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Preliminary communications
UDK: 65.012.34
657.47
004.7.003

ESTIMATING BARGAINING POWER IN LOGISTIC SUPPLY CHAINS – A NETWORK APPROACH

The logistic systems are undergoing a rapid technological revolution towards the 21st century. New technologies are being developed and adopted in each mode of logistic supply chains as well. One of the most important single factors affecting all modes is, of course, information technology. In our view, information technology has a capability of affecting all the logistic modes in the similar way. These technologies in the form of electronic data interchange have begun to reduce the information and communication costs related to logistic decision making.
In our paper we first introduce a network analysis-based model, which makes it possible to focus on the relations among individual and non-individual logistic actors and their informational attributes. The model represents a clear view about the structure of the logistic communications network, thus enabling to describe the contribution of a network position to the relevance, influence, prominence and, most importantly, bargaining power of any actor functioning in the network. Different mathematical coefficients measuring bargaining power and interconnected relations are derived.
The last part of the paper combines these power coefficients with some basic ideas arising from modern economics of organization, especially from transaction cost economics (TCE), thus clarifying the mechanisms through which profits derived from logistics operations are to get shared amongst different actors. Some illustrative hints concerning the usage of this model in the empirical context are scrutinized as well.

Key words: bargaining power index, logistic supply change, economics of organization, transaction cost economics.

1. INTRODUCTION

The Coase theorem is one of the cornerstones of modern economic analysis. It shapes the way how economists think about the efficiency or inefficiency of outcomes in economic situations. The message of the Coase theorem is as follows; if property rights are exactly and fully allocated, economic agents will always exhaust any mutual gains from trade. Fully informed rational agents, unless they are not restricted in their bargaining opportunities, will ensure that there are no unexploited gains from trade. When economists face an inefficient outcome of the negotiation between two or more rational parties, they will automatically look for reasons that impede full and frictionless bargaining between them.

Modern *economics of organization* basically offers two explanations for these situations. One can use either the models of *complete* or *incomplete contracting* as explanatory devices (cf. Foss 1999). In the tradition of complete contracting theories start from the ideas that the impediments are due to the divergent risk preferences of the *unboundedly rational* agents and/or due to the asymmetric nature of information. This view again leads to the so-called *principal-agency* models (Jensen and Meckling 1975; Holmström and Milgrom 1994), which are effective tools when analyzing some ex ante incentive alignments questions. In our power-related context the main message from this perspective is that the most powerful agents are often in a position to acquire most relevant information. This again means that they can effectively utilize the asymmetries for their own favor when negotiating about sharing the surplus of joint production between partners.

From the *incomplete contracting* perspective, where the agents' rationality is typically assumed to be *bounded*, the impediments can be traced back either to the *transaction and management costs* (i.e. *governance costs*, see Coase 1937; Williamson 1975; Teece 1986) or to the issues of *property rights* i.e. *ownership* of non-contractible assets, which give rise to power of dictating the distribution of residual surplus of joint production (Grossman and Hart 1986; Hart 1995). The property rights models are useful. Here the main lesson of property rights approach is that in such a situation where there are large power asymmetries the best strategy is to distribute the property rights of residual assets in a way which maximizes the individual contribution of each party. Without this policy the owners of the most valuable assets most likely vote by exiting. From the logistics perspective this means that it is of great importance to regocnize the agents with extraordinary power concentration and let them to dominate ownership issues. Only their threat concerning the potential withdrawal of assets or exit have to be taken seriously.

Another incomplete contracting approach, TCE, also stems arises from the idea of bounded rationality and builds on the Coasean, Williamsonian and Teecean ideas about positive transaction (or more extensively governance) costs as the primary causes of the inefficient outcomes that reflect power asymmetries. The main determinants of power-related transaction costs are (i) *information asymmetries* i.e. information impactnedness between the parties, (ii) *asset specificity* concerning the relational investments, (iii) ownership of strategically important *complementary assets*. As a starting hypothesis one can conclude that the greater the information asymmetries, the higher the asset specificity, and the more inefficient are the markets of complementary assets, the higher are transaction costs involved in the bargaining process and the more likely are power asymmetries between parties (more about the largely neglected role of power in TCE analyses, see Dow 1987). In this paper we put these relationships in a way upside down and argue that if there are high power concentrations to be found they tell us about hidden TCE determinants. This again means that the firms which face such situations have to react in a way consistent with main lessons of TCE. For instance, if a firm notices that its bargaining partner has much more power in the whole system it has to be ready for more integrated cooperative solutions.

A paradigmatic economics of organization case of a bargaining process can be defined as a buyer and seller alternating making offers until an offer is accepted or someone terminates negotiations. Impatience to reach an agreement comes from two sources: the traders discount future payoffs and there are transaction costs of bargaining. Equilibrium behavior involves either immediate trade, delayed trade, or immediate termination, depending on the size of the gains from trade and the relative bargaining costs.. The bargaining process is therefore typically seen as a negotiation process between two isolated parties (cf. Holmström and Roberts 1998).

However, in the real world parties are interdependent, rather than independent, and there are many of them. Relational ties between them are the channels for transfering the material or nonmaterial (informational) resources. In this article we shall discuss the idea that in addition to standard transaction (or governance) costs, also the *structural position* of the parties, is another cause which may give rise to inefficient bargaining outcomes. Our sociologically inspired but economics of organization-targeted *network perspective* differs in a fundamental way from standard economics-related methods, because it views characteristics of the units as arising out of structural or relational processes or focuses on properties of the relational systems themselves. The task is to understand underlying properties of the structural system, and how these structural properties influence observed characteristics and associations among the units. The goal of the analysis is to obtain from the low-level relational data a higher-level description of the structure of the system. The higher-level description then help identify various kinds of patterns in the set of relationships. These patterns will be based on the way how companies are related to other companies in the network. Some approaches to network analysis look for clusters of individuals who are tightly connected to one another; some look for sets of individuals who have similar patterns of relations to the rest of the network.

2. NETWORK PERSPECTIVE

With the recent advent of computer-based communication technologies, communication networks have become an important factor in global interactions. The world in the information age can be described as being connected by a lattice of networks. In fact, information technologies now provide the basic infrastructure for an interdependent world, leading theorists to characterize the world as a "global village". One consequence of modernization is the increase in time-space compression, which makes physical distance increasingly less important in social and business relations. Globalization stretches the boundaries of social and business interactions in a way where all the relevant connections between different social contexts or companies necessarily become networked. This research is grounded in the view that organizations as a matter fact are information processing systems . Organizations design their structure, processes, and information technologies for the purpose of processing, exchanging, and distributing the information required for their functions.

Network analyses focus on the relations among companies, and not individual actors and their attributes. This means that the actors are usually not sampled independently, as in many other kinds of studies (most typically, empirical surveys). The results represent clear view about the structure of the transport communications network, enabling to describe the contribution of a network position to the *importance, influence, prominence and power* of an actor in a network.

A lot of theoretical research on network structures has emerged over the last 25 years Cook 1977; Granovetter 1985; ;). These theoretical perspectives include ideas about resource dependence and related exchange theories, contagion theories, cognitive theories, and theories of networks and organizational forms. These diverse theories are unified in part through the use of the so-called *social network analysis* that is based on the graph theory and by a common interest in structure derived from observable actions of individuals. The social network analysis assumes that the network measurements are of central importance. In terms of this theory the following statements can be complied:

- The structural position of a company is a result of its interactions with other companies;
- The structural position of a company determines its potential for development and its interaction patterns;
- The structural position of a company defines a series of measurements identifying the relevance, influence, prominence and, most importantly, bargaining power.
- There are two kinds of semiperiphery companies: (i) core-like company, which are developing core-like dominance within the system; and (ii) periphery-like company which are losing their major dominance in the system.

Main unit of the analysis is a network. A network can be viewed in several ways. One of the most useful views is as a graph, consisting of nodes joined by directed lines. A graph Γ consists of a two sets of information: a set of a nodes $\eta = \{n_1, n_2, \ldots, n_g\}$, and a set of lines $\lambda = \{ l_1, l_2, \ldots, l_L\}$ between pairs of nodes. There are g nodes and L lines. In a graph each line is an ordered pair of distinct nodes $l_k = <n_i, n_j>$. We will exclude a reflexive line, or loop , between a node and itself $<n_i, n_i>$. The graph with node set η, and line set λ will be denoted as Γ (η,λ).

The graph can be also presented by a diagram in which points depict nodes, and a line is drawn between two points if there is a line between the corresponding two nodes in the set of lines η, λ.

The information in the graph Γ (η,λ) may also be expressed in a variety of ways in a matrix form. Especially useful is adjacency matrix μ of size $g \times g$. The entries in the matrix $x_{i,j}$ record which pairs of nodes are adjacent, ie $x_{i,j} = 1$ if exists $l_k = <n_i, n_j>$, and $x_{j,i} = -1$ if exists $l_k = <n_i, n_j>$ and does not exist $l_k = <n_j, n_i>$, otherwise $x_{i,j} = 0$. It is possible that the cell $x_{i,j}$ has value different than $\{0,-1,1\}$, but in that case the incidence matrix becomes attribute-incidence matrix μ with cells defined as $z_{i,j}$.

Using this approach one can now define a plethora of parameters, indicating behaviour of one node, multiple nodes (diads, triads, groups) and a network as a whole. Some of the parameters can be used in *power calculations*, and hence they will be next defined.

Degree of the node denoted by $d(n_i)$ is the number of lines that are incident with it. We can also consider a number of a lines in a graph as a whole. The proportion of possible the lines that are actually present in the graph is called *density* of the graph D_g. The standard deviation of the degrees is calculated as:

$$S_d = \sqrt{\frac{\sum_{i=1}^{g}(d(n_1) - \frac{l}{g}}{g}}$$

Next parameter in use is *distance* between two nodes. The length of a path is the number of edges it contains. The distance between two nodes is the length of the shortest path and is defined as:

$U_{dn}(i,k) = \min(\sum_{j=1}^{g}\sum_{i=1}^{g} k(n_i,n_k))$ *where* $k(n_i,n_k) = 1$ *if* node is between n_1 and n_k, otherwise 0;

The *generalised distance* is the length of an optimum path n. For purpose of power calculation the distance has to be normalized in exponential way:

$U_d(i,k) = 2^{-U_{dn}(j,k)}$, so that the distant nodes will have smaller distance measure.

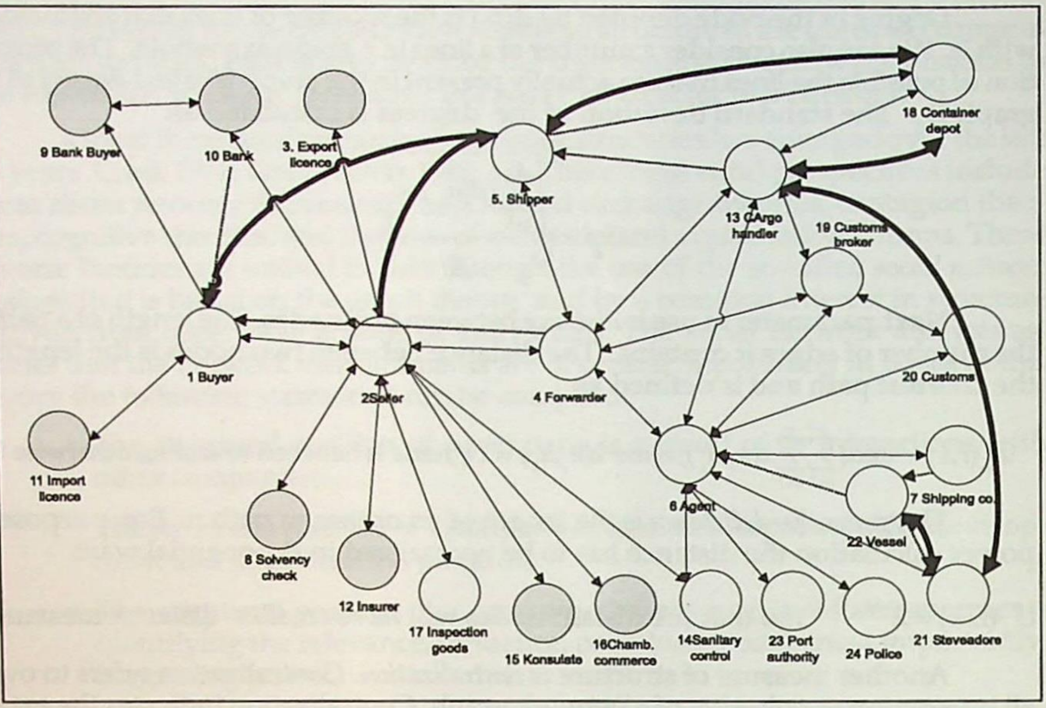
Another measure of structure *is centralization.* Centralization refers to overall integration or cohesion of a network graph. Centralization indicates the extent to which a graph is organized around its most central point.. Actors who have more ties have greater opportunities because they have choices. This autonomy makes them less dependent on any specific other actor, and hence more powerful. The more ties an actor has then, the more power they (may) have. For example if actor A has more ties, and actor B is tied only with A, if B elects to not provide A with a resource, A has a number of other actors to go to get it, but if B elects to not exchange with A, then B will not be able to exchange at all. Formula for the calculation of the *degree centrality* is:

$$C_D(n_i) = \frac{\sum_{j=1}^{g}\left|x_{i,j}\right|}{g-1}$$

For a graph one can define two different types of degree centrality : in-degree C_{di} and out-degree C_{do} centrality. In addition, if the data is valued then the degrees (in and out) will consist of the sum of the values of the ties. The normalised degree centrality is the degree divided by the maximum possible degree expressed as a percentage.

3. CASE STUDY – NETWORK REPRESENTATION OF LOGISTIC SUPPLY CHAIN

Now we are to go our numerical illustrative example in order to clarify our power indexes. The units of the analysis are transportation documents (relations) and companies (actors). Relations are characterized by content, direction and strength. The content of a relation refers to the resource that is exchanged. Picture 1 below illustates the structure of the example.



Picture 1. Graph representation of the model.

The logistic flows illustrated in our Picture 1. 1 describe the actors through whom transportation-related material and nonmaterial flow. The basic categories of our logistic model, whose numerical representation can be found in addendum at the end of the paper, are as follows

Node Categories. Nodes (the companies) in the transport and supply chain are categorized and idealized in order to present normalized tasks in use. 24 different normalized actors were selected for the model. In order to simplify the graphical presentation of the network, graph has been shown at picture

Relation Categories. Relation categories were derived from a content analysis of the documents interchanged in the transport and supply chain. From more than 200 different documents , 103 are used in model.

Network Structure. The structure of the network is shown at picture 1. Arrow at the end of the line represents the direction of the tie. Network is structured with 103 from 552 possible ties, having thus an average tie density of 19%, with standard deviation of 0,65 indicating heterogeneous distribution of the tie densities in the network.

Distance between companies is calculated using the minimal path between them, attenuated exponentially. For each pair of nodes, the algorithm finds the number of edges in the shortest path between them.

	1 P1	2 P2	3 P3	4 P4	5 P5	6 P6	7 P7	8 P8	9 P9	10 P10	11 P11	12 P12	13 P13	14 P14	15 P15	16 P16	17 P17	18 P18	19 P19	20 P20	21 P21	22 P22	23 P23	24 P24
1 P1	1.00	0.25	0.03	0.06	0.03	0.06	0.02	0.50	0.13	0.50	0.13	0.03	0.13	0.13	0.13	0.13	0.06	0.03	0.03	0.00	0.03	0.03	0.03	0.03
2 P2	0.25	1.00	0.13	0.25	0.13	0.25	0.06	0.13	0.50	0.13	0.50	0.13	0.50	0.50	0.50	0.50	0.25	0.13	0.13	0.02	0.13	0.13	0.13	0.13
3 P3	0.06	0.25	1.00	0.06	0.03	0.06	0.02	0.03	0.13	0.03	0.13	0.03	0.13	0.13	0.13	0.13	0.06	0.03	0.03	0.00	0.03	0.03	0.03	0.03
4 P4	0.13	0.50	0.06	1.00	0.06	0.13	0.25	0.06	0.25	0.06	0.25	0.25	0.25	0.25	0.25	0.25	0.13	0.50	0.06	0.01	0.06	0.06	0.06	0.06
5 P5	0.06	0.25	0.03	0.06	1.00	0.06	0.02	0.03	0.13	0.03	0.13	0.03	0.13	0.13	0.13	0.13	0.50	0.03	0.03	0.00	0.03	0.03	0.03	0.03
6 P6	0.06	0.25	0.13	0.25	0.13	1.00	0.25	0.03	0.13	0.03	0.13	0.50	0.50	0.13	0.13	0.13	0.25	0.13	0.50	0.06	0.50	0.50	0.50	0.50
7 P7	0.02	0.06	0.01	0.02	0.25	0.02	1.00	0.01	0.03	0.01	0.03	0.01	0.03	0.03	0.03	0.03	0.13	0.01	0.01	0.00	0.01	0.01	0.01	0.01
8 P8	0.13	0.50	0.06	0.13	0.06	0.13	0.03	1.00	0.25	0.06	0.25	0.06	0.25	0.25	0.25	0.25	0.13	0.06	0.06	0.01	0.06	0.06	0.06	0.06
9 P9	0.50	0.13	0.02	0.03	0.02	0.03	0.01	0.25	1.00	0.25	0.06	0.02	0.06	0.06	0.06	0.06	0.03	0.02	0.02	0.00	0.02	0.02	0.02	0.02
10 P10	0.50	0.25	0.03	0.06	0.03	0.06	0.02	0.50	0.13	1.00	0.13	0.03	0.13	0.13	0.13	0.13	0.06	0.03	0.03	0.00	0.03	0.03	0.03	0.03
11 P11	0.50	0.13	0.02	0.03	0.02	0.03	0.01	0.25	0.06	0.25	1.00	0.02	0.06	0.06	0.06	0.06	0.03	0.02	0.02	0.00	0.02	0.02	0.02	0.02
12 P12	0.13	0.50	0.06	0.13	0.06	0.13	0.03	0.06	0.25	0.06	0.25	1.00	0.25	0.25	0.25	0.25	0.13	0.06	0.06	0.01	0.06	0.06	0.06	0.06
13 P13	0.06	0.25	0.25	0.50	0.25	0.06	0.13	0.03	0.13	0.03	0.13	0.13	1.00	0.13	0.13	0.13	0.50	0.25	0.03	0.00	0.03	0.03	0.03	0.03
14 P14	0.13	0.50	0.06	0.13	0.06	0.50	0.13	0.06	0.25	0.06	0.25	0.25	0.25	1.00	0.25	0.25	0.13	0.06	0.25	0.03	0.25	0.25	0.25	0.25
15 P15	0.13	0.50	0.06	0.13	0.06	0.13	0.03	0.06	0.25	0.06	0.25	0.06	0.25	0.25	1.00	0.25	0.13	0.06	0.06	0.01	0.06	0.06	0.06	0.06
16 P16	0.13	0.50	0.06	0.13	0.06	0.13	0.03	0.06	0.25	0.06	0.25	0.06	0.25	0.25	0.25	1.00	0.13	0.06	0.06	0.01	0.06	0.06	0.06	0.06
17 P17	0.13	0.50	0.06	0.13	0.06	0.13	0.03	0.06	0.25	0.06	0.25	0.06	0.25	0.25	0.25	0.25	1.00	0.06	0.06	0.01	0.06	0.06	0.06	0.06
18 P18	0.06	0.25	0.03	0.06	0.03	0.06	0.02	0.03	0.13	0.03	0.13	0.50	0.13	0.13	0.13	0.13	0.06	1.00	0.03	0.00	0.03	0.03	0.03	0.03
19 P19	0.06	0.25	0.06	0.50	0.06	0.50	0.13	0.03	0.13	0.03	0.13	0.25	0.25	0.13	0.13	0.13	0.13	0.25	1.00	0.13	0.25	0.25	0.25	0.25
20 P20	0.03	0.13	0.06	0.13	0.06	0.50	0.13	0.02	0.06	0.02	0.06	0.25	0.25	0.06	0.06	0.06	0.13	0.06	0.25	1.00	0.25	0.25	0.25	0.25
21 P21	0.01	0.03	0.02	0.03	0.02	0.13	0.03	0.00	0.02	0.00	0.02	0.06	0.06	0.02	0.02	0.02	0.03	0.02	0.06	0.01	1.00	0.50	0.06	0.06
22 P22	0.02	0.06	0.03	0.06	0.03	0.25	0.06	0.01	0.03	0.01	0.03	0.13	0.13	0.03	0.03	0.03	0.06	0.03	0.13	0.02	0.13	1.00	0.13	0.13
23 P23	0.03	0.13	0.06	0.13	0.06	0.50	0.13	0.02	0.06	0.02	0.06	0.25	0.25	0.06	0.06	0.06	0.13	0.06	0.25	0.03	0.25	0.25	1.00	0.25
24 P24	0.03	0.13	0.06	0.13	0.06	0.50	0.13	0.02	0.06	0.02	0.06	0.25	0.25	0.06	0.06	0.06	0.13	0.06	0.25	0.03	0.25	0.25	0.25	1.00

Table 1. Distance between companies

The next step now is to calculate the values of our power indexes. This can be done in the following way.

Degree Centralization.. One can distinguish in and out degree centrality, depending of the number of the received and dispached documents In our illustrative example there are three powerful actors that have the biggest centrality value: agent , freight forwarder and seller, having normalised out and in degree centrality by value 78.26 , 60.87 ; 69.57, 60.87 and 65.22 , 60.87 respectively (see Table 2 below).

	OutDegree	InDegree	NrmOutDeg	NrmInDeg
1 P1	5.00	6.00	21.74	26.09
2 P2	15.00	14.00	65.22	60.87
3 P3	2.00	6.00	8.70	26.09
4 P4	16.00	14.00	69.57	60.87
5 P5	6.00	8.00	26.09	34.78
6 P6	18.00	14.00	78.26	60.87
7 P7	2.00	4.00	8.70	17.39
8 P8	1.00	2.00	4.35	8.70
9 P9	1.00	1.00	4.35	4.35
10 P10	4.00	1.00	17.39	4.35
11 P11	1.00	1.00	4.35	4.35
12 P12	1.00	8.00	4.35	34.78
13 P13	8.00	2.00	34.78	8.70
14 P14	2.00	1.00	8.70	4.35
15 P15	1.00	1.00	4.35	4.35
16 P16	1.00	1.00	4.35	4.35
17 P17	1.00	2.00	4.35	8.70
18 P18	1.00	3.00	4.35	13.04
19 P19	7.00	4.00	30.43	17.39
20 P20	4.00	7.00	17.39	30.43
21 P21	4.00	1.00	17.39	4.35
22 P22	2.00	2.00	8.70	8.70
23 P23	1.00	1.00	4.35	4.35
24 P24	1.00	1.00	4.35	4.35

Table 2. Centralization degrees of different actors

4. DEFINING BARGAINING POWER

Now we are ready to introduce our bargaining power interpretation into the our framework. For definition of the bargaining power in the networked system let us assume following model:

$$P_1 = \xi_{12} P_2 + \xi_{13} P_3 + \ldots + \xi_{1n} P_n + \mu_1$$
$$P2 = \xi_{21} P_1 + \xi_{13} P_3 + \ldots + \xi_{2n} P_n + \mu_2$$
$$\ldots$$
$$P_n = \xi_{n1} P_1 + \xi_{n2} P_2 + \ldots + \xi_{nn} P_n + \mu_n$$

Where P measures bargaining power, ξij is a parameter representing the bargaining power matrix due to the structural position of the firm in the network (ξii = 0), and μ_i is the parameter representing bargaining power due to economic conditions. The model can now be defined in matrix form simply as **P= ξP+μ**.

In this paper we propose that the network bargaining power will be representing in terms of matrix ξ. We further assume that the external economic conditions power matrix μ is a null matrix. The network approach emphasizes that power is inherently relational. An individual does not have power in any abstract form, they have power if and only if they can dominate over others — one's power is alter's dependence, and vice versa.

The bargaining power matrix consists of two parts. Main part is the degree of centralization vector for all companies in network. Generally, though, companies that are more central to the structure, in the sense of having higher degree or more connections, tend to have favored positions, and hence *more power*. The centralization vector is average of in- and out- degree network parameters i.e. $C_d = (C_{di}+C_{do})/2$.

The second part of the network bargaining power is matrix defining the distance between the nodes (companies) in the network, and thus the dissipation of the power in the network. As the distance matrix has $U_d(i,i)=1$ and no one uses power over itself, the identity matrix has to be subtracted from network bargaining matrix in order to have null reflexive power index.

Based on previous definitions the bargaining power matrix can be defined as follows:

$$\begin{bmatrix} \xi_{11} & \xi_{12} & \cdots & \xi_{1n} \\ \xi_{21} & \xi_{22} & \cdots & \xi_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \xi_{n1} & \xi_{n2} & \cdots & \xi_{nn} \end{bmatrix} = \left(\begin{bmatrix} U_{d11} & U_{d12} & \cdots & U_{d1n} \\ U_{d21} & U_{d22} & \cdots & U_{d2n} \\ \cdots & \cdots & \cdots & \cdots \\ U_{dn1} & U_{dn2} & \cdots & U_{dnn} \end{bmatrix} - \begin{bmatrix} 1 & 0 & \cdots & 0 \\ 0 & 1 & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots \\ 0 & 0 & .. & 1 \end{bmatrix} \right) \begin{bmatrix} \frac{d_{1i}+d_{1o}}{2} \\ \frac{d_{2i}+d_{2o}}{2} \\ \cdots \\ \frac{d_{ni}+d_{no}}{2} \end{bmatrix}$$

In terms of this bargaining power matrix we can now calculate "power indexes", which make it possible to derive empirical conclusions about the issues, which have traditionally proved to be very hard to grasp from the empirical point of view.

It is well known that the empirical content of the complete/incomplete contracting theories is rather undeveloped unless we do not analyze the paradigmatic hold-up problem. Our network-based measurement approach opens up new perspectives to measure the power concentrations and to reveal, who has got bargaining power and, hence, an ability to pick up the biggest share out of the surplus of joint venture production.

5. CONCLUSIONS

Our network approach emphasizes that power is *inherently relational* and therefore very relevant in logistic networks as well. In terms of our framework we can utilize insights arising from different economics of organization-related approaches (*principal-agency, property rights and transaction cost*) and look at different factors which may give rise to power in networks. The sources of power are asymmetric information, differences in risk avertness, asset specificity, ownership of strategically important complementary assets, etc. Different approaches also highlight different aspects, which have to be taken into account when formulating a firm's strategic options.

Our network approach shows that there is no such thing as abstract power. The firm has power only if it is able to dominate over other firms – one's power is alter's dependence, and vice versa. In logistic systems this means that the most powerful firms can capture a lion's share of the joint surplus. If the other firms cannot realize this fact they will lose the bargaining game. Especially from the point of view of the smaller firms it is important to recognize that in face of power asymmetries it is quite necessary to step into more (vertically) integrated inter-firm arrangements or to develop such arrangements through which the other party will become dependent. The more equally the power between different parties is distributed, the more advisable it is to use open market options (outsourcing, licensing, etc.).

- According to our approach power can be regarded both as a systemic (macro) and relational (micro) property. From the logistic point of view, it is important to notice that the firms manage to position themselves in their complicated supply chains. In order to be able to do this rightly, they have to clearly analyze underlying micro and macro power relations.
- The amount of power in the whole system and it's distribution across companies are related. Since power is a relational concept a firm has to think about the whole logistic power system, not only its closest partners as usual Only through this more holistic knowledge a firm can rightly evaluate its strengths and weaknesses as to the threat for losing ground in logistic bargaining processes.
- In this paper the authors have proposed some measures of the bargaining power. We hope that in terms of tools like these, it becomes easier to evaluate the position of a firm in any logistic value chain.
- Our claim is that recent economics of organization theories suffer from the lack of empirically measurable concepts (the concepts relevant for "the paradigmatic hold up"-problem are noteworthy exceptions, see Williamson 1999). Our modest aim was in a minor scale to overcome this gap between theory and practice.

- The case study about power in an illustrative logistic supply chain network was exposed in order to reveal the network parameters used in bargaining power calculations.
- The next step in our research project will be the utilization of real empirical data in order to look at the temporal and geographical shifts in the power structures of European transport networks.

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Addendum 1.
Actors and attribute-incidence matrix which characterize the transport-related actors and their role in our illustrative example.

	Actor		Actor
P1	Buyer	P13	Cargo handler
P2	Seller	P14	Sanitary control
P3	Export licence	P15	Consulate
P4	Freight forwarder	P16	Chamber of commerce
P5	Carrier	P17	Inspection of goods
P6	Agent	P18	Container depot
P7	Shipping company	P19	Customs broker
P8	Solvency check	P20	Customs
P9	Bank (buyer)	P21	Steveadore
P10	Bank (seller)	P22	Vessel
P11	Import licence	P23	Port administration
P12	Insurer	P24	Police

0	3	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	2	4	0	0	0	1	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0
0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	4	0	0	4	2	0	0	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	5	0	0	2	0	0	0	0	1	1	0	0	0	0	0	1	4	1	1	1	1
0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sažetak

PROCJENA SNAGE PREGOVARANJA U LOGISTIČKIM SUSTAVIMA – MREŽNI PRISTUP

Logistički sustavi prolaze kroz brzu tehnološkun revoluciju koja ih vodi ka 21. stoljeću. Nove tehnologije razvijaju se i primjenjuju unutar svakog moda logističkog sustava. Jedan od najvažnijih pojedinačnih čimbenika koji utječe na sve modove jest informacijska tehnologija koja je u obliku elektroničke razmjene podataka počela smanjivati informacijske i komunikacijske troškove, posebice povezane s logističkim odlučivanjem.

U ovom se članku uvodi mrežni model koji omogućava usredotočenje na veze između individualnih i skupnih logističkih činitelja i njihovih informacijskih značajki. Model predstavlja jasan pogled u strukturu logističke komunikacijske mreže, i time omogućava uvid u djelovanje pozicije unutar mreže na relevantnost, utjecaj, važnost i, što je najvažnije, na snagu pregovaranja bilo kojega činitelja koji djeluje unutar mreže. U radu su prikazane različite matematičke mjere snage pregovaranja i njezinih odnosnih veza.

Na kraju se u članku spajaju mjere snage s osnovnim idejama koje proizlaze iz suvremene ekonomije organizacije, a posebice iz ekonomije transakcijskih troškova, rasvjetljavajući načine na koje se dobit iz logističkih operacija dijeli među činiteljima logističke mreže. Zaključak sadrži pomno analizirane natuknice o primjeni ovog modela u empirijskom kontekstu.

Ključne riječi: indeks snage pregovaranja, logistički dobavni lanac, ekonomija organizacije, ekonomija transakcijskih troškova.