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# **PUBLIC PRIVATE PARTNERSHIP AND GAME THEORY**

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**Key words:** public-private partnership, co-operation, game theory.

## **CONCLUSIONS**

**Due to a lot of entities engaged in PPP, such as government (central state or local) authority or a government-owned enterprise, project sponsors, construction companies, providers of necessary equipment, plant operators, insurers, etc., they must to co-operate one another. This co-operation in some cases could be examining as a game. The better understanding of PPP games can decrease costs and potential losses. Because of relatively short time of functioning of PPP we should carefully prescribe obligations and rights of every partner and think about PPP as a co-operation, not rivalry.**

## **ABSTRACT**

Public-private partnership (PPP) is a form of co-operation of public and private sector, aiming at the realisation of public tasks connected to supplying public goods and services by private firms or with their participation. The significance and forms of PPP have been developing for several years according to changes in economic, social and political conditions of economic activity. At present, PPP can be treated as an important instrument of providing public goods, especially if we take to the consideration budgeting constraints. There are a lot of benefits with applying PPP, e.g. increasing of the quality of public goods, decreasing of costs of their providing, more efficient allocation of resources. In the case of engaging a lot of entities in the realisation of any project such as government (central state or local) authority or a government-owned enterprise, project sponsors, construction companies, providers of necessary equipment, plant operators, insurers, etc., they must co-operate one another. In order to under-

stand motivation both public sector and private sector it is useful to examine PPP as a social game. Game theory contributes to better understanding the mechanism of PPP and accompanying social dilemmas combining with it functioning.

## **INTRODUCTION**

Nowadays PPP is becoming an important instrument of infrastructure development in Europe. One of the main imperative of UE policy in this area is an improvement of efficiency and quality of public services. The most important incentive of PPP development is appreciation of the role of private sector in achieving public aims – providing of public goods and services (such as: transport infrastructure, waste utilization, health and education services, etc.). In order to take such collaboration it is important to understand mechanism of economic cooperation, which allows using advantages both public and private sector in increasing of social welfare. Useful guidance in exploring PPP field could be game theory.

## METHODOLOGY

The authors exploit descriptive method in order to analyze the theoretical aspects of PPP and game theory.

### Public-private partnership – some theoretical implication

It is very difficult to analyse public-private partnership (PPP) in theoretical context, because there is no clear-cut (unambiguous) definition of this concept in economic literature. Apart from that it is worth mentioning that PPP is still transforming. Now we would like to introduce some interpretations of this concept with special regard to some economic, legal, social and psychological aspects.

Critical survey of different meanings of PPP deriving from liberal and conservative ideology we could find in S.H. Linder's article (*S. H. Linder, 1999, pp. 35-51.*). In accordance to his classification we could distinguish:

- *Public-private partnership as a management reform* – promoting partnership as innovating tool, which could change the way of functioning of the government, because public sector will be treated by market discipline (liberal conception).

- *Public-private partnership as a conversion problem* – from this point of view partnership is not treated as a tool of changing the way of management but as a tool serving the solving of most problems accompanying providing public goods. In this meaning it is important to persuade private sector to taking from public sector the realisation of its tasks, which will cause the decreasing of costs. Private sector gives know-how and their financial resources and public sector decreases tax burdens and can provide additional funds.

- *Public-private partnership as a moral renovation* – partnership has a

mental influence on people engaging in that, e.g. the nationalisation of public service enterprises in Great Britain (Thatcherism). The main purpose is giving people a chance for ownership of shares of utilities sold by the state on the stock market.

- *Public-private partnership as a risk shifting* – transfer of the risk means that private sector supports public sector. Private sector, which jointed to co-operative enterprise is some kind of financial lever for public funds but doesn't replace them. Aims are the same even if financial resources are mixed.

- *Public-private partnership as reconstruction of public sector (public services)* – partnership can serve as a way of movement public servants to private sector and as a way of deregulation of labour market.

- *Public-private partnership as a sharing of the power* – partnership can fundamentally change relations between public and private sector. Ethos of co-operation and trust replaces adversarial relations specific for command-and-control regulations. Apart from it relations between partners have multilaterally beneficial division of responsibility, knowledge and risk. Each partner contributes to create some exchange value. It stimulates innovation and cost saving.

As *S. H. Linder* said these six meanings of PPP we can examine from lingual point of view. In this context there is no place for usual events of partnership with non-profit sector, with social organisations, schools, churches.<sup>1</sup> This kind of partnership is worth investigating too

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<sup>1</sup> In Polish economic literature it is worth seeing: S. Golinowska, D. Głogosz (red.), *Pozarządowe instytucje społeczne. Między państwem a społeczeństwem*, Instytut Pracy i Spraw socjalnych, Instytut Polityki Społecznej UW, Warszawa 1999.

- such public-public or private-private partnership can have its historical roots in given communities, which is developing with time;

- rhetoric of this partnership has typically ethical connotation, bounding with satisfying social needs;

- lack of profit motivation changes the dynamics of such partnership.

In above discussion we omit the aspect of privatisation, but PPP can be considering as a privatisation process too. Above-mentioned definitions were designed in such a way, in order to show what partnership can be. Now we will concentrate on explaining the functioning of PPP in economic context. In „*Guidelines for Public Private Partnerships*” (European Commission (a) 2003, p. s. 16.) we could find following definition:

„PPP is a form of collaboration between public in private sector aiming at realisation a project or supplying public services traditionally providing by public sector. Both public and private sector achieve some benefits adequate to degree of realising specific tasks by them. By enabling every sector doing, what it can best, public services or infrastructure are providing in the most efficient way. The main purpose of PPP is shaping such relations between parties to taking the risk by the sector, which can control it best then. We think that it is the best definition, promoted by European Union now.

### CO-OPERATION IN GAME THEORY

Game theory provides simple tools, which allow observing dependencies between entities activity. Its greatest worth is contribution to explaining the mechanism of competition and co-operation. Most of the relationships between entities are neither strict conflicting nor strict co-operative. Using the terminology of the game theory, most of the social inter-

actions are non-zero-sum games, which means games between players whose interests aren't either totally opposite or fully coherent. In other words between players exist rivalry that does not exclude possibility of co-operation.

Non-zero-sum game's solutions are Nash equilibrium – the situation where no player has anything to gain by changing only his or her own strategy. If each player has chosen a strategy and no player can benefit by changing his or her strategy while the other players keep theirs unchanged, then the current set of strategy choices and the corresponding payoffs constitute a Nash equilibrium (Nash, 1950). The most often analysed game illustrating social dilemmas is Prisoner's Dilemma (PD) game.

In PD game Nash equilibrium is obtained when both players decide not to co-operate. The solution of the game representing Nash equilibrium is the consequence of individual rationality principle. Rationality is the property of maximising one's pay-off and taking into account the fact that the opponent is also rational and also is trying to maximise his payoff (Rapoport, 1988). Following one's rationality in cases illustrated by PD game causes a conflict between the self-interest and collective interest. According to the logic of the group rationality, represented by Pareto optimum, we shouldn't accept a solution if there is another one, more effective for all players or more effective for one player but not less effective for another player. From a self-interested standpoint, in PD no matter what another player would choose, the best strategy is to defect. As a consequence, the solution of the game is not optimal in Pareto sense. The dilemma is that the optimal choice for each player leads to a suboptimal collective outcome (Straffin, 2004; Boone – Macy, 1999).

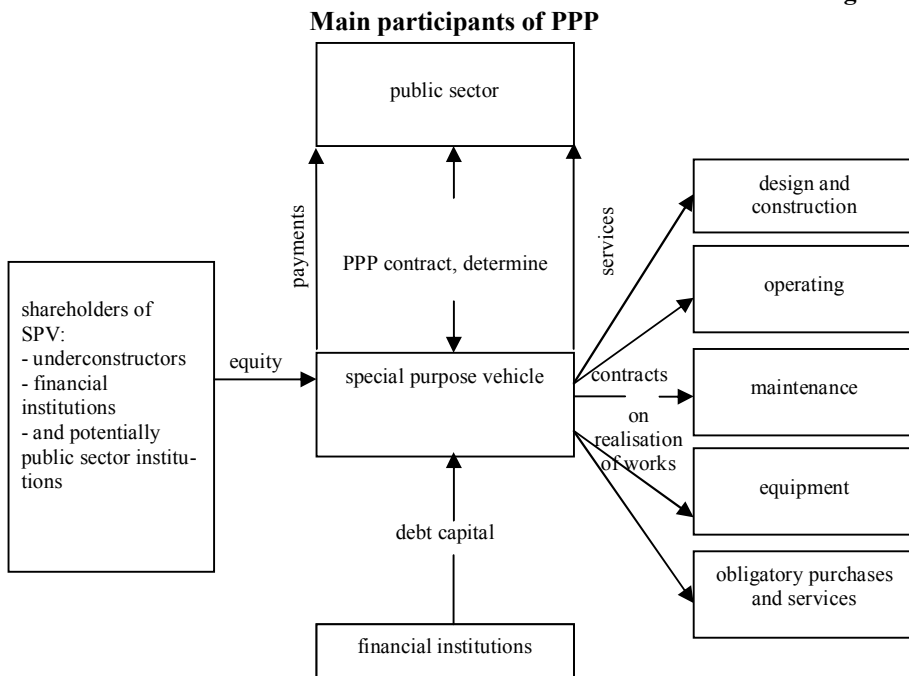
Table 1

## Selected definitions of Public-Private Partnership

European Commission, Guidelines for Public Private Partnerships, (2003)	„PPP is a form of collaboration between public in private sector aiming at realisation a project or supplying public services traditionally providing by public sector. Both public and private sector achieve some benefits adequate to degree of realising by them specific tasks. By enabling every sector to do, what it can best, public services or infrastructure are providing in the most efficient way. The main purpose of PPP is shaping such relations between parties to taking the risk by sector, which can control it best then.
European Commission, Public finances in EMU, European Economy, 3/2003 (2003), p. 128	Public-Private Partnership concerns transfer investments projects from public sector to private sector, which traditionally were realised by public sector.
P. A. Grout, Public and private sector discount rates in public-private partnerships, Economic Journal, Mar 2003, Vol. 113 Issue 486, p. C62-C68.	<i>„In the last twenty years there has been a major increase in the role of the private sector in the delivery of what were once considered public sector services. Outside of transition economies, probably the single most significant change has been the international wave of privatisation of utilities. Such privatisations typically involve the complete transfer of ownership to the private sector with the role of the state being reduced to policing prices and conduct. More recently, however, there has been a rapid growth in more complex forms of private involvement. In many cases the public sector or its agencies remain the immediate final purchaser of the services but no longer own or operate the assets necessary for the provision of the service. Such arrangements tend to be referred to as public-private partnerships. In a typical PPP the government and the private consortium designs, builds, owns and runs the physical assets required for delivery of the service. This contracts with traditional public sector provision where the government builds or purchases physical assets, retains ownership and uses public sector employees or a private contractor to deliver the required service. A PPP can be characterised as a situation where the government becomes a purchaser of services not physical assets. This type of arrangement is now common in the case of roads, prisons, hospitals and schools both in UK and elsewhere.”</i>
J. Blöndal, Market Type Mechanisms and the Provision of Public Services, OECD Journal on Budgeting, Volume 5, No. 1, OECD 2005, p. 90	Public-private partnerships (PPPs) refer to arrangements whereby the private sector finances, designs, builds, maintains, and operates (DBFMO) infrastructure assets traditionally provided by the public sector.
D. Grimsey, M.K. Lewis, Accounting for Public Private Partnership, Accounting Forum, Sep-Dec 2002, vol. 26, Issue3/4, p. 248	Accordingly, for our purpose, PPPs can be defined as agreements where public sector bodies enter into long-term contractual agreements in which private parties participate in, or provide support for, the provision of infrastructure, and a PPP project results in a contract for a private entity to deliver public infrastructure-based services. A fundamental feature is that the government does not own the infrastructure but, rather, contracts to buy infrastructure and related ancillary services from the private sector over time. Traditionally, infrastructure procurement has been viewed as asset procurement; decisions relating to the provision, production, and financing of assets as well as the operation and maintenance of the services were undertaken by the public sector. Assets were procured from private sector contractors the responsibilities of which were limited to the construction of the asset, and the risks associated with the operation of the facility remained with the public sector. With a PPP, the emphasis is upon the purchase of services not the procurement of an asset. Under the PPP contract, the government pays for services provided to it by the private sector over time. These services are delivered utilising the new infrastructure built by the private sector entities as part of the service arrangement.
Ministry of Economy and Labour, Regional Policy Department Public-Private Partnership as a method of realisation of public tasks, Warsaw 2005 r., Poland, p. 3.	Public-Private Partnership as a long term collaboration between public and private sector in enterprises aiming at realisation public tasks. The main purpose is achievement of mutual benefits both social and economical at a given enterprise.
Public-Private Partnership Act 28 July 2005 (Dz.U. no 169, pos. 1420) Poland	Art. 1. par. 2 „Public-private partnership is collaboration between public and private sector, based on a partnership agreement (contract), serving realisation public tasks, with saving principles of this Act.” Art.2. par.1 „The subject of partnership contract is realisation by private sector the project (with proper payment) for public sector. par.2 „Private partner takes all or more costs of realisation or secure taking these costs by other entities.

Source: own study

Figure 1



SPV – Special Purpose Vehicle

Source: Raport Amerykańskiej Izby Handlowej w Polsce, Partnerstwo publiczno-prywatne jako metoda rozwoju infrastruktury w Polsce Warszawa 2002, s. 7; por. także: D. Grimsey, M.K. Lewis, Accounting for Public Private Partnership, Accounting Forum, Sep-Dec 2002, vol. 26, Issue3/4, s. 254.

Figure 2

### Nash Equilibrium of Prisoner's Dilemma Game

	co-operate	defect
co-operate	0 → [+1] 0 ↓ [+1]	1 ← [-1] -2 ↓ [+1]
defect	-2 → [+1] 1 ↑ [-1]	-1 ← [-1] <b>NASH EQUILIBRIUM</b> -1 ↑ [-1]

Source: own study

Figure 3

### Nash Equilibrium and Pareto optimum of the Prisoner Dilemma Game

	co-operate	defect
co-operate	Pareto optimum	
defect		Nash equilibrium

Source: own study

Observation of social interactions shows very often that they are played as a PD game and in consequence the obtained outcome is suboptimal. Hence there are many researches which try to find the solution of this issue. According to the economic game theory, the players can escape this trap if the game is iterated. The shadow of the future should determine players to co-operation. But if the game is repeated and the number of iteration is given then the player would take an advantage by defection in the last interaction. However according to this logic there emerges the „domino effect” and as its consequence the only rational decision is not to co-operate at all. Fortunately real life does not prove that this effect is a common problem because most people don't use this logic. Moreover, in many situations described by the PD game, players don't know how many times they will be interacting (*Straffin, 2004*). If there isn't the last domino block, the problem of the „domino effect” won't exist. Answering the question: „how to exclude the last domino block” we should consider a proper strategy of the game taking into account conditions in which the game is played. In the case of iterated n-person PD game without the exit option, that means that the player isn't allowed to choose partners and has to play with each player, experiments show that the most effective strategy is Tit-for-Tat (*Axelrode, 1984*). The principle of this strategy is to co-operate when the partner co-operates and defect when the partner defects. An *agent* using this strategy will initially co-operate, then respond in kind to a previous opponent's action. That means that we should begin the game by co-operation and keep on co-operation unless our opponent defects and get back to co-operation only if the opponent does. Instead in the case of the games with the exit option Out-for-Tat strategy is more

effective (*Yamagishi – Nahoko, 1996*). Similarly to TFT an agent using this strategy will initially co-operate, then respond to a previous opponent's action. The difference is that the reaction to opponent's defection is not defection but it is desertion. In other words when the opponent defects, we should walk away and find a new partner. Most real-life PD games involve the ability to abandon an undesirable partner and look for someone else. We should choose our partner very carefully, and analyse its nature to predict its anticipated liability of defection. If the player is an aggressive one it will be tempted to play „hit and run” strategy, and can use the exit option to exploit new partners and then escape retaliation. But if the player is a defensive one it will be playing „flee rather than fight” strategy and will use the exit option to avoid defectors and remain with co-operators (*Boone – Macy, 1999*). The serious problem emerges when a relation involves only one interaction or there is only one partner we can interact with. In these circumstances the most important thing is influencing the future behaviour of the partner before the interaction begins. In this context we should consider appropriate strategic moves which ensure partner co-operation such as commitments, threats and promises. The effectiveness of all these incentives require credibility which means the other player must believe that you not renege, that you will follow through (*Schelling, 1960*). Thus the building block of co-operation is mutual credibility of partners. This credibility can be confirmed by positive reputation of partner or enforced by contract.

#### **SPECIFIC CONDITIONS OF GAMING PPP**

Most PPP schemes can be identified as sequential games: e.g. model BOT (Build – Operate – Transfer) includes

three main phases, model BOOTT (Build – Own – Operate – Train – Transfer) includes five main phases. Generally we can look at the PPP as at a four-stage model including: 1) preparation of enterprise, 2) implementation, 3) design and construction, 4) operating and maintenance. So many stages of realization of PPP scheme can suggest that it makes sense to interpret PPP as a game due to a set of interactions involving players with

a complex character, particular strategy, behavior, interest, pay-off etc. Thus a very important thing is to analyze all potential risks and benefits (pay-offs) associated with realization of a given activity as a PPP and their distribution between parties. In below table we examine the different stages of PPP with division of responsibility between public and private sector.

**Table 2**

### Responsibility for realisation of different stages of PPP

Preparation of the enterprise	Implementation	Designing and construction	Operating and maintenance
<b>Private sector</b>			
<ul style="list-style-type: none"> <li>- identification and evaluation of different (specific risks) bounding (connecting) with the enterprise</li> <li>- defining of optimal structure of the enterprise</li> <li>- forming of special purpose vehicle SPV, responsible for realisation of works</li> <li>- making the best bid (tender, offer) for realisation of the project</li> </ul>	<ul style="list-style-type: none"> <li>- collecting special permissions, decisions, opinions</li> <li>- forecast of incomes from realisation of the enterprise (added value)</li> <li>- giving the price for realisation of the enterprise (payment mechanism)</li> <li>- collecting needed funds for the realisation</li> <li>- defining financial structure of the enterprise and special securities</li> <li>- negotiations of conditions of collaboration with undercontractors</li> </ul>	<ul style="list-style-type: none"> <li>- doing appropriate works connected with fittings (building site)</li> <li>- constructing of detailed technical project</li> <li>- constructing the object (infrastructure) according to schedule and payments</li> <li>- efficient transmission (transfer) the infrastructure to operating for operate partnership</li> <li>- insurance of the infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>- operating and maintenance of the infrastructure and reconstruction investments</li> <li>- good quality (condition) of the infrastructure in the moment of transferring it to public sector</li> <li>- debt service and realisation of returns for shareholders of SPV</li> <li>- taking different risks – insurance, inflation risk)</li> </ul>
<b>Public sector</b>			
<ul style="list-style-type: none"> <li>- defining of the enterprise and preparing initial documentation</li> <li>- formation of special implementing group responsible for working out detailed specification of enterprise and suitable materials and information needed to realization of the enterprise</li> <li>- preparation</li> <li>- making formal decision about the realization</li> <li>- hire(ing) of group adviser</li> <li>- preparation of tendering documentation</li> <li>- organization of public procurement</li> </ul>	<ul style="list-style-type: none"> <li>- collecting and securing funds needed to realisation</li> <li>- season payments for private sector</li> <li>- buying lands and infrastructure using rights connected to the enterprise</li> <li>- collecting special permissions, decisions and opinions</li> <li>- choosing the best offerer</li> <li>- negotiating the final conditions of the realization of the enterprise</li> </ul>	<ul style="list-style-type: none"> <li>- monitoring of private sector</li> <li>- negotiating possible changes of specification of public procurement</li> <li>- alternatively – realization of insurance obligations</li> </ul>	<ul style="list-style-type: none"> <li>- monitoring of private sector payments for private sector</li> </ul>

Source: Raport Amerykańskiej Izby Handlowej w Polsce, Partnerstwo publiczno-prywatne jako metoda rozwoju infrastruktury w Polsce, Warszawa 2002, pp. 16-17.



Considering PPP as a game we must take into account that it is played in the environment with imperfect and incomplete information. That means that players must take steps to maximize their bargaining power by enlarging their access to information. In public service decision making the most important are following issues (*Scharle, 2002, pp. 239-240*)

- all entities involved in decision making process should have the same information about relevant parameters,
- integrity of public sector depends on symmetric and/or perfect information of the administration outside public interest,
- public sector should use advanced assessment tools in its decisions,
- very important role of public media in monitoring of PPP project,
- some times public sector production is cheaper and then privatization is not a preferable way of providing public goods.

What we should emphasize is that the process of decision making in public sector is much more complex and unstable

than in the case of private sector. The separation of decision making and decision executing, and unclear distribution of responsibilities between them enhance the risk associated with PPP. The political risk is one of the main causes why private sector avoids PPP. On the other hand there is often no social acceptance for this kind of delivering of public goods. In some cases it is reasonable e.g. because in a given country there is high level of corruption. But in the most cases the problem is the result of ignorance. The lack of necessary knowledge precludes an effective use of this hybrid form of delivering public goods. PPP isn't easy and does not always work well. But if we stop treating state and market as an alternative mechanisms for solving social problems with the availability of public goods, we can gain more. The co-operation in PPP means that state and its commercial partners go in the same direction: to enhance social welfare.

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