

Pathways of Property Transformation: Enterprise Network Careers in Hungary, 1988-2000

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Outline of an Analytic Strategy

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Pathways of property transformation: Enterprise network careers in Hungary, 1988-2000 Outline of an Analytic Strategy

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Abstract

This study analyzes the restructuring of a national economy by identifying the career pathways of its enterprises. This analysis is conducted in a setting strategically chosen as a case of rapid and profound economic transformation: the postsocialist Hungarian economy between 1988-2000.

The goal of this study is to chart the multiple pathways of property transformation. Property pathways are conceptualized as the patterned sequences of change that firms undergo 1) in the composition of their ownership structure and 2) in their position within network structures of ties to other enterprises. These career pathways are neither unidirectional nor plotted in advance. The landscape and topography of the socioeconomic field are given shape and repeatedly transformed by the interaction of the multiple strategies of firms attempting to survive in the face of variable political, institutional, and market uncertainties. These different types of uncertainties will have different temporalities, and the study explores whether and how they increase or diminish in various periods. We develop and test specific hypotheses about how enterprise pathways along the compositional and positional property dimensions are related to the shifting contexts of these types of uncertainty.

The core dataset for this study includes the complete ownership histories of approximately 1,800 of the largest enterprises in Hungary for a twelve year period, starting with the collapse of communism in 1989, recording each change in a company's top 25 owners on a monthly basis. Monthly entries for each enterprise also include changes in top management, boards of directors, major lines of product activity, raising or lowering of capital, and location of establishments and branch offices, as well as the dates of founding, mergers, bankruptcy, etc. Data on revenues, number of employees, and operating profit will be compiled from annual balance sheets.

These rich data make it possible to map the life cycles of the business groups that are formed by network ties among enterprises, identifying not only when they arise, merge, or dissipate, but also the changing shapes of their network properties.

To identify patterns of change, the study draws on sequence analysis, a research tool that makes possible the study of historical processes in an eventful way similar to historiography while retaining social scientific abstraction. Whereas sequence analysis has given us a perspective on careers as historical processes but has not been applied to business organizations, network analysis has been applied to business organizations but has not been done historically. The methodological innovation at the heart of this study is to combine the tools of sequence analysis and network analysis to yield a sequence analysis of changing network positions.

Keywords: social network analysis, Eastern Europe, historical sociology, sequence analysis, interorganizational networks, economic change, property transformation.

Introduction

Business organizations today face the challenge of adapting to a transforming global economy: enterprises must increasingly cope with market volatility and the extraordinarily rapid pace of technological change. Under conditions of complex strategy horizons (Lane and Maxfield 1996) and rugged fitness landscapes (Kauffman 1989) where dislocations can be anticipated in general but are unpredictable in their specific contours, firms confront a radical uncertainty. In attempts to cope with these uncertainties, firms create hybrid organizational forms and build networks of strategic alliances (Powell 1996; Powell, Koput, and White 2001; Stuart 1998, 2000; Gulati and Gargiulo 1999; Beckman, et al 2000; Lane 2000; Kogut, Shan, and Walker 1992; Sabel 1990).

During the past decade, perhaps the most acute forms of radical uncertainty were those confronting enterprises in Eastern Europe and the former Soviet Union. Here the sources of uncertainty were less directly technological. More importantly, firms faced an uncertain economic and institutional environment. With the demise of the old COMECON alliance that regulated trade among the socialist economies, firms watched the collapse of their once secured trading partners. Literally within a month, and not at the margin but in overwhelming proportions, they had to seek new suppliers and new customers. They would do so in an institutional environment of extreme complexity. Newly elected democratic governments were dismantling the socialist planning apparatus and launching ambitious programs of privatization. From one month to the next, government agencies promulgated regulations governing banking, bankruptcy, accounting, contracting, foreign direct investment, and corporate governance. For firms remaining in state ownership, for recently “privatized” firms, and for new start-up firms alike, the challenge was to navigate through a maze of new policies.

How have postsocialist firms attempted to cope with these radical uncertainties? Which strategies have been successful and which were deadends? Were some firms able to survive, perhaps even to prosper, by consistently adopting the same bundle of practices across the entire epoch of transformation from 1989 into the 21st Century? Or were there path dependencies (Arthur 1994) operating in which firms locked-in to strategies that were successful in one set of external conditions but that proved less effective when conditions changed? Were some firms able to survive to the present through a process of almost continuous morphing by repeatedly shifting strategies throughout the epoch? Or was too much change a liability leading to failure? More discriminately, was the pace of change a positive factor in some periods while a liability in others? If the cross-sectional distribution of types of firms and types of strategies differs across time, was this a result of replacement (firms of some types fail and are replaced by firms of other types) or was it a result of adaptation (firms changing from some types to others)? In short, what were the pathways of transformation?

We will analyze the restructuring of a national economy by identifying the career pathways of its enterprises. We conceptualize career pathways as the patterned sequences of changes that firms undergo 1) in their ownership structure and 2) in their position within networks of enterprises. We conduct this analysis in a setting strategically chosen as a case of rapid and profound economic transformation: the postsocialist Hungarian economy between 1989-2000. To carry out this study we are constructing datasets that include the complete histories of the changes in ownership, top management, boards of directors, and other organizational change events for

1,800 of the largest Hungarian enterprises. Because these data chart changes on a monthly basis, we are able to mobilize a set of research tools that innovatively combine network analysis and sequence analysis to yield a sociological account of historical processes.

Theoretical Framework

In the mid 1990s, Stark (1996) investigated how Hungarian firms were responding to the uncertainties of postsocialism. Drawing on a repertoire of research methods – ethnographic research in firms, the analysis of government agency documents, and the analysis of the ownership records of the 200 largest enterprises (ranked by revenues) and top 25 banks (ranked by assets) in 1994 – Stark identified an ensemble of practices that he labeled “recombinant property.” Its two major features were hybrid property forms and inter-enterprise ownership networks.

Stark argued that the simple public/private dichotomy that was dominant in policy circles and scholarly research on privatization was inadequate to understand the actual processes of property transformation in postsocialism (for a related view on organizational change in China see Walder 1994, 1995; Guthrie 1997; and Zhou 2000a, 2000b). In place of a switch from public to private, many firms were combining public and private ownership. Because there was uncertainty about which institutional rules would count in a given situation, they engaged in organizational hedging (Sabel and Zeitlin, 1996), attempting to hold resources that could be mobilized in more than one justificatory framework. Rather than moving in one direction they moved in several, reconfiguring resources into new organizational forms. Sociological accounts of economic transformation must take into account the multi-directionalities at play in major social upheavals (Stark and Bruszt 1998; Padgett 2000).

Complementary to organizational hybridity as a response to uncertainty, inter-enterprise ownership networks, Stark argued, served as a strategy to spread risk. Like mountain climbers assaulting a treacherous face, postsocialist firms used networks of cross-ownership as the safety ropes binding them together. Using a combination of block-modeling and cliquing analysis of the “Top 200” data from the mid ‘90s, Stark and his colleagues (Stark, Kemeny, and Breiger 2000) identified eight major Hungarian business groups formed through these inter-enterprise ownership ties.

Stark stressed that recombinant property might increase chances of survival without increasing performance. Some firms were diversifying their portfolio of resources (blurring the boundaries of public and private), for the purpose of socializing liabilities while privatizing assets; and business group networks were a means not only of risk-spreading but of risk-shedding in a context in which policies of credit-worthiness and debt forgiveness were highly politicized.

Stark’s observations of Hungarian enterprises were made at approximately the mid-point between the collapse of state socialism in 1989 and the present. We will not, however, take another static snapshot – as if the task were merely to repeat the original study at a later moment in time. Instead, we conduct a rigorous analysis of the entire epoch from 1989-2000. By widening the scope in time and by widening the depth of enterprises studied (from the top 200 firms to the top 500 in any given year), we can assess the prevalence of recombinant practices

and trace their rise and demise in comparison to the full set of competing and coexisting enterprise strategies. To do so, we introduce more finely-grained categories of property, refine the concept of business groups by differentiating their network properties, and specify the types of uncertainties that were prevalent at different periods within the time-span of the study.

For a sociological account of historical processes.

The goal of this study is to chart the typical career pathways that firms negotiate through a sequence of changes in the composition of their ownership structure and the typical pathways that firms navigate as they move through a sequence of changes in their position in network structures. These “careers” are neither unidirectional nor plotted in advance. The landscape and topography of the socioeconomic field are given shape and repeatedly transformed by the interaction of the multiple strategies of firms attempting to survive in the face of political, institutional, and market uncertainties. We expect that these different types of uncertainties will have different temporalities, and we explore whether and how they increase or diminish in various periods. We develop and test specific hypotheses about how enterprise pathways along our compositional and positional property dimensions are related to the shifting contexts of these types of uncertainty. Our task is to produce a sociological account of historical processes.

To identify the multiple pathways taken by Hungarian enterprises across our twelve year time frame, we draw on sequence analysis, a new research tool that makes it possible to study historical processes in an eventful way similar to historiography while retaining social scientific abstraction (see especially Abbott 1990, 1992, 1995). With its roots in the study of gene sequencing in biology, sequence analysis has been applied in sociology predominantly to the careers of persons (Abbott and Hrycak 1990; Abbott 1995; Stovel, Savage, and Bearman 1996; Blair-Loy 1999). By our novel application of sequence analysis to the “careers” of enterprises, we extend it to economic sociology. Instead of collapsing time to before-after dichotomies, sequence analysis reveals the variable structuring of time: the varying paces of change, path dependencies, turning points, lock-ins, and contingencies – in ways that differ from simple calendar time. To study the unfolding of multiple, parallel processes, sequence analysis provides a methodology to follow, with much detail and rigor, events at the socially meaningful level of action. These events, changes within a state-space that is not assumed in advance but emerges from the analysis, are the building blocks of sequences.

How do we build from events to patterned processes? At the level of the firm, we gather data about attributes with a finely-grained resolution of one-month intervals. These data include, for example, the firm’s owners, its directors, its managers, its major lines of product activity, capital, revenues, profitability, and so on (see the data section below for details). From these data we construct the state-space for each of the relevant dimensions of the study, using clustering algorithms to identify the set of possible states (types). Within the state-space of firm ownership, for example, a possible state is that a firm is fully state-owned; other possible states are that it is held by a coalition of other Hungarian firms, or held by coalition ownership plus a private individual, or the majority holding of a foreign multinational, and so on. (The actual state-space is more elaborated. See the analytic strategies section below for details.) Thus, for each of the 144 time intervals in our study we can report the state (the configuration of relevant attributes) of

a given firm. We record each firm's re-positioning within the state-space as a 144-length sequence.

As with the work histories of persons, it is unlikely that two firms will have exactly the same histories. But as with human careers, it is also unlikely that every enterprise history will be so unique as not to share similarities to those of others. As in the study of human careers, so in the study of enterprise histories, we as sociologists, are interested in identifying patterns. Are there typical careers? What is their patterning? Applying an algorithm to the distinct sequences of all of the firms in our study, we cluster sequences to identify the relatively discrete career pathways.

Having identified the typical pathways, our task will be to interpret their varying contours. Pathways will differ in their directionality but also in their temporality, and so we will be attuned to how acceleration or deceleration in the pace of change varies within and across pathways. The notion of pathway, of course, implies some degree of path dependency – from a particular course there is not an equal probability of moving to any of the possible states. But sequence analysis also allows us to identify turning points (Abbott 1997), critical configurations of events in which a pathway changes directionality. It is important to emphasize that turning points are the properties of pathways and are not derived directly from macro properties of the system or of changes in the institutional environment. That is, although it is customary to think about a major political event as a turning point (e.g., “the new banking law marked a turning point in government policy”), our method allows us to take such changes into account without assuming that they will have invariant effects across all pathways. In fact, part of our contribution to the institutionalist literature in economic sociology will be to assess how major institutional changes in regulatory policies such as privatization, accounting, banking, and bankruptcy induced turning points in some pathways while leaving others on their previous trajectories.

A theoretical and methodological turning point.

Our study is a turning point in economic sociology. Whereas sequence analysis has given us a perspective on careers as historical processes but has not been applied to business organizations, network analysis has been applied to business organizations but has not been done historically. The historical sociology that we are attempting is more ambitious than bringing sequence analysis into economic sociology. The methodological innovation at the heart of our study is to combine the tools of sequence analysis and network analysis to yield a sequence analysis of changing network positions.

For several decades, the methodology of social network analysis was almost exclusively applied to static snapshots of relational systems. In the most recent major handbook for social network analysis, for example, we find only one paragraph on longitudinal or dynamic network analysis in the chapter on “Future Directions” (Wasserman and Faust 1994). Subsequent to that writing, some network analysts have taken a growing interest in dynamics. Two lines of work stand out in this development. On one side, we find analysis of the micro dynamics of dyads (Gulati and Gargiulo 1999; Iacobucci 1989; Lincoln, Gerlach, and Takahashi 1992; Snijders 1990; Snijders 2001; Stuart 1998; Zeggelink 1994). On the other, we find analysis of the macro dynamics of whole network systems (Brudner and White 1997; Powell, White, and Koput 2001; Watts 1999)

with an emerging part of the latter literature inspired and influenced by physics (e.g., Barabási, Albert, and Jeong 1999).

We find these developments exciting, but still insufficiently historical. On the first side, the logic of the dynamic study of dyads is similar to time series models: values of variables at time point t are used to estimate values at time point $t+1$, where the cases are dyads. On the second, the logic of the study of macro network dynamics is to find functions for change in connectivity, clustering, etc. based on assumptions of network parameters (for example, the way in which new ties are created, the number of ties each node has, and so on). Operating primarily with lagged variables in regression models rather than pathways of network events with turning points (but see Powell et al 2001), these new directions introduce dynamism while still lacking an historical dimension. Attention to change between two network snapshots or analysis of the dynamism of networks is not equal to recognizing multiple temporalities. [

Our conception of the structuring of time thus differs from conceptions prevalent in current modeling. On one hand, the still predominant transition views on economic change means a focus on the ideal typical starting and ending points of change. In a transition logic change is a succession of two systems, a switch from one equilibrium to the other. On the other hand, dynamic views of time series or network systems treat time as a dimension, a continuous variable along which a predefined process (inflation, growth of a dense central component) unfolds. Both approaches leave some or all aspects of the structure of time unquestioned. While transition approaches hardly conceptualize time at all, dynamic approaches treat it as a background metronome for predefined processes. Our approach is to put time as a central dimension and identify the multiplicity of times, multiple processes that establish the context to one another. This means that we do not posit any external predefined metric to judge the speed, direction and temporality of processes, but let each process be judged in the context of all other processes. For example the speed of a process of gradual privatization of firms (say the share of the state declines 10% each year in favor of private owners) will be judged faster if all other processes are stalled (no ownership changes occur for a period) and will be judged slower if there are fast paced changes in most of the other processes.

As Harrison White challenges the field: “Social structures often are made to seem the antipodes to, or at least unrelated to details and nuances of, sequencing in timing. This is in part because of the influence of structuralism. Social times should instead be accounted as much part of structure as are network spaces” (White 1992). In taking up White’s challenge, our contribution to a more historical network analysis does not simply include time as a variable but, instead, recognizes time as variable. Our task will be to chart the life cycles of the business groups that are formed by the network ties among enterprises, identifying not only when they arise, merge, or dissipate, but also the changes in their configurations (differentiating, for example, star-shaped groups from more cohesive cliques). In doing so, we address Granovetter’s (1994) concern about the “paucity of literature on the growth and evolution of business groups.” We will then turn our attention to firms, as actors who weave the network of property or who are woven into (or left out of) such networks, by mapping the sequences of changes of each firm’s position in this network space. Rather than presenting a block model as a snapshot with the typology of firm positions in a given moment (or at multiple moments in time), we present a typology of firm movements in the space of network positions. Our purpose is not to identify the block of central

firms and the block of isolates or bridges, but instead to identify typical careers of how and when firms become central, peripheral, or bridging players. And rather than assume a general dependence of alliance ties at time t on alliance ties at time $t+1$ we leave open the possibility for turning points in network formation: points when group building turns into rapid network dissolution and the dissipation of business groups or when building safety nets against institutional change turns into building business groups along industry lines for grasping market opportunities.

Data

The comprehensiveness of our dataset is unprecedented in the literature on ownership restructuring in a reforming economy.¹ The dataset we are assembling includes the complete ownership histories of approximately 1,800 of the largest enterprises in Hungary during the period from 1989-2000. We define a large firm as being in the annual ranking of the top 500 firms (based on revenue) in any of the twelve years. For a small country like Hungary, our inclusion rules mean that our population of firms accounts for more than a third of all employment, half of the GDP, and the overwhelming proportion of export revenues (Figyelo, 2000).

The core of our dataset has already been collected while Balázs Vedres, the graduate student collaborating on this project, was working for the office of the Hungarian Prime Minister as a researcher of business networks. Following the data collection strategy initiated by Stark (1996), Vedres and his assistants collected these data directly from the official courts of registry, where companies are obliged to register their top owners, the names of top and middle managers, their activities, locations of branch offices, etc. and any changes in these data with exact dates. Consequently, for any given firm in any given month, we can precisely identify the owners and the percentage of the assets each holds.

To be most useful, the dataset already in hand will be augmented in several ways. The structure of the current dataset was based on those firms that were in the top 500 rankings in 1999. It therefore has a “retrospective” character since it traces back the histories of the firms that were large at the end of the period. To include data on firms that were large at any point in the period but went bankrupt, were merged, or otherwise disappeared from the top 500 ranking by 1999, we will conduct new data collection to record the complete ownership histories of all firms that were among the largest 500 companies in any year during the twelve years, including those in the latest year 2000 rankings. These inclusion rules result in approximately 1,800 firms.

For the property (ownership and network structure) components of our study we will collect the following data: the names of the firm’s top twenty-five owners and the percentage stake that

¹ Similar research projects in the region on inter-enterprise networks cover fewer companies, in less depth, over less time. Toth (1998) used two samples of 300 companies (the largest companies based on revenue and export volume). His descriptive statistics recorded the presence of a Hungarian firm as an owner without constructing the network of ownership ties. Ferlogoj et. al. (2001) have analyzed the networks of the largest Slovenian companies based on ownership and board interlock ties in 1997 and 2000. Their sample, however, was limited only to the top 150 firms. Both of these studies were cross sectional.

each holds in the company, and the names and addresses of its board of directors (recording any change on a monthly basis). With these data on the links between firms for each of the 144 months we will construct datasets on inter-enterprise ownership networks and interlocking directorate networks. That is, we will have a data entry for each month indicating whether firm A owns or is owned by firm B as well as an entry indicating whether firm A and firm B share a director. Because we are also collecting data on the top management of each firm, we will be able to identify cases of “directed ties” where a director on one company’s board is an officer in another firm in our population.

In addition to data on property relations, we will also collect data on the following organizational features for each month for each firm: SIC codes of activity (to identify sectors as well as specify when a firm enters a new product field), raising or lowering of capital, location of establishments and branch offices, and top management (with names and positions). Data on revenues, number of employees, and operating profit will be compiled from yearly balance sheets. We will also collect data on the date of founding, dates of mergers, of changes in the legal form of the company, as well as dates of filings for bankruptcy or liquidation, completion of bankruptcy or liquidation, and cessation.

With these data we will construct two panel-datasets: a dataset of firm attributes and a dataset of firm network ties. Both of these panel-datasets will contain data on the firms for each month of the twelve years. Thus, for a firm that existed throughout the entire period, we will have 144 data entries on each attribute and each network tie.

After preliminary data analysis, we will conduct targeted interviews with enterprise managers, bankers, investors, and government agency officials to ascertain their perceptions of the constraints and opportunities they faced and to gain a deeper understanding of their interpretations and strategies. We will also analyze surveys of enterprises, reports of risk assessment firms, enterprise annual reports, and articles from the business press to develop indicies of the types of uncertainty.

Analytic Strategy

In this section we outline our strategy for analyzing the pathways of property transformation. We conceptualize property along two dimensions: 1) a compositional dimension (a firm’s ownership structure) and 2) a positional dimension (a firm’s position in network structures). We define these terms, indicate how we will operationalize the concepts, and present for each dimension a demonstration, in simplified form, of how we will use sequence analytic and network analytic methodologies. For each dimension, we present some of our preliminary hypotheses, focusing here on our expectations about the relationships between property transformation and political, institutional, and market uncertainty.

1) Enterprise pathways as changes in firms’ portfolios of owners.

The compositional aspect of property. Central to our analysis of property is the concept of portfolio. An investor’s portfolio, for example, is diversified across a range of instruments for hedging against risk and uncertainty. Our conceptual turn is to shift from an investor’s portfolio of holdings to the postsocialist firm’s portfolio of owners. Just as an investor’s portfolio is

composed of the types of instruments and the proportions of each, so we think about a firm’s portfolio of owners as the different types of owners and the proportions of each. Going beyond the public/private dichotomy, our types of owners will include not only state institutions and private individuals but also other Hungarian enterprises (distinguishing financial/non financial), foreign individuals, and foreign multinationals (distinguishing financial/non-financial) and Hungarian local governments. The composition of enterprise ownership portfolios will also be differentiated according to the proportions of these holdings by identifying, for example, whether a given firm’s ownership is concentrated or dispersed, whether the largest owner is clearly dominant, whether there is a coalition of several owners whose combined pluralities of shares are dominant, and so on. By cross-classifying the two compositional variables (discrete owners and their proportions) we construct a distinctive set of types of ownership portfolios.

This typology provides the building blocks of our state-space along the compositional dimension of an enterprise career. Firms traverse through this state-space from one type of ownership portfolio to another, and we record these moves in this space as sequences.

To illustrate our approach we have constructed a simplified hypothetical dataset of fifteen firms with careers spanning ten time spells. The first task is to construct a state-space by identifying the types of owners and their relative weight in the portfolio. One possibility that is suited to the ownership structures of Hungarian firms is to record the types of the largest owner, then record the second, third, fourth, etc. owner. In this simplified example we consider the three largest owners. Our hypothetical state-space consists of 8 portfolio types. In portfolio types 1-3, firms have only one owner; types 4-6 are “coalitions” with only two owners, and so on. (Our actual models will include more types of owners and will build from their proportional holdings, and not simply rank, yielding more portfolio types.)

state code (portfolio types)	rank of owner as firm shareholder		
	largest owner	2 nd largest	3 rd largest
1	state		
2	Hung firm		
3	foreign firm		
4	state	foreign firm	
5	Hung firm	state	
6	foreign firm	Hung firm	
7	Hung firm	Hung firm	Hung firm
8	Hung person	Hung person	Hung financial

Table 1: Hypothetical ownership portfolio types – the portfolio state-space.

For each of the fifteen firms in our demo we designate portfolio types for each of the ten time spells. The following table presents the three-pathway clustering solution for our hypothetical data. We have used OPTIMIZE, Abbott and Prellwitz’s (1997) optimal matching analysis² program, to generate the typical pathways of ownership portfolio careers.

² Abbott and Prellwitz’s (1997) OPTIMIZE program compares two sequences by recording the number of modifications (or steps) that it took to make one sequence identical to the other. There are two ways to modify a sequence: substituting its elements with another or deleting or inserting elements. To refine the algorithm one can assign costs to these steps, so the output will be the total cost of making sequence X into sequence Y. If this cost is high, the two sequences contain different events. If the cost is low, the two

firms	time spells										pathway
	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	
a	1	1	1	1	1	1	1	1	1	1	1
b	1	1	1	1	1	5	5	5	5	5	1
c	1	1	1	5	5	5	5	7	7	2	1
d	1	1	1	1	1	1	1	1	4	4	1
h	5	5	5	5	5	5	5	5	5	5	1
g	7	2	8	8	8	8	8	8	8	8	2
f	1	7	7	7	7	2	2	8	8	8	2
i	5	5	7	7	7	7	2	2	2	2	2
j	2	2	2	2	2	2	2	2	2	2	2
k	2	2	2	7	7	7	2	2	7	7	2
n	6	6	6	6	7	7	7	7	2	2	2
e	4	4	4	3	3	3	3	3	3	3	3
l	1	2	2	6	6	6	3	3	3	3	3
m	3	3	3	3	3	3	3	3	3	3	3
o	2	6	3	3	3	3	3	3	3	3	3

Table 2: Pathways identified in our hypothetical data of ownership portfolio changes.

Most firms in the first cluster (or pathway) start with the state as their only owner. After some spells, we see portfolio diversification with a Hungarian firm or a foreign firm appearing as a partner to the state (i.e., portfolio types 4 or 5) with this pattern continuing through to the cut-off point. Although it is difficult to present turning points with such few data points (only 15 firms and only 10 time spells), we could consider the period from the fourth spell to the sixth as a turning point when the dominance of the state starts to fade away. The careers of firms in the second pathway, unlike those in the first pathway, “start” from a wide range of locations in the state-space, and they traverse through more diversified portfolios. The careers in this pathway have different temporalities; but they share a common event: a change from the 7th type of ownership portfolio (of two Hungarian firms as owner) to the 2nd type of portfolio (with a single Hungarian firm as owner). Because the dissolution of the Hungarian firm coalition portfolio takes place at many different points in the sequences that make up this type of career, there are no obvious turning points in this pathway. The third pathway shows yet another pattern: firms from different locations at the outset converge to the 3rd type of portfolio in which a foreign firm is the sole owner. The firms go through various diversified portfolios to arrive at having a single foreign owner. Three of the four firms traverse a course that includes a “coalition” (the 4th and 6th portfolio types), and each dissolves into a solely foreign firm holding. In this pathway the seventh time spell can be a good candidate for a turning point: after this spell, there are no changes in enterprise careers.

The application of optimal matching techniques to our hypothetical data illustrates several features of sequence analysis. Although our units of observation are firms, our units of analysis are pathways. That is, it is not the starting point and the endpoints that define pathways, but the similarities and dissimilarities of the patterns of whole careers. As we saw in our example,

sequences are similar. We have used the matrix of transitions to determine substitution costs by reversing and symmetrizing the transition matrix. The insertion/deletion cost was set to be equal to the maximal substitution cost.

pathways can have diverse as well as uniform phases. Moreover, the temporality of firm careers can vary. Whereas some pathways exhibit clearly marked turning points in which all firms experience a shift in the direction of their careers, other pathways exhibit no turning points as firms make similar moves but with different timings.

Our hypothetical example is simplified, indeed, impoverished by comparison to the rich data we are collecting. With these data we can construct a much more refined state-space from the ownership portfolios (based on the exact percentage holdings of up to 25 owners) for 1,800 firms across 144 time spells. From the analysis of the careers of these firms we can address how firms respond to uncertainty – which we will differentiate as institutional, political, and market uncertainties.

Types of uncertainty. *Institutional uncertainties* refer to the “rules of the game” of doing business (DiMaggio and Powell 1983; North 1981; Fligstein 1996b). Such rules are normative, first in the sense of formalized regulations, but also in the sense of normative expectations about the behavior of others. We anticipate that institutional uncertainty is highest in the period from roughly 1992 to 1995. Although it might seem that new government regulations would reduce uncertainty (by specifying the new rules in a given domain), the cumulation of regulations actually increased uncertainty by raising questions about the interpretation of rules and their enforcement, as well as by increasing the anticipation of yet more rules in other domains. On January 1, 1992, for example, new rules took effect governing accounting, banking, and bankruptcy; and the unanticipated interactions among them produced a wave of filings for bankruptcy that led to a crisis of the entire financial system, a bailout of the banks, and a program of debt forgiveness for failing enterprises – thereby clouding rather than clarifying expectations about the “rules of the game” (Stark and Bruszt 1998). Institutional uncertainty likely declines steadily after 1995 as the behavior of regulatory agencies becomes more predictable and firms mutually calibrate their expectations about contract enforcement.

Very high immediately after 1989, *political uncertainty* rises through the installation of the first democratically-elected government, and shows a secular decline throughout the period – with episodes of increasing uncertainty immediately before and after parliamentary elections in 1994 and 1998. Whereas firms confront institutional rules as applying to categories of firms, in a highly politicized environment, political uncertainty involves the possibility that government actions will target a given firm in particular, whether as victim or beneficiary. *Market uncertainty* is uncertainty about access to resources (capital, labor, material inputs) and the ability to find customers. In Hungary, it spikes in 1991-92 (with the dissolution of the Soviet Union and the collapse of the COMECON market), declines thereafter, and then stays flat – but high relative to the other sources of uncertainty.

As our discussion indicates, on the basis of our current knowledge of the field, we can preliminarily identify three periods. To create more refined indices of levels of uncertainty, we will collect articles from the business press, from risk assessment firms, and from enterprise surveys, as well as consult with Hungarian specialists. We anticipate that overall uncertainty is highest in the middle period (1992-1995) and lowest in the final period (1995-2000). In each period, we anticipate that one form of uncertainty is paramount: political uncertainty marks the

first period (1989-1992), insitutional uncertainty is most salient in the middle period, and market uncertainty is the prevalent form of uncertainty in the final period.

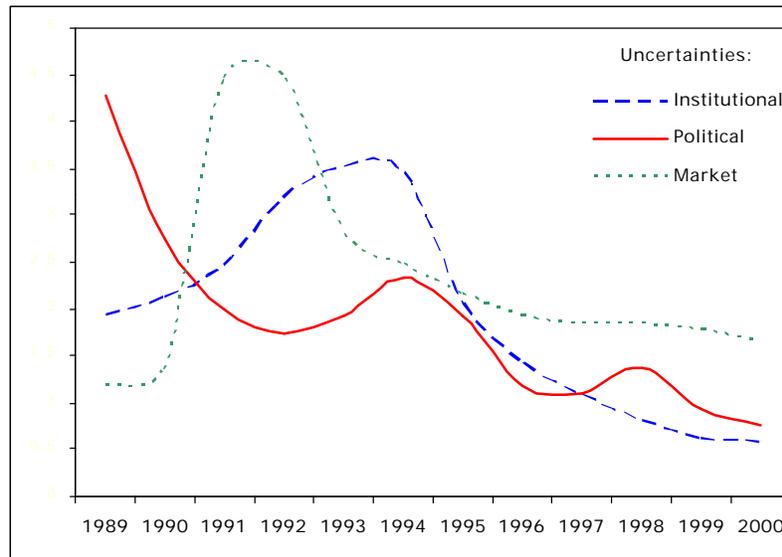


Figure 1: Hypothetical intensities of uncertainties over time.

Ownership portfolios as responses to uncertainties. Firms will hedge against uncertainty by attempting to manage their ownership portfolios. The difficulty in such hedging, however, is that there is no unitary “ideal” portfolio as a clearly dominant choice for every type of uncertainty. A portfolio that sheltered a firm in times of political turmoil, for example, might lead to bankruptcy in market upheavals or increased vulnerability to profound institutional changes.

In periods of high *institutional* uncertainty we expect that firms aim for highly diversified portfolios. Diversification should not be confused with highly dispersed ownership (so rare as to be almost non-existent in our population of Hungarian firms). Instead of many owners, diversified ownership portfolios exhibit a broader range of types of owners allowing the firm access to more diversified resources, especially information and knowledge from different parts of the institutional fields relevant to its operations. In this, they resemble the more diversified ownership and alliance portfolios of start-up firms in high technology (Powell et al 2001). When and where there is uncertainty about the evaluative criteria of performance, having multiple types of owners is a good hedging strategy for attempting to claim compliance with multiple criteria. As performance criteria become less ambiguous and as the regulatory environment stabilizes, we expect less diversified ownership portfolios.

In periods of high *market* uncertainty, we expect that firms will attempt to attract types of owners that can help provide sources of financing and reduce input/output uncertainties. Thus, we expect ownership portfolios that include banks, foreign owners, suppliers and/or customers. A bank as an owner holds the promise (not always realized) of privileged lines of credit; and a foreign owner can be a source of capital, technology, and predictable orders. Supplier and buyer firms as owners can help reduce input/output uncertainties. Acquiring a foreign owner might

seem to be an ideal choice, but it usually comes with the risk of restructuring the firm and in many cases replacing top management.

The various responses to uncertainties we have hypothesized are the building blocks of enterprise careers. We do not think that firms act in a hyper-rational way jumping to the optimal portfolio or network position immediately when they face a type of uncertainty. Ownership portfolios and network positions have rigidities: it is not easy to acquire new types of owners and join new groups instantaneously. On the other hand we do not think that firms are entirely locked-in to path dependencies regarding ownership portfolios and network positions. We depict firms to be somewhere in between these two extremes: they are sometimes able to alter their portfolios and network positions in abruptly novel ways, though in many cases their moves are limited by path dependencies. This image of firm behaviour is what makes a career focus necessary: it enables us to identify stable path directions as well as abrupt turning points in typical firm careers. What are the constellations of uncertainties and previous paths that enable firms to break away from path dependencies. Will firms react in novel ways when uncertainties are the highest? Or will they adopt a “small steps” strategy when uncertainty is extremely high leaving experimentation to times when uncertainties are not threatening their very existence? Will firms be paralyzed or will they boldly innovate when two or three types of uncertainties require them to move in more than one direction at the same time?

2) Enterprise pathways as changes in firms' network positions

The positional aspect of property. In addition to thinking about ownership as the holding of a given entity in a firm, we should also think about an ownership relation as establishing a tie between actors. These ties are especially of interest when a given firm is owned by or is an owner of another firm in our population. We are also attentive to boards of directors (as the agents with fiduciary responsibility for exercising property rights), especially in cases where a top manager of one firm in our population is linked to another enterprise as a member of its board of directors. These ownership and directorship ties have network properties, that is, they have distinctive shapes or topologies that can be specified in network-analytic terms. From our dataset of the ownership and directorship ties among our firms at each of the possible 144 monthly intervals, we will construct the histories of the business groups that are formed through these networks, and trace the pathways of positions that firms traverse_within (or outside) these business group networks.

Our first task is to map business groups and chart their life-cycles. In his review essay on business groups, Granovetter (1994) identifies the key structural dimensions for understanding variation among groups: size, industry composition (especially the participation of financial firms), the occupants of key positions, the level of cohesion, and the internal configuration of ties (especially the level of centralization). Our focus is not the variation across business groups along these dimensions at a certain point in time, but variation in the sequencing of group properties that yield the distinctive pathways groups take across their life course. A group might start as small, homogenous in composition, and cohesive and non-centralized in its structure. As it grows, the composition might become heterogenous, might lose cohesion, or the shape of the group might be transformed around more central firms. A typical group might finish its life by falling apart, or it might merge into a single legal entity, a large multidivisional firm.

To demonstrate our approach we again present a hypothetical dataset of 15 firms, this time with network data on one relation over ten time points. We have created a small, simplified dataset, ten sociomatrices with only one relation. The following figures show the graphs with optimized layouts that we generated using the PAJEK software (Batagelj and Mrvar 2001) and its graph visualization module. (Arrows indicate the directionality of an ownership tie.)

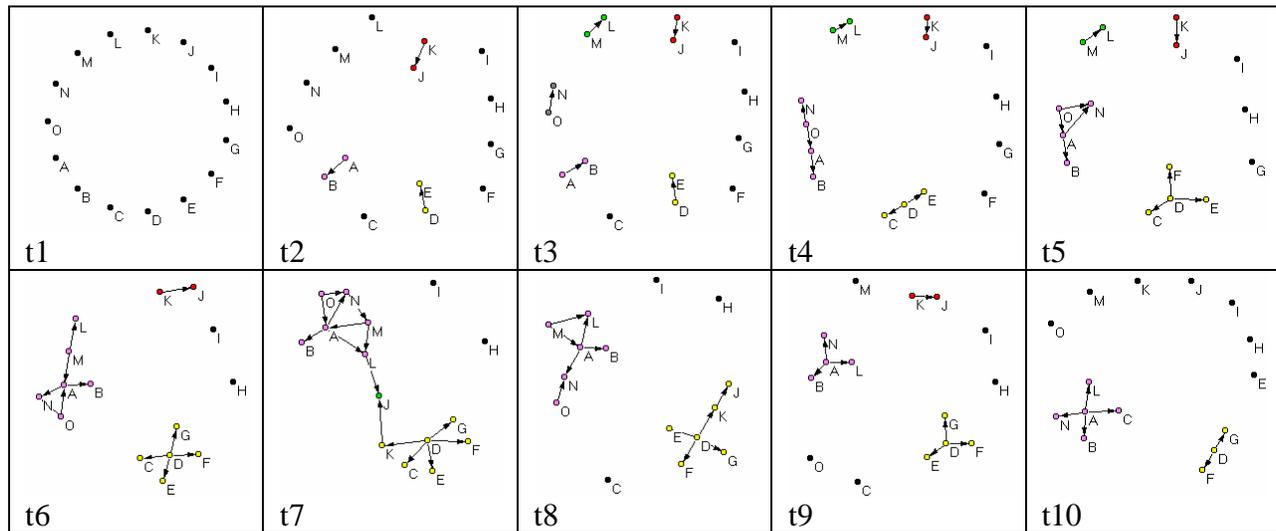


Figure 2: Graph representations of the network changes in our hypothetical dataset.

The graphs of these ten time periods allow us to follow the emergence and dissipation of groups. We see two groups emerging clearly from the 5th time spell, “X” and “Y.” At their height in the 7th spell, their members are the following: X={a, b, l, m, n, o}, while Y={c, d, e, f, g, k}. Group X starts as a clique-type group, but with the dissolution of ties it becomes a less cohesive and more centralized star-shaped group. Group Y, on the other hand, is a star-shaped group all along. Both groups have a period of formation and dissolution. In our actual models we will be able to assess whether group formations have a periodicity – perhaps with periods of rapid group expansion (see Gerlach 1992 on such periods in the case of the Japanese keiretsu) and periods of sharp contraction.

The graphs of these ten time periods also allow us to focus on the changing position of firms. Whereas some firms are on the periphery of groups all along (e.g., “c”, “h”, “i”), we see other firms becoming central members (e.g., “a” and “d”) whose centrality later declines. Firm “j,” which had been in a dyad with “k” for five spells, becomes a bridge between groups X and Y for a brief spell at t7, and returns as a dyad with “k” before becoming an isolate.

Tracing these enterprise pathways through such network positions is exactly what we want to do. But it’s difficult enough to follow each of our 15 hypothetical firms, and we could not hope to follow 1,800 firms across 144 PAJEK representations. We will proceed by thinking about each of these positions as a state in a “network position state-space” just as we did for the previous field of ownership portfolios. By recording the sequences of these positions and clustering them,

we can find the patterns in these movements and thus identify the typical kinds of pathways in time.

To demonstrate our approach we return to our hypothetical network of 15 firms over 10 spells. First we need to define the network positional states of firms. To do so we identify the shapes of groups where firms might participate as well as the theoretically important forms of participation. A simple set of states is the following:

state code	state description
1	isolate
2	dyad member owner
3	dyad member owned
4	star-shape group peripheral member
5	star-shape group central member
6	clique-shape group peripheral member
7	clique-shape group central member
8	bridge between groups

Table 3: Hypothetical network positions – the network state-space.

We use these state codes to describe the sequences of each firm. The sequences are represented in the following table, where cells contain one of the codes from the above table, and clustered (as with our ownership portfolio example) using the optimal matching algorithm:

firms	time spells										pathway
	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	
a	1	2	2	4	4	7	7	7	5	5	1
b	1	3	3	4	4	6	6	6	4	4	1
d	1	2	2	5	5	5	5	5	5	5	1
e	1	3	3	4	4	4	4	4	4	4	1
j	1	3	3	3	3	3	8	4	3	3	1
l	1	1	3	3	3	3	6	6	4	4	1
n	1	1	3	4	4	6	6	6	4	4	1
f	1	1	1	1	1	4	4	4	4	4	2
g	1	1	1	1	1	1	4	4	4	4	2
c	1	1	1	4	4	4	4	1	1	1	2
h	1	1	1	1	1	1	1	1	1	1	3
i	1	1	1	1	1	1	1	1	1	1	3
k	1	2	2	2	2	2	4	4	2	1	4
m	1	1	2	2	2	2	6	6	1	1	4
o	1	1	2	5	5	6	6	6	1	1	4

Table 4: Pathways identified in our hypothetical data of ownership network position changes.

Whereas the PAJEK graphs grouped firms according to their group membership, the optimal matching algorithm has clustered them according to similarities in the types of paths. In the first pathway of network careers, firms get quickly connected as the owned member of a dyad, then they become (peripheral or central) members of a star-shaped group. Some of them are central group members at some point, but in the final spells they are mostly peripheral group members. In the second pathway we see firms that are isolates for a longer time than firms in other pathways. Then they join a star-shaped group as peripheral members and tend to remain in this

position. The third type of network career pathway is being an isolate all along. This is a completely event-less pathway, but it is not without interest. In fact, it is the lack of an event that happens to everyone else that makes this pathway interesting. The isolation of these firms in the first period is not a feature which distinguishes it from other pathways. In the middle period, however, when all other firms are members of a group, their isolation in a certain sense becomes an event. In the fourth pathway, firms become owners in dyads early on, then become group members (mostly central), and in the final time spells they are isolates or dyad members again.

After collecting and coding data on more than 1,800 firms with entries for 144 time spells, we will be able to conduct an incomparably more refined analysis. Our state-space will be distilled from the actual typical network positions from 144 networks of two relations (owner and owned). We will be able to chart, for example, the pathways to central positions in groups. Do firms in central positions remain? Are core positions retained despite changes in group position (see Gerlach 1992)? Can we recognize a typical firm career of balancing in between groups? Are there turning points when previously central firms become isolated and new central firms emerge?

By framing these questions in terms of shifting political, institutional, and market uncertainties, moreover, we will address the lacunae noted by Koza and Lewin (2000) in their comprehensive review of the literature on inter-organizational alliances: “Rarely has research on alliances explicitly considered alliances to be embedded within the strategic portfolio of each partner and/or within accepted industry practices or as a function of the regulatory environment, institutional arrangements, and culture of the nation state or form of capitalism.”

Networked properties as responses to uncertainties. As in the case of ownership portfolios, we do not expect that there is one best type of network position that is a dominant choice for all companies in all types of uncertainties. In general terms we expect that when overall uncertainties are high, network density will also be high; the shapes or forms of network groupings and the composition of these groupings, however, will vary with the types of uncertainty.

We expect that firms will respond to *political* uncertainties by having network ties to government institutions. (We exclude state agencies’ ownership ties in our network models, thereby taking into account the fact that many firms will have state agencies as owners in the initial period as a legacy of state socialism.) We expect that firms will co-opt government officials to their boards to minimize the possibility of an unfavourable decision against the firm and to lobby for special credits, subsidies, and debt forgiveness (Frydman and Rapaczynski 1996). And we further expect some periodicity in these efforts corresponding to electoral cycles. In addition to directorship ties to state officials, we also expect that firms that are not state-owned will build ties to state-owned firms. These ties are likely to provide weaker opportunities for hedging, but they make it possible to avoid visible commitment to a politician or a political party that is not possible with direct cooptation.

Under conditions of high *institutional* uncertainty we expect to find the formation of star-shaped groups. At the center of the group is a holding firm that represents the group towards the state or business partners (see especially Keister 1998 on hierarchical, star-shaped business groups in

China; and Johnson 1997 and Kim 2000 for similar examples in Russia). This structure provides flexibility in allocating assets and liabilities. Central firms can strip assets from the peripheral members; alternatively, structurally peripheral firms can accumulate assets and shift debts and liabilities to the holding center whose size (“too big to fail”) can increase the chances of exploiting ambiguities in the institutional regulations. The minimal version of this group is a dyad: an owner and an owned firm (or two firms mutually owning each other) where ties increase possibilities to regroup assets, activities, and liabilities depending on expected legislation (or new patterns of enforcement) on bankruptcy, accounting, and bailouts. In the extreme case, one of the firms is driven into bankruptcy while the other is the “life boat” where assets and market niches are salvaged.

We expect cohesive clique-shaped groups (with greater density of ties among the firms in the group) to form in several waves. The first episode of such group formation occurs in the early period of privatization in which firms exchanged shares with each other to comply with regulations requiring firms to adopt the legal form of a share-holding company. These groups are likely to include firms across a range of industries.

We expect the second and third waves of cohesive clique formation to occur in periods of high *market* uncertainty. In contrast to the star-shaped group, this form provides better opportunities for recombining assets to occupy new market niches. As firms forge ownership and directorship ties to buyers, sellers, and even competitors, these groups will form along industry lines. Whereas in periods of political uncertainty firms will form ties to state-owned firms, under conditions of market uncertainty they will form ties to firms that are owned by multinationals in the promise of becoming their suppliers or gaining access to new technologies without the threat of management restructuring that comes with direct multinational ownership.

References

- Abbott, Andrew, and Alexandra Hrycak. 1990. "Measuring Resemblance in Sequence Data: An Optimal Matching Analysis of Musicians' Careers." *American Journal of Sociology* 96(1):144-85.
- Abbott, Andrew, and Grant Prellwitz. 1997. "PROGRAM OPTIMIZE" University of Chicago.
- Abbott, Andrew. 1988. "Transcending Linear Reality." *Sociological Theory* 6:169-86.
- Abbott, Andrew. 1990. "Conceptions of Time and Events in Social Science Methods. Causal and Narrative Approaches." *Historical Methods* 23(4):140-150.
- Abbott, Andrew. 1992. "From Causes to Events." *Sociological Methods and Research* 20(4):428-55.
- Abbott, Andrew. 1997a. "Of Time and Space: The Contemporary Relevance of the Chicago School." *Social Forces* 75(4):1149-82.
- Abbott, Andrew. 1997b. "On the Concept of Turning Point." *Comparative Social Research* 16:85-105.
- Anderson, Philip. 1999. "Complexity Theory and Organization Science." *Organization Science* 10(3):216-232.
- Arthur, W. Brian. 1994. *Increasing returns and path dependence in the economy*. Ann Arbor: University of Michigan Press.
- Barabási, Albert-László, Réka Albert, and Hawoong Jeong. 1999. "Scale-Free Characteristics of Random Networks: The Topology of the World Wide Web." Unpublished manuscript.
- Batagelj, Vladimir, and Andrej Mrvar. 2001. "PAJEK. Program for Large Network Analysis." University of Ljubljana.
- Beckman, Christine, Pamela Haunschild, and Damon Phillips. 2000. "Friends or Strangers?: Firm Uncertainty, Market Uncertainty, and Network Partner Selection." Unpublished manuscript, University of California-Irvine.
- Blair-Loy, Mary. 1999. "Career Patterns of Executive Women in Finance: An Optimal Matching Analysis." *American Journal of Sociology* 104(5):1346-97.
- Boltanski, Luc and Laurent Thevenot. 1991. *De la justification: Les économies de la grandeur*. Paris: Gallimard.
- Böröcz, József. 2001. "Change Rules." *American Journal of Sociology* 106(4):1152-68.
- Brudner, Lilyan A. and Douglas R. White. 1997. "Class, Property, and Structural Endogamy: Visualizing Networked Histories." *Theory and Society* 26:161-208.
- Burawoy, Mchael and Pavel Krotov. 1992. "The Soviet Transition from Socialism to Capitalism: Worker Control and Economic Bargaining in the Wood Industry." *American Sociological Review* 57:16-38.

- Cao, Yang and Victor Nee. 2000. "Comment: Controversies and Evidence in the Market Transition Debate." *American Journal of Sociology* 105(4):1175-89.
- DiMaggio, Paul and Walter Powell. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48: 147-60
- Everett, Martin G. and Stephen P. Borgatti. 1998. "Analyzing Clique Overlap." *Connections* 21(1):49-61.
- Ferligoj, Anuska, Janez Prasnikar and Marko Pahor. 2001. "Ownership and Board Interlock Networks of the Largest Slovenian Firms". Unpublished manuscript, Ljubljana University.
- Figyelő. 2000. *Top 200: a legnagyobb vállalkozások*. (The top 200 largest enterprises). *Figyelő*, special issue.
- Fligstein, Neil. 1996a. "The Economic Sociology of the Transitions from Socialism." *American Journal of Sociology* 101(4):1074-1081
- Fontana, Walter and Leo W. Buss. 1994. "The Arrival of the Fittest: Toward a Theory of Biological Organization." *Bulletin of Mathematical Biology* 56(1):1-64.
- Fontana, Walter and Peter Schuster. 1998. "Continuity in Evolution: On the Nature of Transitions." *Science* 280 (29 May): 1451-1455.
- Frydman, Roman, and Andrzej Rapaczynski. 1994. *Privatization in Eastern Europe: Is the State Withering Away?* Budapest, London, and NY: Central European University Press.
- Frydman, Roman, Cheryl W. Gray, and Andrzej Rapaczynski, editors. 1996. *Corporate Governance in Central Europe and Russia*. vol. 1 and 2. Budapest: Central European University Press.
- Gerlach, Michael L. 1992. "The Japanese Corporate Network: A Blockmodel Analysis." *Administrative Science Quarterly* 37:105-139.
- Gerlach, Michael L. 1992. *Alliance Capitalism. The Social Organization of Japanese Business*. University of California Press.
- Gerlach, Michael L., James R. Lincoln and Christina L. Ahmadjian. 1996. "Keiretsu Networks and Corporate Performance in Japan." *American Sociological Review* 61: 67-88.
- Eyal, Gil, Ivan Szelenyi, and Eleanor Townsley. 1998. *Making Capitalism Without Capitalists*. London and New York: Verso.
- Gould Roger V. 2000. "Uses of Network Tools in Comparative Historical Research." Unpublished manuscript.
- Grabher, Gernot and David Stark, eds. 1997. *Restructuring Networks in Postsocialism: Legacies, Linkages, and Localities*. London and New York: Oxford University Press.
- Grabher, Gernot and David Stark. 1997. "Organizing Diversity: Evolutionary Theory, Network Analysis, and the Postsocialist Transformations," *Regional Studies*, 31(5):533-544.
- Granovetter, Mark. 1985. "Economic Action and Social Structure: The Problem of Embeddedness." *American Journal of Sociology* 91(3):481-510.

- Granovetter, Mark. 1994. "Business Groups." *The Handbook of Economic Sociology*, editors Niel J. Smelser and Richard Swedberg. Princeton University Press.
- Granovetter, Mark. 1995. "Coase Revisited: Business Groups in the Modern Economy." *Industrial and Corporate Change* 4, no. 1.
- Gulati, Rnjay and Martin Gargiulo. 1999. "Where Do Interorganizational Networks Come From?" *American Journal of Sociology* 104(5):1439-93.
- Guthrie, Douglas. 1997. "Between Markets and Politics: Organizational Responses to Reform in China." *American Journal of Sociology* 102(5):1258-1304.
- Hamilton, Gary G., ed. 1991. *Business Networks and Development in South East Asia*. Hong Kong: University of Hong Kong, Centre of Asian Studies.
- Hamilton, Gary G., William Zeile, and Wan-Jin Kim. 1990. "The Network Structures of East Asian Economies." In *Capitalism in Contrasting Cultures*, edited by S. R. Clegg and S. G. Redding. Berlin: Walter de Gruyter.
- Hannan, Michael T. 1986. "Uncertainty, Diversity, and Organizational Change." Pp. 73-94 in *Behavioral and social sciences : fifty years of discovery: in commemoration of the fiftieth anniversary of the "Ogburn report"*, edited by Neil J. Smelser and Dean R. Gerstein. Washington, D.C.: National Academy Press.
- Hannan, Michael T., and John Freeman. 1989. *Organizational Ecology*. Cambridge, Mass.: Harvard University Press.
- Hoshi, Takeo. 1994. "The Economic Role of Corporate Grouping and the Main Bank System." In M. Aoki and R. Dore (eds.), *The Japanese Firm: The Sources of Competitive Strength*: 285-309. London and New York: Oxford University Press.
- Hutter, Michael and Günther Teubner. 1993. "The Parasitic Role of Hybrids." *Journal of Institutional and Theoretical Economics* 149(4): 706-715.
- Huynen, Martin A., Peter F. Stadler, and Walter Fontana. 1996. "Smoothness within ruggedness: The role of neutrality in adaptation." *Proceedings of the National Academy of Sciences* 93 (January):397-401.
- Jain, Sanjay and Sandeep Krishna. 2000. "A Model for the Emergence of Cooperation, Interdependence and Structure in Evolving Networks." Unpublished manuscript.
- Kauffman, Stuart A. 1989. "Adaptation on rugged fitness landscapes." Pp. 527-618 in D. Stein, ed., *Lectures in the Science of Complexity*. Vol. 1. Reading, MA: Addison-Wesley, Longman.
- Keister, Lisa A. 1998. "Engineering Growth: Business Group Structure and Firm Performance in China's Transition Economy." *American Journal of Sociology* 104(2):404-40.
- Kogut, Bruce. 2000. "The Small World of Firm Ownership and Acquisitions in Germany: The Durability of National Networks." Paper presented at Santa Fe Institute Workshop on "Heterarchies: Distributed Intelligence and the Organization of Diversity."
- Koza, Mitchell P. and Arie Y. Lewin. 2000. "The Co-Evolution of Strategic Alliance." *Organization Science* 9(3):255-264.
- Lane, David, and Robert Maxfield. 1996. "Strategy under complexity: Fostering generative relationships." *Long Range Planning* vol. 29(2):215-31.

- Lane, David. 2000. "Building a New Market System: The LonWorks Case." Paper presented at Santa Fe Institute Workshop on "Heterarchies: Distributed Intelligence and the Organization of Diversity."
- RRMiner, Anne, Terry L. Amburgey, and Timothy M. Stearns. 1990. "Interorganizational Linkages and Population Dynamics: Buffering and Transformational Shields." *Administrative Science Quarterly* 35:689-713.
- Morin, Edgar. 1974. "Complexity." *International Social Science Journal*, 26(4):555-82.
- Nee, Victor. 1989. "A Theory of Market Transition: From Redistribution to Markets in State Socialism." *American Sociological Review* 54(5):663-681.
- Nee, Victor. 1999. "Path Dependent Societal Transformation: Stratification in Hybrid Mixed Economies." *Theory and Society* 28:799-834.
- Neumann, Laszlo. 1993. "Decentralization and Privatization in Hungary." *The Embedded Firm*, Gernout Grabher. London: Routledge.
- North, Douglass C. 1981. *Structure and Change in Economic History*. NY.: Norton.
- Orru, Marco, Nicole Woolsey Biggart, and Gary G. Hamilton. 1991. "Organizational Isomorphism in East Asia." Pp. 361-89 in *The New Institutionalism in Organizational Analysis*, edited by Walter W. Powell and Paul J. DiMaggio. Chicago: University of Chicago Press.
- Padgett, John. 2000. "Organizational Genesis, Identity and Control: The Transformation of Banking in Renaissance Florence." Paper presented at Santa Fe Institute Workshop on "Heterarchies: Distributed Intelligence and the Organization of Diversity."
- Powell, Walter W. 1996. "Inter-organizational Collaboration in the Biotechnology Industry." *Journal of Institutional and Theoretical Economics* 152:197-215.
- Powell, Walter W., Douglas R. White, and Kenneth W. Koput. 2001. "Evolution of a Science-Based Industry: Dynamic Analyses and Network Visualization of Biotechnology." Unpublished manuscript.
- Sabel, Charles. 1990. "Moebius-Strip Organizations and Open Labor Markets: Some Consequences of the Reintegration of Conception and Execution in a Volatile Economy." In *Social Theory for a Changing Society*, ed. Pierre Bourdieu and James Coleman, pp. 23-54. Boulder, Colo., and New York: Westview Press and the Russell Sage Foundation.
- Stark, David. 1986. "Rethinking Internal Labor Markets: New Insights from a Comparative Perspective." *American Sociological Review*, 51(4):492-504.
- Stark, David 1989. "Bending the Bars of the Iron Cage: Bureaucratization and Informalization under Capitalism and Socialism." *Sociological Forum*, 4(4):637-664.
- Stark, David. 1990. "Privatization in Hungary: From Plan to Market or From Plan to Clan?" *East European Politics and Societies* 4(3):351-92.
- Stark, David . 1992. "Path Dependence and Privatization in East Central Europe." *East European Politics and Societies* 6(1):17-54.
- Stark, David. 1996. "Recombinant Property in East European Capitalism." *American Journal of Sociology* 101(4):993-1027.

- Stark, David. 2000. "For a Sociology of Worth." Keynote address for the Annual Meetings of the European Society for Evolutionary Economics, Berlin, November.
- Stark, David and Bruszt Laszlo. 1998. *Postsocialist Pathways. Transforming Politics and Property in East Central Europe*. Cambridge University Press.
- Stark, David and Laszlo Bruszt 2001. "One Way or Multiple Paths?: For a Comparative Sociology of East European Capitalism." *American Journal of Sociology*, 106(4):1129-1137.
- Stark, David, Szabolcs Kemeny, and Ronald Breiger. 2000. "Post-Socialist Portfolios: Network Strategies in the Shadow of the State." Unpublished manuscript, Department of Sociology, Columbia University.
- Stiglitz, Joseph E. 1999. "Whither Reform?: Ten Years of the Transition." Keynote Address, World Bank Annual Conference on Development Economics, April.
- Stovel, Katherine, Michael Savage, and Peter Bearman. 1996. "Ascription into Achievement: Models of Career Systems at Lloyds Bank, 1890-1970." *American Journal of Sociology* 102(2):358-99.
- Stuart, Toby E. 1998. "Network Positions and Propensities to Collaborate: An Investigation of Strategic Alliance Formation in a High-Technology Industry ." *Administrative Science Quarterly* 43:668-98.
- Stuart, Toby E. 2000. "Interorganizational Alliances and the Performance of Firms." *Strategic Management Journal*(August).
- Toth, Istvan Janos. 1998. "Inter-Enterprise Ownership Links in Hungary." *Acta Oeconomica* 49(3-4):365-396.
- Vedres, Balazs. 2000a. "The Constellations of Economic Power: The Position of Political Actors, Banks and Large Corporations in the Network of Directorate Interlocks in Hungary, 1997." *Connections* 23(1):44-59.
- Vedres, Balázs. 2000b. " A Tulajdonosi Hálózatok Felbomlása (The Dissolution of Ownership Networks)." *Közgazdasági Szemle* 47(September).
- Voszka, Éva. 1997. *A dinoszauruszok esélyei. Nagyvállalati szerkezetváltás és privatizáció.* (The chances of dinosaurs. Large firm restructuring and privatization.) Budapest: Pénzügykutató Rt.
- Wagner, Gunter P. and Lee Altenberg, 1996. "Complex Adaptations and the Evolution of Evolvability." *Evolution*, 50(3):967-76.
- Walder, Andrew. 1994. "Corporate Organization and Local Government Property Rights in China." Pp 53-66 in *Changing Political Economies: Privatization in Post-Communist and Reforming Communist States*, edited by Vedat Milor. Boulder, Colo.: Lynne Rienner.
- Walder, Andrew. 1995. "Local Governments as Industrial Corporations: An Organizational Analysis of China's Transitional Economy." *American Journal of Sociology* 101:263-301.
- Wasserman Stanley and Katherine Faust. 1994. *Social Network Analysis: Methods and Applications*. USA: Cambridge University Press.

- Watts, Duncan. 1999. "Networks, Dynamics and the Small-World Phenomenon." *American Journal of Sociology* 105(2):493-527.
- Whitley, Richard D. 1991. "The Social Construction of Business Systems in East Asia." *Organization Studies* 12(1): 1-28.
- Zhou, Xueguang. 2000a. "Economic Transformation and Income Inequality in Urban China: Evidence from Panel Data." *American Journal of Sociology* 105(4):1135-74.
- Zhou, Xueguang. 2000b. "Reply: Beyond the Debate and Toward Substantive Institutional Analysis." *American Journal of Sociology* 105(4):1190-95.