Network Effects on the Dynamics of Slovenian Corporate Ownership Network

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1 Introduction

Social networks represent relations (e.g. friendship, esteem, control, etc.) between actors (e.g. individuals, companies, etc.). Social network analysis is a set of mathematical and statistical techniques that deal with relational data (see e.g. Scott (1999) or Wasserman and Faust (1994)). Complete networks are considered in this paper, i.e. a set of n actors and a relation defined with an $n \times n$ matrix $X = (x_{ij})$ where $x_{ij}$ represents the directed relation from actor $i$ to actor $j$ ($i, j = 1, \ldots, n$).

Traditionally we deal with cross section network, i.e. observation of a network in one point in time. The data can still be gathered through a longer time period (e.g. a year), however the resulting network is always one. A wide array of techniques has been developed to describe and understand the structure of social networks and the role of actors within it.

In this paper we deal with longitudinal data on entire network. The data available is a time-series $x(t); t \in (t_1, \ldots, t_8)$ of social networks for a constant set of actors. The observation times are ordered, i.e., $t_1 < t_2 < \ldots < t_8$. The purpose of the statistical analysis is to obtain an insight in the evolution of the network, where the initial state $x(t_1)$ is taken for granted. Markov Chain Monte Carlo methods, developed by Snijders (1996) are used to test a stochastic actor-oriented model, with which we try to understand drivers of change in the network.

Although primarily developed in sociology, social network analysis has found many applications in economic and business sciences. When actors in a network are some sort of economic entities (companies, countries, etc.) we talk about economic networks. Following the division of economics into microeconomics and macroeconomics we can identify two main levels of economic networks:

- micro-level networks; typical actors in this level of networks are companies, parts of companies, departments, etc. Relations of interest are typically ownership relations (companies owning shares in each other), governance and control (between companies, departments), financial relations, production chain relations, etc. On this level corporate networks are of special interest. Corporate network is a network that describes relations between companies.
  - macro-level networks typically involves countries, regions, sectors, industries, etc. and the relations examined are trade, investments, financial flows, etc.

In this paper we start looking at the reasons that drive companies in Slovenia (financial and non financial) into the activity in ownership network. In this paper, only the effects that deal with network structure are examined and we just control for a company being a financial or non-financial and the relative size of the company.

Following this introduction first the corporate network in Slovenia will be described.
Next we present the techniques used to examine the data, followed by the description of data used. After the presentation of empirical results we will conclude.

2 Corporate network in Slovenia

In the 1990-ies Slovenia as other post-socialistic countries underwent the process of transition. Before the transition, we couldn’t talk about the corporate network in the traditional meaning of this word (see e.g. Mizruchi, 1982), as in Slovenia as in other parts of the former Yugoslavia companies were mostly “socially owned” ans self-managed. “Social capital self managed-firm” was a construct specific for the form of market-planed economy that was in act in former Yugoslavia. Companies were essentially owned by no-one (or every one, whichever one prefers) and formally controlled by its employees, so there couldn’t be any ownership or governance network present.

Some sort of economic network between companies still existed. There were of course the supply chain network, and there also existed a network formed by banks and companies. Companies owned banks that serviced their financial needs. This network was politically influenced and locally based and mostly disappeared with the sanation of the bank system in mid-1990.

In the privatization process corporations also appeared in the Slovenian economy. Former social capital took on new owners as prescribed by the privatization law. Each company chose a privatization model that best suited it; whereupon it could give more stress to either internal or external ownership. After the formal process of privatization was finished, trading in shares began. Today, stocks are being traded in the organized market of the Ljubljana Stock Exchange (LSE), where mostly smaller investors trade. Institutional investors (i.e. privatization and other funds) trade mostly over-the-counter in large, package deals. The beginning of trade has opened up possibilities for other companies to become owners, to acquire companies and merge with them and to thereby form a corporate network.

As described in Pahor et al. (2000), financial institutions play a central role in the Slovenian corporate network. Only one large group of companies has so far formed around a core of financial institutions. Companies in this group have developed cross ownership and a hierarchical structure of control. Forming of groups and structures within them is common for traditional economies, but we usually observe several of such groups. By offering a complete range of financial services, they tend to reduce uncertainty for companies participating in the cluster.

\[1\] The 1992 Privatization Law allocated 20 percent of a firm’s shares to insiders (workers), 20 percent to the Development Fund that auctioned the shares off to investment funds, 10 percent to the National Pension Fund, and 10 percent to the Restitution Fund. In addition, in each enterprise the worker’s council or board of directors (if one existed) was empowered to allocated the remaining 40% of a company’s shares for sales to insiders (workers) or outsiders (through a public tender). Based on the decision on the allocation of this remaining 40 percent of shares, firms can be classified as being privatized to insiders (the internal method) or outsiders (the external method).
3 Methodology used

The methodology used to establish the network effects on the dynamics of corporate ownership network in Slovenia is the stochastic actor-oriented model, developed by Snijders (2001).

Longitudinal social network data are a complex data structure, requiring complex methods of data analysis for a satisfactory treatment. Holland and S. (1977) already proposed to use continuous-time Markov chains as a model for longitudinal social networks. In a continuous-time model, time is assumed to flow on continuously, although observations are available only at the discrete time points $t_1$ to $t_M$, and between the observations the network is assumed to change unobserved at random moments as time progresses.

We have $n$ actors and a relation defined with the sociomatrix, which is an $n \times n$ matrix $X = (x_{ij})$ where $x_{ij}$ represents the directed dichotomous relation from actor $i$ to actor $j (i, j = 1, \ldots, n)$. Network evolution, defined as the change in $X$ between time periods $t_m$, is a function of structural (or network) effects, explanatory actor variables and explanatory dyadic variables.

We talk about actor-oriented models, so the main assumption is that the actor is able to control its outgoing relations, which are represented by the rows of the sociomatrix. In the model, actors act independently from each other, one at the time and have a perfect knowledge of the current network. They are struck with “myopia” meaning that they only try to improve their present situation and are not following any strategy.

If we briefly consider the viability of this assumptions for the corporate ownership network in Slovenia we can see, that they are reasonably well met. Full information about the network is available to anyone (as we will see later in the description of data), there is only the question of the costs - data is available to some actors at lower costs than to the others. Actors (companies) are mostly independent, there is no network-wide coordination among them, there could however be some group-wide coordination present. Given short enough times the assumption of actors acting one at the time is well met. The only violated assumption is that of the myopic behavior of actors - at least some of them have a strategy that they follow.

Each time an actor acts a “mini-step” occurs and this happens at stochastic times (with rate function $\lambda$). In a mini step actor $i$ changes his relation with actor $j$ in order to maximize his objective function $f$.

3.1 Formal definition

The objective function is denoted by

$$f_i(\theta, x), \ i = 1, \ldots, n, \ x \in X,$$

and indicates the degree of satisfaction for actor $i$ inherent in the relational situation represented by $x$. This function depends on a parameter vector $\theta$. In the simple model specification of this section, the parameter of the statistical model is $\theta = (\beta, \rho)$, where $\rho = (\rho_1, \ldots, \rho_{M-1})$ is the vector of change rates during the time periods from $t_m$ to $t_{M}$.

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1 Snijders (2001)
At random times \( i \) has the opportunity to change its relation with \( j \), which is selected in a way to maximize the objective function plus a random element

\[
f_i(\beta, x(i \rightarrow j)) + U_i(t, x, j),
\]

where \( U_i \) is a random variable, indicating the part of actor’s preference not present in the systematic component \( f_i \). The probability of actor \( i \) choosing the actor \( j \) for changing the relation \( x_{ij} \) is multinominal logit expression

\[
p_{ij}(\theta, x) = \frac{\exp(f(i, j))}{\sum_{h=1, h \neq i}^{n} \exp(f(i, h))}, \quad (i \neq j)
\]

\( X \) follows a continuous time Markov chain, where only discrete time observations are visible. Changes occur one at the time following the intensity matrix, represented by functions

\[
q_{ij}(x) = \lim_{dt \to 0} \frac{P\{X(t + dt) = x(i \rightarrow j) \mid X(t) = x\}}{dt}
\]

Computer simulation of the process follows the algorithm

1. Set \( t = 0 \) and \( x = X(0) \)
2. Generate \( S \) according to the negative exponential distribution
   \[ 1/\lambda_+(\theta, x) \]\n   where \( \lambda_+(\theta, x) = \sum_i \lambda_i(\theta, x) \)
3. Select \( i \) using probabilities \( \frac{\lambda_i(\theta, x)}{\lambda_+(\theta, x)} \)
4. Select \( j \) using probabilities \( p_{ij}(\theta, x) \)
5. Set \( t = t + S \) and \( x = x(i \rightarrow j) \)
6. Go to step 2 (unless stopping criterion is satisfied)

The objective function reflects the structural properties of the network as well as actor-dependent covariates and dyadic covariates. The objective function can be defined as:

\[
f_i(\beta, x) = \sum_{k=1}^{L} \beta_k s_{ik}(x),
\]

where \( \beta_k \) are statistical parameters indicating the strength of the effect \( s_{ik} \), controlling for all other effects in the model. \( s_{ik}(x) \) are relevant functions of the digraph that are supposed to play a role in its evolution.

\( s_{ik}(x) \) can be defined at will with an infinite number of possibilities, here are some examples of possible network effects, as listed by Snijders (2001) with a rationale for their use in a corporate ownership network:
1. Density effect, defined by the out-degree

\[ s_{i1}(x) = x_{i+} = \sum_j x_{ij} \]

This effect shows the general tendency to increase the number of links. In an ownership network this shows the general tendency of a rational investor to place excess funds in a well-diversified portfolio.

2. Reciprocity effect, defined by the number of reciprocated relations

\[ s_{i2}(x) = \sum_j x_{ij}x_{ji} \]

Shows the tendency of actors to reciprocate relations - this effect will be important if there is an inbound relation from \( j \) to \( i \), \( i \) will tend to establish the relation from \( i \) to \( j \). In an ownership network the importance this effect could have two rationales - whether companies are forming groups of mutually interconnected firms or this a defense measure against takeovers.

3. Popularity of alter effect, defined by the sum of the in-degrees of the others, to whom \( i \) is related

\[ s_{i3}(x) = \sum_j x_{ij}x_{+j} = \sum_j x_{ij} \sum_h x_{hj} \]

In an ownership network one would expect, that companies with higher in degrees will be larger and/or more profitable.

4. Activity of alter effect, defined by the sum of the out-degrees of the others

\[ s_{i4}(x) = \sum_j x_{ij}x_{j+} = \sum_j x_{ij} \sum_h x_{jh} \]

If this effect is important in an ownership network, companies are trying to achieve indirect links to more companies.

5. Transitivity effect, defined by the number of transitive patterns in \( i \)'s relations (ordered pairs of actors \( (j, h) \), to both of whom \( i \) is related, while \( j \) is also related to \( h \))

\[ s_{i5}(x) = \sum_{j,h} x_{ij}x_{jh}x_{ih} \]

If an indirect relation exists, actors tend to form also a direct relation. In a corporate ownership network this would mean consolidating positions within the network. Many other network effects can be defined and tested, however only the effects described above were tested in this paper.

Beside the network effects, actor dependent covariate effects were also tested. These effects are as follows:
6. covariate related popularity, defined by the sum of the covariate over all actors to whom \( i \) has a relation 
\[
s_{i8}(x) = \sum_j x_{ij} \nu_j
\]

7. covariate related activity, defined by \( i \)'s out-degree weighted by its covariate value 
\[
s_{i9}(x) = \nu_j x_{i+}
\]

8. covariate related dissimilarity, defined by the sum of absolute covariate differences between \( i \) and all the others, to whom he is related.
\[
s_{i10}(x) = \sum_j x_{ij} |\nu_i - \nu_j|
\]

The rationale for the covariate effects depend on the covariates chosen, so it is not given at this point. Parameters of the model are estimated using the method of moments (Bowman and Shenton, 1985). A statistic \( Z = (Z_1, \ldots, Z_K) \) is used, for which \( \theta \) is determined as the solution of the \( K \)-dimensional moment equation
\[
E_{\hat{\theta}} Z = z,
\]
where \( z \) is the observed outcome and the moment estimate \( \hat{\theta} \) is defined as the parameter value for which the expected value of statistic is equal to observed value.

\( Z \) is a vector of statistics relevant for the estimation of the objective function. \( C_m \) is the relevant statistic for \( \rho_m \) (rate of change) and is defined
\[
C_m = \sum_{i,j=1}^n |X_{ij}(t_{m+1}) - X_{ij}(t_m)|
\]

\( S_{mk} \) on the other hand is the relevant statistic for \( \beta_k \) and is defined as
\[
S_{mk} = \sum_{i=1}^n s_{ik}(X(t_{m+1}))
\]

The statistic has an intuitive appeal: if \( \beta_k \) is larger, the actors strive more strongly to have a high value of \( s_{ik} \), so more important that effect.

\( Z \) can that way be rewritten as
\[
Z_m = (C_{m1}, \ldots, C_{m,M-1}, S_{m1}, \ldots, S_{m,L})
\]

\( E_{\hat{\theta}} Z \) can not be calculated explicitly, instead Robbins-Monroe iterative process is used to estimate the parameters. The algorithm of the process is embedded in the SIENA program.

The iteration step for the Robbins-Monroe process are:
\[
\hat{\theta}_{N+1} = \hat{\theta}_N - a_N D^{-1}(z_N - z)
\]
\( D \) matrix that links \( Z \) and \( \theta \)
\( z_N \) is simulation of \( Z \)
\( a_N \) constant term, \( a_N \to 0 \)

The estimation algorithm has three phases and can be summarized as follows
1. preliminary estimation for defining matrix $D$

2. estimation phase, where $a_N$ gets smaller between subphases

3. check the convergence and calculate standard errors

4 Data

The data used in this paper were acquired from the Central Brokerage Clearing House (CBCH), which by today has of all shareholders for all Slovenian companies with share capital; this is for more than 900 companies. CBCH has is foundations in the Law on the dematerialization of securities, which was passed in 1997. In the same year CBCH began functioning and the share companies in Slovenia had time until the end of 1999 to transfer the shareholder records to CBCH to be kept in dematerialized form. The number of companies in the database gradually increases, which is evident from. In this paper we used eight time observations from the January 1991 to July 2001, half a year apart. Dates are selected in order to capture the time just after the financial report are filed and most of the shareholders assembles are finished. Both events can have short term effects on the ownership structure happening just before the event and disappearing soon after (see Cirman and Konič, 2000) and we wanted to avoid these errors. Table 1 displays the number of companies in the database.

Table 1: Number of companies in the database

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning 1998</td>
<td>360</td>
</tr>
<tr>
<td>Mid 1998</td>
<td>428</td>
</tr>
<tr>
<td>Beginning 1999</td>
<td>493</td>
</tr>
<tr>
<td>Mid 1999</td>
<td>587</td>
</tr>
<tr>
<td>Beginning 2000</td>
<td>788</td>
</tr>
<tr>
<td>Mid 2000</td>
<td>857</td>
</tr>
<tr>
<td>Beginning 2001</td>
<td>865</td>
</tr>
<tr>
<td>Mid 2001</td>
<td>856</td>
</tr>
</tbody>
</table>

Source: CBCH database

Due to computational demands of estimation process described above and consequent limitations, embedded in the estimation software, we could not use all data available but only a smaller sample.

We began the sampling procedure by identifying the 200 largest non-financial companies and 50 largest banks and other financial institutions. When defining the size of the companies, different criteria were used for financial and non-financial companies - total revenue defined the size of financial companies whereas total assets were deemed to be an appropriate measure for the size of financial companies.

As we only have data for publicly held (share) companies, some of the largest financial companies are still owned by the state or data was unavailable for other reasons, so the
final sample was composed by 152 of the largest Slovenian non-financial companies and 26 financials.

Essentially we had $8 \times 178$ egocentric networks with mutually overlapping egos and alters, which allowed us to construct a sequence of eight relations or a dynamic network. The relation at each observed point in time is a directed dichotomous relation meaning "is among the 30 largest owners in the defined time period" of the company.

Beside that two covariates were defined. One is just a dummy variable indicating the type of company having the value 1 if a company is a financial company and 0 instead. The other is a size indicator. Because of the software limitations, size is defined relatively as the rounded percentage of the largest companies’ size, separately for financials and non-financials.

If we compare the eight networks in the sequence\(^3\) (Table 2) we can see, that the network is gaining on density, however neither the in-degree nor the out-degree centralization has a systematic movement in either direction. We can however notice that the number of strong component is slowly diminishing and the largest strong component is gradually increasing, which would indicate the increase of cross-ownership in the network.

Table 2: Network properties in each time period

<table>
<thead>
<tr>
<th></th>
<th>Density</th>
<th>Indegree Centralization</th>
<th>Vertices with In-degree 0</th>
<th>Outdegree Centralization</th>
<th>Largest Outdegree</th>
<th>Strong Components</th>
<th>Largest Strong Component</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beginning 1998</strong></td>
<td>0.0037</td>
<td>0.07</td>
<td>138</td>
<td>0.041</td>
<td>8</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Mid 1998</strong></td>
<td>0.0054</td>
<td>0.074</td>
<td>127</td>
<td>0.092</td>
<td>17</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td><strong>Beginning 1999</strong></td>
<td>0.0076</td>
<td>0.078</td>
<td>117</td>
<td>0.141</td>
<td>26</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td><strong>Mid 1999</strong></td>
<td>0.0091</td>
<td>0.059</td>
<td>92</td>
<td>0.168</td>
<td>31</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td><strong>Beginning 2000</strong></td>
<td>0.0139</td>
<td>0.071</td>
<td>58</td>
<td>0.203</td>
<td>38</td>
<td>2</td>
<td>61</td>
</tr>
<tr>
<td><strong>Mid 2000</strong></td>
<td>0.0151</td>
<td>0.064</td>
<td>40</td>
<td>0.190</td>
<td>36</td>
<td>2</td>
<td>71</td>
</tr>
<tr>
<td><strong>Beginning 2001</strong></td>
<td>0.0154</td>
<td>0.076</td>
<td>36</td>
<td>0.196</td>
<td>37</td>
<td>2</td>
<td>68</td>
</tr>
<tr>
<td><strong>Mid 2001</strong></td>
<td>0.0161</td>
<td>0.155</td>
<td>36</td>
<td>0.189</td>
<td>36</td>
<td>1</td>
<td>71</td>
</tr>
</tbody>
</table>

Source: CBCH database

If we compare the results of changes, which are summarized in Table 3 we can see, that in the first two years (four periods) we have a lot of missing data, which is due to the slow transferring of the shareholders records to the CBCH, evident from Table 1. So if we look back to Table 2, only last four periods are relevant, the changes in the former four being due to the reduced number of missing data. We can observe a slight increase in in-degree and a decrease in out-degree centralization and still the presence of the increasing

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\(^3\)For the definition of network properties see Scott (1999) or Wasserman and Faust (1994).
cross-ownership among the largest Slovenian companies.

Table 3: Number of changes between subsequent observations

<table>
<thead>
<tr>
<th>Observation times</th>
<th>No ties in either period</th>
<th>Created ties</th>
<th>Dissolved ties</th>
<th>Tie in both periods</th>
<th>Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>from Beginning 1998 to Mid 1998</td>
<td>12410</td>
<td>52</td>
<td>17</td>
<td>88</td>
<td>18939 (60%)</td>
</tr>
<tr>
<td>from Mid 1998 to Beginning 1999</td>
<td>11499</td>
<td>61</td>
<td>16</td>
<td>106</td>
<td>19824 (63%)</td>
</tr>
<tr>
<td>from Beginning 1999 to Mid 1999</td>
<td>12891</td>
<td>34</td>
<td>33</td>
<td>140</td>
<td>18408 (58%)</td>
</tr>
<tr>
<td>from Mid 1999 to Beginning 2000</td>
<td>18129</td>
<td>54</td>
<td>43</td>
<td>182</td>
<td>13098 (42%)</td>
</tr>
<tr>
<td>from Beginning 2000 to Mid 2000</td>
<td>29104</td>
<td>70</td>
<td>61</td>
<td>324</td>
<td>1947 (6%)</td>
</tr>
<tr>
<td>from Mid 2000 to Beginning 2001</td>
<td>31018</td>
<td>85</td>
<td>75</td>
<td>328</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>from Beginning 2001 to Mid 2001</td>
<td>31039</td>
<td>54</td>
<td>51</td>
<td>362</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

Source: CBCH database, SIENA output

In Table 3 we can see, that the amount of change in the network between observations is not great and the number of created relations is systematically higher than the number of dissolved links, confirming the idea of the increasing cross ownership among the largest Slovenian companies. The question now is, what drives these changes.

5 Results

We applied the model, described in section 3 of this paper to the data described above. At this point we present the results of the model estimation.

Estimated model (Table 4) showed good convergence. Rate of change does not differ much between periods, it is however somewhat lower in the last period. First we can notice that there is apparently no significant effect of size of the company on the rate (and neither on other parameters, which was tested but is not reported here).

Financial companies are as expected more active as the non-financials. the effect of the financial dissimilarity is significant and positive, as financial tend to own more
Table 4: Results of the model estimation on the sequence of eight observations

<table>
<thead>
<tr>
<th>Effect</th>
<th>coeff</th>
<th>s.e.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate parameter period 1</td>
<td>1.3191</td>
<td>0.2367</td>
<td>5.57</td>
</tr>
<tr>
<td>Rate parameter period 2</td>
<td>1.5723</td>
<td>0.2518</td>
<td>6.24</td>
</tr>
<tr>
<td>Rate parameter period 3</td>
<td>1.1277</td>
<td>0.1861</td>
<td>6.06</td>
</tr>
<tr>
<td>Rate parameter period 4</td>
<td>1.2311</td>
<td>0.1513</td>
<td>8.13</td>
</tr>
<tr>
<td>Rate parameter period 5</td>
<td>1.0485</td>
<td>0.0903</td>
<td>11.62</td>
</tr>
<tr>
<td>Rate parameter period 6</td>
<td>1.3455</td>
<td>0.1095</td>
<td>12.29</td>
</tr>
<tr>
<td>Rate parameter period 7</td>
<td>0.7548</td>
<td>0.0813</td>
<td>9.28</td>
</tr>
</tbody>
</table>

l: effect size on rate -0.0043 0.0173 -0.25  
f: density (out-degree) -3.6509 0.1364 -26.7 
f: reciprocity 1.5176 0.1611 9.42  
f: transitivity 0.4640 0.0840 5.52  
f: popularity of alter 17.3937 4.0856 4.26  
f: activity of alter -0.2507 1.6727 -0.15  
f: fin popularity of alter 0.3768 0.1724 2.19  
f: fin activity of ego 1.6970 0.2233 7.60  
f: fin dissimilarity 0.3878 0.1358 2.86  

Source: CBCH database, SIENA output

non-financial companies. It is however relatively low, which might be due to a lot of cross-ownership between non-financial companies.

Popularity of alter effect is positive and very strong. We assume that the popularity of alter should be dependent on size and profitability of the company, so the size effect might be non-significant because of that through multicollinearity.

Companies also tend to reciprocate relations and there is weak but significant transitivity effect. This further supports the increasing cross-ownership between companies. Activity of alter effect is not significant showing that companies are not interested in indirect ownership.

Because of the amount of missing data in the first two years we decided to retest the model on just the last four observations, when the amount of missing data is drastically reduced. Table 5 summarizes the results.

Results of the estimation on the last (stable) four periods show very similar results as the estimation on the whole sequence. The only real difference is that now the financial dissimilarity effect becomes non-significant, which might indicate that non-financial companies own other non-financials and vice versa.

6 Conclusions

Corporate ownership networks have a long tradition in developed economies, they are however new to transitional economies like Slovenia, where these networks developed only recently as a result of institutional changes. The resulting network is not natural and
Table 5: Results of the model estimation on the sequence of last four observations

<table>
<thead>
<tr>
<th>Effect</th>
<th>coeff</th>
<th>s.e.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate parameter period 1</td>
<td>1.0814</td>
<td>0.1061</td>
<td>10.19</td>
</tr>
<tr>
<td>Rate parameter period 2</td>
<td>1.3718</td>
<td>0.1246</td>
<td>11.01</td>
</tr>
<tr>
<td>Rate parameter period 3</td>
<td>0.7695</td>
<td>0.0872</td>
<td>8.83</td>
</tr>
<tr>
<td>l: effect size on rate</td>
<td>-0.0036</td>
<td>0.0151</td>
<td>-0.24</td>
</tr>
<tr>
<td>f: density (out-degree)</td>
<td>-3.9678</td>
<td>0.1553</td>
<td>-25.55</td>
</tr>
<tr>
<td>f: reciprocity</td>
<td>1.5373</td>
<td>0.1777</td>
<td>8.65</td>
</tr>
<tr>
<td>f: transitivity</td>
<td>0.4208</td>
<td>0.1033</td>
<td>4.07</td>
</tr>
<tr>
<td>f: popularity of alter</td>
<td>18.3403</td>
<td>5.7378</td>
<td>3.20</td>
</tr>
<tr>
<td>f: activity of alter</td>
<td>-0.3730</td>
<td>1.7033</td>
<td>-0.22</td>
</tr>
<tr>
<td>f: fin popularity of alter</td>
<td>0.5847</td>
<td>0.2222</td>
<td>2.63</td>
</tr>
</tbody>
</table>

Source: CBCH database, SIENA output

is therefore changing rapidly.

Techniques like the stochastic actor-oriented models give us an insight into the factors that influence the rate and the direction of the changes in the network. We tested a sequence of eighth corporate ownership networks on the sample of 178 largest financial and non-financial Slovenian companies.

Result show that there is weak or no differences between financial and non-financial companies except that the financial companies are changing their portfolio more rapidly than the non-financial companies do. This would indicate that contrary to some popular belief most of the financial investments of non-financial companies is of strategic and as such of long-term nature (see Cirman and Končič, 2000; Gregorič et al., 2000). On the other hand it could also support some other popular belief, that the portfolio of Slovenian financial companies is too dispersed and their activity shows the consolidation of these portfolios.

The importance of transitivity and reciprocity effect shows the tightening of the connections between Slovenian companies, which could me a defense measure or merely a measure of reducing uncertainty and therefore reducing risk (see Podolny, 1994).

In the future we plan to test for other significant effects. The most interesting findings in this paper are that apparently the size of the company has no significant effect on the dynamics of ownership change and the other being that non-financial companies seem to be important and active actors in the corporate ownership network. The former is to a certain extent explained by the fact, that alter popularity, which is strongly influenced by companies’ size (see Pahor et al., 2000) has a very strong effect on the probability of a link being present, which through multicollinearity effect eliminates the effect of size. The later is however more peculiar and unexpected. We plan to concentrate our research in the future into defining the factors that drive non-financial companies to involve themselves into financial activities they are not specialized for and possibly examine the effects of this activities on the companies performance.
References


