Dynamics of social structure: Poland's transformative years 1988-2013,
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Chapter 1.

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Occupational Careers: From Simple to Complex Approaches*

Introduction

In this chapter 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.

In sociology, the measures of status for individuals are derived from classifications of jobs/occupations: each person's job receives a score according to a given scale, such as occupational prestige, complexity of work, or socio-economic index. We focus on predicting mean values of the socio-economic index (SEI) for each point of the trajectories of selected groups of people using panel data on Poland. The scales are described in Domański, Sawiński, and Slomczynski 2009.[1] In this chapter

* In this chapter we use our previous work (Slomczynski, Tomescu-Dubrow, and Sawiński 2013); cf. www.tandfonline.com/doi/pdf/10.2753/IJS0020-7659420403.

[1] This scale is constructed in accordance with Duncan's (1961) tradition in which SEI is a linear function of education and earnings aggregated to the occupational level. Originally, occupational prestige was regressed on these two variables for a limited number of occupations and then the coefficients from regression equation were used to estimate the SEI scores for the complete set of occupations. The Polish SEI was constructed in 1979 in a similar way. We use this version of SEI because it strongly correlates with other occupational scales and is stable in time. In particular,

we visualize occupational trajectories and analyze them by means of regression and simulation analysis.

Most 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 (socialist-type) to a free market (capitalist-type) economy. We demonstrate that occupational trajectories can be analyzed by traditional techniques, but we go beyond them. In the research tradition of 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 assumptions.

Analyzing Occupational Trajectories

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 Abbot 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 called failure-time models,

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the correlations of this scale with the 2009 scales of educational requirements and material remuneration are above 0.9. (Domański et al. 2009). In Poland, the socioeconomic index is the most suitable scale for analysis of occupational status of individuals in a historical perspective.

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 predicated with a set of covariates. These techniques make it possible to deal with time-varying covariates and with censored data (Blossfeld 1986; Hamerle, and Mayer 1989; Li et al. 1998).

Both approaches are compatible. Laura Arosio summarizes and compares various techniques related to them, concluding that they are "useful and complementary tools that can offer a best understanding of the career systems of contemporary societies" (Arosio 2004: 454). However, they all deal with jobs *classified in different categories*. For analyzing occupational trajectories understood as a sequence of *numerical values on the timeline,* the methodology is less developed.

In this chapter, we apply simple tools including regression analysis, and dynamic modeling based on differential equations to examine occupational trajectories. 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 cases when 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 decreasing 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 Peradzynski (1986), is given by 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 σ dM/dt makes the model flexible, allowing for decrease in status at the end of career. This model is in agreement with the econometric model of occupational career proposed by Sicherman and Galor (1990), in which the link between occupational statuses with recalibrated education changes in time.

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. A straightforward way is 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 analyses come from POLPAN 1988–2013. POLPAN provides respondents' full employment history. During interviews, all jobs in consecutive intervals, 1988–1993, 1993–1998, 1998–2003, 2003–2008, and 2008–2013 were recoded. The description of all jobs contains a great deal of information, including:

– year and month when the respondent started their job;

– job characteristics coded with the Polish Social Classification of Occupations, SKZ (Domański et al. 2009; Pohoski and Slomczynski 1978), and with SEI (Slomczynski and Kacprowicz 1979; Domański et al. 2009); and

– year and month when the respondent left the job.

Originally, the data on jobs are recorded in a floating format, that is, the information on a given job in a given time point – whether in term of calendar year or number of years in the labor force – could appear in

different parts of the record of respondent's answers. Some respondents have a short record (one or two jobs) while others have a long record (several jobs). Thus, information on jobs in a given calendar year appear in different places of the record for different respondents. 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 expressed in time units.

CONVERTER is a special software that enables researchers to compensate for this shortcoming by transforming records of jobs a particular person holds over the years from a *floating time format* (consecutive jobs) into *fixed time points* (calendar years). This program was developed especially for POLPAN to transform the data collected in subsequent POLPAN waves into coherent occupational careers. Each job is described by SKZ four-digit category, SEI, and other scales.[2]

In POLPAN the first recorded entry into the labor force took place at the beginning of 1934, when a respondent born in 1920 turned fourteen years old. CONVERTER records all jobs for all respondents from this date until 2013, for every year interval. Thus, for each respondent and each job characteristic of the occupational career, such as socio-economic scale (SEI), or detailed occupational code, CONVERTER introduces a set of auxiliary variables. For each year prior to the year of respondents' first job, the auxiliary variables have missing values. Interruptions in career (due to parental leave, unemployment, or other reasons) are coded and can be used in the same way as other variables.

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 14 to 91 years, but practically the lower boundary is 14 and the upper boundary is 70 years. 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 1.1–1.3 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

[2] Scales not used in this chapter refer to skill requirements, complexity of work, material remuneration, and occupational prestige (Domański et al. 2009).

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 1.1) when he was sixteen years old (Figure 1.2) and ended his career after working for fifty years (Figure 1.3). Note that respondent B (born in 1945) and respondent C (born in 1955) started their careers at the beginning of the 1970s (Figure 1.1), although at different ages: twenty-five and eighteen, respectively (Figure 1.2), and with different numbers of years in the labor force (Figure 1.3). Careers of respondents B and C are censored on the age line (for B at 58 years and for C at 48; Figure 1.2) and on the line of years in the labor force (for B at thirty-four and for C at thirty-one; Figure 1.3).

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 post-communist transition, which saw increased unemployment and competition for jobs,

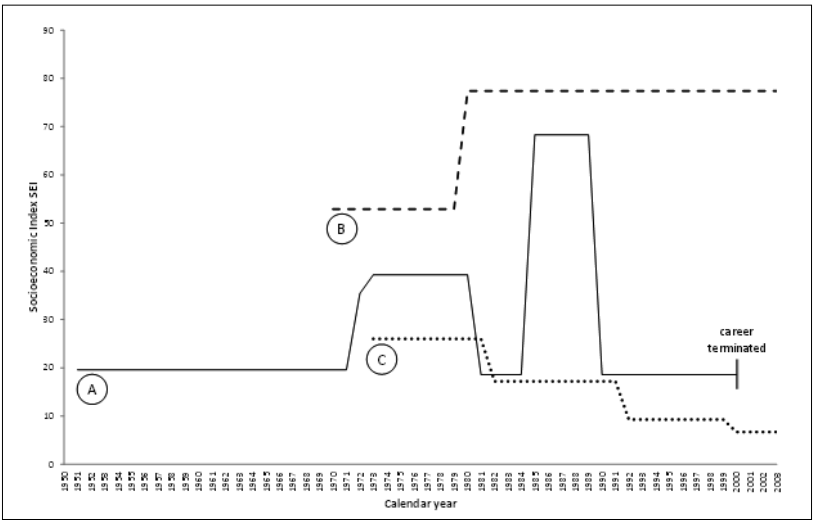

Figure 1.1. Example of Individual Occupational Trajectories for Calendar Years

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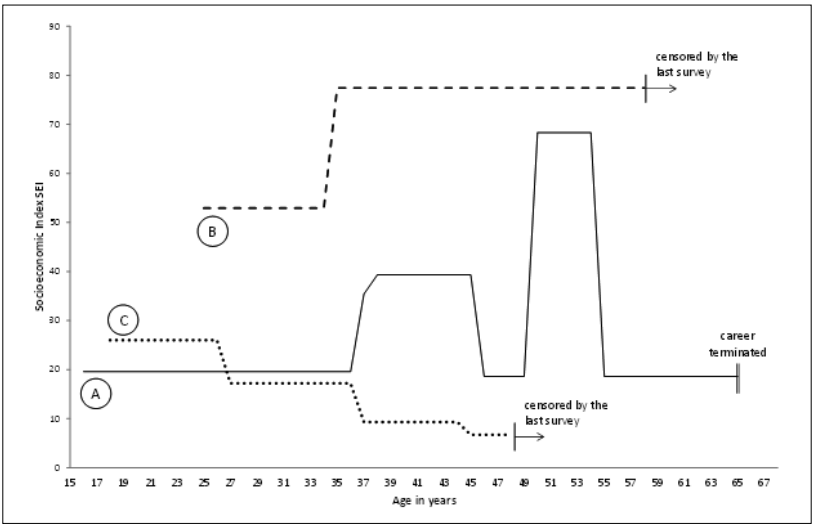

Figure 1.2. Example of Individual Occupational Trajectories for Age

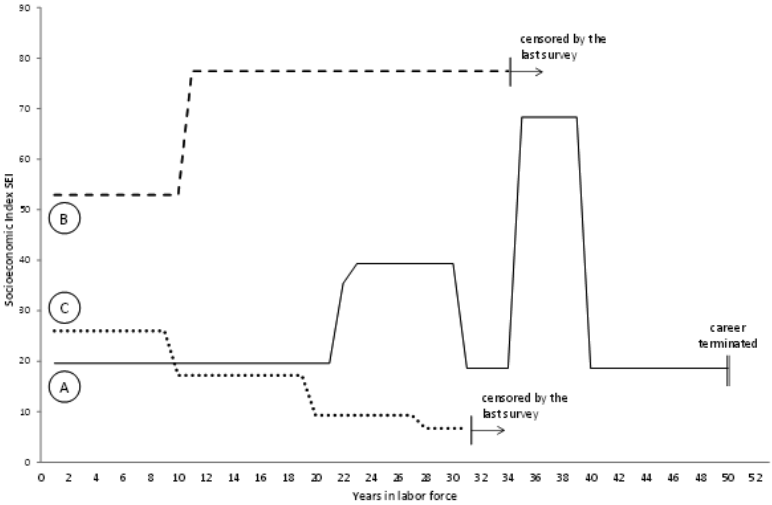

Figure 1.3. Example of Individual Occupational Trajectories for Years in the Labor Force

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

Although in Figures 1.1–1.3 the shape of trajectories is preserved, their location varies depending on the type of lifetime. 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 for 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 complementary information that could be used to study occupational careers.

Structural Constraints for Occupational Careers

CONVERTER allows researchers to reconstruct the structure of the labor market in different periods of time, providing a framework for occupational careers. Figure 1.4 presents such a picture for 1945–2013. For the purposes of this analysis, occupations are classified into five broad segments: farm, unskilled manual, skilled manual, sales and services, and non-manual. In the late 1940s, the job market in Poland was dominated by jobs in agriculture (64%) as well as by manual jobs: unskilled manual (15%) and skilled manual workers (10%); sales and service workers constituted the same proportion as non-manual workers (5%). In 2013, non-manual jobs dominated (36%), and only 9% of the labor force worked in agriculture. The sharp decrease of farmers and farm laborers and accompanying increase of manual workers in the 1950s reflects the period of the "forced industrialization" of Poland at that time (Szczepański 1978).

Two additional issues that shape occupational careers in Poland should be emphasized. First, the share of manual jobs was relatively constant over the period from the late 1950s, 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 restructuration 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 of the post-1989 market economy.

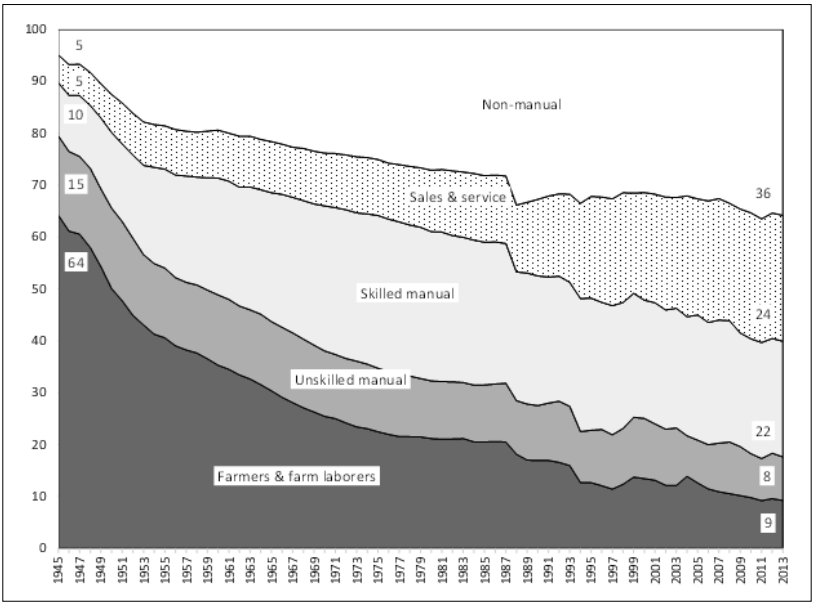

Figure 1.4. Shares of Farmers and Farm Laborers, Unskilled and Skilled Manual Workers, Sales and Service Workers, and Non-Manual Workers Jobs in the Labor Market in Poland, 1945–2003

Figure 1.4 depicts the transformation of the occupational structure in Poland, with clearly marked periods of different rate of change for different occupational categories. However, it should be noted that our data are not based on representative samples of employed people in particular years. For the period 1945–1987 these are retrospective data pertaining to POLPAN respondents' occupational careers obtained during the 1987/1988 interviews.

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

Figure 1.5 presents the occupational trajectories for two groups of POLPAN respondents: the first group is composed of Poles who entered the labor force in 1945–1950; the second group captures respondents who started their first job between 1951–1960. We chose these periods because they correspond to different phases of economic development in Poland, from the period of the nationalization of the economy, land reform, and relocation of the labor force to different territories of Poland, to the period of "forced" industrialization mentioned before. These two cohorts differ with respect to the increase of the average SEI. The first group has relatively stable average SEI value through time, and this value is relatively low. The other cohort starts on higher average SEI value and enjoys a small increase in socio-economic status over time.

The next two cohorts, presented in Figure 1.6, correspond to the periods of *mala stabilizacya* (small stabilization) through the economic

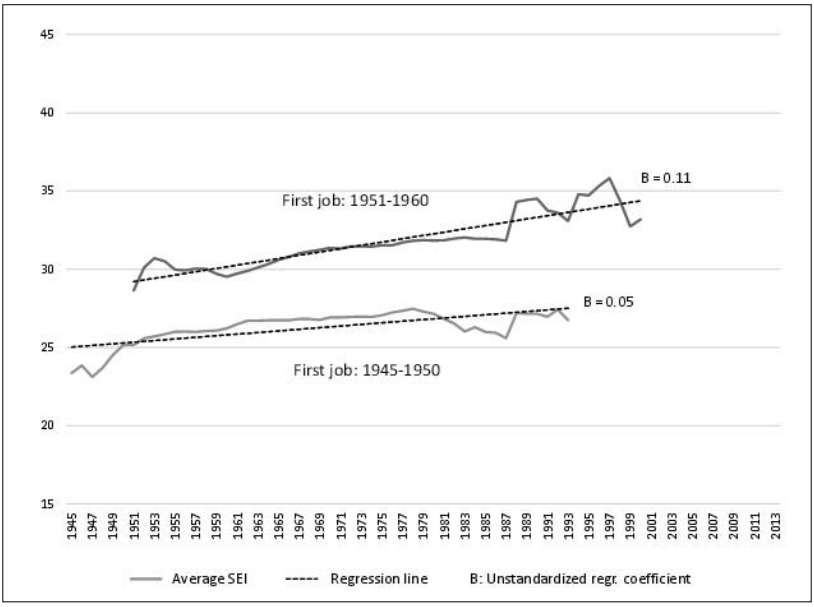

Figure 1.5. Occupational Trajectories for Entering the Labor Force in 1945–1950 and 1951–1960

crisis of the late 1960s and early 1970s, to Gierek's reforms. They are of special interest because of the shape of the trajectory – increasing at the beginning of the career, and then decreasing. Note that the regression coefficients for the trajectory to 1993 are positive (higher for the younger cohort), then, after 1993 coefficients are negative. The position, 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.

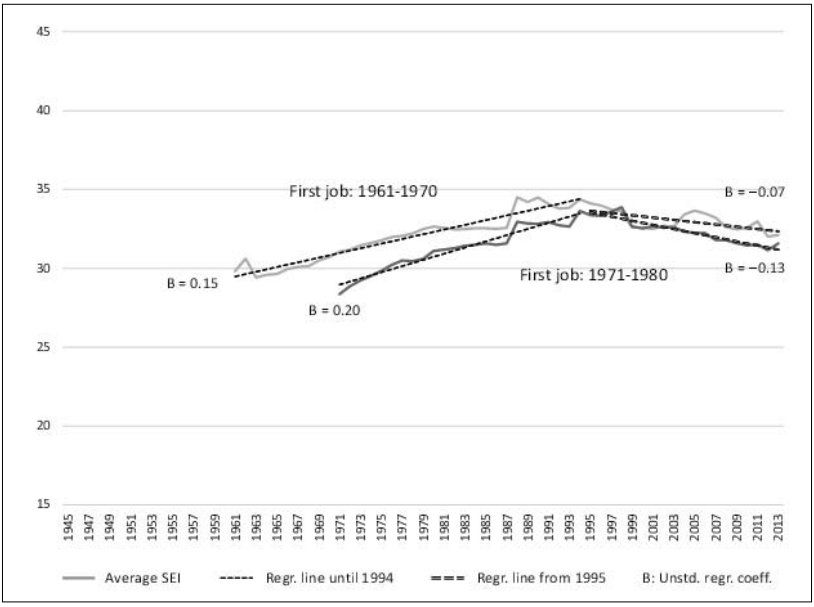

Figure 1.6. Occupational Trajectories for Entering the Labor Force in 1961–1970 and 1971–1980

Figure 1.7 depicts three cohorts: (1) entering the labor force at the end of the communist regime, (2) entering the labor force at the beginning of the transition but before Poland's accession to the European Union (EU), and (3) entering the labor force after the EU accession. The later people enter the labor force the more steady the increase of SEI. The difference in metric regression coefficients is large. For the first cohort the increase in SEI for one year is 0.14, for the second cohort it is 0.41, while for the third one it is 1.06. It should be noted that these groups start, on the average, at different levels: the first cohort has the highest starting level, and the third one, the lowest.

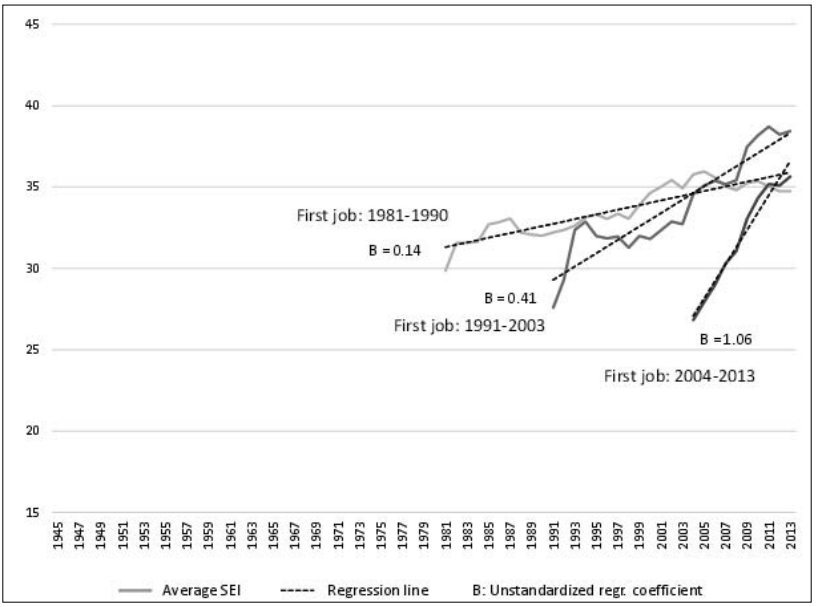

Figure 1.7. Occupational Trajectories for Entering the Labor Force in 1981–1990, 1991–2003, and 2004–2013

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 the 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 *intracohort* competitiveness.

We achieve the recalibration of education into status through a two-step procedure that takes into account, for a selected calendar period, distributions of years of schooling (E) and scores of the socio-economic index. First, we construct the joint distribution maximizing the relationship between E and SEI. In the second step, we compute for each value of E the mean value of SEI. 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 find parameters α and σ.

Table 1.1 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 observed means. In our model the parameter α refers to a half-life parameter of reaching the maximum of SEI – that is, reflecting the total number of years so that 50% of a group of people with the same SEI starting period reach their status peak. The parameter σ was obtained through minimization of squared differences between actual and predicted values of SEI. The data fit our model relatively well: the difference between actual and predicted values of SEI usually does not exceed two points.

We should note that the theoretical model predicts a decline in SEI, while in reality the decline is only modest. Table 1.1 shows that it is more difficult to model shorter careers than longer ones due to the restricted number of career points. 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 which the theoretical model implies operate with differing accuracy in time.

Table 1.1. Actual and Predicted SEI for Individuals with Full Careers in Cohorts Entering the Labor Force in 1963–1968, 1969–1973, 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

Conclusion and Discussion

This chapter focused on two interrelated issues: representing occupational trajectories using the COVERTER program and analyzing them in various ways, including computer simulations based on a differential equation model. In presenting our results we referred to the Polish economy, that is, an economy of transition from central planning and state control under the socialist period, to the post-1989 free market environment. We found substantial change in the structure of the labor market. Just after World War II farmers and farm laborers were the dominating category. Afterward, the process of industrialization stimulated the growth of manual worker positions who, together with sales and service workers reached around 50% of the labor force in the late 1970s. At that time non-manual workers constituted over 20%. This category continued to slowly increase in later years. After 1989 sales and service workers became the most expanding category, reaching 24% of the labor force in 2013.

Cohort analysis reveals important differences between occupational trajectories of persons entering the labor force in different periods of economic development in Poland. Although consecutive cohorts enter the labor market at similar or lower levels of SEI, the rise in the average SEI at the beginning of an occupational career varies. For those who enter the labor market in 1945–1950 the average SEI does not rise much. This can be contrasted with those who enter the labor force after Poland's accession to the European Union. For them the slope of SEI is very steep. We also showed that the cohorts entering the labor force in 1960–1970 and 1971–1980 experienced a decline in average SEI during the post-communist transformation period, specifically after 1992.

In this chapter we also presented the model in which SEI depends on recalibrated education. The model provides relatively good estimates of respondents' actual trajectories, although we discovered that the optimization process is very sensitive and parameters α and σ are not stable. In further research these parameters should be based on independent analyses of career properties. Currently, we provided the model for illustrative purposes: how the data obtained with CONVERTER can be modeled together with external information about the recalibrated education.

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

1. Occupation 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.
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 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, while the other is to treat all jobs as separate careers.

We invite scholars to use POLPAN, which is available free of charge from the survey administrators (polpan.org) to take up these points in further research on occupational trajectories.