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Professoral Career Patterns between Academia and the Corporate World

Applying sequence analysis to the study of academic autonomy[1]

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1. Introduction

The rise of collaborations between scientific research and private industry holds a central place in contemporary debates on the autonomy of science and higher education. These collaborations can take various forms and evolve in time. This paper focuses on Swiss professors' professional careers as a dimension of the ties that participate to define the changing boundaries between academic and private sector.

Little is known about historical trends of relations between universities and the economic sphere in Switzerland. If the academic field does not escape the movement of "economization" of higher education at the end of the 20th century (Jost, 2015: 130), it is likely that collaborations took other forms before, especially for engineering sciences, chemistry or, later, biotechnologies and life sciences. In a study about Swiss pharmaceutical research in the 20th century, Bürgi (2011) shows the importance of the ties between academic research and private industries in the development of chemistry and biotechnologies during the whole century. Focusing on the first part on the century, Tamm (1997) and Simon (1997) note that academic research and private interests have converged since the early development of chemical industry, notably through the recruitment of professors in private research institutes.

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1.1 The Changing Career Patterns of Professors

The scientific field has never been entirely autonomous from exogenous dynamics as the production of knowledge relies on extra-academic resources in various proportions. Autonomy therefore becomes a central concept for sociology of science to broach classification struggles to impose a definition of science and disciplines in their historical dimension (Gingras, 2012: 294).

The recent research on collaborations between academic and private sphere mostly focuses on the network dimension (i.e. co-publications, co-signatures of patents or research mandates[2]). Our purpose is to explore another dimension of connections through the study of professors' careers. By using sequence analysis, we open an innovative perspective on the analysis of collaborations between scientific research and the private sector, both biographically and historically. Our research revolves around three main points of inquiry:

First, how do careers evolve biographically in terms of phases, turning points, rhythm? Second, how do careers change depending on historical period, i.e. how do they reflect institutional transformations? Third, can typical careers be identified for specific disciplines, or groups of disciplines?

Furthermore, concentrating on professor's careers allows us also to shed new light on the changing autonomy of the academic field. Following Weber's definition of openness and closure of social relations (Weber, 1995), we propose to consider professional careers as a dimension of exchange at the interface between scientific and economic spheres, and thereby as an indicator of autonomy. As defined by Lamont and Molnar (2002), *boundary-work* is either a way to protect professional autonomy against outside powers (political, economic), as well as a form of social control. Hence, we can analyse careers as a specific dimension of boundary-work through collaborations across fields.

This conceptual framework allows us to focus also on disciplinary boundaries, as we expect careers to be strongly differentiated between disciplines. Gingras (2012) states that the homogeneity of careers is an indicator of the degree of autonomy of disciplines. The more a scientific field is institutionalised, the more careers are buoyed. Again, careers function as a strategy to maintain scientific autonomy and at the same time as a way to strongly limit subversion strategies (Gingras, 2012: 290). A focus on typical career trends constitutes a way to comprehend the legitimacy of different types of capital among peers.

1.2 Why study the case of the EPFL

To study the careers of professors we concentrate on the case of the Ecole polytechnique fédérale de Lausanne (EPFL). The EPFL is one of two federal technical universities in Switzerland (Jost, 2015). It was recently rated in the top 15 of world's

[2] For some examples, see Grossetti & Milard, 2003; Callon & Gamberini, 2000; Barrier, 2014.

universities (top 5 of European universities)[3] and it is widely renowned for cultivating close relations to the private sector. From 2000 to 2014, 192 start-ups were established, 129 inventions disclosed and 99 priority patents were filed. Moreover, the "EPFL Innovation Park" hosts currently several big companies such as Axa Technology services, Credit Suisse, Logitech, Siemens, Merck-Serono or Nestlé.

We chose to divide the history of the EPFL into three periods: The first period lasts from 1969 to 1980. Engineering sciences are developed together with scientific disciplines (chemistry, physics and mathematics), although all diplomas are delivered as engineer's degree. During this first period, the EPFL remained the most disconnected from the University of Lausanne and the Swiss academic field in general.

The second period, from 1980 to 2000, is characterized by the progressive concentration of activities on engineering sciences, and the development of microengineering and computer sciences. Collaborations between EPFL and the University of Lausanne revive. Several projects of coordination are also developed with other Swiss universities. Biology is not a priority, in contrast to engineering physics and chemistry (Leresche et al., 2012: 194). Although some structures of collaboration with industries had been established since the 1970's, they strongly increase from 1990. In year 2000, the EPFL hosts 47 private companies, including 37 start-ups, which have been founded at the EPFL (Pont, 2010: 106).

The last period starts in 2000 with the reorientation of the EPFL toward the development of biology and biotechnologies. Partnerships with industrial firms expand strongly, with a concomitant growth of new start-ups. The number of professors increases from around 150 in 2000 to more than 200 in 2010, significantly in the Faculties of basic sciences (chemistry and physics) and life sciences[4].

2. Data and strategy

We built an original dataset that includes all full, extraordinary and associate professors of the EPFL active at least at one of three benchmarks: 1980, 2000 and 2010. These benchmarks refer to the three periods presented in the precedent chapter.

Based on a positional approach (Mills (2010 [1956]) the inclusion criterion of our sample is the position held, namely the position of full, extra-ordinary or associate. We attempted to gather data on the entire career of each professor, including academic and extra-academic functions.

[3] http://information.epfl.ch/chiffres (02.01.2016)

[4] http://vpri.epfl.ch/files/content/sites/vpplnew/files/shared/Stat%202014/Personnel%202014.pdf (12.01.2016)

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Table 1. Total number of professors of the EPFL

1980	2000	2010
N=112	N=142	N=211

Table 1. Indicates the total number of professors holding a position of full and extraordinary (associate) professor for year 1980, 2000 and 2010. Some individuals may be present on two different dates if their mandate runs, for example, from 1978 to 2004.

We examined careers from the age of 20 to the age of 65 for all professors. The alphabet includes all the functions held within and outside the academic field. For each professor, we collected data for the year of nomination and departure of the function, the nature of the function, place and country of workplace. The alphabet is composed of 8 states.

Academic positions are divided into three states, related to the hierarchy of positions within academic institutions. The first state includes all full professors. The second state includes extra-ordinary and associate professors. The third includes all other academic positions namely post-doctoral fellowship, lecturer, senior lecturer, assistant professor, research positions, head of research.

Extra-academic positions are pooled into one single state: positions as engineer, researcher, head of research, director of research within private laboratories or companies and executive directors. Non-executive functions such as member of the board of directors are not taken into account; they are not considered to be full-time activities.

The third set of states is related to multipositionality, namely holding one of the three academic positions at the same time with an extra-academic position: ordinary professor + extra-academic position, extra-ordinary or associate professor + extra-ordinary position, other academic position + extra-ordinary position.

The last state is related to educational period running from the age of 20 to the date of the graduation. Namely doctoral degree or high degree diploma such as Licence, Master, diploma or equivalent in the case individual does not hold a doctoral degree.

Finally, missing data are added as a state when at the beginning or when resulting from a lack of data during the career. Missing data at the end of the career are not taken into account when they due to still going on career The data on careers are completed by a set of biographical indicators such as date and place of birth and death, sex, nationality and educational degree (graduate diploma, PhD, discipline, place and year of acquisition).

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3. First results and perspectives

Our analytical strategy is based on sequence analysis, mainly optimal matching and clustering. Our results on data for 1980[5] (N=112) relies on a TramineR clustering using a Ward method and a standard matrix, all substitution costs set at 1 (optimal matching using a constant method, including missing data). The sequences are defined from the age of 20 to the age of 65.

The results distinguish three relatively distinct types of careers: "academic careers" (Type 2, N=54), "extra-academic careers" (Type 1, N=43) and "part-time careers" (Type 3, N=15). Careers type 1 is characterized by a relative short period of education and a relative long career outside the academic field prior to the nomination of professor. What is more, out of 43 trajectories, 20 indicate a nomination as full professor directly following the extra-academic career and 18 indicate a nomination as extra-ordinary professor directly following the extra-academic career. Type 2 is composed of careers that follow a "full academic career". Only eight trajectories include extra-academic functions with a meantime of two years. In comparison, the time of extra-academic functions is of 12 years in average for type 1. Type 3 contains trajectories of part-time careers until the age of 65, mostly extra-ordinary professors and some full professors keeping an extra-academic activity until the end of their career.

Fig. 1: Extra-academic careers (Type 1)

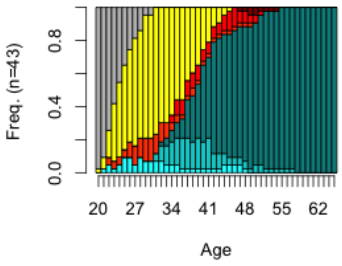


Fig. 2: Academic careers (Type 2)

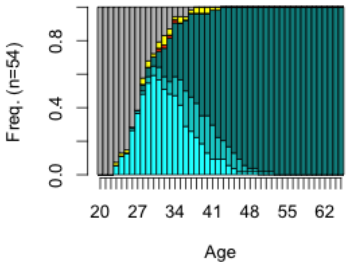
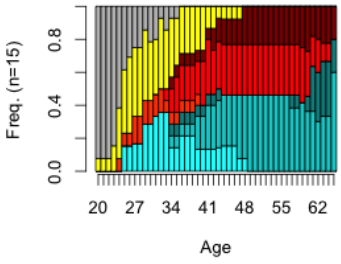
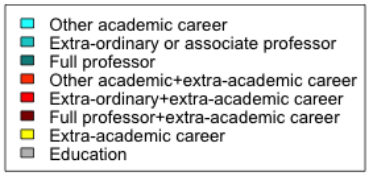


Fig. 3: "Part-time professorship" (Type 3)





[5] In the final paper we will have comparative data on all three years: 1980, 2000 and 2010.

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To complete this first analysis for year 1980, we crossed three variables with each clusters, as shown in table 2.

Table 2. Characteristics of the three career types

Variable	Type 1	Type 2	Type 3	Ø
Doctoral degree YES	0.30	0.89	0.47	0.60
Natural sciences YES	0.14	0.50	0.20	0.32
Foreign nationality YES	0.14	0.24	0.13	0.19

Table 2. All variables are dummies. Doctoral degree YES includes all professors holding a doctoral degree (60%). Natural sciences YES include chemistry, physics and mathematics department (32%) *versus* departments of engineering and architecture. Foreign nationality YES (19%) gathers all non-Swiss nationalities (18 Europe, two USA, one India). Total variable ratio is calculated through total of the variable on total population.

Comparing the characteristics of the three types, the percentage of professors with doctoral degree is much higher for Type 2 than for the average. Also the natural sciences and foreign professors are clearly overrepresented in Type 2. In comparison, Type 3 and particularly Type 1 are mostly composed of Swiss professors, engineering sciences and a relative low percentage of professors holding a doctoral degree.

This first descriptive analysis shows three interesting results. First, the average of professors holding a doctoral degree is of remarkably low 60%. Thus we may argue that at the EPFL, an extra-academic career is a substitute for a doctoral degree, and we may ask to what extend this is true for 1980. Second, the EPFL appears not to be as internationalized in 1980 as it is today, with 19% of foreign professors. This percentage is very likely to increase for the recent period together with a diversification of countries. Third, regarding closer to disciplines, the results show two different patterns. On one hand, natural sciences, highly represented in Type 2, are mostly linked with doctoral degrees and foreign origin. On the other hand, a low percentage of doctoral degrees together with a high proportion of Swiss professors and engineering sciences characterize the Type 1. We expect this opposition between natural sciences and engineering sciences to decrease in the recent period.

Finally, these first results bring us to formulate broader questions about career patterns and academic autonomy: What is the frequency and the biographical pattern of professor's shifts between the corporate sector and the academic domain? Do professor change between business and academic mainly in the beginning of their career or only once they enjoy a stable academic position? Can we observe parallel careers between the private and the academic field?

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