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Modeling Occupational Careers for a Turbulent Economy

From Simple to Complex Approaches

Abstract: Using data from the Polish Panel Survey, we analyze changes in occupational-career patterns by means of trajectories defined as the sequence and duration of work positions expressed on a numerical scale on different timelines: calendar years, age, and years in the labor force. We apply a program (CONVERTER) that transforms the floating format of the occupational history (recorded with dates at the beginning and end of each job) into a fixed format (where occupational codes are given on an established timeline). After presenting career trajectories for calendar years and age, we use a model based on difference equations that has an important feature: It predicts values of socioeconomic status even if they decrease over time, especially at the end of the career. In the discussion ending the study, we relate the occurrence of nonsmooth trajectories, career interruptions, and multijob situations to the turbulent economy in Poland.

In this project we study dynamics of individuals' jobs in Poland, focusing on both structural opportunities and individual determinants. We build on the technical definition of trajectory, as a time-ordered set of states (values) of a dynamic system to define an occupational trajectory to be a set of values of status (S) as a function (dependent) of time: $S = f(t)$. Occupational trajectories characterize social inequality in a dynamic manner.

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In sociology, the measures of status for individuals are derived from classifications of jobs/occupations: Each person's job receives a score according to the scale applied, such as occupational prestige, complexity of work, or socioeconomic index. We focus on predicting mean values of the socioeconomic index (SEI) for each point of the trajectories of selected groups of people using panel data on Poland. We visualize these trajectories and analyze them by means of regression and simulation analysis.

Most of the analyses of occupational trajectories were performed for developed *stable* economies. Our analysis deals with a *turbulent* economy, that is, an economy of transition from orthodox central planning and state control to a free market (capitalist-type) economy. For Poland, we can outline the following timetable:

- In 1978: central planning and state control—the last year of a normal communist regime
- 1979–81: economic and political crisis
- 1982–83: martial law, an attempt to restructure the economy
- 1984–88: new economic crisis
- 1989–90: change of the regime
- 1991–93: postcommunist transition, “shock therapy”
- 1994–2003: high fluctuation in gross national product
- 2004: joined European Union, adjustment strategies

We demonstrate that occupational trajectories can be analyzed by traditional techniques, but we go beyond them. In the tradition of research by Sørensen (1974), Tachibanaki (1979), and Rosenfeld (1980), we develop and test a model of career trajectories that overcomes some major shortcomings of earlier studies. In particular, previous models were based on the assumptions that there is no decrease in occupational status and that education—on which the jobs strongly depend statistically—is constant through individuals' careers. Our model relaxes both these assumptions.

Alternative Approaches

Form and Miller (1949) coined the term *occupational career pattern* to denote the sequence and duration of work positions (for a classical statement, see also Slocum 1974). Occupational trajectories are specific occupational career patterns, since they represent the sequence and duration of work positions expressed on a numerical scale on the timeline (Spilerman 1977).

Approaches to studying occupational trajectories have been diverse, with two gaining prominence in recent years:

1. Optimal matching analysis. This approach uses an iterative minimization procedure to find the distance between every pair of sequences in a sample, and then applies cluster analysis to ascertain whether the sequences belong to

distinct types drawn from a typology (for original formulations, see Jovanovic 1979; McCall 1990; for extended applications, see Abbott and Tsay 2000).

2. Event history analysis. The purpose of this approach is to explain when and why individuals are moving from one job to another, using special types of techniques, which are called failure-time models, life-time models, survival models, transition-rate models, response-time models, event history models, duration models, or hazard models. Usually the "risk" of changing jobs at a certain time point is predicted with a set of covariates. These techniques make it possible to deal with time-varying covariates and with censored data (Blossfeld 1986; Blossfeld, Hamerle, and Mayer 1989; Li et al. 1998).

Both of these approaches are compatible. Laura Arosio summarizes and compares various techniques related to them, concluding that "to be useful and complementary tools that can offer a best understanding of the career systems of contemporary societies" (Arosio 2004: 454). However, all these techniques deal with jobs *classified in different categories* rather than being represented on continuous scales. Thus, there is a need to develop tools appropriate for analyzing occupational trajectories understood as a sequence of *numerical values on the timeline*.

In this study, we apply simple tools to analyze occupational trajectories, including regression analysis. However, we also apply dynamic modeling based on differential equations. In its original formulation (Sørensen 1974; see also Brüderl 1992; Rosenfeld 1980; Tachibanaki 1979), the career-trajectory model describes the convergence of status to recalibrated education into a status metric. If other characteristics are disregarded, the equation can be written as:

$$d(S - M)/dt = -\gamma(S - M),$$

where γ is positive and S and M stand for status and recalibrated education, respectively. However, if we consider the case in which both S and M change over time, then the above equation may be inadequate. One could expect that, if for some cases M suddenly changes, then S would lag behind. The lag is contrary to the above equation. In general terms, this type of equation does not account for lowering status during the career. Since downward intragenerational mobility is a reality, there is a need for new models based on differential equations.

When representing trajectories, one should consider that for individuals, SEI is stable for a given job, but can change with each new job. For sets of individuals, we consider mean values of SEI for their entire careers. The model that we apply, proposed by Slomczynski, Krauze, and Peradzyński (1986), is contained in the following equation:

$$d(S - M)/dt = -\alpha(S - M) + \sigma dM/dt,$$

where the parameter α can be interpreted as the rate of convergence of actual status S to an equilibrium enforced by the recalibrated education, and parameter σ is a correction factor, which increases or decreases the impact of changes in the

recalibrated education. The presence of $\sigma dM/dt$ makes the model flexible, allowing for a decrease in status at the end of the career.

Our model is in agreement with the econometric model of occupational career proposed by Sicherman and Galor (1990), in which the link between occupational status with recalibrated education involves two processes:

The theoretical model provides an ambiguous prediction concerning the unconditional effect of schooling on career mobility. On the one hand, highly educated individuals are able to start their working careers in a higher-level occupation (higher step on the ladder). Their careers, therefore, might involve fewer occupations. On the other hand, highly educated individuals face greater opportunities (longer ladders). The model suggests, therefore, that given an occupation of origin, more educated individuals are more likely to move to a higher level occupation. (Sicherman 1990: 178)

One of the main issues is how education is recalibrated in the occupational status metrics. The most natural way seems to be to assume that the value of each educational level corresponds to the mean value of SEI scores for this level. However, as we emphasize in a later section, the mean value of SEI for different educational levels depends on both cohorts and career stages.

Data

Data for most of the analyses presented in this study come from the Polish Panel Survey, POLPAN 1988–2003. POLPAN provides information on respondent education for each year of the study. We also have respondents' full employment history.

During the POLPAN waves, all jobs in consecutive intervals, 1988–93, 1993–98, 1998–2003, were recoded. The description of all jobs contains a great deal of information, including:

- year and quarter when the respondent started their job;
- job characteristics coded with the Polish Social Classification of Occupations (Domański, Sawiński, and Slomczynski 2009; Pohoski and Slomczynski 1978) and with the Polish socioeconomic index (Slomczynski and Kacprowicz 1979); and
- year and quarter when the respondent left the job.

Originally, the data on jobs are recorded in a floating format: some respondents have a short record (one or two jobs) and others have a long record (several jobs). Thus, information on a person's work in a given calendar year is entered in different places of the data set. The floating format optimizes coding procedures and data size, but it is very difficult to manage for any kind of data analysis that deals with occupational careers explicitly.

One way to compensate for this shortcoming is to use CONVERTER, special software that transforms records of jobs a particular person holds over the years from a *floating time form* into *fixed time points* of a full career. Although this program

was developed especially for the 1988–2003 POLPAN, it has general features and can be applied to any other data with a longitudinal component for occupation.

In POLPAN, the first entry into the labor force took place at the beginning of 1934 (when a respondent born in 1923 turned eleven years old). CONVERTER records all jobs for all respondents from this date until 2003, for every half-year interval. Thus, for each respondent and each job characteristic of the occupational career—such as SEI through a career—it introduces 140 variables in a fixed format. If a given respondent obtained the first job after 1934, for each year prior to the year of his or her first job, SEI is missing (.); interruptions in career (due to parental leave, unemployment, or other reasons) are noticed (coded)—SEI is not given.

CONVERTER provides data not only for calendar years but also for age: Job K at $G = Y(\text{birth}) - Y(K)$, where G refers to age in years, $Y(\text{birth})$ denotes year of birth, $Y(K)$ is calendar year of job K . Theoretically, the grid for age runs from eleven to eighty-five years, but practically (for $n > 5$) the lower boundary is fourteen and the upper boundary is seventy. Another transformation that can be applied: Job K at $L = Y(K) - Y(E)$, where L refers to number of years in the labor force, $Y(K)$ denotes calendar year of job K , and $Y(E)$ is the year of entry into the labor force.

Figures 1–3 provide examples of status trajectories, expressed in SEI, on calendar years, age, and years in the labor force, respectively. For these figures we selected three individual trajectories that represent very different patterns of mobility: varied direction of changes in SEI (respondent A), clear upward mobility (respondent B), and clear downward mobility (respondent C).

Respondent A, born in 1935, began his occupational career in 1951 (Figure 1) when he was sixteen years old (Figure 2) and ended his career after working for fifty years (Figure 3). Note that respondent B (born in 1945) and respondent C (born in 1955) started their careers at the beginning of the 1970s (Figure 1), although at different ages: twenty-five and eighteen, respectively (Figure 2), and with different numbers of years in the labor force (Figure 3). Careers of respondents B and C are censored on the age line (for B at fifty-eight and for C at forty-eight; Figure 2) and on the line of years in the labor force (for B at thirty-four and for C at thirty-one; Figure 3).

Changes in SEI according to calendar years reflect the economic situation in Poland. Consider respondent A: in the 1950s and 1960s the values of SEI for A are stable and relatively low, typical for unskilled manual workers; in the 1970s, in the economic boom of the Edward Gierek era, the SEI value increases; later, during the crisis of the 1980s, we see downward mobility, followed by an increase in SEI after the mid-1980s thanks to the economic reforms of the final years of state socialism; finally, for person A, the beginning of the postcommunist transition, which saw increased unemployment and competition for jobs, meant a sharp decrease in SEI. The trajectory of respondent B, typical for semiprofessionals, rises at the same time as the trajectory of respondent A falls. What is important here is that the same events—in this case, the establishment of the Solidarity movement—produce different effects for particular categories of people. It is also illustrative that the trajectory of respondent C, typical for skilled workers

Figure 1. Examples of Individual Occupational Trajectories for Calendar Years

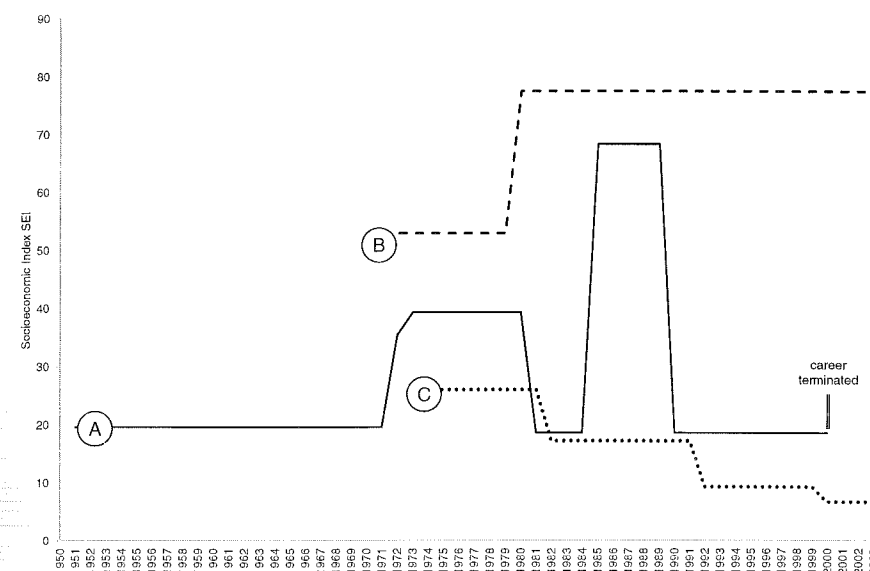


Figure 2. Examples of Individual Occupational Trajectories for Age

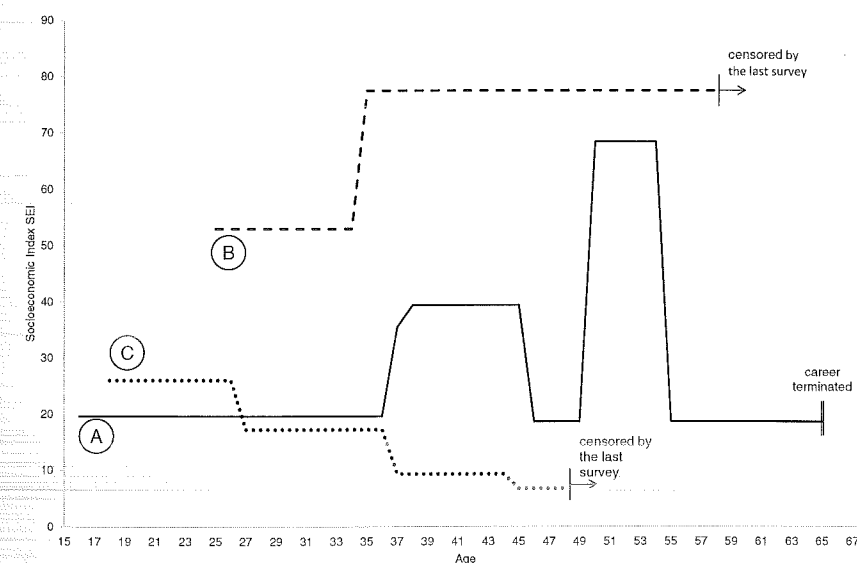
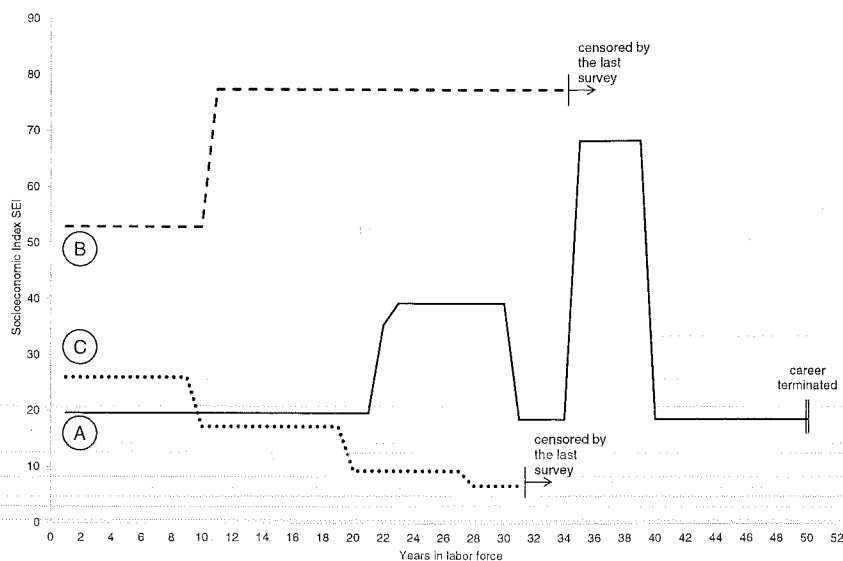


Figure 3. Examples of Individual Occupational Trajectories for Years in the Labor Force



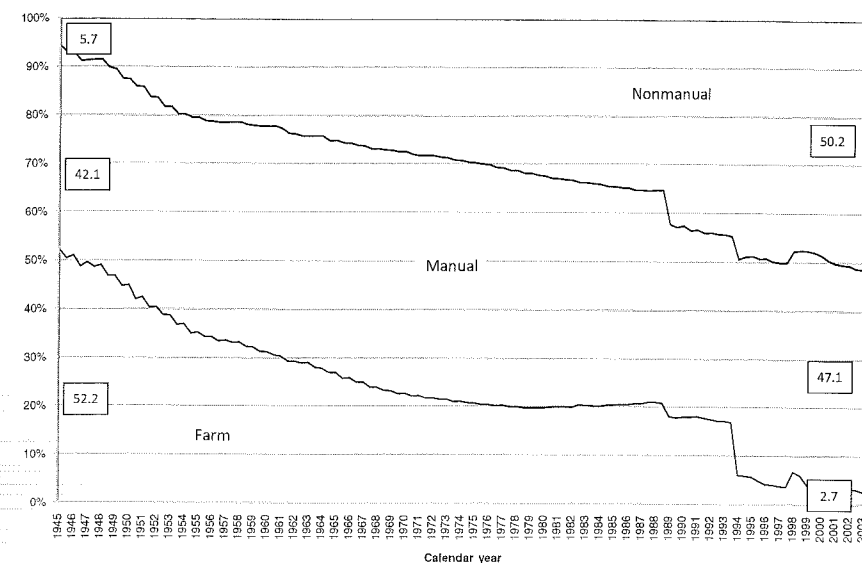
in heavy industry, presents a decline in SEI that parallels the deindustrialization process in Poland.

Although in Figures 1–3 the shape of trajectories is preserved, their special location varies depending on the type of timeline. For example, the opposite changes in SEI values for respondents A and B occurred at the beginning of the 1980s. However, at that time respondent A was forty-five years old while respondent B was almost a decade younger. At the beginning of 1980 respondent A had already been working for more than thirty years, while respondent B had worked around ten years. The dramatic change in status of respondent B and C occurred in similar calendar time and both individuals had a similar number of years in the labor force, but at very different ages. Thus, all three metrics—calendar time, age, and number of years in the labor force—provide new information that could be used to study occupational careers.

Structural Constraints for Occupational Careers

The CONVERTER computer application allows researchers to reconstruct the structure of the labor market in different periods of time, providing a framework for occupational careers. Figure 4 presents such a picture for 1945–2003. For the purposes of this analysis, occupations are roughly classified into three broad segments: farm, manual, and nonmanual. In the late 1940s, the job market in Poland was dominated by jobs in agriculture as well as by manual jobs in industry and service. Less than 6 percent of jobs were nonmanual at that time. At the end of the 1945–2003 period, the job structure reversed. In 2003, nonmanual jobs dominated

Figure 4. Shares of Nonmanual, Manual, and Farm Jobs in the Labor Market in Poland, 1945–2003



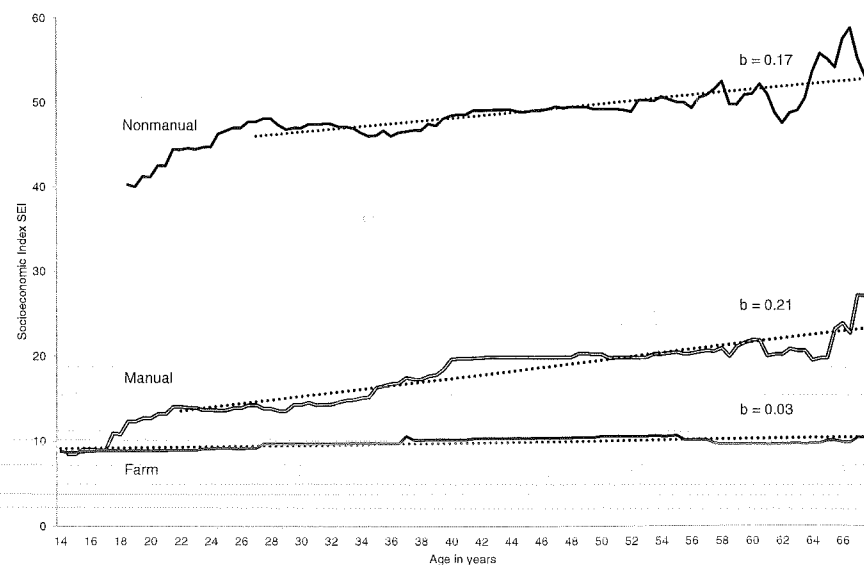
(50 percent), and less than 3 percent of the labor force worked in agriculture. Of course, these figures reflect the composition of our panel sample, in which only people active in the labor force in 1988 and participating in the later POLPAN waves are included. One could argue that the limitations of our sample exaggerate the trends over time presented in Figure 4.

Two additional issues that determine the shape of occupational careers in Poland should be emphasized. First, the share of manual jobs was relatively constant over the period under consideration, despite the fact that in modern economies this share should gradually decrease. The development of heavy industry, typical of the communist era, is subjected to restructuring but only gradually. The second issue lies in the rapid decrease of the share of agricultural jobs at the beginning of the 1990s. Under communism, Polish agriculture was based on small, labor-intensive farms. They did not prevail in the growing competition as the market economy became commonplace.

Mean SEI for Calendar Years: Simple Analysis of Cohorts Entering the Labor Market in Different Periods

Figure 5 presents the occupational trajectories for three groups of POLPAN respondents: the first group is composed of Poles who entered the labor force in 1964–67; the middle group captures respondents who started their first job between 1968 and 1972; the third group refers to the youngest cohort, formed of individuals who entered the labor market between 1973 and 1978. We chose these periods because

Figure 5. Occupational Trajectories for Three Cohorts Entering the Labor Force in 1964–1967, 1968–1972, and 1973–1978



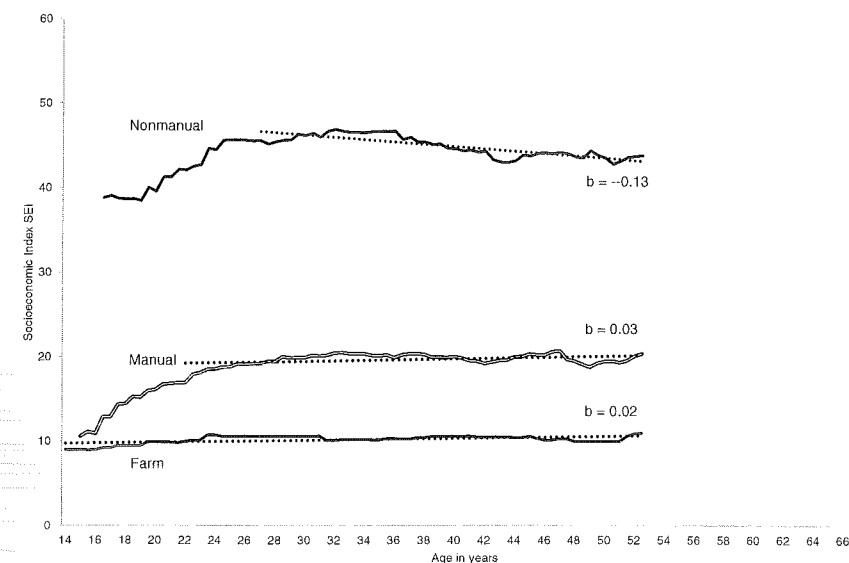
they correspond to different phases of economic development in Poland, from *mala stabilizacja* (small stabilization) through the economic crisis of the late 1960s and early 1970s, to Gierek's reforms.

In the two oldest cohorts people experienced, on average, a steady increase in SEI in the 1980s and a slow decrease in the 1990s. In the last five years, the trajectory of the oldest cohort, which entered the labor force in 1964–67, first fell and then rose, while the trajectory of the middle cohort, entering the labor force in 1968–72, first rose and then fell. The trajectory of the youngest cohort, which entered the labor force in 1973–78, parallels those for the older cohorts but on a systematically much lower level. This reflects structural constraints on available positions for successive cohorts: Beginning with the 1980s the younger cohorts faced a situation in which positions with relatively high SEI scores were often occupied. In addition, the number of positions in state and political bureaucracy diminishes in the postcommunist period, decreasing the average value of SEI overall.

Mean SEI for Age: Regression Analysis of Cohorts Born in 1922–1936, 1937–1951, and 1952–1966

To analyze occupational trajectories of people in nonmanual, manual, and farm jobs and to account for intercohort differences, we divided POLPAN respondents into three groups: born in 1922–36, 1937–51, and 1952–66. The oldest cohort started working between 1936 and 1950—before World War II and in the early postwar years. The

Figure 6. Trajectories of SEI for Individuals Starting Occupational Careers in 1922–1936 in Nonmanual, Manual, and Farm Jobs (b) 1937–1951, and (c) 1952–1966

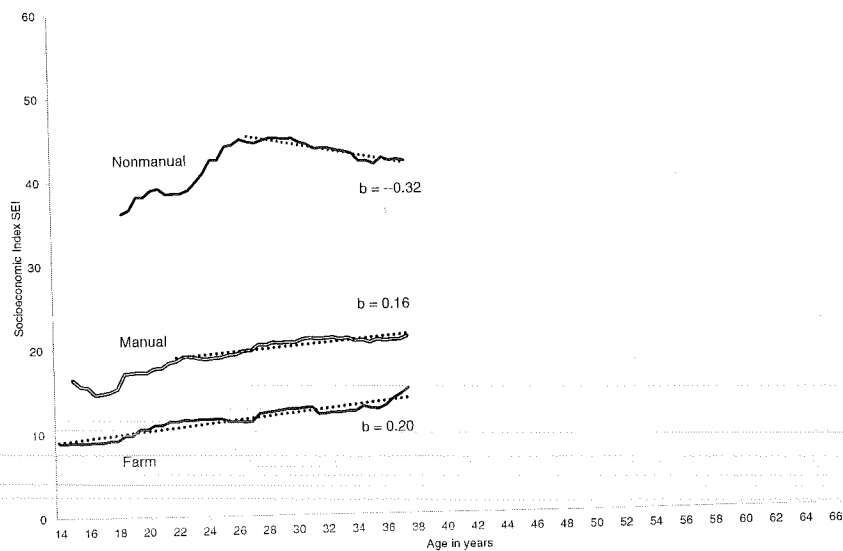


youngest cohort began to work between 1970 and 1984, when the intensive development of the centrally planned economy led to economic crisis and martial law.

In Figures 6–8, we present the mean values of socioeconomic status (SEI) together with regression lines of SEI on age. Each cohort was divided according to type of job in the person's first remunerated work. Among the members of the oldest cohort, starting to work in agriculture basically determined low social status for the rest of their life (Figure 6). The regression line (dashed) shows that, on average, this category of workers increased their status each year by scores of only 0.03 on the SEI scale. Thus, in Poland, being born in a peasant family before World War II created a strong barrier to upward mobility. This disadvantage was maintained in the next cohort, who entered the labor market in the 1950s and 1960s (Figure 7). One can see that only for the youngest cohort does the first job in agriculture not close the road to higher social positions (an increase in SEI scores of 0.20 per year) (Figure 8). These results correspond to the structural changes at the time: the agricultural sector needed fewer and fewer workers, which forced the outflow of farmers to other sectors of the economy.

In the two oldest cohorts, the individuals who began their occupational careers as manual workers started from the lowest positions, like their peers in agriculture. But from that moment, the position of this category improved systematically, as a result of the inflow of new workers starting their careers after completing vocational schooling. This inflow ends about at about age twenty-one. From this point, that is, when one's educational career is almost completed, we estimated linear trends to determine changes

Figure 7. Trajectories of SEI for Individuals Starting Occupational Careers in 1937–1951 in Nonmanual, Manual, and Farm Jobs

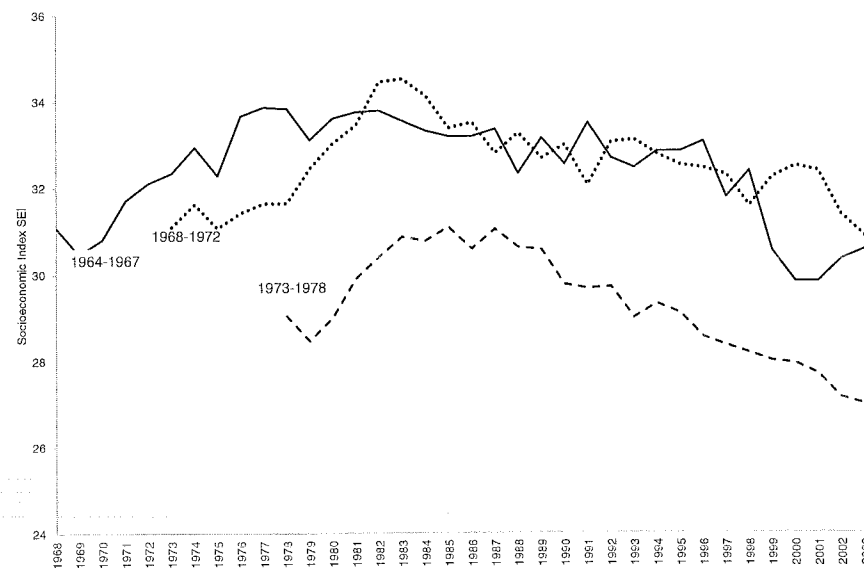


in SEI to the end of the job career. It appears that opportunities for upward mobility among people starting job careers as manual workers were the lowest in the middle cohort. Probably, the intensive industrial development, which required a stable and disciplined manual workforce, did not favor transitions to other occupations.

People entering nonmanual jobs start their careers from a much higher level than farmers or manual workers. During the first years on the age timeline, we observe an increase in average SEI mainly because this category expands by taking in graduates from colleges and universities. This inflow ends at age twenty-six, when people generally end their tertiary education. For the rest of the career of nonmanual individuals, starting at age twenty-seven, we calculated the coefficients of regression models. We did so in order to predict the values of SEI dependent on age. These values indicate that an occupational career that started with nonmanual jobs created opportunities for upward mobility only in the oldest cohort. For the two youngest cohorts the coefficients are negative. The position of early achievers, instead of maintaining the status quo, tends to decrease during the life cycle. This is the opposite effect than that predicted by Sørensen's (1974) model.

The overall privileged position of nonmanuals seems to result entirely from the initial lead at the moment of entry into the labor market. From then on, this advantage begins to decrease, especially in relation to people starting their occupational careers as farmers or manual workers, whose status is increasing rather than decreasing. One of the causes of the declining status of nonmanual employees may lie in the steadily increasing share of this category in the labor market. The

Figure 8. Trajectories of SEI for Individuals Starting Occupational Careers in 1952–1966 in Nonmanual, Manual, and Farm Jobs



demand for new candidates increases the inflow of young, better-educated people. They capture the higher occupational positions, displacing those who reached them before. At least some early achievers must accept the necessity of changing their occupation, which may lead to demotion and lower SEI.

Mean SEI for Career Time: A Simulation Model for Cohorts Entering the Labor Market at Different Periods

Here we refer to the model $d(S - M)/dt = -\alpha(S - M) + \sigma dM/dt$. Under interpolation of M for time intervals (t_i, t_{i+1}) , the solution for our proposed equation is given by:

$$S(t) = e^{-\alpha(t-t_i)} [S(t_i) - M(t_i) - (\sigma/\alpha) k_i] + k_i(t - t_i) + M(t_i) + (\sigma/\alpha) k_i,$$

where $k_i = [M(t_{i+1}) - M(t_i)] / (t_{i+1} - t_i)$.

Recalibration of education into SEI units is usually an expression of how much education is worth in terms of SEI. The value of education in terms of SEI changes across time due to two processes:

1. Cohort-dependent devaluation: people from successive cohorts attempt to obtain more education to increase their *intercohort* competitiveness.
2. Career-dependent devaluation: after entering the labor force some people continue to receive more schooling to increase their *intra*cohort competitiveness.

We achieve the recalibration of education into status through a two-step proce-

ture that takes into account, for a selected calendar period, distributions of years of schooling (E) and scores of the socioeconomic index. In the first step, the joint distribution maximizing the relationship between E and SEI is constructed. In the second step, for each value of E the mean value of SEI is computed. These averages become the values of M that can be assigned to each respondent for his or her education in time t_i . Since for the same periods we have the values of S , the problem is to establish parameters α and σ .

Table 1 compares the predicted values of SEI to the observed mean values in the data, for respondents who assumed their first job between 1964 and 1978. In this analysis we include cohorts that entered the labor force in 1964-67, 1968-72, and 1973-78, but restrict them to respondents who worked without major interruptions, to avoid missing data on SEI . We consider the occupational trajectory lengths of thirty-five, thirty, and twenty-five years, respectively.

Generally, the predictions with optimal parameters α and σ come very close to the actual means. In our model the parameter α (0.05) refers to a half-life parameter of reaching the maximum of SEI and the parameter of σ (1.3) was established as a result of data simulation. The data fit our model relatively well as indicated by the difference between actual and predicted values of SEI , usually not exceeding two points.

We should note that the model predicts a decline in SEI , while in reality the decline is only modest. The data in Table 1 show that it is more difficult to model shorter careers than longer ones due to the restricted number of career points for which we have information. In addition, the changes in the value of education for the younger cohorts become chaotic since the labor market reacts to the expansion of education—in which a sizable proportion of employees participate—unevenly over time: The rules of meritocracy are applied without expected determination.

Conclusion and Discussion

This study focused on two interrelated issues: representing occupational trajectories by applying the CONVERTER program and analyzing them by different means, including simulation modeling based on a differential equation model. In presenting our results we referred to the Polish economy, that is, an economy of transition from orthodox central planning and state control to a free market.

For further discussion, we pose three problems that stem from the empirical analysis using CONVERTER:

1. Occupational trajectories are not smooth. A sizable proportion of trajectories is characterized by unexpected jumps. In some cases, status changes are dramatic due to shifts to new jobs across the line of private-public firms. SEI depends on the job nomenclature and private firms are prone to using "better" occupational titles. How can intersectoral differences in job nomenclature be accounted for?
2. Occupational careers are interrupted due to unemployment, illness, parental leaves, care of adult family members, full-time household duties, military service, imprisonment, or other reasons. How can job interruptions, and thus

Table 1

Actual and Predicted SEI for Individuals with Full Careers in Cohorts Entering the Labor Force in 1963-1968, 1969-1972, and 1973-1978

Years in the labor force	Mean actual SEI (A)	Predicted SEI (B)	Difference (A - B)
Cohort entering the labor force in 1963-1968			
Beginning, 0	30.60	29.65	0.95
5	31.88	32.05	-0.17
10	33.22	33.14	0.08
15	32.74	33.60	-0.86
20	31.55	33.85	-1.30
25	31.27	32.02	-0.75
30	32.11	31.40	0.71
35	30.56	28.65	1.91
Cohort entering the labor force in 1969-1972			
Beginning, 0	31.55	30.15	1.40
5	32.11	31.64	0.47
10	34.93	33.81	1.11
15	33.54	34.45	-1.01
20	33.52	34.35	-0.83
25	32.19	33.26	-1.07
30	32.12	29.68	2.44
Cohort entering the labor force in 1973-1978			
Beginning, 0	28.46	26.00	2.46
5	30.76	29.51	1.25
10	30.55	31.27	-0.72
15	29.13	31.48	-2.35
20	28.35	30.84	2.49
25	27.57	26.68	0.89

gaps in SEI, be accounted for when analyzing occupational trajectories?

3. Trajectories are subject to branching. At some points in their career people hold more than one job. How can this situation be accounted for? To average the status for all jobs an individual holds is one possibility. Should researchers use different parameters of equations for different jobs? Are such techniques available?

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