payoff matrix in Titanic games

The discovery of the elementary model constitutes a certain methodological guide when searching for a way to "puzzle out the reality". In our case, this involves the simplest model which simultaneously encapsulates the specific characteristics of Titanic games.

Let us recall the basic characteristics of Titanic games, which these games should comply with from an intuitive point of view:

- The payoff values involve the probability of the player's rescue in various situations.
- The situations which occur are the result of the strategy choices of the individual players and specifically (in the simplest case) of whether each of the players chooses a cooperative or non-cooperative strategy.
- The probability that a cooperative strategy will be implemented increases with the number of players who choose a cooperative strategy.
- The probability that a non-cooperative strategy will be implemented increases with the number of players who choose a non-cooperative strategy.

We will further presuppose (as a starting simplification):

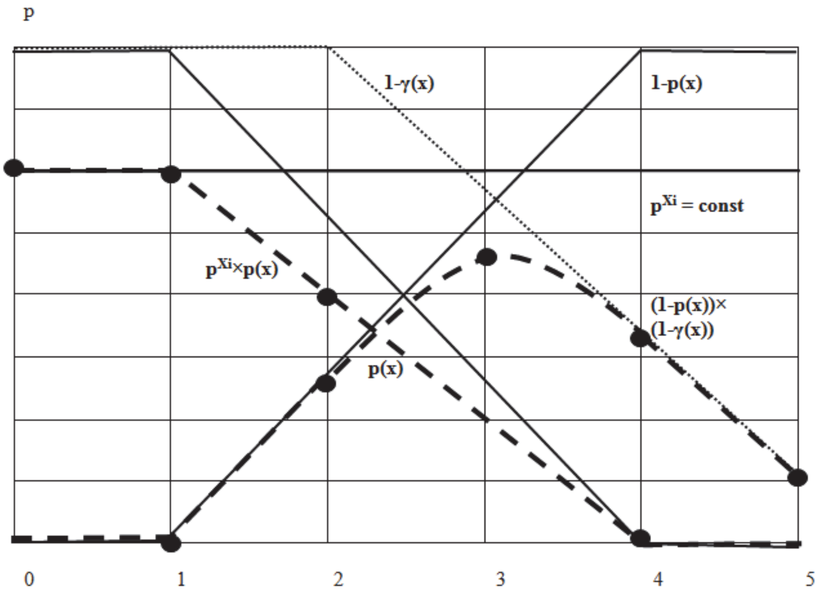
- The players' starting positions are symmetrical (all of the players have identical starting parameters for making their decisions).
- When implementing a non-cooperative strategy, the probability of rescue for each of the players adopting the non-cooperative strategy falls from a certain moment (i.e. the acceptance of each other non-cooperative player among the chosen few comes with a cost in the form of the reduced probability of rescue for each of the non-cooperative players).
- When implementing a cooperative strategy, the probability of rescue for all the players (cooperating and non-cooperating) is the same, i.e. the non-cooperating players are not "punished" for not contributing to the application of the cooperative strategy or for endeavouring to apply a different strategy.

If we interpret the given assumptions as functions, whose argument is the number of non-cooperating players and whose functional value is the given probability of what will happen, we can then state that:

- The function of the probability of the implementation of a cooperative strategy is a non-increasing function.
- The function of the probability of the implementation of a non-cooperative strategy is a non-decreasing function.
- The function of the probability of the rescue of non-cooperative players is a non-increasing function.
- The function of the probability of the rescue of each of the players during the implementation of a cooperative strategy is a constant function.

If we assume for the sake of simplicity (and for the reason of illustrative imagination, which plays an important role in the interpretation of received assumptions and the results arising from them) that all of the aforementioned functions are linear, one of the possible cases can be described using the diagram contained in Figure 2.

Figure 2: Basic diagram of Titanic game payoffs



The horizontal axis shows the number of players using a non-cooperative strategy, while the vertical axis shows the probability according to the following description
Source: our own work

Here:

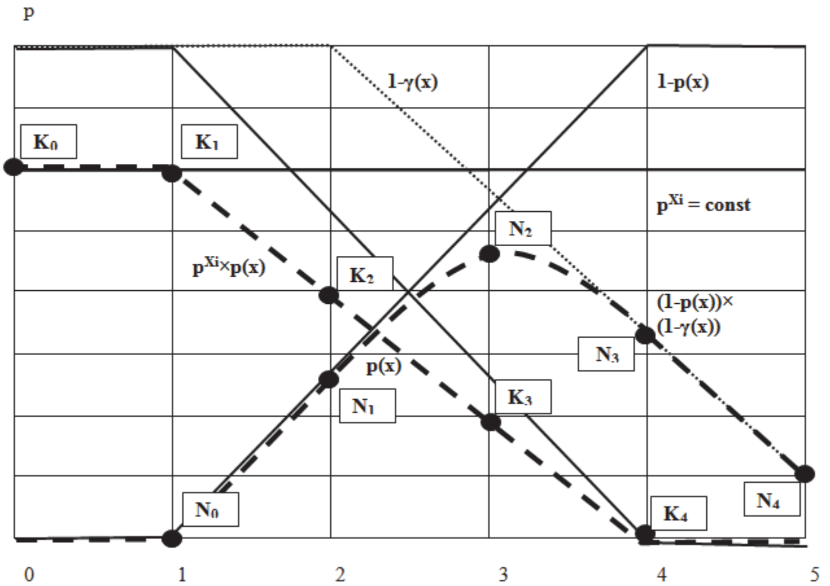
P^{Xi} = const	The probability that the nth (each) player (player **X_i**) will be rescued when implementing a cooperative strategy. In the given model, we assume that it is the same for everybody.
p(x)	The probability that a non-cooperative strategy will be implemented as a function from the number of players (**x** is the number of players) who implement it or who will not implement a non-cooperative strategy
1-p(x)	The probability that a non-cooperative strategy will be implemented.
1-γ(x)	The cost of accepting a player among the chosen few: in the given case, we assume that all the players who implement a cooperative strategy will be accepted among the chosen few (there is no punishment for the implementation of a non-cooperative strategy). The chance of all of the chosen few being rescued within the framework of the chosen few will fall from a given moment (for reasons of capacity). This is expressed by the function **γ(x)**, which can be interpreted as the increasing function of the costs, and then with the negative sign as a function of the reduction of the probability of rescue within the framework of the non-cooperative strategy, the variable of which is the number of players **x**.
P^{Xi}×p(x)	The chance of a specific player being rescued, if they choose a cooperative strategy.

(1-p(x))× (1-γ(x)) The chance of a specific player being rescued, if they choose a non-cooperative strategy.

The values on the horizontal axis can be interpreted as five players or as five groups of players, i.e. the concept for setting the payoff can be used on any (larger) number of players, which is appropriate from the point of view of the possible interpretations. The concept can also be understood by dividing the players into Pareto quintiles, i.e. that this always involves a group of players which will be understood as a single player. In other words, if the concept with five players enables us to read something significant from reality, the results will also be transferable to a large number of players. As we will show later, it is also possible to further fine-tune the rasterisation of the concept, if necessary.

We will now consider the situations where 0, 1, 2, 3 and 4 players do not cooperate and the player from whose position we are viewing the game is deciding whether or not to cooperate. We must then read the probability of the player's rescue given the different values for the numbers of non-cooperating players. See Figure 3 for this.

Figure 3: Diagram of a Titanic game with selected payoff points marked



Source: our own work

K_i are the payoffs for players who select a cooperative strategy in the case of the implementation of a cooperative strategy. We will suppose that the chance of rescue for the players who selected a cooperative strategy will be zero, if a non-cooperative strategy is implemented.

N_i are the payoffs for players who select a non-cooperative strategy, if the non-cooperative strategy is implemented.

The important moment here lies in the fact that if cooperative players accept a non-cooperative player among them in the case of the implementation of a cooperative strategy, he or she will have the same chance of rescue as they do. (This involves the case where the cooperating players do not punish a player for any non-cooperative behaviour). The player's chances of rescue are therefore equal to the probability of rescue within the framework of the cooperating strategy multiplied by the probability that a cooperative strategy will be implemented, i.e. $\mathbf{K_{i-1}}$, and the probability that a non-cooperative strategy will be implemented multiplied by the probability that the player will be rescued within the framework of the chosen few in the case of the given number of non-cooperative players, i.e.:

$$\mathbf{N_i^* = N_i + K_{i-1}} \tag{1}$$

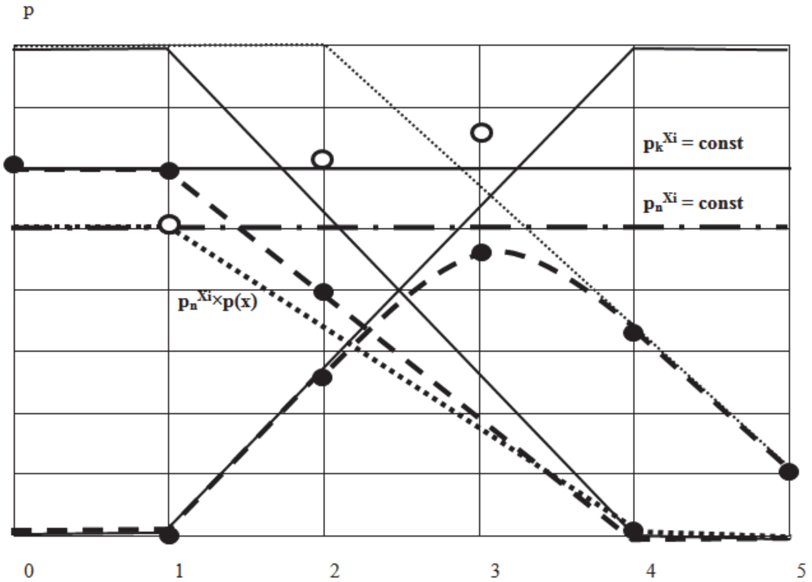
The N_i*points are designated with black points with a white centre.

a. **Model including the punishment of non-cooperative players and the discovery of Clash of Clans games**

So far, we have presumed that if a cooperating strategy is implemented, the non-cooperative players will be in the same boat as the cooperating ones. They have the same chance of rescue. This is added to by the increase in the probability of their rescue if a cooperative strategy is implemented. This may seem "unfair", but it will mainly mean that the probability of the implementation of a non-cooperative strategy will increase under certain parameters.

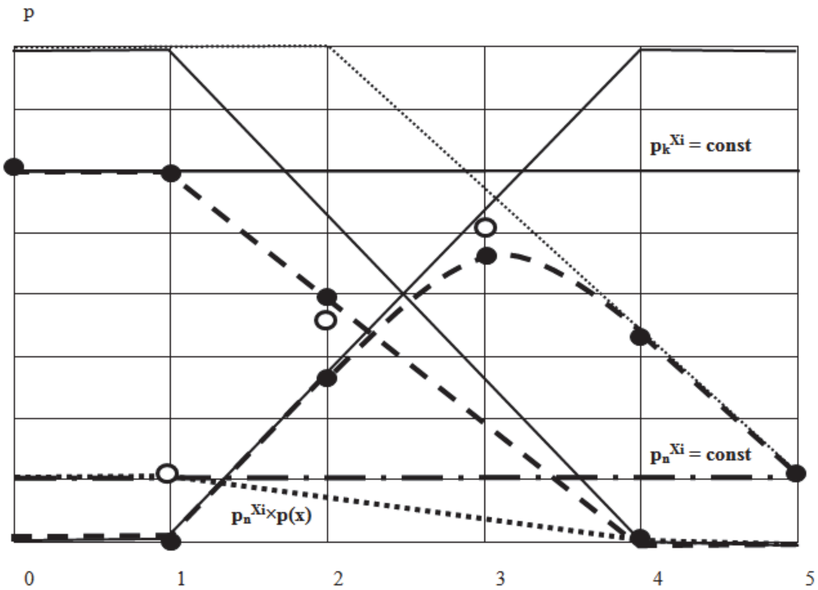
By means of the simple generalisation of the preceding model, we can show what will happen if the cooperating players introduce "punishment" for non-cooperating players which will be based on the fact that the probability of their rescue will fall. The punishment can be of varying sizes, ranging from slight to harsh and full punishment. To illustrate, we will show all three cases. The p_n^{Xi} line is the probability of rescue for non-cooperating players during the implementation of a cooperative strategy (we have also analogously depicted the line p_k^{Xi}, which expresses the probability of the rescue of cooperating players during the implementation of a cooperative strategy). In Figures 4, 5 and 6, we have marked the important points which show the sum probability of rescue for non-cooperating players in the case of the implementation of a cooperative or a non-cooperative strategy as points with a white centre. We have considered the cases of slight, harsh and full punishment.

Figure 4: Diagram of a Titanic game with the slight punishment of non-cooperative players



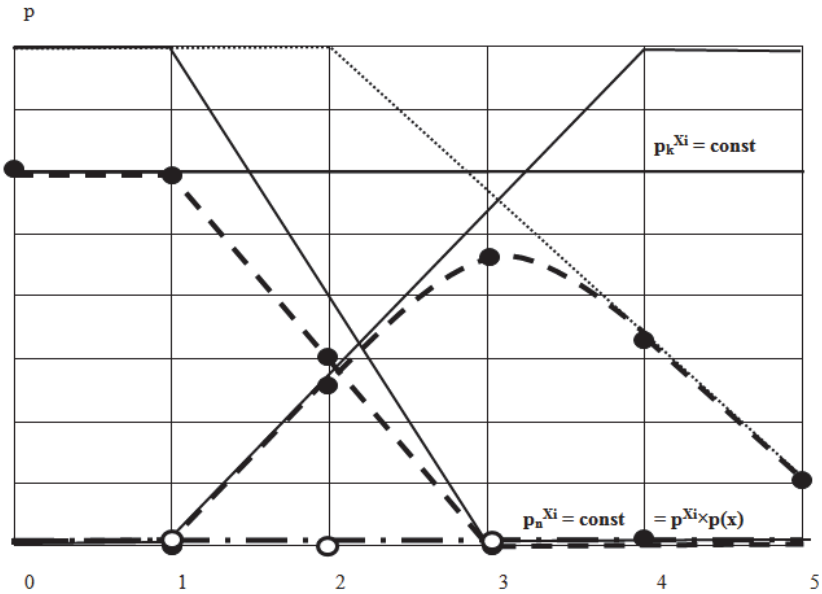
Source: our own work

Figure 5: Diagram of a Titanic game with the harsh punishment of non-cooperative players



Source: our own work

Figure 6: Diagram of a Titanic game with the full punishment of non-cooperative players



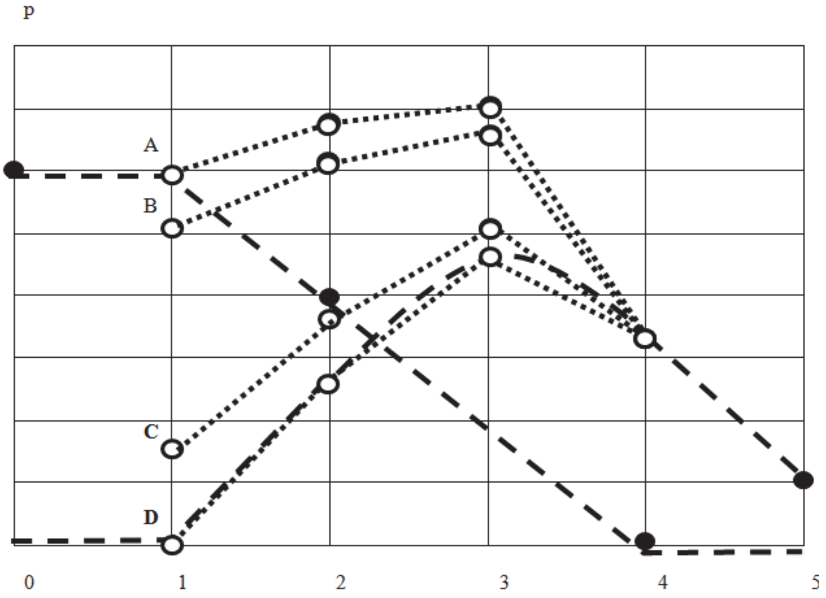
Source: our own work

Let us recall that in the case of the implementation of a non-cooperative strategy, the probability of rescue falls for each of the chosen few who have selected the non-cooperative strategy from a certain moment (i.e. there are costs for the acceptance of each further non-cooperating player to be among the chosen few).

In the case of a cooperative strategy, we have assumed that all the players have the same chance of rescue. As soon as we begin to consider the possibility of the punishment of non-cooperating players by the cooperating players, we move to another concept for the designation of the payoffs.

Now we will undertake a certain graphic modification of the previous graphs (we will omit some of their elements) and combine them into one graph in Figure 7, so that we can achieve an interesting result. We will combine graphs 4, 5 and 6 on the punishment of non-cooperative players into a single graph, remove all the extraneous matters and highlight the important ones.

Figure 7: Various cases of Titanic games with the punishment of non-cooperating players



Source: our own work

We have marked letters A, B, C and D with dotted lines connecting the player payoffs where:
A = non-punishment of the non-cooperating player
B = slight punishment of the non-cooperating player
C = harsh punishment of the non-cooperating player
D = full punishment of the non-cooperating player

We can see that as the punishment increases (the reduction in the probability that the non-cooperating player will be rescued during the implementation of a cooperative strategy) all of the non-cooperating player's payoffs gradually fall below the level of the payoffs for the cooperating players when a cooperative strategy has been implemented.

This is admittedly a somewhat trivial conclusion, nevertheless, the model enables the confrontation of our ideas with reality and the specification of the appropriate probabilities on the basis of a qualified estimate.

It is critical that the following important moment is mentioned. **During full punishment, the game begins to transform into a game which we could designate as a Clash of Clans game.** This explains the situation which we know from social policy, when breaches in social consensus (Krebs, 2015) occur with devastating effects for the stability and economic development of society (Piketty, 2014) as a result of mutual animosity between individual social groups or the absence of social dialogue. In this game, it is all about who joins the "right side". The situation is almost symmetrical. The only difference lies in the fact that we consider the costs for the rescue of each other non-cooperating player in the case of non-cooperating players, but not in the case of the cooperating players (the probability of rescue for each of the cooperating players is the same).

As soon as we introduce these costs with regard to cooperating players, the game will become fully symmetrical and will become a Clash of Clans game. This is very important from the point of view of the understanding of the specifics of Titanic games. We are looking for the maximum simplification which differentiates Titanic games from others.

One of the most important questions which arises is whether the pressure on the behaviour of the cooperating players increases commensurately with the harshness of the punishment of the non-cooperative players. Apparently not. One of the goals, which we will monitor, will be an investigation into the optimum degree of punishment for non-cooperative behaviour. The probability of rescue is much smaller for the players as soon as a Titanic game transforms into a Clash of Clans game.

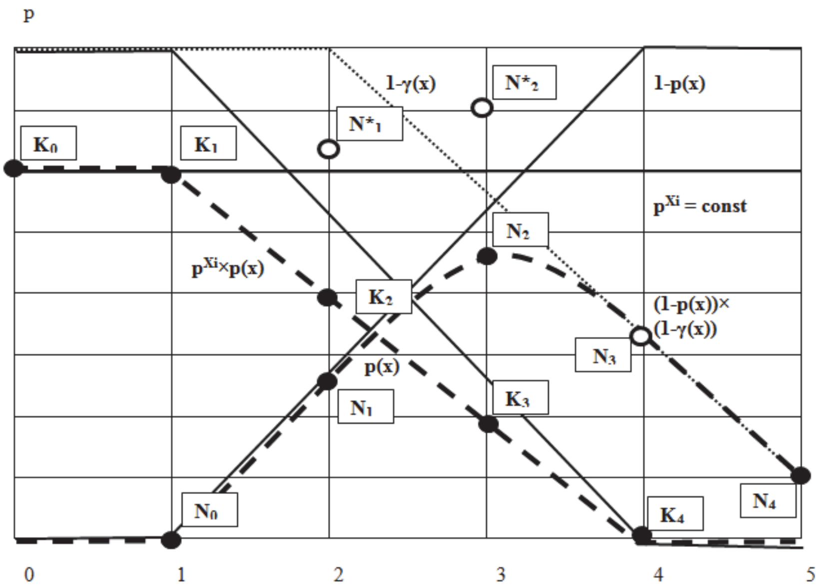
Before demonstrating the relationship between Titanic games and Clash of Clans games, we will present the possibility of using non-cooperative game tools in 2x2 games with a constant sum (two games, two strategies).

3 Use of the apparatus of 2x2 non-cooperative games to analyse Titanic and Clash of Clans games

In the interests of simplicity, we will assume that there are five players playing the given game. It is possible to consider any arbitrary number of players, in that we will interpret each player as a group of players.

This involves the cases where the decision-maker and one other player know how three of the other four players have decided. We will assume that the player (from whose position we are viewing the game) has been informed about how three players have decided. A further assumption involves the fact that another player (apart from the three mentioned players) has been informed in addition to our player. This situation can be interpreted as such that **two players are playing four games with different parameters**. We have used the diagram in Figure 8 to acquire the appropriate values of the individual payoff matrices.

Figure 8: Diagram of a Titanic game with significant points marked



Source: our own work

Here, we notice that

$$N_0^* = K_1 = K_0 \qquad (2)$$

1. In the case of CCC (all three other players cooperate), we have the game:

		B	
		cooperates	doesn't cooperate
A	cooperates	$K_0 : K_0$	$K_0 : N_0$
	doesn't cooperate	$N_0 : K_0$	$N_1^* : N_1^*$

2. In the case of CCN (two other players cooperate, but one doesn't cooperate), we have the game:

		B	
		cooperates	doesn't cooperate
A	cooperates	$K_1 : K_1$	$K_2 : N_1^*$
	doesn't cooperate	$N_1^* : K_2$	$N_2^* : N_2^*$

3. In the case of CNN (one other player cooperates, two don't cooperate), we have the game:

		B	
		cooperates	doesn't cooperate
A	cooperates	$K_2: K_2$	$K_3: N_2^*$
	doesn't cooperate	$N_2^*: K_3$	$N_3: N_3$

4. In the case of NNN (all three other players don't cooperate), we have the game:

		B	
		cooperates	doesn't cooperate
A	cooperates	$K_3: K_3$	$K_4: N_3$
	doesn't cooperate	$N_3: K_4$	$N_4: N_4$

In our case, the following relationships apply among the appropriate values in the payoff matrix:

$\mathbf{K_0 = K_1 = N_0 > K_2}$

$\mathbf{N_2^* > N_1^* > K_0 = K_1 = N_0}$

$\mathbf{N_2^* > N_1^* > N_3 > N_4}$

$\mathbf{K_2 > N_3}$

$\mathbf{K_3 = K_4 = 0}$

Various levels of inequality may occur. In our case, **CNN** is very interesting, i.e. the case where two of the players select a non-cooperative strategy and one selects a cooperative strategy, see:

		B	
		cooperates	doesn't cooperate
A	cooperates	$K_2: K_2$	$0 : N_2^*$
	doesn't cooperate	$N_2^*: 0$	$N_3: N_3$

Each player would receive the highest payoff $\mathbf{N_2^*}$, if he did not cooperate, but the second player did (the cooperating player would have the payoff 0). If, of course, both of them do not cooperate, they will have a higher payoff both in the case where the other player cooperates and where he does not cooperate ($\mathbf{N_2^*}$ or $\mathbf{N_3}$ compared to $\mathbf{K_2}$ or **0**). If both players do not cooperate, they will have a lower payoff than if they both cooperated. This involves a case which has the same matrix as the well-known prisoner's dilemma. This case always signals an interesting moment in the given game.

The choice of both players not to cooperate (the shaded field in the matrix) is the Nash equilibrium. This is the case where the player's position will not improve on the basis of a unilateral change of strategy. In our case, a unilateral change of strategy in each of the players would mean a change in the payoff to 0 (i.e. certainty of death in our interpretation).

By substituting zeros, we have simplified the record and we have marked the Nash equilibrium in the pure strategies (the shaded fields):

In the case of CCC:

		B	
		cooperates	doesn’t cooperate
A	cooperates	K_0: K_0	0 : N_2*
	doesn’t cooperate	N_0: K_1	N_3: N_3

In the case of CCN:

		B	
		cooperates	doesn’t cooperate
A	cooperates	K_2: K_2	0 : N_2*
	doesn’t cooperate	N_2*: 0	N_3: N_3

In the case of CNN:

		B	
		cooperates	doesn’t cooperate
A	cooperates	K_2: K_2	0 : N_2*
	doesn’t cooperate	N_2*: 0	N_3: N_3

In the case of NNN:

		B	
		cooperates	doesn’t cooperate
A	cooperates	0: 0	0: N_3
	doesn’t cooperate	N_3: 0	N_4: N_4

Let us recall Figure 7, when we consider the option of punishing a non-cooperating player. Here, for example, the Nash equilibrium during the cooperation of the other three players is different in case C (the harsh punishment of the non-cooperating player):

In the case of CCC:

		B	
		cooperates	doesn't cooperate
A	cooperates	K_0: K_0	K_1: N_0
	doesn't cooperate	N_0: K_1	N_1*: N_1*

In other words, it pays for all the players to cooperate.

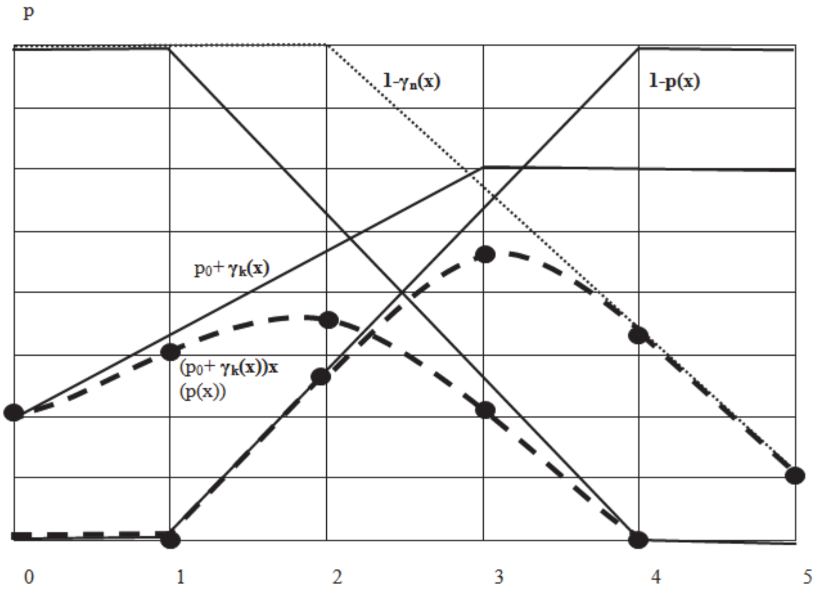
We have shown that the concept of designating the payoff for the players, which is our original result, enables us to move to the creation of quite specific models using game theory to describe real situations. In other words, we have a tool which we are able to use to model real situations which we intuitively understand as being analogies of what took place during the sinking of the *Titanic*. However, the most important result which we have achieved concerns something else: namely, the fact that when endeavouring to model Titanic games, we have discovered a related, but essentially different type of game, which we have named Clash of Clans.

4 The relationship between Titanic games and Clash of Clans games

Let us now take a more detailed look at the relationships between Titanic games and Clash of Clans games:

- A Titanic game with the punishment of the non-cooperating players is a game in which a player who has selected a non-cooperative strategy has a lower chance of rescue than a player who has selected a cooperative strategy, once a cooperative strategy has been implemented.
- A Clash of Clans game is a game where players from different clans mutually punish one another (their strategies in this case are chosen by the clans to which the player belongs). In this game, both sides have costs associated with the acceptance of each other player. The acceptance of a player (and as such the increased probability that the given clan will win) reduces the probability of rescue for non-dominant chosen players.
- The transition from a Titanic game with the full punishment of non-cooperating players to a Clash of Clans game can be expressed as the transition from Figure 2 (The basic diagram of Titanic game payoffs) to the following Figure 9.

Figure 9: Expected costs associated with the acceptance of each new player



Source: our own work

It would seem that the difference is not overly significant. We should notice how the probability of rescue falls in the case of a large number of cooperating players with the occurrence of the costs for the acceptance of each new player among the cooperating players (the bold dotted curve in the first and second graphs).

What may be causing this in reality? As soon as a Titanic game begins to transform into a duel between two groups as to whose followers will survive, the struggle to rescue the greatest number of players is reduced and this leads to a reduction in the probability of rescue in conjunction with the increasing number of cooperating players. The original cooperative strategy admittedly means a greater probability of rescue than a non-cooperative strategy, but this probability falls with the number of players.

This answers, amongst other things, the question as to why **an increase in the degree of punishment for a non-cooperative strategy within the framework of a Titanic game leads to a fall in the player payoff (the probability of rescue) from a certain level of punishment onwards**. This is a very important conclusion.

We can present the developments in different real situations with the use of the graphs derived from the basic Titanic game graph. Knowledge of the graphs and **the improvement in the ability to imagine reality using them is also significant from the point of view of estimating and revealing how other players see reality**. According to various indications, it is possible, for example, to differentiate between players who see the real game as a Titanic game or as a Clash of Clans game.

5 Results and discussion

The compilation of a concept which on the one hand depicts the essence of Titanic games and their differences from other games and on the other hand enables the entry of the parameters of specific types of Titanic games in different situations, constitutes the main contribution of this article and at the same time a significant shift forward in relation to the previous phase of research (Mertl & Valenčík, 2017). The concept is intuitively comprehensible and can be variously modified according to specific conditions. One of the possible applications of the concept involves the case where we know the decision of some of the players, and we describe a specific game which reveals the logic of the other players' decision-making. The main goal has been achieved in this regard.

Given the fact that dominant strategies exist in the majority of situations which can occur, we are only interested in those situations in which dilemmas occur and whose analysis brings game theory non-trivial results.

When drawing up the concept which enables the entry of the specific parameters of individual Titanic games, we discovered that these games seamlessly merge into another type of game in some situations. We have called these games Clash of Clans games.

The states of equilibrium in this game arise because the chances of victory for a given clan increase with the number of players who become part of a given clan on the one hand. On the other hand, the probability of rescue within the framework of the winning clan falls for each of the players who becomes part of the appropriate clan.

The parameters which characterise the individual clans (in a simple case, we assume that this involves two clans) may differ, but Clash of Clans games are distinguished by a certain basic symmetry. By contrast, the Titanic game is non-symmetrical in principle. Its basic variant presupposes that all the players have the same probability of rescue in the case of the victory of a cooperative strategy, and therefore the players' probability of rescue does not fall with the increase in the number of players who have selected the cooperative strategy, which is the case if the players choose a non-cooperative strategy. Titanic games are principally non-symmetrical in this sense. A smooth transition exists between Titanic games and Clash of Clans games. We consider the identification and characterisation of the transition from Titanic games to Clash of Clans games to be the most significant finding within the framework of the fulfilment of the article's main goal.

From an intuitive point of view, Clash of Clans games are simpler and their analogues appear in reality more often. From this point of view, it is interesting that they were not described earlier than Titanic games, but merely in connection with Titanic games, which are more complicated in some ways. The Titanic games arise as a certain continuation of Clash of Clans games when one group of players comes up with an idea (vision, concept, proposal) which provides the option of the joint rescue of the greatest number of players and therefore also includes a moral ethos which enables this group of players to acquire the largest number of players. Perhaps this corresponds to the case of the development of science, when a developmentally lower stage is revealed based on a developmentally higher stage.

We can say with a number of reservations and an awareness of the hyperbole that the Old Testament conforms to the perception of reality according to Clash of Clans games, while the New Testament contains the idea of Titanic games as its game base.

A further exceptionally interesting methodological problem arises in association with this. Prior to a specific situation developing into the form of a Titanic or Clash of Clans game, a certain game is played (a meta-game in relation to the Titanic or Clash of Clans game) where the players decide whether they will behave as in a Titanic game or in a Clash of Clans game in the given specific social reality. The real situation develops into the form of one of these games or into some transitional form on the basis of that. The given process also takes place in the practice of social policy. For example, employees (or their representatives in the trade unions) decide in the labour market what strategy to adopt during collective bargaining, while the representatives of the company management similarly have their goals which they endeavour to implement. It all depends on the atmosphere, culture and economic situation in which the negotiations take place.

From the point of view of Titanic and Clash of Clans games, it is clear that the majority of important social systems contain the risk of these games being played. In education, this involves the criteria according to which it is organised and the principles on which it is based. In other words, whether this will involve the actual development of each individual/pupil/student to the maximum of their personal abilities on the basis of objective educational procedures with the aim of achieving knowledge, skill and a work qualification, or whether the principle of the preference of social status and the creation of exclusive clubs will be applied in education. At present, eight-year grammar schools, which are attended by up to one third of children in larger cities, predominantly from better socio-economically situated families, instead of the optimal 5%, are a typical example of this in the Czech Republic.

In the area of pensions, this involves the fact of whether life-long secure pensions, which are available to every citizen, will be preferred or whether privatisation and stock exchange speculation with the need to provide citizens with a pension will take place. In the case of the second variant, this once again involves a non-cooperative game, because each citizen is confronted with their own personal risk of life expectancy and the possibility of gainful activity in the period of retirement age. Naturally, the option of selecting individual retirement strategies also exists in social insurance, but the mortality tables are common and typically exist for the selection and drawing down of the funds of the legal limit, which significantly stimulates cooperative behaviour between the participants in the system. The logic of Titanic games therefore shows why social insurance must be compulsory (for the participants whom we want to provide with a pension according to uniform rules).

In the case of healthcare, the situation is significant with regard to the fact that the universal part of the system must essentially be medically complete and therefore relatively extensive. As we know, an individual may choose a cooperative or non-cooperative strategy within the framework of Titanic games. In a non-cooperative system, i.e. if the universal system is not compulsory, a citizen may consider how to finance their healthcare, whether to do so alone (without a health insurance company) or by purchasing a private health insurance plan or whether they meet the conditions for participation in state-supported insurance plans. The healthcare system in the USA, where the right of the individual to freely choose a product has been extensively debated, is an example of such considerations in practice. Moreover, given that the health situations of the participants differ significantly, these participants and the insurance companies and doctors find themselves in serious ethical dilemmas which are the result of the necessity of choosing between cooperative and non-cooperative behaviour. For example, in the sense of covering a given insured event within the framework of the given insurance pool or the necessity of public support within the framework of the Medicare and Medicaid programmes (and setting the criteria for participation in these programmes), discussions on the nature and necessity of so-called medical underwriting (ascertaining the state of health by means of questionnaires before the conclusion of the policy), the entitlement to treatment in different situations and the differing extent of the provided medical care in relation to the objective medical need.

In contrast, these problems fall away if a cooperative solution, that is to say a universal healthcare system, is spontaneously implemented or enforced by law. Naturally, there can occur problems of a different kind; the weak response to individual needs and the small amount of choice or dependency on the sufficient volume and effective allocation of public funds. However, the essential aspect from the point of view of Titanic games is the fact that the consideration of the individual's option to withdraw from the universal system, the question of the amount and the nature of the expenditure on healthcare within the framework of individual social groups, the definition of universal and above-standard services from the point of view of medicine and the point of view of payments and so on all exist. During all of these discussions and the definition of public policies, it has been shown that the choice between cooperative and non-cooperative strategies, albeit this may appear banal in theory, has a fundamental influence on the function of social systems and on the positions of individual actors.

We can also state the problem of the redistribution of the insurance premiums for public health insurance as an example, whereby the idea existed upon its introduction (in the 1990s) that the citizen's insurance contributions would exclusively constitute income for their chosen health insurance company within the framework of social health insurance. Technically, the insurance contribution is still sent directly to the chosen insurance company, but this is a relic of the past, because the collected insurance contributions are subsequently redistributed and the health insurance companies receive a completely different amount which corresponds to the current cost indexes and therefore to the structure of the risk associated with their insurance portfolios at a given time.

The discussions on the redistribution of insurance contributions which effectively took place especially after 2000, were essentially reminiscent of a Clash of Clans game, when the General Health Insurance Company (Všeobecná zdravotní pojišťovna) on the one hand and employee health insurance companies on the other hand tabled a series of arguments for and against. A specific expression of a Clash of Clans game involved the proposals for the eventual splitting of the General Health Insurance Company into several health insurance companies with the aim of modifying the quasi-competitive environment in favour of the employee health insurance companies, which at that time had a positive balance of collected insurance contributions in their bank accounts. Moreover, a shift in the discussion on the levelling out of the conditions for the individual health insurance companies to a discussion on the effectiveness of the General Health Insurance Company could be observed. Instead of a discussion on a cooperative or non-cooperative solution (the degree of redistribution of the insurance contributions), they began talking about the structure of the health insurance companies as such, with extreme proposals in the sense of a transition to a single health insurance company model on the one hand and the aforementioned break-up of the General Health Insurance Company into multiple insurance companies on the other hand. This naturally meant a choice between one of the clans in the form of the employee health insurance companies and their interests and the second clan in the form of the General Health Insurance Company and the Ministry of Health, which in addition freed the General Health Insurance Company of its debt at that time using certain methods. Naturally, the choice of the concept for the health insurance companies (single-payer vs. multi-payer) is a legitimate question of health economics, but it is not possible to realise it on the basis of a game for the balances contained in the insurance companies' bank accounts or in an environment of inadequate distribution of insurance contributions and therefore also significantly uneven positions between individual actors (Goulli & Mertl, 2006).

Some years later, a solution was adopted in the form of the redistribution of all insurance contributions which equalises the influence of the state of health of the insurance portfolio on the income balance of the given health insurance company. This is the result of an undoubtedly cooperative principle which is practically the only possible one for a universal health system, which moreover does not rule out the plurality of insurance companies, which can be single-payer or multi-payer. But for all that, the road to this solution and the necessity of enforcing it by means of law shows that the theoretical game models which we have analysed in this article also have a practical dimension. We would further point out that in the history of social health insurance, when the differences in the state of health in the population and the associated costs were not that great, this was resolved by means of the spontaneous selection of cooperative solutions in the form of mutual insurance companies (called sickness funds), which worked on a non-profit basis and de facto shared the health risk of their members on a socially conditioned basis. A certain form of this, which still exists, involves the so-called *mutuelles* in France (Brouland & Priesolová, 2016). The interpretation of the model of Titanic and Clash of Clans games has thus enabled us to fulfil our secondary goal.

Players usually make decisions spontaneously; they are not aware of the appropriate alternatives and the models of the given games which are associated with them or derived from them. Nevertheless, the experience of the players (specific people), their imagination and their emotional assessment of both experienced and imagined situations can more or less precisely express and reveal the logic of their decision-making using game models. Players identify a specific life situation in accordance with their specific personality and intellectual traits and act accordingly, including their evaluation of reality, which can be expressed using our approach as a decision on whether to behave as if they were playing a Clash of Clans game or a Titanic game. At the same time, this essentially influences how the real situation develops. The application of behavioural economics suggests itself in this area.

Illustratively stated, if a large majority of players behaves as if they were playing a Clash of Clans game, the real development will take place within the logic of this game; if, on the other hand, a large majority of players behaves as if this involves a Titanic game, a cooperative strategy will enter the real game and the real development will take place within the logic of the Titanic game. This can also be expressed from a certain point of view by stating that, if there are too few players (with a small influence) who are endeavouring to implement a cooperative strategy, the real development will not enable them to achieve success within the logic of the Titanic game based on their decision-making. Therefore, functioning social systems require a certain developmental level of society which creates space for the rescue (development) of the majority or all of its members. As the used modelling shows, this process is not guaranteed to happen, and failure to implement it can lead to mutual conflict between individual social groups (clans), which is unproductive in the long term.

There is clearly no dispute as to the fact that the tendency to implement developments in a certain area as either a Clash of Clans game or a Titanic game emerges in reality in a number of specific areas, many of which are among the most current social problems or directly escalated conflicts. The question is whether it is possible to improve the apparatus which we use so that it can use the mathematical tools of game theory to express these situations given the suitable definition of the players. We are optimistic in this direction, and we see this as an area in which it is possible to continue with this research.

Conclusions

Behavioural economics endeavours to reveal and describe the characteristics of the human psyche, by means of which human decision-making is differentiated from purely rational decision-making and is based on the concept of bounded rationality. To a certain extent, our approach is the very opposite, because it identifies the strategies and games within which individual people move and make decisions rationally. We have shown that the generalisation of real situations using an exact model associated with the supposition of rational behaviour may reveal the causes of human behaviour that at first glance may seem strange or senseless.

We are of the opinion that the compilation of these models clarifies the logic of the development of socio-economic systems in the present time to a significant extent. We consider the naming and theoretical expression of the area of meta-games (optimal decision-making in this specific type of game) to be the key contribution of this article.

Despite the fact that people use various elements of their psyche and the interconnection of these elements (their imagination, emotions and intuition amongst other things) in their decision-making, the synergetic result is a relatively precise estimate of real situations. The created models show that human behaviour corresponds to what strategy they can choose and what game is being played. An advanced analysis of Titanic games contributes to the understanding of the way in which people are reacting to the current socio-economic period, how they make their decisions and the logic of current events.

It has been shown that a large number of related models are available when using this approach. The differentiation between asymmetric Titanic games and symmetric Clash of Clans games was especially important. The fundamental difference concerns the fact that Clash of Clans games do not have any cooperative strategy for the players to choose. They can only choose membership of a given clan (one group of players) as their strategy, and their chance of survival depends on whether or not the given clan (group of players) wins. Conversely, Titanic games offer players the option of choosing a cooperative or non-cooperative strategy, which, in association with the degree of punishment, influences the nature of the resulting game and the probability of rescue for the players under the condition of limited resources.

At the same time, we have also used the game models to explain the essence of the disputes over universally accessible social systems, such as healthcare and pensions. The long-term achievement of the key principles in these systems, such as the distribution of the health risk at a national level or a secure life-long pension for the entire population, requires the use of a cooperative strategy. If this does not occur, the degree of punishment for non-cooperative players will increase, which will lead to a reduction in the performance of these systems and eventually to their breakdown into individual clans, i.e. mutually opposed social groups, or individualised players who often cannot be rescued or secured at an adequate level.

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