MICROECONOMIC MODELS OF FUNCTIONAL OVERLAPPING COMPETING JURISDICTIONS (FOCJs)[1]

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Abstract

One of the newer suggestions for the design of public economic units refers to Functional Overlapping Competing Jurisdictions (FOCJs), which are instruments to shape cooperation of jurisdictions, e.g. municipalities.

The study clarifies important types of FOCJ. It concentrates on FOCJs where the members are municipalities. How useful such FOCJs are for designing public services depends on the composition of members, their decision concept of cooperation, the task of the FOCJ, the resources devoted to the FOCJ and the development phase of the FOCJ. For better understanding of those determinants, a microeconomic theory is needed. Therefore, the authors formulate models of FOCJ establishment, FOCJ operation and FOCJ competition for clients and members. The authors present already existing models and extensions of them based on the models in public choice and location theory, cooperation and game theory, and market theory to cover oligopolistic situations.

Key words: public service design, institutional design, FOCJ, microeconomic FOCJ models, functional reform, territorial reform.

JEL-code: D2, D4, D7, H1, H4, H7, I28, R53.

1. Introduction

1.1. Determination of the Research Question

In recent years, not only in Europe, but all over the world, the role of local authorities in public service provision has been significantly increasing (CISCO 2011; Farvacque-Vitkovic, Kopanyi 2014). Municipalities face different development trends of growth and decline. In some municipalities, negative externalities occur and the division of labour extends. Municipalities have to provide higher quality services and satisfy heterogeneous preferences of citizens. To diminish the resulting difficulties, municipalities should embark on inter-municipal cooperation, thus

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showing the need for new institutions and the redesign of old ones to tackle those problems. Therefore, the authors investigate Functional Overlapping Competing Jurisdictions (FOCJs)[4] as one of the tools for inter-municipal cooperation and public service provision.

The discussion on Functional Overlapping Competing Jurisdictions (FOCJs) was opened by Bruno S. Frey and Reiner Eichenberger to introduce new forms of decentralisation and self-governance not only for developed capitalist countries, but also for countries in transition (Eichenberger 1996; Frey 1997, 2000, 2005, 2009; Frey, Eichenberger 1995, 1996, 1997, 1999, 2001a, 2001b, 2002, 2006). FOCJs have also been considered as a tool for inter-governmental cooperation (Friedrich, Popescu 2006; Bartholomae, Popescu 2007; Friedrich, Ukrainski, Timpmann 2014) and as alternative governments (in the case of FOCJ without territories like quangos (Friedrich, Ukrainski 2013)). FOCJs with municipalities as members are widely investigated in the works of Friedrich, Reiljan (2011) and Friedrich, Eckardt (2014). Their integration in economic theory has been developed in the latter work. The literature on FOCJs also considers functional jurisdictions as a means for cross-border cooperation between EU countries (Detig, Feng, Friedrich 2002; Friedrich, Ukrainski 2013; Metis 2014; Eckardt, Gritsch 2016). Several studies have analysed the historical cases of FOCJ-like organisations (e.g., Hansa trade union, School boards in England) (Frey 2005; Smith 2011; Fink 2012; Shaw 2012; Eckardt, Gritsch 2016) and attempt to implement FOCJs in several sectors such as general education, forestry, population policy, and health organisations (Spindler 1998, 2008a, 2008b; Detig 2004; Friedrich 2006; Friedrich, Popescu 2006; Friedrich, Reiljan 2011).

There has been no detailed investigation of the behaviour of an FOCJ as an owner (jurisdiction) and as an economic unit. There are only a few approaches to microeconomic theory linked to FOCJs (Friedrich, Kaltschuts, Nam 2004; Friedrich, Fladung 2008; Gabbe 2008; Friedrich, Eckardt 2014; Friedrich, Chebotareva 2017). Therefore, the authors try to develop and discuss approaches for a theory of FOCJ "economic plans".

The authors discuss and focus on the **research tasks** in the following order:
- to describe the characteristics of FOCJs as an instrument of municipal cooperation;
- to define four types of FOCJ;
- to develop theoretical approaches in economic theories, which can contribute to microeconomic FOCJ theory;
- to propose theoretical models of phases and types of FOCJ activities;
- to introduce future research directions.

1.2. FOCJs as an Instrument of Inter-municipal Cooperation

FOCJs (Functional Overlapping Competing Jurisdictions) should be **functional** because they provide special services, such as school services, water provision,

[4] Sometimes the plural of FOCJ is expressed as "FOCJ" and the singular as "FOCUS" (Frey 2005). For sake of simplicity, the authors of this article use for the plural "FOCJs" and for the singular "FOCJ".

garbage collection, etc. **Overlapping** means that the territories of jurisdictions do not coincide with the municipal borders. There are two types of overlap: jurisdictions with the same functions overlap on one territory, but jurisdictions providing different services may overlap as well. Therefore, a municipality is a dense network of jurisdictions. They **compete** for clients or members who can be different legal persons and governmental bodies. The **jurisdictions** show a degree of autonomy and authority, and have a democratic structure (Frey 1997; Spindler 1998; Frey, Eichenberger 2002; Friedrich, Eckardt 2014). Other features related to FOCJs deal with the kinds of functions performed, the legal forms, the kinds of competition for members, the number of members, the kind of decision-making bodies of the FOCJ, types of procedures, rights to fix contributions and fees, the entry and quitting conditions for members, the provision of services to members and non-members, and the members' influence on the board of directors. Moreover, they can be characterized by economic features like types of services and products, capital intensity and way of finance, labour intensity, production techniques, forms of competition, goals, etc.

In general, four types of FOCJ can be distinguished:

- FOCJ type I with citizens as members.
- FOCJ type II with governments as members, e.g. municipalities, counties, states, nation states, the European Union, etc.
- FOCJ type III with governments and subjects of public and private law (firms, etc.) as members.
- FOCJ type IV with members who are natural persons, and/or private and public legal persons, e.g. citizens, associations, chambers, churches, municipalities, private and public firms (Friedrich, Eckardt 2014).

The FOCJ definition coincides with the typical features of municipal cooperation, which covers the following main aspects:

1) it implies agreement between two or more municipalities to work together in order to fulfil public tasks and gain mutually beneficial results;
2) participants should possess competences, powers, and resources they can share to cooperate;
3) cooperation is voluntary, but at the same time municipalities could be strongly recommended to cooperate legally;
4) the arrangement between municipalities is durable;
5) municipalities keep indirect control over the decisions and services that result from cooperation (IMC Toolkit Manual 2010, pp. 7-8).

Municipal cooperation can be organised all over Europe in the following broadly described forms:

1) **Informal inter-municipal cooperation** occurs when there is no need in specific legal acts for cooperation, and municipalities are not obliged to execute decisions. At the same time, such coordination allows the solutions of many local problems like town planning (IMC Toolkit Manual 2010, p. 13) to be accelerated; 2) Many inter-municipal connections are organised in a **weakly formalised** form, such as agreements or contracts to fulfil some administrative services; 3) Other cooperations

have to perform with proper legal status. They could be called **economic units of coordination**. They usually perform one (single) or several (multi) public functions, and possess a budget, legal status, and management bodies. Municipalities as members form its equity capital, and its current costs are covered by member fees. This type of municipal cooperation can be established either under public or private law; 4) A certain amount of financial and political autonomy belongs to **municipal cooperation as second level self-government authorities**: they have their own legal status, strong political structures, and even sometimes the power to impose and collect fees (IMC Toolkit Manual 2010, pp. 13-14). Municipal cooperation in a broad sense may also include cooperation with households and public and private institutions. Such relations are analogous to FOCJ types III and IV. Examples of FOCJ type I exist in Switzerland (e.g., school communes) and the USA (special purpose districts). Zweckverband in Germany could serve as an example of FOCJ type II and as a tool for municipal cooperation.

FOCJ type I is **indirectly** linked to cooperation of municipalities; rather than municipalities themselves, citizens are members of this kind of FOCJ. The coordination process between municipalities in FOCJ I is conducted through citizens' membership choice. Competition among FOCJ I for citizens as members and for clients is the driving force. **Direct** municipal cooperation prevails in types II to IV, because in those types municipalities themselves can be members of an FOCJ. They transfer the performance of functions to FOCJs, including enterprises of public and private law and second-level self-government authorities (Wilhelm 2013). The coordination involves municipal membership competition and service provision competition. Clients are located in the member municipalities and other towns which are not FOCJ members. With all types of FOCJ market coordination determines the parameters of the actions of the municipalities. FOCJ coordination differs from municipal coordination. Moreover, stipulations in the constitution about municipal coordination, incentive policies of higher rank government, and public finance measures are used to change the environment of FOCJ coordination.

The authors do not discuss **informal coordination** between municipalities, municipal cooperation through agreements and contracts, and cooperation with private partners in the forms of sub-contracting and public-private partnership.

2. Roots of FOCJ Theories

2.1. Discussions on Type I and Other Types of FOCJ from the Legal, Societal, Economic, and Management Point of View

The idea of the FOCJ was introduced by B. Frey (1997, 2000) and Eichenberger (1996) as a form of jurisdiction to enrich federal structures. They also elaborated this new form of jurisdiction in the context of the federalism discussion with respect to European applications. He argues that the welfare of European citizens could be improved substantially by promoting competition between newly emerging jurisdictions organized according to functions instead of territories. He argues for having FOCJs of **type I** that are jurisdictions without a fixed governmental territory (Frey 2009). By referring to international organizations such as churches or international

firms, Frey argues that power over a given territory is not necessary to produce and deliver services according to the preferences of citizens. Therefore, the citizens should form jurisdictions according to the functions they like to have performed, whereas Type I FOCJs should compete for citizens. Therefore, citizens could be members of several of those jurisdictions. Frey deals especially with municipal services. He expects that the preferences of citizens will be respected and competition will automatically lead to optimal sizes of jurisdictions. The territorial dimension of power will become variable and the territorial monopoly of jurisdictions with respect to the related citizens will be abandoned, thus reducing conflicts and wars for territories and reducing conflicts between EU members. At least at the EU level for some functions such as foreign policies or customs, common market regulations need to have a territorial monopoly and one must create a competition regulation with respect to the coordination of Type I FOCJs. Frey points to the effects of FOCJs on federalism, and to the strength and weaknesses of the FOCJ I concept (Frey 2009). The investigations of Frey have contributed to shaping Type I FOCJs and their internal structures, thus laying the foundations of the FOCJ definition and the basis for development of an FOCJ management theory. Frey also sees Type I FOCJs as a means to strengthen the influence of individual citizens in democracy. However, tendencies may develop to increase the influence of wealthier citizens, which conflicts with redistribution aims. The burden of much decision making (Blatter, Ingram 2000) is also switched to the citizens.

The **other FOCJ types** (II, III, and IV) are discussed as more appropriate instruments of municipal co-operation within the given framework of existing constitutional government structures of a country (IMC Toolkit Manual 2010). In this line of literature the strength and weaknesses of different possible public and private legal forms to establish an FOCJ II is shown. The possibilities of municipalities (public owners) to influence the decision making of management and the competences of management within the democratic structures are discussed. The kinds of activities are identified for which the FOCJ is appropriate, e.g. water provision, energy provision, education, tourism and planning, joint procurement (IMC Toolkit Manual 2010). The power to charge FOCJ members and clients and financing possibilities are highlighted (Friedrich, Chebotareva 2017) and subsidization possibilities detected. Problems of staffing, employment of public officials, and regulations about FOCJs are tackled. How such conditions in FOCJ types III and IV are influenced by the participation of private or public firms or citizens in the FOCJ is discussed primarily in the literature with respect to public-private partnership.

This paper concentrates on business-like as well as economic **management problems**; it shows situations for which management theories must be developed and refers to the main determinants of management in the stages of FOCJs which must be considered when elaborating theory of FOCJ management behaviour. Models on relations between public owners to management are used. The microeconomic models developed to explain decisions of public firms and quangos will be helpful (Friedrich, Ukrainski 2013). FOCJ theory is related to club theory (Buchanan 1965), since the optimal size of both clubs and FOCJs is defined according to comparison of marginal

utility, which members get from the consumption of public goods and the marginal costs that they have to pay. If one additional member increases marginal costs, then the FOCJ size is not optimal anymore. The authors turn to those approaches when formulating the models of FOCJ establishment, operation, and competition.

2.2. Cooperation Theory Stemming from Location Theory

Location theory is also a source for developing management theory for FOCJs. Each FOCJ must have locations for production, delivery, clients, and procurement and a legal location which determines where taxes are paid, etc.; it must consider environmental restrictions as well and this creates, according to location, different effects for society, the economy, and members. Therefore, benefits and costs for members and for society are location dependent. The microeconomic "industrial" location theories (Weber 1909; Beckmann 1968, 1999; Drezner, Hamacher 2001) can be used to determine advantages and disadvantages when moving the location of the FOCJ away from the members or in the case of establishment of an FOCJ from the founding members. These advantages and disadvantages can be expressed in cost savings as well as in social benefits and social costs, in time savings, or political results (voting) (Friedrich 1976). It is also possible to find the optimal location if the members agree to a joint evaluation (Weber 1909). Agglomeration theory assists in finding an FOCJ location area or location point where the FOCJ location creates net advantages for the members establishing the FOCJ. Client-oriented models of consumer location choice can show the conditions under which FOCJ clients demand which service volume (Drezner, Eiselt 2001). Covering location, models look for locations where all demand of the clients or members get satisfied in a Euclidian space or in a traffic network (Drezner, Hamacher 2001). However, the respective models, operation research algorithms, and heuristics to determine locations for several facilities are seldom appropriate for solving the managerial problem of one FOCJ. In addition, central place theories and theories of landscape are mostly applied for several facilities (Beckmann 1999; Farhauer, Kröll 2014). One can apply the location theory of public firms because an FOCJ is a kind of public firm (Feng, Friedrich 2013). Other sources are the public sector facility and public office location theories (Friedrich 1976; Marianow, Serra 2001). They show the determinants of the location choice and the delivery areas with respect to clients and members of FOCJ. They also point to problems resulting from several decision makers looking for FOCJ location. When negotiation processes take place and coalition formation is allowed the "high school problem" shows that three FOCJ members with equal power cannot come to a decision about location or FOCJ establishment because of cycling coalitions (Isard, Smith, Tung, Dacey 1986). In this article, the location-related theoretical approaches are not explicitly applied. Some locational determinants are behind the functions chosen to characterize the managerial problem of the FOCJ to be solved.

2.3. Principal-Agent Approaches

A **principal-agent relationship** characterizes an arrangement in which one decision-making entity legally appoints another to act on its behalf. In a principal-agent

relationship, the agent acts on behalf of the principal and should not have a conflict of interest in carrying out the act (Jensen, Meckling 1976). Such relationships exist with FOCJs as well. They may refer internally to the relation of FOCJ managers (e.g., directors) to lower rank managers and staff. Externally there is a principal-agent relationship between the members of an FOCJ and the management of an FOCJ, there are principal-agent relations between higher rank jurisdictions and the FOCJ, or there are such relations between clients and the FOCJ and vice versa. Such relations can also exist with non-member municipalities. Therefore, the literature on principal-agent relations and models becomes relevant for FOCJ management models. The models differ according to the power of the principal. This can be very strong, leaving the agent the only alternative of following the order or to quit the relationship. However, in most models it is assumed that the agent needs a minimum utility; otherwise, he quits. Thus, the principal maximizes his utility under the condition that he must allow for the minimum utility of the agent (Gravelle, Rees 2004). However, the principal might formulate a general policy rule, e.g. achievement of cost coverage by the FOCJ and the FOCJ is free to make other strategic choices. Another principal-agent situation occurs if the principal, e.g. member municipalities, bargain with the management about the strategy (Friedrich, Ukrainski, Timpmann 2014) or the FOCJ negotiates with a higher rank jurisdiction about grants. The literature on principal-agent relations concentrates on situations with imperfect information about the expected output of the action of the agent or there is uncertainty about the efforts the agent will apply (Gravelle, Rees 2004). The findings of these approaches are useful when introducing uncertainty in the FOCJ management models. As the authors look at different levels of management, they incorporate principal-agent relations in their models.

2.4. Public Choice Approaches

Public choice refers to non-market decision-making and applies economic tools of analysis (Muller 1976, 2003) in the course of applying economics to political science. Much of the respective literature (cf. Muller 2003) deals with the need for decision rules to come to collective decisions, the existence and determination of welfare functions, and the determinants for such decisions and evaluation. Among the latter are bureaucracy, legislation, and relations between higher rank and lower rank public offices as well as jurisdictions and conditions under which decisions in clubs come about. Especially with respect to FOCJ management, microeconomic aspects play a role in looking at the FOCJ as a society of members (Blatter, Ingram 2000). The literature on the necessity of coordination (Mueller 1976, 2003) and the state because of external effects (Coase 1960; Mueller 2003) and redistribution (Musgrave, Musgrave 1989; Mueller 2003) are useful to explain the chances and necessity to form an FOCJ. Coalition theory also deals with the size and membership in coalitions (Bandyopadhyay, Chatterji 2006). The appearance of cycling in coalition formation as mentioned above as a "high school problem" is also tackled and sometimes relevant for FOCJs. A part of coalition formation deals with the theory of clubs as well. There, it is defined under what conditions members enter and leave (voting by feet) the FOCJ. Citizens choose a jurisdiction to live in and one that is respectively more appropriate

for them when they compare taxes and quality of services (Tiebout 1956; Buchanan 1965; Mueller 2003) in several jurisdictions. Steps for formulating FOCJ theories stem from discussion of the voting system, which might govern the decision making in FOCJs (Mueller 2003) and the factors that influence, e.g. the power of management (sometimes dealt with as bureaucracy), the role of courts and referees, fixing of internal rules and regulations for the FOCJ (Mueller 2003), and the economic, social, and environmental factors. The authors partially consider these factors in the models to be developed here.

2.5. Game Theory Approaches

Many conflicts and cooperation between intelligent rational decision-makers are studied in the framework of mathematical models, which are referred to as **game theory** (Luce, Raiffa 1967; Umbhauer 2016). Players choose strategies to obtain a favourable pay-off. They concern the coalition formation theories mentioned before, and their modelling of FOCJs may use game theory formulations with respect to the establishment, operation, and competition of FOCJs. The conflicts concern the interests of management and of members of FOCJs as described above about principle-agent relations. Some game theory situations capture cooperative games when potential members (players) of an FOCJ try to form a coalition for establishing an FOCJ and allocate the rights and responsibilities to form statutes and the initial investments. Such situations may also appear if existing FOCJs are going to work together in procurement, sales, planning, etc. However, it is not easy to overcome the gap between sophisticated mathematical models, the model solutions obtained, and real management situations. Many games are non-zero sum games between two parties (players), e.g. management and members, where the players can find solutions by choosing adequate strategies, which allow both to improve their wellbeing. The result can reveal a coordinated strategy choice, an agreement, a contract, etc. Solutions can exist which so-called absolute equilibrium points (a best strategy combination for both of them), a Nash equilibrium, etc. or the players find a solution by negotiation driven by threats (Nash 1953), the risk of termination of negotiations (Zeuthen 1930; Pen 1952), time pressure, etc. and by applying fairness rules (Nash 1950; Luce, Raiffa 1967; Isard, Smith, Isard, Tung, Daycey 1968) and so-called referee solutions (Schneider 1969). All determinants of a negotiation path may be considered in a function leading to solutions (Schneider 1969; Friedrich 1976). Many such situations are reflected in FOCJ management in FOCJ establishment, operation, and competition, leading to contracts dealt with in contract theories (Nobel Prize committee 2016). The contracts might be complete or incomplete. Many contracts within an FOCJ are incomplete and need regulations like membership and management rights that determine the statutes of the FOCJ; the findings add to the FOCJ theory and to the microeconomic plan theory of the FOCJ, e.g. when the FOCJ management has to consider a cost coverage rule. However, the authors deal primarily with complete contracts between members and management or when dealing with subsidies, finance, investments, and locations. Although there are many FOCJ application possibilities, the authors use only very simple models as starting points for developing FOCJ theories. They also concentrate on one-shot games.

2.6. Market Coordination Approaches

The FOCJ is also embedded in exchange and **market relations**. Therefore, market and competition theories are needed (Krelle 1976; Gravelle, Rees 2004) for microeconomic FOCJ theories. Sometimes one FOCJ competes against another FOCJ formembers or for clients. Potential members compete to become part of an FOCJ. The competition is horizontal as well as vertical between members as owners and FOCJ management or between management and employees, etc. or between FOCJs for grants from higher rank jurisdictions. These competitive relations show mostly oligopolistic or monopolistic relations. Therefore, oligopoly theory and monopoly theory can add a lot to the microeconomic theory of FOCJs. Oligopoly theory will be applied to create the FOCJ establishment model and to explain FOCJs competition for clients or members. Monopoly theory is used for models of vertical competition between members and the FOCJ management especially when the operation theory is developed. Management theory of public enterprises and of quangos (Friedrich, Ukrainski, Timpmann 2014) is applied too. For the following models, the authors assume a monopolistic market position of the FOCJ on the demand side of its service provision.

3. Public Management Related to the FOCJ Theories

3.1. Basic Model of FOCJ Establishment

The municipalities-members of FOCJs have to decide which resources should be dedicated to the FOCJ. A municipality might participate in fiscal means through tax payment, credit, or resources in kind, e.g. real estate (Friedrich 2006; Fladung, Friedrich 2008; Friedrich, Reiljan 2011; Friedrich, Eckardt 2014). The contribution of a municipality *i* to the equity capital of the FOCJ is e_i and $\sum e_i$ (i=1,…,n) shows the total amount of resources *E* dedicated by all municipalities. In this model each municipality participate with only *one kind of financing* (for several kinds of financing see Chebotareva, Friedrich 2017). The financial contribution of other members equals $E_R = E - e_i$. The benefits of municipality *i* increase with a higher proportion of that community in the FOCJ equity capital, e.g. the voting power of the municipality within the FOCJ might grow and more favourable solutions for FOCJ activities might be achieved. These benefits are marked with the parameter b_i. Therefore, the benefits every participant get equal to $b_i * \frac{e_i}{E}$. The dedication of resources by a municipality to the FOCJ also shows some negative effects, such as a loss of centrality of the municipality, movement of buyers to places abroad, higher transportation time and other unfavourable effects on the achievement of municipal goals. They are reflected by c_i. The utility function of a municipality is obtained:

$$U_i = b_i * \frac{e_i}{E} - c_i * e_i \qquad (1)$$

The differentiation with respect to the financing mode e_i in municipality i yields.

$$\frac{dU_i}{de_i} = b_i * \frac{E_R}{\left(E_{R_i} + e_i\right)^2} - c_i = 0 \qquad (2)$$

After all necessary elaborations and substitutions we get the optimality condition[5]:
$\frac{e_i}{E}=1-\frac{c_i}{b_i}*E$ (10) - the optimal proportion of municipality i in the equity capital of the FOCJ.
Municipalities are eager to participate in FOCJs if they get higher benefits b_i; then their shares of financing ($\frac{e_i}{E}$) grow. If the costs (c_i) increase, the share shrinks. All shares of finance must add up to 1. Hence, the optimal number n of municipalities participating in an FOCJ results from[6]:
$n = 1+\sum \frac{c_i}{b_i}*E$ (11)

3.2. Basic Model of FOCJ Operation

The demonstrated model is applicable for FOCJ type II with municipality-members and graphically illustrated in Figure 1 (Friedrich 2006; Fladung, Friedrich 2008; Friedrich, Reiljan 2011; Friedrich, Eckardt 2014). In this **model**, the members of the FOCJ must cover costs of the FOCJ. They must pay a contribution that is equal to the costs per unit. How much the services of the FOCJ are in demand also depends on the contribution to be paid. The FOCJ must control cost level, since if the costs are high, some municipalities can quit the FOCJ. For the sake of simplicity, only the case of two factors is depicted. The FOCJ possesses a management that shows a **utility function** related to the production and labour input of the relevant FOCJ.
$U = U(X,L)$ (12)
The **cost function** demonstrates fixed cost K_A and two types of variable cost. We assume that there is one fixed factor A and there are two variable production factors, L - labour and C - materials. The factor price of labour is l and that of materials is i, hence
$K = K_A + l L + i C$ (13)
The towns should cover the variable costs K_v and K_A
$K_v = l L + i C$ (14)
Variable costs are covered from the respective **budget**, which is marked in the fourth quadrant. The budget lines show how the budget (net revenue) can be allocated to labour and material. Then the production function is as follows:
$X = f(L,C)$ (15)
An added-up **demand curve** of all members exists for the services of the FOCJ depending on the level of cost contribution per service unit and shows relations between price and amount of output P = P (X). The demand curve can be seen in the second quadrant. Moreover, there is the turnover curve, which results in and reflects contribution revenues, which are used to cover all costs. A restriction that contribution revenue minus fixed costs is equal to total variable costs. We assume a self-financing

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[5] $(E_R+e)^2=\frac{b_i}{c_i}*E_R$ (3) $E_R+e=\sqrt{\frac{b_i}{c_i}}*\sqrt{E_R}$ (4) $E=\sqrt{\frac{b_i}{c_i}}*\sqrt{E_R}$ (5) $E=\sqrt{\frac{b_i}{c_i}}*\sqrt{E-e}$ (6)
$E^2=\frac{b_i}{c_i}*(E-e)$ (7) : E $E=\frac{b_i}{c_i}*(\frac{E-e}{E})$ (8) $E=\frac{b_i}{c_i}*(1-\frac{e}{E})$ (9)

[6] $\sum_{i=1}^{n}\frac{e_i}{E} = n-E\sum_{i=1}^{n}\frac{c_i}{b_i}$

FOCJ:

$$P(X)X - K_A = l\,L + i\,C \quad (16)$$

The **output-labour curves** in the first quadrant show which combination of labour and output can be achieved when the respective budget is totally used for alternative combinations of labour and materials. To achieve such a net budget the FOCJ members have to order services. The municipalities demand a specific volume of services, which can be produced in two ways under covering costs. There is material- or labour-intensive production possible when the whole budget (net-revenue) is used to cover costs. At the respective output-labour curve, two points become relevant. For each service volume such two points are situated on the thick line. If we connect them, the thick line in the first quadrant appears as a possible solution curve. FOCJ management wants to **maximize utility** according to relation (12) and (13). Respective indifference curves with respect to output and labour are introduced in the first quadrant. The solution S with fee Z is found where an indifference curve of the highest level touches the possible solution curve shown in the first quadrant again.

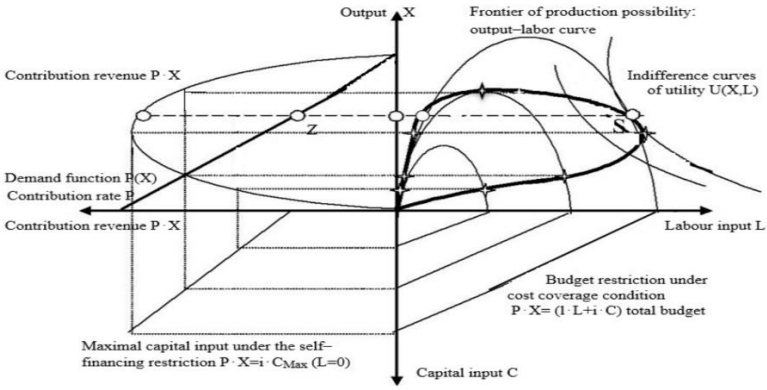

Figure 1. Determination of fees and contributions for FOCJ type II
Source: compiled by the authors based on Friedrich, Eckardt 2014, p. 117.

Utility maximization of management under the restrictions mentioned above leads to the following **Lagrange equation**:

$$\Lambda = U(X,L) + \lambda(P(X)X - K_A - l*L - i*C), \text{ where } X = f(L,C) \quad (17)$$

Setting its partial derivatives with respect to λ, X, L and C equal to zero, we get:

$$\delta\Lambda/\delta\lambda = P(X)X - (K_A + l*L + i*C) = 0 \quad (18)$$

$$\delta\Lambda/\delta X = Ux' + \lambda(\delta P/\delta X*X + P) = 0 \quad (19)$$

$$\delta\Lambda/\delta L = Ux' * fl' + Ul' + \lambda\,(P'* fl'*X + P*fl' - l) = 0 \quad (20)$$

$$\delta\Lambda/\delta C = Ux' * fc' + \lambda\,(P'* fc'*X + P*fc' - i) = 0 \quad (21)$$

The first-order conditions reflect **two optimality conditions**. One concerns the equivalence of the relation of marginal utilities of marginal factor-inputs to the proportion of respective marginal profits caused by the contribution (22) and the other refers to the contribution rate under cost coverage (23). Consequently,

$$\frac{(U_X'^* f_L' + U_L')}{UX'^* fC'} = \frac{P'^* f_L'^* X + P^* f_L' - l}{P'^* f_C'^* X + P^* f_C' - i} \quad (22)$$

and P =

$$\frac{K_A + l\,L + i\,C}{X} \quad (23)$$

3.3. Basic Model of FOCJ Competition

The model illustrates the distribution of members between **two already established and competing** type II FOCJs. The net-benefit of FOCJ members increases until a particular point when one additional member, who before this point took part in cost reduction, now entails declining utility for other member-participants. Hence, there is an optimal size for an FOCJ. And if the size grows, it leads to congestion of the FOCJ and a decrease in quality of services provided. A net-benefit to a member results from the service and the contribution paid. For one FOCJ this net-benefit is reflected in curve TL in Figure 2 in the left-hand section. The middle graph shows the situation for the competing FOCJ. Left of assignment G it makes no sense for possible members of the FOCJ2 to stay with FOCJ1. The same is true for possible members of FOCJ1 right of point G. Therefore, the size of FOCJ1 turns out to be N1 and that of FOCJ2 is N2 (Friedrich 2006; Fladung, Friedrich 2008; Friedrich, Reiljan 2011; Friedrich, Eckardt 2014).

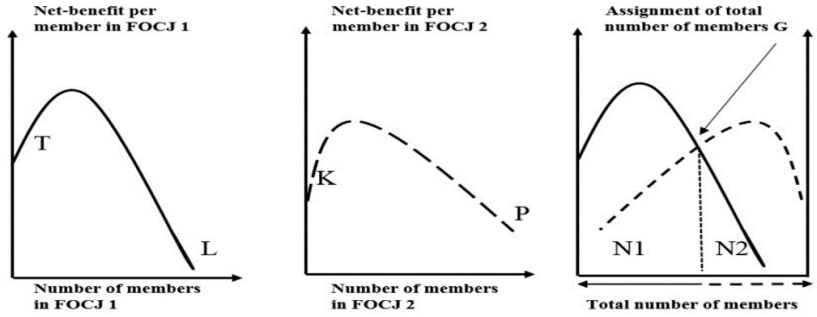

Figure 2. Distribution of FOCJ members
Source: Friedrich 2006, p. 150

4. Extensions of the Basic Models Including Financial and Fiscal Conditions

4.1. The Model of Establishment with a Non-negotiable Grant

If a higher rank government gives a grant for FOCJ establishment (G), the **share of FOCJ equity capital** ($\bar{E}$) which participants have to cover goes down. This means that establishment costs are partly covered by higher rank authorities. We assume that in the case of establishment the equity capital consists of two part: E_1 – shares of municipalities in equity capital, G – grant from higher rank or other governments. Then the equity capital yields:

$\bar{E}_{100\%} = E_1 - G$

In this case, the share of each municipality member increases, which allows having fewer participants.

$$\frac{e_i}{\bar{E}} = 1 - \frac{c_i}{b_i} * \bar{E}$$

4.2. The Model of Current Operation with a Non-negotiable Grant

If an FOCJ receives a grant or donation from a higher rank jurisdiction, the scope of financing increases (Friedrich, Chebotareva 2017). The equation (16) becomes:

$$P(X)* X + G = K_A + l\ L + i\ C \quad (24)$$

The first **optimality conditions** are not changed if G is a constant sum independent of x. However, the second condition shows the following variation:

$$P = \frac{K_A + l\ L + i\ C - G}{X} \quad (25)$$

The contribution is decreased and corrected by G/X. In Figure 3, the turnover curve gets a push to the left as far as there is a demand of the clients (members). The net-revenues become higher. The budget lines move downward in parallel. The output-labour curves move to the right and the solution space becomes bigger. The solution moves from point S to M, and the contribution decreases from the point Z to O. Consequently, the **solution possibility curve** moves up and to the right. The solution will be a lower contribution and a larger service volume. Such grants and donations might also be paid directly to the FOCJ II from non-member jurisdictions, from private donors, etc. or indirectly from the member municipalities.

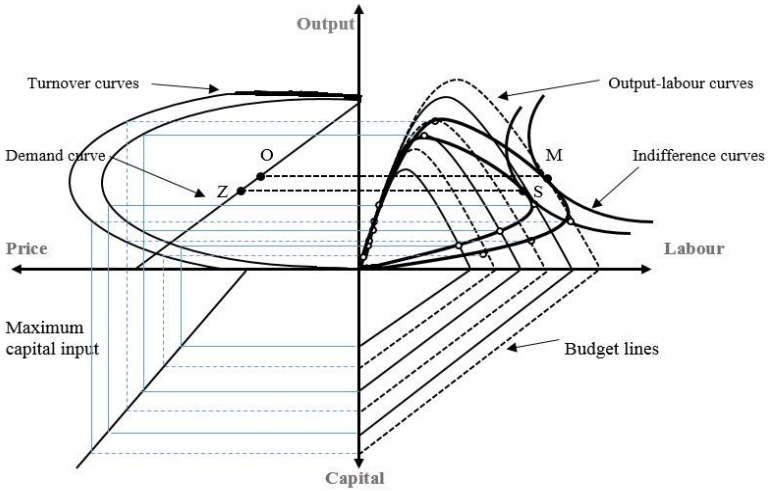

Figure 3. Determination of fees and contributions for FOCJ type II after receiving grant Source: compiled by the authors based on Friedrich 2006, p. 150; Friedrich, Eckardt 2014, p.118.

4.3. The Model of Competition with a Non-negotiable Grant

The two or more FOCJs can also receive grants from other jurisdictions including higher rank jurisdictions. If the **amount of grant is equal** for both competing FOCJs, then curves TL and KP move up, and the new allocation point G does not change the distribution of members among FOCJs. The members of both FOCJs will just have higher net-benefit than before receiving the grant (see Figure 4). The members still choose that FOCJ which allows the highest net-benefit.

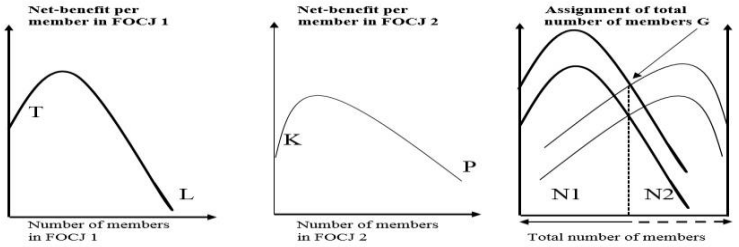

Figure 4. Distribution of FOCJ members when both FOCJs receive equal grant
Source: compiled by the authors based on Friedrich 2006, p. 150; Friedrich, Eckardt 2014, p.118.

If one of the competing municipalities receives (for example, FOCJ 2) a bigger grant, then net-benefit curves move up again, but with different distance. A new allocation of point G appears. In the far right hand picture, the crossing point of the two optimal net-benefit curves reflects the resulting allocation of members to the two FOCJs. For some of the members of FOCJ1, FOCJ2 gives higher net-benefit. Hence, the distribution of members between two FOCJs has changed. **Similar result** occurs when, for example, FOCJ2 gets a grant, but FOCJ1 does not have one. In this case, more members of FOCJ1 are willing to change their service provider in favour of FOCJ2, since they will perceive higher net-benefit.

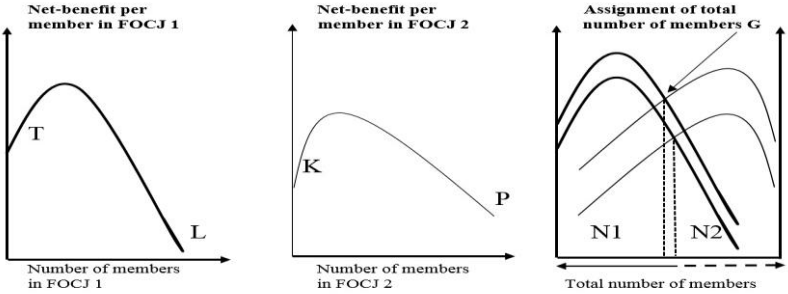

Figure 5. Distribution of FOCJ members when FOCJ2 receives bigger grant
Source: compiled by the authors based on Friedrich 2006, p. 150; Friedrich, Eckardt 2014, p.118.

4.4. The Models Considering an Active Negotiating Higher Rank Government

The higher rank government can be active during the **establishment** of the FOCJ by joining the FOCJ as a member. In principle, the solution of the basic establishment model of section 4.1 is obtained again.

For influencing **the FOCJ's operations** with respect to output the FOCJ may also negotiate with higher rank authorities for a grant (e.g., with regions or provinces in some countries). By means of this grant the FOCJ as well as donating higher-level jurisdictions maximize the utility. The regional government utility function, which depends on the X – FOCJ production and the size of conditional grant F. In the current case, FOCJ negotiates about grant F. Therefore, the **utility function of the higher rank jurisdiction** looks like:
$\mathbf{U_R = g_{XL}*X - g_{FL}*F}$, where g_{XL} and g_{FL} – utility weights.

The FOCJ utility is dependent on the amount of production X that is implicitly influenced by the amount of grant and the grant as such, which emphasises the importance of the grant for the FOCJ:
$\mathbf{U_G = (a - b*X)X+(a - b*X)X(F) + g_{FG}*F}$, where a, b – parameters, and g_{FG} – the value of one unit of grant F an FOCJ gets.

Both partners possess utility functions, which can be expressed with respect to the volume of services X and the grant F. For each negotiator a set of **indifference curves**, which gives us a Pareto-optimal path of possible negotiation results, occur (Friedrich, Gwiazda, Nam 2004). Out of these results a negotiation result is determined according to Nash for a cooperative non-zero sum game. As long as the output is not dependent technically on F, the output gets fixed and the size of F is determined. If the evaluation of the FOCJ depends also on the output increase allowed by the grant, we get a solution where output volume depends on the evaluation of the grant, the evaluation of additional output allowed by the grant, and the evaluation of the negotiating partners of the output. F is determined by this output, by minimum utilities of the negotiators, and parameters of the evaluation functions. From the **solution** obtained for F and X the reader may learn that with the higher grant induced, evaluation of the additional output by the FOCJ management, the volume of X and the size of F will increase. The whole range of solution steps can be found in Box 1.

Box 1. Nash solution of negotiation between higher rank jurisdiction and FOCJ on grant

The utility equations of higher rank jurisdiction and the FOCJ look as following:
$\mathbf{U_R = g_{XL}*X - g_{FL}*F}$
$\mathbf{U_G = (a - b*X)X+(a - b*X)X(F) + g_{FG}*F}$ (27)
To determine the indifference curves the derivation of utility curve of the region gives:
$$dU_R = \frac{\partial U_R}{\partial X}\, dX + \frac{\partial U_R}{\partial F}\, dF = g_{XL}\, dX - g_{FL}\, dF = 0 \quad (28)$$
And the derivation of the FOCJ utility curve yields:

$$dU_G = \frac{\partial U_G}{\partial X} dX + \frac{\partial U_G}{\partial F} dF = (a-2bX)dX + ((a-bX)\frac{\partial X}{\partial F} + g_{FG})dF = 0 \quad (29)$$

To identify Pareto solution we reduce both sides of two equations (28) and (29) on dX and get:

$$g_{XL} - g_{FL}\frac{dF}{dX} = 0 \quad (30)$$

$$(a-2bX) + ((a-bX)\frac{\partial X}{\partial F} + g_{FG})\frac{dF}{dX} = 0 \quad (31)$$

In equation (31) the expression $\frac{\partial X}{\partial F}$ is substituted by l:

$$\frac{\partial X}{\partial F} = l \quad (32)$$

The relations $\frac{dF}{dX}$ are found from the equations (30) and (31) as a condition for X_{pareto} identification:

$$\frac{dF}{dX} = \frac{g_{XL}}{g_{FL}} \quad (33)$$

$$\frac{dF}{dX} = -\frac{a-2bX}{(a-bX)l + g_{FG}} \quad (34)$$

The conditions (33) and (34) denote the Pareto solution:

$$\frac{g_{XL}}{g_{FL}} = -\frac{a-2bX}{(a-bX)l + g_{FG}} \quad (35)$$

$$-g_{XL}((a-bX)l + g_{FG}) = g_{FL}(a-2bX) \quad (36)$$

$$-g_{XL}a\,l + g_{XL}bXl - g_{XL} * g_{FG} = g_{FL} * a - 2bX * g_{FL} \quad (37)$$

$$g_{XL}bXl + 2bX * g_{FL} = g_{FL} * a + g_{XL}a\,l + g_{XL} * g_{FG} \quad (38)$$

$$X_{Pareto} = \frac{g_{FL} * a + g_{XL}a\,l + g_{XL} * g_{FG}}{g_{XL}bl + 2bg_{FL}} \quad (39)$$

The utility of higher rank jurisdiction and the FOCJ with X_{Pareto} result as:

$U_R = g_{XL} * X_{Pareto} - g_{FL} * F$

$U_G = (a - b * X_{Pareto})X_{Pareto} + (a - b * X_{Pareto})X_{Pareto} + g_{FG} * F = 2(a - b * X_{Pareto})X_{Pareto} + g_{FG} * F$ (4

, where

$$X_{Pareto} = \frac{g_{FL} * a + g_{XL}a\,l + g_{XL} * g_{FG}}{g_{XL}bl + 2bg_{FL}}$$

From (41) we get F and put into (40):

$$U_G - 2(a - b * X_{Pareto})X_{Pareto} = g_{FG} * F \quad (42)$$

$$F = \frac{U_G - 2(a - bX_{Pareto})X_{Pareto}}{g_{FG}} \quad (43)$$

$$U_R = g_{XL} * X_{Pareto} - g_{FL} * \frac{U_G - 2(a - bX_{Pareto})X_{Pareto}}{g_{FG}} \quad (44)$$

$$U_R = g_{XL} * X_{Pareto} - \frac{g_{FL}}{g_{FG}} * U_G + 2\frac{g_{FL}}{g_{FG}}(a - bX_{Pareto})X_{Pareto} \quad (45)$$

$$U_R = -\frac{g_{FL}}{g_{FG}} * U_G + (g_{XL} + 2\frac{g_{FL}}{g_{FG}}(a - bX_{Pareto}))X_{Pareto} \quad (46)$$

Asume that in the equation (46)

$$(g_{XL} + 2\frac{g_{FL}}{g_{FG}}(a-bX_{Pareto}))X_{Pareto} = \mathbf{\Phi}$$

$U_R = -\frac{g_{FL}}{g_{FG}} * U_G + \mathbf{\Phi}$ (48), while $\mathbf{\Phi}$ =

$[g_{XL} + 2\frac{g_{FL}}{g_{FG}}(a - b\frac{g_{FL}*a + g_{XL}a\,l + g_{XL}*g_{FG}}{g_{XL}bl + 2bg_{FL}})] * \frac{g_{FL}*a + g_{XL}a\,l + g_{XL}*g_{FG}}{g_{XL}bl + 2bg_{FL}}$

To find the negotiation solution, Nash product must be maximised considering the restriction (48) for the possible utility distribution between the region and the FOCJ. NP = $(U_R - U_{Rmin})(U_G - U_{Gmin})$ – Nash product function, where U_{Rmin} denotes minimal utility level of higher rank jurisdiction, and U_{Gmin} – minimal utility level of the FOCJ.

Implementing the Lagrange method, the Nash solution occurs:

$$L = (U_R - U_{Rmin})(U_G - U_{Gmin}) + \lambda(\Phi - U_R - \frac{g_{FL}}{g_{FG}} * U_G) \quad (49)$$

The first order conditions are:

$$\frac{\partial L}{\partial U_R} = U_G - U_{Gmin} - \lambda = 0,\ \lambda = U_G - U_{Gmin} \quad (50)$$

$$\frac{\partial L}{\partial U_G} = U_R - U_{Rmin} - \lambda\frac{g_{FL}}{g_{FG}} = 0,\ \lambda = \frac{g_{FG}}{g_{FL}}(U_R - U_{Rmin}) \quad (51)$$

$$\frac{\partial L}{\partial \lambda} = \Phi - U_R - \frac{g_{FL}}{g_{FG}} * U_G = 0 \quad (52)$$

Right parts of (50) and (51) are equal

$$U_G - U_{Gmin} = \frac{g_{FG}}{g_{FL}}(U_R - U_{Rmin}) \quad (53)$$

$$U_G = \frac{g_{FG}}{g_{FL}}(U_R - U_{Rmin}) + U_{Gmin} \quad (54)$$

(54) is inserted into (52)

$$U_R = \Phi - \frac{g_{FL}}{g_{FG}} * (\frac{g_{FG}}{g_{FL}}(U_R - U_{Rmin}) + U_{Gmin}) \quad (55)$$

$$U_{RNash} = \Phi - U_{RNash} + U_{Rmin} - \frac{g_{FL}}{g_{FG}} U_{Gmin} \quad (56)$$

$$2U_{RNash} = \Phi + U_{Rmin} - \frac{g_{FL}}{g_{FG}} U_{Gmin} \quad (57)$$

$$\mathbf{U_{RNash}} = \frac{\mathbf{\Phi + U_{Rmin} - \frac{g_{FL}}{g_{FG}} U_{Gmin}}}{\mathbf{2}} \text{ is obtained} \quad (58)$$

Steps from (50) to (57) are the same for U_{GNash}:

$$\lambda = U_G - U_{Gmin} \quad (59)$$

$$\lambda = \frac{g_{FG}}{g_{FL}}(U_R - U_{Rmin}) \quad (60)$$

$$\Phi - U_R - \frac{g_{FL}}{g_{FG}} * U_G = 0 \quad (61)$$

$$U_G - U_{Gmin} = \frac{g_{FG}}{g_{FL}}(U_R - U_{Rmin}) \quad (62)$$

$$U_R - U_{Rmin} = \frac{g_{FL}}{g_{FG}}(U_G - U_{Gmin}) \quad (63)$$

$$U_R = \frac{g_{FL}}{g_{FG}}(U_G - U_{Gmin}) + U_{Rmin} \quad (64)$$

$$\Phi - \frac{g_{FL}}{g_{FG}}(U_G - U_{Gmin}) - U_{Rmin} - \frac{g_{FL}}{g_{FG}} * U_G = 0 \quad (65)$$

$$\Phi - 2\frac{g_{FL}}{g_{FG}}U_G + \frac{g_{FL}}{g_{FG}}U_{Gmin} - U_{Rmin} = 0 \quad (66)$$

$$\mathbf{U_{GNash}} = \frac{\frac{g_{FG}}{g_{FL}}\Phi + U_{Gmin} - \frac{g_{FG}}{g_{FL}}U_{Rmin}}{2} \quad \text{is obtained} \quad (67)$$

To find F as a result of negotiations, (58) is inserted into (26)

$$\frac{\Phi + U_{Rmin} - \frac{g_{FL}}{g_{FG}}U_{Gmin}}{2} = g_{XL} * \left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) - g_{FL} * F) \quad (68)$$

$$F = \frac{g_{XL}}{g_{FL}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) - \frac{\Phi}{2g_{FL}} - \frac{U_{Rmin}}{2g_{FL}} + \frac{U_{Gmin}}{2g_{FG}} \quad (69)$$

$$F = \frac{g_{XL}}{g_{FL}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) - \frac{[g_{XL} + 2\frac{g_{FL}}{g_{FG}}(a - b\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}})] * \frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}}{2g_{FL}} - \frac{U_{Rmin}}{2g_{FL}} + \frac{U_{Gmin}}{2g_{FG}} \quad (70)$$

$$F = \frac{g_{XL}}{g_{FL}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) - \frac{g_{XL}}{2g_{FL}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) - \frac{a}{g_{FG}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) + \frac{b}{g_{FG}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right)^2 - \frac{U_{Rmin}}{2g_{FL}} + \frac{U_{Gmin}}{2g_{FG}} \quad (71)$$

$$F = \frac{g_{XL}}{2g_{FL}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) - \frac{a}{g_{FG}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right) + \frac{b}{g_{FG}}\left(\frac{g_{FL} * a + g_{XL} a\, l + g_{XL} * g_{FG}}{g_{XL} bl + 2bg_{FL}}\right)^2 - \frac{U_{Rmin}}{2g_{FL}} + \frac{U_{Gmin}}{2g_{FG}} \quad (72)$$

4.5. The Models Considering Risks

In the **establishment** case risks can be introduced with respect to the probabilities of realizing the benefits and costs of the members. The members may have a preference order concerning taking risks, and they negotiate their participation as shown with the establishment model proposing their utility maximum preferred FOCJ participation. The number of members of FOCJs compared to the deterministic case may change. In addition, the participation of members must cover the equity capital E (compare subsection 3.1).The **risk of current operation** can be considered in various ways (e.g., risk of demand of members and clients, production risks, factor price risks, and risks with respect to evaluations). This section concentrates on demand risk (Friedrich, Ukrainski 2013). That means there are demand curves, which reflect different probable actual demand curves. According to a preference function, the FOCJ determines optimal risks it will bear. In Figure 6, alternative risky demand curves are indicated with dotted lines. Belonging to each demand curve is a respective dotted solution curve. For different demand curves and solution spaces different optimal solutions result with respect to labour and output. For the preferred risk by management, i.e. the demand curve illustrated by the thick line, results in a solution space and the point of tangency between this solution space and the highest attainable indifference curve of the management results. The optimal output and contribution is determined.

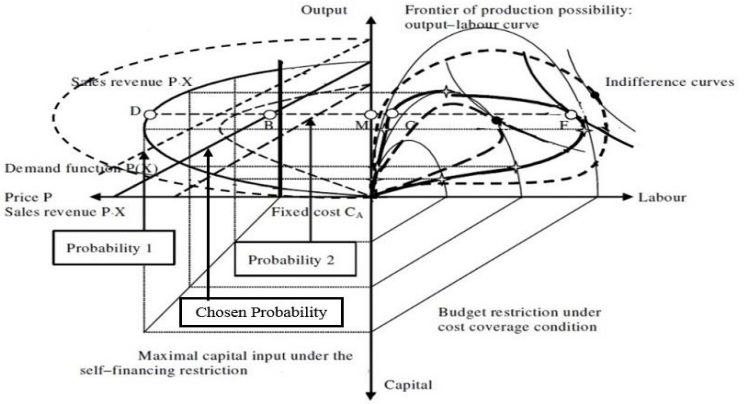

Figure 6. The model considering risk for current operation stage
Source: Friedrich, Ukrainski 2013, p. 45.

4.6. The Model Considering Internal Self-administrative Structures

When analysing the current operation model it was assumed that the members only intervene by formulating the cost coverage rule, which must be followed by the management. The management freely chooses the solution it prefers, determining the output. However, according to stipulations fixed in the statute of the FOCJ it might also be possible that **management directly influences the output** through decision-making power. In this case, the management has to follow the wishes of the members directly by following an order, or it might be necessary to negotiate the solution and the volume of output. For these purposes, utility function of the members, which is related to the volume of output and minimum utility of the management, is introduced into the model. This leads to Figure 7 where in the second quadrant the demand function and the minimum utility function of the management are introduced. The minimum function of the management shown in this quadrant corresponds with the minimum utility indifference curve U_{MAmin} of the management in the first quadrant. If this minimum utility is not reached, the management quits its activities. Therefore, the solution space presented by the thick line is only available between A and C. The best solution for the management is at B, and the best solution for the members is at A. Therefore, the more powerful member position would be to order volume A. If the management could decide freely, it would choose point B. If the members and the management determine the output by bargaining, then they negotiate a solution between A and B. Figure 8 can also illustrate this where the vertical axis is dedicated to the utility of the members, and the horizontal axis shows the utility of management. The utility transformation line AB highlights the Pareto optimal combination of utility of both partners. Applying the concept of maximizing the Nash product to find a negotiation solution leads to point D (Figure 8) where the highest reachable indifference curve of the set of Nash product indifference curves can be attained.

Internal self-administrative structures can be modelled in this way.

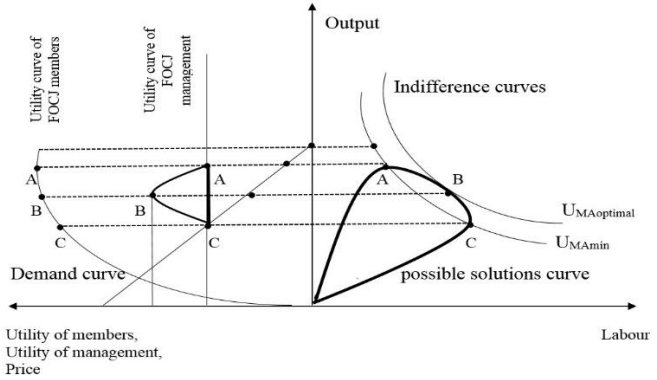

Figure 7. Internal self-administrative structures of FOCJ with minimum requirement of management utility
Source: compiled by the authors.

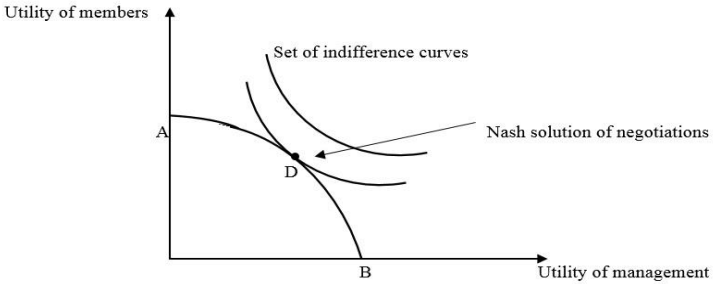

Figure 8. Nash solution of negotiations between management and members of the FOCJ Source: compiled by the authors.

In some statutes according to the legal form of the FOCJ, the members may directly or through a supervisory board **determine the management by voting**. If there is the minimum output necessary to be re-elected, then there is a minimum utility and output which will be offered to the members by the management. The election process should also consider the minimum utility of management and the restriction induced by the cost coverage requirement and the minimum utility for the management to keep it active. Therefore, an output higher than A (in Figure 9), the maximum possible, which the solution space allows, is not feasible. An output smaller than B does not influence the decision for optimal output in the sense of management. In contrast, a minimum output requirement like E does not allow the management to reach its best situation B. The best positon for the management in this case is then the solution E. If there are still negations between management and members then the negotiation corridor is between E and A. For these negotiations in Figure 10 the Nash product solution is attained at point F, and in Figure 9 in F as well. In this way, also a democratic structure and its effects on management can be demonstrated.

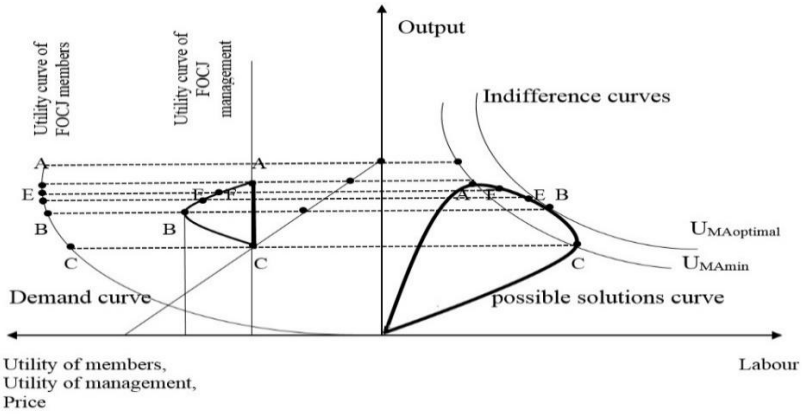

Figure 9. Internal self-administrative structures of FOCJ with minimum requirement of output and utility of management
Source: compiled by the authors.

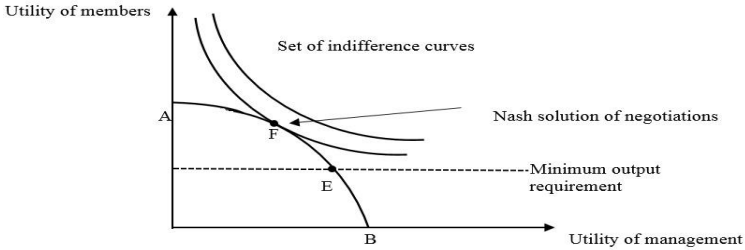

Figure 10. Nash solution of negotiations between management and members of the FOCJ with minimum output requirement
Source: compiled by the authors.

5. Conclusion

Four types of FOCJ have been defined. Standard models for the establishment, current operation and competition, especially for type II, have been evolved. These standard models can also be applied for other types of FOCJ, but then the standard models must be adjusted according to the kinds of membership and the utility functions of the actors. If a higher rank jurisdiction participates in the FOCJ, the number of FOCJ members normally changes as well as their share in equity capital. The standard models have been extended by considering the financial influence of a third actor like a provincial or central government, which may intervene through providing non-negotiable grants in the phases of establishment, current operation and competition for members. The case of a negotiable grant has been tackled as well. The output and grant size was negotiable. A solution according to the Nash solution for cooperative games was found, where the Nash product is maximized. How demand risk influences

the solutions in the framework of the current operation model was elaborated. The authors also point to the effects of a democratic structure by considering internal decision makers like representative bodies of members and the management. Appropriate changes to the current operation model show the effects of determining the management by votes on output decisions, on contribution levied, on output, on labour input, and the utilities of the decision makers. Therefore, the **management theories presented** tackle many management issues and how they can be incorporated in the microeconomic theory of FOCJs.

They offer many opportunities to elaborate supply function for products and demand functions for factors, and to integrate them in goods and supply markets. The models shown concentrated on the monopoly case of the FOCJ with respect to service supply. However, it is also possible to model other forms of competition in the model of current operations, when the FOCJ has to compete against other FOCJs or against private firms. The first attempts have been shown (Friedrich, Ukrainski 2013, pp. 53-55) by introducing oligopolistic competition. **Extensions** by linking oligopolistic competition with the other situations dealt with here should follow. Further extensions concern the consideration of quality issues. The models presented here may serve to analyse political situations of intermunicipal cooperation.

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