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Changing European Academics

A COMPARATIVE STUDY OF SOCIAL STRATIFICATION, WORK PATTERNS AND RESEARCH PRODUCTIVITY

Marek Kwiek

ROUTLEDGE

RESEARCH INTO HIGHER EDUCATION

Changing European Academics

European academics have been at the centre of ongoing higher education reforms, as changes in university governance and funding have led to changes in academic work and life. Discussing the academic profession and, most importantly, its increasing stratification across Europe, *Changing European Academics* explores the drivers of these changes as well as their current and expected results.

This comparative study of social stratification, work patterns and research productivity:

- Examines 11 national, higher education systems across Europe (Austria, Finland, Germany, Ireland, Italy, The Netherlands, Norway, Poland, Portugal, Switzerland and the United Kingdom)
- Provides a panoramic view of the European academic profession
- Confronts misconceptions of academic work and life with compelling results and detailed analyses
- Discusses new dilemmas inherent to the changing social and economic environments of higher education.

A thoughtful and comprehensive study of the changing academic profession in Europe, this book will be of interest to higher education practitioners, managers and policy makers, both in Europe and globally. *Changing European Academics* will benefit anyone whose work relates to changing academic institutions and changing academic careers.

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A Comparative Study of Social Stratification, Work Patterns and Research Productivity
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Series editors' introduction

This series, co-published by the Society for Research into Higher Education and Routledge Books, aims to provide, in an accessible manner, cutting-edge scholarly thinking and inquiry that reflects the rapidly changing world of higher education, examined in a global context.

Encompassing topics of wide international relevance, the series includes every aspect of the international higher education research agenda, from strategic policy formulation and impact to pragmatic advice on best practice in the field. Each book in the series aims to meet at least one of the principal aims of the Society: to advance knowledge; to enhance practice; to inform policy.

Marek Kwiek's book focuses on the academic profession in 11 European higher education systems and deals with different forms of stratification in academic careers. Informed by theoretical insights from the sociology of science, data from the Changing Academic Profession survey are analysed to elucidate the contemporary nature of work in academia. Against the background of asserting that the profession in the Europe is highly stratified, the analyses show important differences between the higher education systems. The book offers significant food for thought for those embarking on an academic career, and also for institutional managers and national policy makers.

Jennifer M. Case
Jeroen Huisman

Introduction

Changing career structures, award and recognition systems, and work patterns

Toward a comprehensive cross-national comparative view of European academics

European academics have been at the very center of ongoing higher education reforms across the continent. Changes in university governance and funding, as widely reported (Musselin and Teixeira, 2014; Jongbloed and Lepori 2015; de Boer et al. 2017; Bleiklie, Enders, and Lepori 2017), have inevitably led to changes in academic work and life. Traditional theories of social stratification in science, penetrating as they are, appear to be only partially useful in analyzing the directions of ongoing changes as viewed from a cross-European empirical perspective. New academic realities seem to require a closer look at the micro-level data and, by extension, traditional theories. Today, academics are in the eye of the storm, and this book examines the drivers of the aforementioned changes and their current and expected results.

Only in the last decade has it become possible to study the academic profession—that is, academics' attitudes, behaviors, and perceptions, with the individual academic as a unit of analysis—from a quantitative comparative European perspective. A decade ago, it was difficult, if not impossible, to undertake a comprehensive cross-national examination of ongoing transformations. Most studies were single-nation, and most published research was country-specific, with individual chapters devoted to academics in the context of various aspects of changing university governance and funding.

This book provides a panoramic view of the academic profession—specifically, from the university sector—across Europe in 11 national systems (Austria, Finland, Germany, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Switzerland, and the United Kingdom). Until recently, gaining such a perspective was possible at only a very general level, and it was based predominantly on aggregated national higher education statistics. In contrast, this book adopts a quantitative approach based on 17,211 returned questionnaires that were distributed across Europe (and the accompanying qualitative background, which is based on 480 semi-structured in-depth interviews).

This book confronts misconceptions about academic work and life and provides compelling results of detailed analyses performed on large-scale primary empirical material. It asks traditional research questions that are rooted in new comparative empirical contexts, as well as entirely new questions that are pertinent to the changing conditions of academic work. It also confronts academics across Europe who are facing new dilemmas that are inherent in the changing social and economic environments of higher education. Academics from major European systems and beyond can view their own academic trajectories within the context of a larger, cross-national story.

Reputation-and-resource model of scientific careers

Research interest in social stratification in academic science was accelerated with Robert K. Merton's claim that science has an ethos and is organized by the four norms of universalism, communism (or communalism), disinterestedness, and organized skepticism. The four norms govern academic behaviors and form a theory of the normative structure of science (Merton 1973; Hermanowicz 2012). Academics follow the norms because 'like other institutions, the institution of science has developed an elaborate system for allocating rewards to those who variously live up to its norms' (Merton 1973: 297). Universalism is contrasted with particularism, which refers to factors such as age, race, gender, religion, and political or sexual orientation, which are said to be functionally irrelevant to institutional operation but are used in the evaluation of people and their work. Discussion of the extent to which science is governed by universalism, as well as by particularism, has been ongoing ever since Merton formulated this basic contrast. The norm of communism holds that knowledge must be shared, not kept secret, and this is where academic knowledge has often been contrasted with industry knowledge (especially before commercialization came to academe, modifying academic behaviors). The norm of disinterestedness holds that the motives and conduct of science should not be influenced by personal bias; neither personal gains nor issues related to prestige or money should be relevant. Finally, the norm of organized skepticism holds that scientific judgments are to be held until all necessary evidence is on hand to make evaluations of scholarship (Hermanowicz 2012: 211).

Merton developed a reputation-and-resource model of scientific careers starting with three premises: Resources in the scientific world are limited, scientific talent is difficult to observe directly, and the allocation of resources in science is governed by the norms of universalism and communism (DiPrete and Eirich 2006). In the process of accumulative advantage, exceptional research performance early in a young scientist's career attracts new resources, as well as rewards that facilitate continued high performance. Scientific resources are not simply rewards for past productivity; they are allocated to stimulate future productivity:

> With limited ability to evaluate the great mass of ongoing scientific work, and with limited ability to measure future productivity beforehand, the

> scientific community favours those who have been most successful in the past, given their additional resources and attention.
>
> (DiPrete and Eirich 2006: 281–282)

Three consequences of this mechanism are reported at the individual level: The gap in the rewards between a more able and less able scientist may grow over time; chance events may produce a relative advantage for scientists of identical talent, and this relative advantage may increase over time; and the so-called 'Matthew effect', according to which scientists with greater reputations may gain greater rewards from work of the same quantity and quality than scientists with lesser reputations, may result (DiPrete and Eirich 2006: 281–282).

In his theory of the normative structure of science, Merton pointed out that the institution of science has developed a reward system that is designed to give recognition and esteem to those scientists who have best fulfilled their roles:

> On every side the scientist is reminded that it is his role to advance knowledge and his happiest fulfilment of that role, to advance knowledge greatly …. When the institution of science works efficiently … recognition and esteem accrue to those who have best fulfilled their roles, to those who have made genuinely original contributions to the common stock of knowledge.
>
> (Merton 1973: 293)

'Recognition for originality' in science is a 'socially validated testimony' to successfully fulfilling the requirements of the role of scientist (Merton 1973: 293). Academic rewards constitute academic recognition, which is centrally situated in the occupation of science and the lives and minds of scientists (Hermanowicz 2009: 12). Consequently, what is believed to motivate most scientists is 'the desire for peer recognition' (Cole and Cole 1973: 10).

Prestige, success, status, and recognition in academic science

In the last half century, Merton's institutional norms of science as a major mechanism governing higher education and academic research have been tested from various angles; however, they seem to have become systematically threatened within the last two decades or so.

The major attack on the traditional academic rules of conduct governed by the above overarching academic norms does not seem to be coming directly from outside the university sector: It seems to be coming from the inside, and only indirectly from the outside, powered by what has been termed 'academic capitalism' (Slaughter and Leslie 1997; Slaughter and Rhoades 2004), and specifically from the ever more widespread ideology of commercialism. While the impact of academic capitalism is much more powerful in American higher education, the implications of the growing policy emphasis on universities' 'third mission' across Europe should not be underestimated. In an American context, David R. Johnson (2017) explores qualitatively the 'conflict in academic science' between traditionalists and commercialists, and what emerges from this is a fractured profession that operates according to two contrasting academic ideologies: the traditional academic ideology, which reflects the Mertonian institutional norms of science, and the new ideology of commercialism. The focus of this book, which is driven by European data and their interpretation within the European context, will be on the former.

Knowledge produced in universities is increasingly converted into products or services that can be sold; this dramatically changes the nature of work in academic science and the social organization of higher education wherever the process is discernible. In the American case, this is at the elite research universities. As Johnson explains, American academic scientists are now exposed to two main reward systems, which are characterized by two different conceptions of the academic role and its corresponding occupational norms:

> Scholars once conceived of the scientific reward system as singular, referring to the *traditionalist*, or priority-recognition reward system, which mandates that scientists advance knowledge by sharing their discoveries with their scientific community through peer evaluation in exchange for recognition of priority in discovery. This honorary system of rewards now exists alongside a new *commercialist* reward system, which gives scientists a mandate to contribute to economic development through the dissemination of their discoveries in the market in exchange for profits. These are not simply different approaches to scientific work. They are career paths tied to competing visions of the role of the university in society that raise questions with broad implications.
>
> (Johnson 2017: 2, emphasis in the original)

Consequently, in the American elite university sector, the traditional role of universities exists alongside a new institutional role of science that emphasizes the creation of technologies that can be sold. Commercialism, which is defined by Johnson (2017) as a professional ideology that asserts that scientists should create technologies that control societal uncertainties, functions as a second competing reward system, and in academe, such systems 'engender intraprofessional conflict' (Johnson 2017: 3). What academics are supposed to do becomes increasingly unclear, especially as unequal rewards, as well as unequal conditions of work that are accompanied by the devaluing of commitment to traditional goals of science and higher education in the form of basic research, emerge in the system. In the specific American context, a new tension appears in the academic profession, which, in turn, becomes fractured.

However, in the specific European context that is studied in this book, the phenomenon of academic research commercialization is not equally widespread, although its importance as one of the items on the European Union's major policy agenda has been increasing systematically. Parallel processes affecting reward systems in European science can be explored in the context of the emergence of 'third stream' or 'third mission' activities. The commercialist–traditionalist divide explored in the case of the United States does not yet emerge as critically important to European universities. Although 'academic capitalism' has been studied in reference to a number of European systems, following the pioneering work of Sheila Slaughter, Larry L. Leslie, and Gary Rhoades, neither financial implications for individuals and institutions nor for the dominant academic norms (specifically, Merton's 'normative structure of science') seem to be as powerful in European as in North American universities (Cantwell 2016; Cantwell and Kauppinnen 2014).

Academic norms are of critical importance because they provide stability to the functioning of the academic profession. Academic norms demonstrate how academics should behave; they reflect common beliefs about how higher education systems and academic science systems should operate. However, in vertically stratified systems, they seem to be far more applicable to the upper and elite research-focused segments of national higher education systems than to the lower teaching-focused segments. While system segmentation grows, the appeal of the normative structure of science diminishes to the system as a whole. One of the consequences of this systemic segmentation and normative differentiation in this book is that we are focused entirely on the European *university* sector in terms of both theoretical underpinning and empirical data. Traditionally, common academic beliefs converge with common public beliefs to enable the institution of science to benefit from the power of public support, including the power of public subsidization. Finally, professional academic ideologies are formed by academic norms and are promoted in society, providing widely shared visions of how research universities should function. Moreover, professional academic ideologies define which academic roles are most highly valued and which are less valued or not valued at all, and they define success and professional status in science at the levels of individuals, institutions, and national systems.

Based on a traditional account of academic careers, research achievements mattered most, with all other achievements (in teaching, service, or administration) lagging far behind. The academic men and women are represented by their publications, as the traditional story goes:

> In a community of scholars, scholarly performance is the only legitimate claim to recognition … the academic marketplace as a system rests on the assumption that the worth of the academic man can be measured by the quality of his published work.
>
> (Caplow and McGee 1958: 225)

In the specific European context explored in this book, publications are still key regardless of how much the so-called 'third mission activities' are being promoted internally and externally by the academic community and policy makers alike. Assessment of the research output of individual academics and their departments and institutions—compared with the research output of other individual academics in the same specialty, as well as their departments and institutions—is at the core of individual academic recognition and international university rankings (research-based being more informative and less subjective than reputation-based). As emphasized in the sociology of science, 'The working of a reward system in science testifies that the research role is the most highly valued. The heroes of science are acclaimed in their capacity as scientific investigators, seldom as teachers, administrators or referees and editors' (Merton 1973: 520). In other words, 'Contribution to scientific knowledge is the underpinning of the stratification system' (Cole and Cole 1973: 45). The various types of stratification discussed in this book will refer predominantly to research: the inequality in its production (Chapter 1), its links to high academic incomes (Chapter 2), its links to academic roles played within institutions (Chapter 3), its relationships with international collaboration (Chapter 4), the role of patterns of time investments in it and the role of patterns of orientation to it across academic generations (Chapter 5), and its role in enabling academics to climb up the academic ladder (Chapter 6). Research is the core issue in academic careers from the perspective of social stratification in academic science, and it is, therefore, the core of this book. For this particular reason, teaching and students are discussed only marginally.

In academic science, in a specific form of publications, prestige, success, status, and recognition are inseparable from research. Non-publishers or silent scientists do not traditionally belong to the academic community, even though they do work across European universities (see Chapter 5). No publications basically means no research, which, in turn, means no academic success and no academic recognition. Moreover, in the specific context of the increasing role of competitive research funding in most European systems, it also means no research funding. The existence of lower-ranked and, therefore, only indirectly competing reward systems in teaching, service, and administration may be explained as an institutional mechanism that allows higher education organizations to accommodate failures in the core mission of research. Recognition in research was traditionally found to maintain 'high motivation to advance knowledge, and high motivation resulted in the scientist's devoting more of his own time to research; this, in turn, resulted in the high-quality scientific performance, as judged by the researcher's closest professional colleagues' (Glaser 1964: 1012).

There are certainly 'comparative failures in science' (Glaser 1964) and, certainly, some scientists realize early in their careers that they will not be successful in achieving national or international recognition: They are prone to adopt their local colleagues as reference groups and to drop the national or international scientific elite as meaningful reference groups, spending their time teaching and doing administrative work instead. Put bluntly, 'Local prestige probably goes a long way to make up for failure to achieve national recognition' (Cole and Cole 1973: 260–261). In the context of this book, 'internationalists' in research differ sharply from 'locals' in research both in terms of reference groups for their research and their collaborators in research, with far-reaching consequences for access to prestige, status, and resources for further research, as shown in Chapter 4.

Thus, in the tradition of the sociology of science, recognition comes from scientific output rather than anything else inside or outside the science system (Cole and Cole 1967; Hermanowicz 2012; Johnson 2017). The reward system is designed to give recognition and esteem to the scientists who have best fulfilled their research roles with the use of an elaborate system for allocating rewards. Consequently, the reward system reinforces research activities, rather than any other academic activities, and few scientists are believed to continue to engage in research if they are not rewarded for it (Cole and Cole 1967). Consequently, in this traditional account, academics publish their work in exchange for scientific recognition. As Warren O. Hagstrom (1965: 168) stated in his theory of social control in science, and before the massive advent of lower-ranking journals, 'Recognition is given for information, and the scientist who contributes much information to his colleagues is rewarded by them with high prestige.' In this sense, only high-performance research leads to recognition in science, and reward systems function to identify research excellence:

> A substantial part of the efficient operation of science depends upon the way in which it allocates positions to individuals, divides up the rewards and prizes it offers for outstanding performance, and structures opportunities for those who hold the extraordinary talent …. In science, as in most other institutions, prestigious position, honorific awards, and peer recognition, as well as monetary rewards, combine to form an integrated reward structure. The pattern of stratification in science is determined in large measure by the way rewards are distributed among scientists and by the social mechanisms through which the reward system of science operates to identify excellence.
> (Cole and Cole 1973: 15)

The accumulative advantage hypothesis generalizes the 'Matthew effect' to include productivity and recognition: The process consists of two feedback loops in which recognition and resources are intervening variables (Allison and Stewart 1974). However, there is also the darker side of the accumulation of rewards: It is 'the accumulation of failures—the process of "accumulative disadvantage"' (Cole and Cole 1973: 146), leading to the stratification in science between the 'haves' and 'have-nots.' As scientific productivity is heavily influenced by the recognition of early work, the skewed distribution of productivity and the skewed distribution of subsequent rewards result not only in the rich getting richer but also in the poor getting (comparatively) poorer. The 'relative Matthew effect' occurs when both the rich and the poor get richer, 'but the rich get richer by a larger margin, creating a widening gap between themselves and the poor' (Rigney 2010: 8). In summary, the scientific community 'favors those who have been most successful in the past' (DiPrete and Eirich 2006: 282). Prestige in science is, in a way, a system of social control that celebrates 'heroes.' As William J. Goode argues in wider social rather than strictly academic contexts,

> To perform and be ranked at the highest levels … demands both talent and dedication which only a few can muster. Such 'heroes' are given more prestige or admiration because both the level and type of performance are rare and evaluated highly within the relevant group. Most admirers recognize that such performances are possible for only a few people. The supply is and remains low.
>
> (Goode 1978: 67)

Science is highly stratified, the academic profession is highly stratified, and, like other professions, the latter is heavily status-based. While the intense research-related stratification of the academic profession—the major theme of this book—is not easily seen from the outside, it is enormously powerful inside. Science is dominated by 'a small, talented elite [and] [a]ll major forms of recognition—awards, prestigious appointments, and visibility—are monopolised by a small proportion of scientists' (Cole and Cole 1973: 254). The majority of scientists contribute little to scientific advancement, are low or very moderate publishers, and are still necessary to keep national higher education and science systems going, as we shall discuss in detail in Chapter 1. Prestige allocation in science makes some academics work much harder and some only moderately harder, while, on some, it exerts no pressure at all: The pressure or control through prestige allocation is 'fundamental in understanding why some people will try harder or not' (Goode 1978: 81). Certainly, this traditional elitist, exclusive, and hierarchical function of research in universities—differentiating and rank-ordering the academic profession (Marginson 2014)—has been strengthened in the era of new public management, as Marginson suggests, and it is merely one of six social functions of research, among which the balances and relations are constantly changing. However, as he argues, it has deep roots in academic cultures in elite research universities:

> The one unambiguous driver of career advancement in research universities is success at the highest level of research. 'Highest' means both the most prestigious and the most competitive level of performance, as in research grants, and academic publishing status is assigned on the basis of ranked performance …. A persistent pattern in intellectual fields is that a small number of people made a high proportion of the recognized major contributions.
>
> (Marginson 2014: 107)

In a sense, this book is about who gets what, why, and how in science—it is about its inherent inequality. Social stratification in science is not viewed as 'the patterning of inequality and its enduring consequences on the lives of those who experience it' (as is social stratification in general in sociological studies) and this book is not about 'how inequalities persist and endure—over lifetimes and between generations' (Bottero 2005). Stratification processes studied here are confined to the social institution of science; science being 'a communal social enterprise' (Cole and Cole 1973: 14).

Intraprofessional and extraprofessional status

Individual status within the academic community has traditionally been defined by original contributions to fundamental research. In the theory of professions (Abbott 1981; Abbott 1988; Carvalho 2017), which is useful for conceptualizing the organization and stratification of the academic profession, the most highly valued pursuits are 'professionally pure' pursuits—that is, those without nonprofessional considerations. Abbott (1981) draws a very useful distinction between the intraprofessional and extraprofessional status of professions, which explains the internal functioning of status conferment in European universities to outsiders. Intraprofessional status is a function of 'professional purity,' which is 'the ability to exclude nonprofessional issues or irrelevant professional issues from practice. Within a given profession, the highest status professionals are those who deal with issues predigested and predefined by a number of colleagues' (Abbott 1981: 823).

Over time, the academic profession, like all other professions, has developed an internal system of relative judgments of the purity or impurity of academic activities, with the resultant status hierarchy governing academic science. According to this hierarchy, purer considerations in science are more highly valued than less pure considerations; extraprofessional status (gained through nonprofessional channels of knowledge distribution) is less important in the academic world than intraprofessional status, which is traditionally gained through the visibility of research publications in the area of fundamental research. In the same vein, curiosity-driven research is more highly valued than application-driven research because, in the theoretical context of professional purity and impurity, leading to intraprofessional stratification in science, it is more professionally pure. Based on this account, visible science is transmitted through highly valued professional channels, such as top academic journals; much less visible science is transmitted through other channels (such as nonacademic journals, television, and social media). Most importantly, with the exception of humanities, parts of social science, and professional disciplines, scientific research is published primarily in English. As Marginson (2016c: 19) points out in his study of global stratification in higher education, 'Academic publications form a single world library. English-language science is the single global conversation: the claims of French, German and Russian have faded.'

In Merton's account of science and scientists and Abbott's account of professions and professionals, academic recognition comes exclusively from a single set of intraprofessional activities—that is, research activities converted into publications (as well as from their impact on the scientific community or from citations). All academic generations are being socialized to this widely accepted set of academic norms, and any deviance from this is being punished by the academic community.

Academic scientists need clear professional identities: They need to know how they should function to be among the top layers of the academic enterprise, should they choose to want this. In terms of their own academic careers, they need to know what is important, what is not important, and especially why this is the case. They also need to have clear images of a successful scientist and successful science, both in general terms and within their specific national contexts. The career stages of successful scientists need to be clearly defined in advance in terms of research achievements if the academic science enterprise is to continue successfully (see 'the Anna Karenina Principle' which links success to journal space, funds, reception and recognition in Bornmann and Marx 2012). Regarding promotion in the university sector, and especially within its upper layers, what matters and what does not matter need to be clearly stated, and this is exactly where ideologies of academic work and academic careers become useful. Stable professions tend to have clear definitions of high and low status and clear images of success and failure; therefore, they are not troubled by unnecessary tensions, feelings of undeserved inequality, or undue deprivation of access to opportunities, rewards, and resources. Status hierarchies in stable professions need to change slowly over time, if at all, especially as, in some of them, including the academic profession, careers are long term and clear guidance on how to function is needed throughout their lives. Intraprofessional conflicts about well-defined status and success do not serve the long-term goals of science. As Abbott stated, there is tension between what the public expects from professions and what professions expect from themselves:

> Intraprofessional status rests on the exclusion of nonprofessional issues or of professional issues irrelevant in a particular case …. In the pursuit of intraprofessional status, professions and professionals tend to withdraw from precisely those problems for which the public gives them status.
>
> (Abbott 1981: 819)

The changing stratification in science in the current massified higher education systems is related to the diversified external public and internal institutional expectations from the diversified academic profession. While (Abbott's) intraprofessional status rests on prestigious research results, prestigious research is increasingly publicly funded and is increasingly expected to be performed (by the public and by the university administration) only in the upper, elite layers of national systems. Consequently, the traditional rules of individual and institutional competition, academic recognition, and professional status seem to be ever more applicable to the upper university subsectors of national systems only. As evidenced by the European trend of strengthening national research councils as major bodies allocating research funding (with the European Research Council as a transnational manifestation of this trend)—with regard to academics and institutions, the minority garner the majority of competitive research funding.

The pertinence of academic profession studies

The academic profession across Europe is being exposed to similar external pressures despite national variations. The major global forces responsible for the actual changes in academic work and life, as well as those that prevail in international discourses, especially policy discourses on academic work and life, are as follows: economic globalization and its European responses (Europeanization), changing social and economic priorities in emergent generationally divided societies, intergenerational conflicts over the use of scarce public resources, changes in public services along the lines suggested in new public management, the increasing economic relevance of two major products of higher education systems: graduates and academic knowledge, and the transnationalization and internationalization of higher education policies combined with global policy convergence, especially through policies promoted by supranational institutions and organizations.

Simultaneously, the massification of higher education also means the massification of the academic profession, resulting in ongoing global struggles on the part of academics to maintain their traditionally stable (upper) middle-class social and economic status. Globally, huge numbers of students in national systems are accompanied by huge numbers of academics. As massification progresses, stratification follows. At the same time, as massification progresses, higher education research becomes a more attractive field that is gaining increasing scholarly and policy attention and mobilizing research funds (see Jung, Horta, and Yonezawa 2018; Kwiek 2013b). Massified and increasingly stratified higher education systems lead to a massified and increasingly stratified academic profession along dimensions such as institutional location within the system, access to human and material resources, productivity, and connections to global science networks. As Jürgen Enders noted,

> Privileges that were characteristic for members of the academic profession in an elite higher education system came increasingly under pressure in a massified and more diversifying system … 'the gold standards' that were once characteristic for the few are not to be taken for granted for the many.
> (Enders 2006: 7)

Thus, the zero-sum logic of positional competition among universities derived from the high-participation system theory, which argues that there is little room at the top (Marginson 2016c), can be extended to include the level of individual scientists. Stratification guarantees competition and an endless struggle to move up the academic hierarchy at both the institutional and individual levels.

From a global perspective, higher education 'is no longer an elite enterprise, and this new reality has had dramatic implications for the academic profession' (Altbach et al. 2012: 4). However, new large-scale developments in university governance and funding lead to new challenges and require traditional stratification theories to be revisited. Tensions emerge between the traditional theories governing the social and academic imaginations and the reality on the ground, especially if examined through cross-national, large-scale empirical material.

To some extent, there is an element of 'business as usual' in the academic game; however, in many ways, European academics are facing harsh new realities that are not consistently understood across European systems. In some of these systems, changes are believed to be related to globalization; in others, to financial austerity or new public management; and, finally, in others, to the massification of higher education (Enders, de Boer, and Leišytė 2009; Enders and de Weert 2009a; Carvalho and Santiago 2015; Antonowicz 2016; Nixon 2017; Kwiek 2017c). New academic behaviors (how academics actually work) and new academic attitudes (what academics actually think about their work), combined with emergent teaching/research patterns across academic cohorts and emergent productivity patterns across genders and academic disciplines both intra-nationally and cross-nationally, call into question the traditional theories produced in (Martin Trow's) 'elite' systems. The academic profession is working in emergent 'high-participation systems' (Marginson 2016b; Cantwell, Marginson, and Smolentseva 2018; Cantwell, Pinheiro, and Kwiek 2018) across all European countries, including the 11 studied here.

This book attempts to show which elements of the theoretical tradition of higher education research may hold and which may need to be conceptually revisited. For instance, the book's findings clearly indicate that the performance stratification of the academic profession not only continues but also seems to intensify. Originally, the idea was formulated with reference to individual academics as follows:

> The scientific community is not the company of equals. It is sharply stratified; a small number of scientists contribute disproportionately to the advancement of science and receive a disproportionately large share of rewards and the resources needed for research.
>
> (Zuckerman 1988: 526)

For academics, the recognition of their work by the collectivity of competent peers is 'the only unambiguous demonstration that what they have done matters to science' (Zuckerman 1988: 526). In addition, as previously noted, recognition in science is converted into resources for further research. Highly recognized scientists (and their research institutions) are clearly more successful than less recognized scientists (and their less recognized research institutions) in obtaining resources for further research. The distribution of academic rewards, including research funding, is sharply graded. There is enormous inequality in research performance, accompanied by enormous inequality in recognition and rewards in science, and both are highly stratified. Both academics and institutions are also stratified, and the processes of stratification seem to have intensified rather than weakened in the last two decades.

Prime significance is given to symbolic recognition by colleagues rather than by any outside individual or collective body. Members of the scientific community are considered the only competent judges of the merits and significance of one's research. This is part of the socialization of young scientists into the academic profession: 'Differentials in recognition are not only fundamental to differential ranking in science but also provide the base from which scientists may acquire new facilities either in the form of resources for research or in increased influence' (Zuckerman 1970: 236). The viability of modern science depends on the existence of a substantial consensus on the quality of scientific work and the occupational status of academics, who are its producers; therefore, evaluations are constantly made. The current evaluations of academics that are conducted within their institutions and by funding bodies, as well as the evaluations of institutions in rankings (including their international rankings), are merely more sophisticated and data-driven, with growing importance given to bibliometrics and research assessment exercises in various forms for resource allocation (see Kulczycki, Korzeń, and Korytkowski 2017 on Poland). However, these are not new institutionally nor individually. The picture that is half a century old does not seem to differ much from the one presented in Chapter 1 on the inequality in academic knowledge production and the role of top research performers:

> Stratification and ranking are not, however, limited to individual investigators. Disciplines, publication in particular journals, types of research, organisations, and rewards are also ranked. Individual scientists can be located in each of these dimensions and their final rank is the sum or product of these evaluations of their research.
>
> (Zuckerman 1970: 237)

However, research—and even more so, publicly funded research—cannot be conducted across whole national systems, in all of their segments, and with equal intensity. Vertical differentiation, which expects different contributions to knowledge from academics representing diverse segments of the system, with upward mobility guaranteed, may be the only way to protect the academic profession from widespread dissatisfaction if not despair:

> Increased emphases on research will likely be accompanied by increased probabilities of dissatisfaction throughout the system of higher education. As research is more greatly stressed, by institutions as well as by individuals, career expectations rise, in accord with attempting to satisfy external reference groups that are consistent with fulfilling the institutional goals of academe. As expectations rise, the likelihood of satisfying them decreases.
>
> (Hermanowicz 2012: 238)

The attractiveness of academic careers is questioned for a number of interrelated reasons, and the stakes involved in the ongoing changes, including the overall functioning of the academic profession, are high. As discussed in the American context, which is applicable to the European one,

> On many objective criteria, chances of success in academia across many fields are low and, where won, are hard-fought: obtaining regular employment, obtaining tenure, obtaining promotion through standard ranks, publication, citation of work, competitive salary, and competitive salary growth. These basic rewards are also arguably more difficult to obtain across institutional types than in any other historical time in the profession.
>
> (Hermanowicz 2012: 238)

Inequality in academic knowledge production is combined with inequality in academic remuneration. New teaching-only or teaching-mostly segments of the academic profession emerge (in our sample, this is especially the case in the United Kingdom) with new tasks and new responsibilities, thereby contributing to the disintegration of traditional (research-focused) academic norms. There are new 'haves' and 'have-nots' in academia due to the growing role of competitive, project-based research funding distributed by new national research councils and other bodies with a similar function. Institutional governance structures change, and there is a growing cross-generational gap between younger and older academic cohorts: Increasingly, academic job portfolios differ cross-generationally, contributing to the redefinition of what academics do based on their age groups (see Chapter 5). The internationalization of research and international academic mobility change the traditional national prestige structures and exert a powerful influence on national research funding distribution.

A data-rich research context

Despite continuity at the level of ideas governing higher education research—the social stratification in science being a prime example—there has been a rupture in a single dimension: that of the available data, including self-produced primary data collected through international surveys. International comparative higher education has entered a 'data-rich' research context. Four decades ago, Paul L. Dressel and Lewis B. Mayhew analyzed the emergence of the academic profession and of higher education as a specific 'field of study,' and they complained that, with a few exceptions, 'The literature is virtually silent about how faculty members enter the profession, what kinds of people they are, how they proceed in their careers and how they succeed in their professional tasks' (Dressel and Mayhew 1974: 89). Similarly, three decades ago, Burton R. Clark opened his exploration of 'The Academic Life' by stressing that

> relatively little is known about what goes on in the profession's many quarters. What is the quality of the workaday life for its varied members? How do they conceive of themselves and their lives? What, if anything, holds them together?
>
> (Clark 1987a: xxi)

Since the 1990s, both from single-nation perspectives (especially regarding the American one, see quantitatively informed studies by Blackburn and Lawrence 1995; Finkelstein, Seal, and Schuster 1998; and Schuster and Finkelstein 2008) and from a global perspective (Boyer, Altbach, and Whitelaw 1994; Altbach and Lewis 1996; Forest 2002), numerous studies have been published. In contrast, it is only in the last few years that European comparative academic profession studies have, for the first time, become truly 'data-rich,' following collaborative research efforts in the global 'Changing Academic Profession' (CAP) and the European 'Academic Profession in Europe: Responses to Societal Challenges' (EUROAC) research projects. In the last few years, both projects have given rise to a long list of studies.[1] Both also used the same survey questionnaire, based on the 1991–1993 Carnegie Foundation global survey of the academic profession, which provided a benchmark for comparative studies (Altbach and Lewis 1996: xxii). Consequently, in this book, we follow the 'gold standard' in social sciences (and in higher education studies): The research presented here is based on primary data. In the 2000s, there were at least three global and European (see Altbach 2000; Altbach 2003; Enders 2000; Enders and de Weert 2004) large-scale comparative projects on the changing academic profession and changing academic workplace that were relevant to this book. However, none of the three projects was driven by systematically collected primary quantitative data; therefore, they should be categorized as exploratory studies with some inconsistent or problematic data sources.

Academics' work situations change substantially, and this change is central to the academic profession as a whole, as prior analyses underscore. Enders and de Weert (2009b: 252–253) identified five 'drivers' that were central to changing the nature of the academic profession: the massification of higher education, expansion of research, growing emphasis on the societal relevance of higher education and research, processes of globalization and internationalization, and policies and practices geared toward marketization and managerialism. Similarly, Kogan and Teichler (2007: 10–11) identified three recent trends that were pervasive in higher education: relevance, internationalization, and management. Some other analyses refer specifically to financial constraints, the differentiation of higher education systems, competitive forces, and, moreover, the growing uncertainty of the academic profession: 'We live in times of uncertainty about the future development of higher education and its place in society and it is therefore not surprising to note that the future of the academic profession seems uncertain, too' (Enders and Musselin 2008: 145).

This book discusses a long list of uncertainties related to academic work and life, comparing academics' attitudes, behaviors, and productivity across countries, clusters of academic disciplines, age cohorts, and genders. It is structured around the notion of social stratification in science. It explores various manifestations of stratification in the academic profession across Europe and seeks to understand the extent to which ongoing governance and funding changes are consequential with respect to the work and life of academics.

Several approaches to social stratification in science are used, depending on the context, with research as the core university-sector activity figuring prominently in all of them: The idea of *academic performance stratification* is used in Chapter 1 (discussing research performance differentials across Europe, with specifically defined top research performers contrasted with their lower-performing colleagues); the idea of *academic salary stratification* is used in Chapter 2 (discussing links between income differentials and research performance differentials across Europe, with specifically defined academic top earners contrasted with their lower-earning colleagues); the idea of *academic power stratification* is used in Chapter 3 (analyzing the extent to which European systems are still collegial and the role of academic power distribution across layers of academic positions in European systems); the idea of *international research stratification* is used in Chapter 4 (exploring the links between research productivity differentials and international collaboration differentials, with clearly defined 'internationalists' in research contrasted with 'locals' in research, as well as the role of research internationalization in national award systems and resources distribution in science across Europe); the idea of *academic role stratification* is used in Chapter 5 (exploring intergenerational patterns of academic behaviors, attitudes, and productivity, with 'academics under 40' or 'young academics' contrasted with their older colleagues and with 'academic generations' in academic knowledge production at the forefront); and, finally, the idea of *academic cohort (or age) stratification* is used in Chapter 6 (analyzing changing academic careers with the use of qualitative rather than quantitative material, unique in this book, with a special emphasis on young cohorts of academics seeking stability in academic employment in volatile institutional environments).

The notion of social stratification in science allows for a better understanding of the changing academic profession than a number of competing notions used in the research literature, such as globalization, managerialism, financial austerity, or commodification. This is because the notion of social stratification refers directly to academics and their work and lives. In contrast to the four notions outlined above, our guiding notion in this book is internal rather than external to the academic profession. The issues of persistent inequality in research achievements and in academic knowledge production, the systematic inequality in academic incomes and their (disappearing) link to research productivity, the decreasing role of collegiality in university governance for all, not only the lower layers of academics but, the increasing correlation between internationalization in research and productivity (together with the increasing role of international publications in national reward systems, including access to competitive research funding), and the unexplored role of academic generations—and especially of different types of young academics employed in different countries—go to the very heart of the academic profession. And the above dimensions can be rigorously measured and compared cross-nationally with a unique data set.

Some themes in this book have previously been mentioned in higher education research (in a combination of theoretical and empirical contexts). 'Top research performers,' 'internationalists,' and 'academics under 40' have been studied under different rubrics; however, 'academic top earners' has not been present in the research literature, and none of these prototypical figures in higher education have been studied from a comparative quantitative European perspective using large-scale empirical material. The four faculty categories investigated above, as well as predictors of membership of these categories, have not been studied in cross-national comparative detail thus far. This book links new themes to existing themes and to the extant research literature.

Rare scholarly themes are examined in this book using rare prototypical figures, and our intention is to embed them in a larger scholarly conversation about higher education research (including traditional accounts of the academic profession over the last half century) between the previous generations of scholars. The themes studied indicate new differentiations of the academic profession (with a strong dividing line between the 'haves' and 'have-nots' in terms of publication-derived prestige and research-related resources) along under-researched dimensions from a European cross-national comparative perspective: internationalization in research, academic cohorts, academic incomes, and/or academic teaching/research role orientations. The book's findings have implications for theories of academic productivity, theories of university organization, traditional models of university governance, the economics of science, and policy reform theories.

Higher education research tends to view European academics (and European universities more generally) through the theoretical lenses provided by Anglo–Saxon, predominantly American, ideas about what universities are for and what academics should do; these ideas have been developed over the last half century, including by Logan Wilson, Paul Goodman, John D. Millett, Harold Perkin, Paul Lazarsfeld, Wagner Thielens, Clark Kerr, Martin Trow, Burton R. Clark, and Philip G. Altbach. The type of social imagination and academic imagination applied to universities as institutions and the academic profession as a 'key profession' (Perkin 1969) seems not to have changed much. However, in the meantime, academic realities in Europe have been changing. Consequently, there have been interesting tensions between some traditional ideas in higher education research and some academic realities emerging from the data (as Chapter 2 on high academic incomes indicates).

Transformations of European higher education systems in the last two decades have been substantial and have had a significant impact on the academic profession. The growing complexity of the academic enterprise has led to growing uncertainty about its future. Higher education as a whole has already changed substantially in most European economies, but it is expected to change even more (de Boer et al. 2017; Hüther and Krücken 2018). Perhaps the least susceptible to fundamental changes in the next decade will be the traditional research university, with its taste for research, as it is viewed as crucial for the economic prosperity of regions and nations. All other subsectors of national systems are more susceptible to further changes, heavily affecting the academic profession.

As a recent study of 11 reform processes across Europe emphasizes,

> in higher education, we live in an age of reform. All over Europe, state authorities frequently adapt their policies and introduce new ones to encourage public higher education institutions to deliver high-quality services in an effective and effiocient way. They take forceful initiatives and introduce reforms to change the higher education landscape.
>
> (de Boer et al. 2017: 1)

However, governance and funding reforms in Europe have had different timing, implementation results, and intensities in different systems (Paradeise et al. 2009; Maassen and Olsen 2007), as shown in empirical details through the governance equalizer model, which captured and graphically presented changes in governance in England, the Netherlands, Austria, and Germany between 1980 and 2006 (de Boer, Enders, and Schimank 2007) and in the 16 Germany states in the 2000s (Hüther and Krücken 2018: 119–122). Even though national processes of reform implementation shared rationales and tools—with the New Public Management (NPM) ideas in the forefront (Musselin and Teixeira 2014; Bleiklie et al. 2017)—reforms remain 'path dependent and most often incremental' and European higher education systems are reported to 'remain far from converging toward a unified pattern that would progressively erase borders' (Paradeise, Reale, and Goastellec 2009: 197, 198). Domestic institutional contexts matter and historical institutions have a 'filtering effect' on international reform pressures (Dobbins and Knill 2014: 188–189).

Reforms of funding systems were inspired by the NPM doctrine and driven by the assumption that introducing competition and performance-based funding would increase the performance of systems and institutions; however, every country uses in practice a combination of different funding options 'having its own mix, reflecting historical and political developments' (Jongbloed and Lepori 2015: 443). Funding arrangements are reported to be undergoing 'dramatic changes' (Gläser and Velarde 2018: 1), with the increasing role of project-based research funding and performance-based funding (Gläser and Laudel 2016). Across Europe, a convergence toward a funding mode is reported: 'about three quarters of the budget is provided by the state as core funds, which is complemented by third-party funds and student fees' (Jongbloed and Lepori 2015: 449). While the intended scope of governance and funding reforms differs across Europe, as do real effects of implemented reforms, academics are exposed to permanent reform attempts. The reforms increasingly compel them to function in the state of permanent adaptation to changing realities (Krücken, Kosmützky, and Torka 2007). Academics are exposed to both actual reform implementation and reform debates with their peers and with policymakers, being reminded by organization studies that reforming universities leads to further waves of reforms as 'reforms generate reforms' (Brunsson and Olsen 1998: 42–44).

The academic profession has already been fractured into many different academic professions (in the plural), and it is expected to be even more diversified, especially in more vertically stratified systems, with clearly defined top and bottom system layers (see Kwiek 2018a). The increasingly heterogeneous nature of the profession results from

> transformations in employment and working conditions; in their engagement with different activities; in the increased diversification of academic roles; in their different involvement in internationalization processes; and in their participation in decision-making.
>
> (Carvalho 2017: 72–73)

Different directions of academic restructuring in different countries and within particular national systems add to the complexity of the picture, which certainly leads to an overall more stressful working environment. Academics, the core of the academic enterprise, are working in turbulent times. In the last two decades, universities and other higher education institutions, as well as their social and economic environments, have been changing faster than ever before. Today, the academic profession is in the eye of the storm globally, and this book goes beyond change processes in any single European country. It discusses the academic profession and its increasing stratification across Europe, assuming that a theoretically coherent and empirically driven overview of ongoing changes is needed for academics and the general public alike. Examining the national variations of ongoing change through a study of empirical material at the micro level of the individual academic (rather than at institutional or national levels, with their corresponding aggregated data) leads to a better understanding of current realities. Moreover, understanding change is of primal importance to the future shape of the academic profession. Change cannot be effectively opposed nor promoted without such a clear understanding of its drivers and their results.

Not only higher education in Europe (with gross enrollment rates often exceeding 50 percent) but also the academic profession itself are becoming massified, with unclear consequences for individual academics. The end result of this double-massification process is its ever more detailed public scrutiny and ever more sophisticated policy interest. Higher education in general and, by extension, the academic profession are in the public spotlight. Academics are at the core of a multibillion-euro enterprise, but they are also the single most important cost in almost all academic institutions. Therefore, changing realities in which academics function need to be analyzed and understood to enable academics to see more clearly the somehow unexpected context of the large-scale, long-term systemic transformations to which they have been exposed. The general assumption of this book is that the changes directly affecting the life and work of academics will intensify, thereby undermining most principles of traditional academic visions and ideologies or undermining them in most segments of national systems. The drivers of change in higher education across Europe are structurally similar. Before we (the academic profession) decide where we would collectively prefer to be, it would be useful to examine where we are and to see whether and how this goal can be achieved.

Finally, the changes in academic work today are intensive, but, for the first time, they can be assessed in much more detail through large-scale European quantitative research, which adds a refined empirical dimension to the growing research literature on the academic profession. There are ongoing changes in academic work, as well as attempts to measure them and draw valid conclusions from the available empirical material. However, it is also possible that the sheer scale and speed of the changes make it difficult for the community of higher education researchers to interpret them. The inevitable time gaps between data collection and analysis, interpretation, and publication may be more crippling in times of change, as today, than in times of relative stability. It is also possible that we in academic profession studies are actually measuring only the changes of which we are aware; consequently, we may not be measuring the changes of which we are *not* aware and those that are beyond our current analytical frameworks. There may be many reasons why this occurs, the most obvious being the conceptual invisibility of some aspects of change and the resultant lack of proper indicators of change. Consequently, we know much less than we would like to, and we could know, about the changing academic profession in Europe. In academic profession studies, as in any other social research, there are some known knowns and some known unknowns; however, there are also some unknown unknowns of which we are conceptually unaware. This makes social research, including international comparative academic profession studies, extremely exciting and exceedingly rewarding.

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Notes

1 A list of international comparative books includes Locke, Cummings, and Fischer (2011) on governance and management; Teichler and Höhle (2013) on working conditions; Bentley, Coates, Dobson, Goedegebuure, and Meek (2013) on job satisfaction; Kehm and Teichler (2013) on new tasks and new challenges; Teichler, Arimoto, and Cummings (2013) on major findings from the CAP survey; Huang, Finkelstein, and Rostan (2014) on internationalization; Shin et al. (2014b) on teaching and research; Cummings and Teichler (2015) on the relevance of academic work; Galaz-Fontes, Arimoto, Teichler, and Brennan (2016) on biographies and careers; Teichler and Cummings (2015) on recruitment and management; and Fumasoli, Goastellec, and Kehm (2015) on academic work and careers. A list of country-focused books includes Cummings and Finkelstein (2012) on the United States; Arimoto, Cummings, Huang, and Shin (2015) on Japan; and Postiglione and Jung (2017) on Hong Kong. For an overview of papers published in international journals, see Carvalho (2017).

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Chapter 1

Academic performance stratification

Inequality in the knowledge production

Introduction: built-in undemocracy in individual research performance

In this chapter, we focus on a rare scholarly theme of highly productive academics, statistically confirming their pivotal role in knowledge production across Europe. The upper 10 percent of highly productive academics in 11 European countries studied provides on average about a half of all academic knowledge production as measured by peer-reviewed journal articles and book chapters. In contrast to dominating bibliometric studies of research productivity, we focus not on publication numbers and citation numbers but on academic attitudes, behaviors, and perceptions as predictors of becoming research top performers across European systems. Our chapter provides a (large-scale and cross-country) corroboration of the systematic inequality in knowledge production, for the first time argued for by Alfred Lotka (1926) and Derek J. de Solla Price (1963). We corroborate the deep academic inequality in science and explore in more detail this segment of the academic profession. European highly productive academics—termed research top performers in this chapter—form a highly homogeneous group of academics whose high research performance is driven by structurally similar factors, mostly individual rather than institutional. Highly productive academics are similar from a cross-national perspective and they substantially differ intra-nationally from their lower-performing colleagues.

The academic profession in the countries studied is heavily stratified by academic performance—operationalized in this chapter as research productivity. Academic performance stratification explored in this chapter shows the power of inequality and its roots: the academic community is not 'the company of equals' (Zuckerman 1988: 526). Academic research production—and academic rewards and research resources combined with it—is highly skewed across Europe and its patterns of skewness are surprisingly similar. The stratification by output inevitably leads—in productivity-focused and bibliometrics-obsessed global science—to the stratification by all other types of academic rewards, from citations to honorific awards to individual competitive project funding (none of them analyzed in this book; see Bornmann, Bauer and Schlagberger 2017).

The 'Matthew effect' in science and the traditional cumulative advantage (and cumulative disadvantage) theories developed in sociology of science, from Merton to the Coles, become as relevant today as half a century ago: the distribution of academic rewards is as sharply graded as the distribution of research output.

The growing scholarly interest in research top performers comes from the growing policy interest in research top performance itself. The emphasis on stratification by academic performance leads to the stratification of the academic profession. The inequality in academic knowledge production is more consequential for individual academic careers as it is routinely analyzed with publication and citation data—available at fingertips—to assess academics by hiring committees and research funding panels in national funding agencies. The processes of performance stratification refer directly to academics and indirectly to institutions employing them. Highly graded knowledge production on an individual level is becoming ever more associated with highly graded research funding at the level of departments (or institutions). Across Europe, a small number of scholars produce most of the works and attract huge numbers of citations. Performance determines rewards, and small differences in talent translate into a disproportionate level of success, leading to inequalities in resources, research outcomes, and rewards.

The world of science has always been utterly unequal (Ruiz-Castillo and Costas 2014; Stephan 2012): the intrinsic property of science has been what Derek J. de Solla Price (1963) termed 'essential, built-in undemocracy' (59). Individual performance in science tends not to follow a Gaussian (normal) distribution. Instead, it follows a Paretian (power law) distribution (O'Boyle and Aguinis 2012). Distributions of different social phenomena—such as income, wealth, and prices—show 'strong skewness with long tail on the right, implying inequality' (Abramo, D'Angelo, and Soldantenkova 2017a: 324). Academic knowledge production is not an exception because unproductive scientists work alongside 'top researchers' in academic units, universities, and national systems (Abramo, Cicero, and D'Angelo 2013; Piro, Rørstad, and Aksnes 2016). In more internally competitive and vertically differentiated systems (such as Anglo-Saxon systems), top researchers tend to be concentrated in elite universities, and low performers in less prestigious tiers of the system.

Scientific productivity is skewed, and its skewness has been widely studied in terms of two standard measures of individual performance: publication numbers and citations of publications (Albarrán et al. 2011; Carrasco and Ruiz-Castillo 2014; Ruiz-Castillo and Costas 2014). In a study of 17.2 million authors and 48.2 million publications in Web of Science, Ruiz-Castillo and Costas (2014) show that 5.9 percent of authors accounted for about 35 percent of all publications. The skewness of science implies, as Seglen (1992) showed for the first time, that there will always be authors with huge numbers of publications (attracting huge numbers of citations) accompanied by a number of academics who do not publish and a large fraction of uncited publications. While at the one end of the continnum of research productivity there are research top performers, at the other end there are research non-performers (or simply non-publishers). From among all European countries studied, the highest share of non-performers among full-time academics involved in both teaching and research and employed in the university sector is reported for Poland (as we discuss briefly in a section of Chapter 5).

Scholarly interest in the skewness of science and high individual research performance has been growing exponentially in the last few years. Highly productive academics have been studied mostly intra-nationally and in single fields of knowledge (particularly in economics and psychology). Recent studies on high research performers—based either on publication data or citation data—include research on star scientists (Abramo, D'Angelo, and Caprasecca 2009a; Yair, Gueta, and Davidovitch 2017), star performers (Aguinis and O'Boyle 2014), the most productive scholars, including rising stars and stars overall (Copes, Khey, and Tewksbury 2012), the best versus the rest (O'Boyle and Aguinis 2012), academic stars and productivity stars (Aguinis and O'Boyle 2014), high-performing researchers and superstars (Agrawal, McHale, and Oettl 2017; Serenko et al. 2011).

The growing scholarly interest in research top performers comes also from the increasing emphasis on the role of universities in the global competition between nations and regions and the global competition for talent. Academics are at the center of the global knowledge production and global academic enterprise (Cummings and Finkelstein 2012; Leišyte and Dee 2012; Teichler et al. 2013). Not surprisingly, a question has emerged: 'What makes someone a top researcher?' (Kelchtermans and Veugelers 2013: 273). The objective of this chapter is to study specific characteristics of this unique class of academics: who top performers are, how they work, and what they think about academic work, and to explore the predictors of entering it, from a cross-national comparative perspective. While bibliometric data from international (or national) datasets are perfectly suited for research productivity analyses, they can hardly be used in determining the individual characteristics of top performers, for which large-scale survey data work better.

Top performers are studied here through a bivariate analysis of their working time distribution and their academic role orientation, as well as through a model approach, similarly to 'academic top earners' in Chapter 2 and 'internationalists' in Chapter 4. Odds ratio estimates with logistic regression of being highly productive academics are presented. Consistently across major clusters of academic disciplines, the tiny minority of 10 percent of academics produces about half (53.4 percent of peer-reviewed articles and books chapters) of all European publications (45.6 percent of publications in English and 50.2 percent of internationally co-authored publications). The mean research productivity of top performers across major clusters is on average 8.56 times higher than that of the other academics. Beginning with the remarkable similar productivity distribution patterns across European systems, we pose a general research question: who are these highly productive academics and which institutional and/or individual factors increase the odds of entering this class? Additionally, as high inequality was observed, we were exploring the question whether not only the average research productivity distribution is highly skewed (with a long tail on the right) for all European academics but also for top performers; or, in other words, whether the class of top performers is as internally stratified as that of their lower-performing colleagues.

Highly productive academics as a separate segment of the academic profession are a rare scholarly theme. We consider that because if about one tenth of European academics produce about half of all research output (and 1 in 20 produces about a third), then this distinctive academic population deserves more scholarly attention. Following a handful of previous studies focusing on the theme to varying degrees and with different methodological approaches (Price 1963; Crane 1965; Prpić 1996; Abramo et al. 2009a; Brew and Boud 2009; Postiglione and Jung 2013; and Marquina and Ferreiro 2015), our goal was to explore European research top performers from a cross-national comparative perspective and through large-scale quantitative material. We sought to empirically test the expectations arising out of prior single-nation research.

We explore both the intra-national differences in research productivity between European highly productive academics and the rest of research-involved academics (or 'average' academics, as they are termed in Stephan and Levin 1992: 57–58 and Prpić 1996: 185), as well as cross-national differences and similarities among them. Following prior research on the predictors of research productivity (especially Allison, Long, and Krauze 1982; Allison and Stewart 1974; Wanner, Lewis, and Gregorio 1981; Fox 1983; Stephan and Levin 1992; Ramsden 1994; Teodorescu 2000; Lee and Bozeman 2005; and recently Leišyte and Dee 2012; Shin and Cummings 2010; and Drennan et al. 2013), our guiding questions are as follows. Do research top performers across Europe share the same patterns of working time distribution and the same teaching-research academic role oritentation, both being closely linked to research productivity in the research literature? Are their demographics, patterns of socialization into academia, internationalization and professional collaboration, and overall research engagement similar across Europe? Do they perceive their institutions similarly? In a nutshell, how different are highly productive academics from 'average' academics, how differently do they work and perceive their work, and which factors are positively correlated with high research performance? We use a rather crude measure of survey-derived publication numbers but in this way we are able to seek correlations of high research productivity with various individual- and institutional-level characteristics, unavailable through traditional bibliometric tools.

This chapter is an international comparative study based on extensive quantitative material (using national samples, not merely the material from selected individual institutions or academic fields) rather than the single-nation studies that dominate in the prior non-bibliometric literature on research productivity. While it is very important to measure science through sophisticated bibliometric tools, we argue here that it is still very useful to refer to traditional survey-based individual productivity analyses to explore not only the 'what' of knowledge production but also the 'why' of its production (that is, to explore individual and institutional predictors of high research performance). Through a combination of inferential and logistic regression analyses, we explore highly productive academics as a distinctive (and under-researched) segment of the academic profession. Our research in this chapter contributes to several lines of higher education research: social stratification in science, research productivity, and international comparative academic profession studies, all with a focus on European universities.

Theories of research productivity

Three quotations from the last half century or so show roughly the same phenomenon in science: 'the majority of scientific work is performed by a relatively small number of scientists' (Crane 1965: 714); 'no matter how it is measured, there is enormous inequality in scientists' research productivity' (Allison 1980: 163); and, recently, 'inequality has been, and will always be, an intrinsic feature of science' (Xie 2014: 809). The skewed distribution of scientific output found first by Lotka (1926), and shown by Price (1963), was that about 6 percent of publishing scientists produce half of all papers (Lotka's law, or the inverse square law of productivity, states that the number of scientists producing n papers is $1/n^2$ of those producing one paper; see Kyvik 1989). The relative importance of scientists in the right tail of the output distribution—increasingly termed *stars* in recent bibliometric studies—has endured over time (Agrawal et al. 2017: 1).

The 'superstar effect' refers to markets ('relatively small numbers of people earn enormous amounts of money and dominate the activities in which they engage' Rosen 1981: 845), and the 'Matthew effect' (Cole and Cole 1973; Merton 1968) refers to the science system: a small number of scholars produce most of the works, attract huge numbers of citations, hold prestigious academic positions, and form the disciplines' identity (Cortés, Mora-Valencia, and Perote 2016; Serenko et al. 2011). For Robert K. Merton and Sherwin Rosen, performance determines rewards. In Rosen's 'economics of superstars,' small differences in talent translate into a disproportionate level of success. However, Rosen emphasizes innate talent, and Merton emphasizes external resources (DiPrete and Eirich 2006). Resources and the motivation to publish flow to scientists with high esteem in the scientific community, and that esteem 'flows to those who are highly productive' (Allison and Stewart 1974: 604), as discussed in the Introduction. Cumulative advantage is a general process by which 'small initial differences compound to yield large differences' (Aguinis and O'Boyle 2014: 5). Consequently, Merton's 'Matthew effect' in the system of science inevitably leads to 'haves' and 'have-nots,' or inequalities in resources, research outcomes, and monetary or non-monetary rewards (Xie 2014).

Methods for determining the characteristics of top performers proliferate, and they are studied as individual scientists or scientists embedded in organizational contexts, with reciprocal relationships: how they influence and how they are influenced by their organizations or collaborative networks. The skyline for star scientists (Sidiropoulous et al. 2016) is being sought: stars are those scientists whose performance cannot be surpassed by others with respect to all scientometric indexes selected. Apart from stars, the relevant studies focus on the scientific elite or the most highly cited scientists, top researchers (Abramo et al. 2013; Cortés et al. 2016), the academic elite (Yin and Zhi 2016), or prolific professors (Piro et al. 2016). What makes a research star is an all-pervading question in the current productivity-obsessed and number-based academic culture. Star performers ('a few individuals who contribute a disproportionate amount of output') occur in all organizations, including universities. However, a star is a relative position, and identification is possible only by viewing individuals in relation to others' productivity (Aguinis and O'Boyle 2014: 313–315; DiPrete and Eirich 2006: 282).

Research productivity has been an important scholarly topic for a long time (for some original formulations, see Crane 1963; Price 1963; Merton 1968; and Cole and Cole 1973). The literature has identified a number of individual and institutional factors that influence research productivity, including the size of the department, disciplinary norms, reward and prestige systems, and individual-level psychological constructs such as a desire for the intrinsic rewards of puzzle solving (see Leišyte and Dee 2012; Stephan and Levin 1992; Ramsden 1994; and Teodorescu 2000). Faculty orientation toward research is generally believed to predict higher research productivity; as are the time spent on research, being a male academic, faculty collaboration, faculty academic training, years passed since PhD, as well as a cooperative climate and support at the institutional level (Porter and Umbach 2001; Katz and Martin 1997; Smeby and Try 2005; Lee and Bozeman 2005; Fox 2015). The extreme differences in individual research productivity can be explained by a number of theories: we shall focus briefly on the 'sacred spark' theory, the 'cumulative advantage' theory (combined with the 'reinforcement theory'), and 'the utility maximizing theory.'

First, the 'sacred spark' theory presented by Cole and Cole (1973) simply says 'that there are substantial, predetermined differences among scientists in their ability and motivation to do creative scientific research' (Allison and Stewart 1974: 596). Highly productive scholars are 'motivated by an inner drive to do science and by a sheer love of the work' (Cole and Cole 1973: 62). Productive scientists are a strongly motivated group of researchers and they have the stamina, 'or the capacity to work hard and persists in the pursuit of long-range goals' (Fox 1983: 287; Zuckerman 1970: 241). Or, as Paula Stephan and Sharon Levin (1992: 13) argue, 'there is a general consensus that certain people are particularly good at doing science and that some are not just good but superb.'

Second, the 'accumulative advantage' theory developed by Robert K. Merton (1968) holds that productive scientists are likely to be even more productive in the future, while the productivity of those with low performance will be even lower. The accumulative advantage theory is related to the reinforcement theory formulated by the Coles (Cole and Cole 1973: 114), which in its simplest formulation states that 'scientists who are rewarded are productive, and scientists who are not rewarded become less productive.' As Jerry Gaston (1978: 144) points out, reinforcement deals with *why* scientists continue in research activities; and accumulative advantage deals with *how* some scientists are able to obtain resources for research that in turn leads to successful research and publication. Several studies (Allison and Stewart 1974; Allison et al. 1982) support the cumulative advantage hypothesis, without discrediting the sacred spark hypothesis.

Finally, according to the 'utility maximizing theory,' all researchers choose to reduce their research efforts over time because they think other tasks may be more advantageous. As Svein Kyvik (1990: 40) comments, 'eminent researchers may have few incentives to write a new article or book, as that will not really improve the high professional reputation that they already have.' And Stephan and Levin (1992: 35), in discussing age and productivity, argue that 'later in their careers, scientists are less financially motivated to do research. … with each additional year the rewards for doing research decline.' These three major theories of research productivity are complementary rather than competing: to varying degrees, they are all applicable to the academic profession.

Highly productive academics in the research literature

We distinguish two different approaches in the research literature for exploring individual-level high research productivity. The first approach is to explore it through qualitative material: first, rankings of highly productive academics are created, and then academics in the top ranks are interviewed, with a general research question of 'how can they be so productive?' (Mayrath 2008: 42). Various 'keys to productivity' (Kiewra and Creswell 2000: 155) or 'guidelines for publishing' (Kiewra 1994) are drawn from either targeted academic surveys of productive academics seeking the determinants of high research productivity, or from interviews with 'eminent' or 'prolific' academics, or both. The second approach, in contrast, is to explore high research productivity through quantitative material: surveys of the academic profession in which academic, behavioral and attitudinal data are combined with publication data. In this chapter, we shall use the second, quantitative approach.

The qualitative approach is favored in such soft disciplines as, for instance, educational psychology (Mayrath 2008; Kiewra and Creswell 2000; Patterson-Hazley and Kiewra 2013; Martínez, Floyd, and Erichsen 2011). Carefully collected qualitative material in papers based on 'conversations with highly productive educational psychologists' seeks to answer such questions as 'what factors characterize highly productive educational psychologists?' (Kiewra and Creswell 2000: 136). Qualitative studies based on a varying number of conversations with highly productive academics seek to answer a general question: how do scholars become highly productive? They present a large number of useful tips, and refer to some striking individual examples. However, conversation-based qualitative explorations of highly productive academics, though fascinating, are somehow under-theorized.

Faculty research productivity has been thoroughly explored in the academic literature, mostly in single-nation contexts: especially the United States, the United Kingdom, and Australia (Cole and Cole 1973; Allison and Stewart 1974; Fox 1983; Ramsden 1994), as well as South Korea (Shin and Cummings 2010), but rarely in cross-national contexts (exceptions include Teodorescu 2000; Drennan et al. 2013; and Postiglione and Jung 2013). While most productivity studies did not use national samples and focused on faculty from selected academic fields, especially from the natural sciences, our study uses national samples and refers to all academic fields grouped into five large clusters of disciplines.

International comparative studies in higher education have not generally explored a specific class of highly productive academics; however, they have been mentioned in passing in several single-nation academic profession studies (Crane 1965; Cole and Cole 1973; Allison 1980), but they were not researched in more detail in these studies. Exceptions include a discussion of American 'big producers' in *Little Science, Big Science* by Derek J. de Solla Price (1963), a foundational book for scientometrics; a study of 'star scientists' in the context of gender differences in research productivity in Italy in Abramo et al. 2009a; and studies in the productivity of Croatian 'eminent scientists' in Prpić (1996). Abramo and colleagues (Abramo et al. 2009a: 143) conclude that a star scientist 'is typically a male full professor'; and that, if female, star scientists are primarily concentrated in the lower levels of productivity. They argue that 'to obtain levels of scientific production such as those of a star scientist, the time and energy required for research activities are notably superior to the average, and imply an overwhelming dedication to work' (Abramo et al. 2009a: 154). However, as their work is based on bibliometric data, the authors are unable to go beyond gender, academic rank, institutional type, and academic discipline in their exploration of a 'star scientist profile.' Katarina Prpić (1996) compared the scientific productivity of 'eminent' and 'average' scientists. Her research assumptions were that the patterns of predictors for the publication productivity of eminent scientists would be different from those of 'average' scientists because, in the elite group, 'homogeneity is larger and variability is smaller than in the entire research population' (Prpić 1996: 199).

Recently, Postiglione and Jung (2013) studied 'top tier researchers' in four Asian countries, seeking commonalities shared by them based on the CAP ('Changing Academic Profession') survey. They studied 10 percent of the most and least productive academics through descriptive statistics. They found that highly productive academics emphasize discovery, basic/theoretical research, and social responsibility in science more often than the rest of academics, and spend more time on research than on teaching. They also collaborate more than others, especially in the international domain and perceive their institutions as making decisions about personnel and funding allocation on the basis of performance-based criteria (Postiglione and Jung 2013: 171–177). Also, Marquina and Ferreiro (2015) studied a specifically constructed 'elite group' of academics in six 'emergent' countries, based on the same global academic profession survey. They compared 'elite groups' with the 'rest' of academics: they focused on 'elites' defined as academics with graduate degrees, full-timers, spending more than 10 hours per week on research and preferring research to teaching. Their class of 'elite groups' does not refer directly to research productivity. There are important parallels, though: academics in 'elite groups' are more internationalized in both teaching, research, and publishing; they are overall more satisfied with their work; they spend more time on research and are more research-oriented (Marquina and Ferreiro 2015: 191). Finally, Angela Brew and David Boud (2009: 194), through descriptive analysis, only briefly contrasted 'high research productive' with 'low research productive' academics from six Australian universities, and concluded that high productive academics spend on average about five more hours per week on research and have different priorities—they prioritize research over teaching. The major theories of research productivity as well as studies on highly productive academics, rare as they have been, both provide conceptual underpinning for this chapter.

In this chapter, we explore the personal and institutional characteristics linked to high individual research productivity. This cannot be done through citation analysis: because while the scholarly impact of publications may be more important than sheer publication output, especially for policy purposes, their impact cannot be correlated with individual and institutional predictors of research productivity. While the world of 'measuring science' has moved far beyond self-reported publication data in terms of countries, institutions, research fields (for instance the CWTS Leiden Ranking), and even individual academics, such bibliometric exercises are not able to link research output to individual researchers, academic attitudes, behaviors, and perceptions.

Consequently, our study uses a more traditional research instrument (the large-scale survey). We assume, following Fox (1983: 285), that the principal means of communication in science is the publication process, even though today 'publications' are increasingly linked to their 'where' (in globally ranked academic journals), and their academic 'so what' or scholarly impact (through global impact factors and citation analysis).

The quality–quantity dilemma in academic productivity studies based on survey-derived publication numbers is not easy to solve. This chapter follows the explicit assumption that more productive academics produce more peer-reviewed articles and less productive academics produce fewer peer-reviewed articles—but no link is made here to either the originality of journal articles or their current or future impact in academic disciplines or beyond them, in science or beyond it, in the wider society.

Consequently, from among the four ideal types of academic research production (based on both quantity and quality of published research) suggested by Jonathan R. Cole and Stephen Cole (1973: 91–93) for physicists in their study of social stratification in science—'prolific,' 'perfectionists,' 'mass producers,' and 'silent'—our study tends to focus on the 'prolific' segment in which academics are defined by both the high quantity and high quality of their publications. As Cole and Cole (1973: 111) argued,

> since quality and quantity of research output are fairly highly correlated, the high producers *tend* to publish the more consequential research. … engaging in a lot of research is in one sense a 'necessary' condition for the production of high-quality work.

Also, Paula E. Stephan and Sharon G. Levin argue (1991: 364) that the prolific scientists they studied have not 'traded quality for quantity by publishing in journals which have lower impact.' Recently, Ulf Sandström and Peter van den Besselaar (2016: 12), using a Swedish dataset of 48,000 researchers and their Web of Science publications, argued that quantity does make a difference because 'the more papers, the more high impact papers,' or to produce high impact papers, 'certain output levels seem to be required.' Finally, as Price (1963: 41) argued along similar lines, 'although there is no guarantee that the small producer is a nonentity and the big producer a distinguished scientist, there is a strong correlation.'

Defining the top perfomers

We explore research productivity defined here, following Daniel Teodorescu (2000: 206), as the 'self-reported number of journal articles and chapters in academic books that the respondent had published in the three years prior to the survey.' A dependent variable studied is being a member of the class of research top performers (as explored through the proxy of the number of peer-reviewed journal articles and book chapters published in the period of 3 years preceding the survey conducted in the 2007–2010 period).

The data used in this book come from the 'European Academic Profession: Responses to Societal Challenges' (EUROAC) project, a sister project to the global 'Changing Academic Profession' (CAP) project (see Carvalho (2017) for a recent overview of the CAP/EUROAC family of studies). The data come from the countries involved in both the CAP and EUROAC projects, with national datasets subsequently cleaned, weighted and merged into a single European dataset.[1] We base our study empirically on the single most important cross-national source of data on academic views, attitudes, perceptions, and behaviors in Europe available today, with all its inherent limitations for comparative research. The quality of the dataset is high (Teichler et al. 2013: 35; Teichler and Höhle 2013: 9) as well as being well-suited for our research purposes. The survey questionnaire was sent out to the CAP countries in 2007 and to the EUROAC countries in most cases in 2010. The total number of returned surveys was 17,211 and included between 1,000 and 1,700 returned surveys from all countries studied, except for Poland where it was higher. Overall, the response rate differed from over 30 percent (in Norway, Italy, and Germany), to 20–30 percent (in the Netherlands, Finland, and Ireland), to about 15 percent in the United Kingdom, 11 percent in Poland, and 10 percent or less in Austria, Switzerland, and Portugal. Overall, both simple random sampling, systematic sampling, and stratified random sampling methods were used, depending on the country (national-level sampling techniques are described for the CAP European countries in RIHE 2008: 89–178, and for the EUROAC countries in Teichler and Höhle 2013: 6–9). However, in most countries, stratified random sampling was used to allow the resulting sample to be distributed in the same way as the population (Hibberts, Burke Johnson, and Hudson 2012: 61–62; Bryman 2012: 192–193). Stratified sampling frames were created and several stratifying criteria were used (for instance, gender and academic position, as in Poland). The stratification of the sample mirrored the population stratification on the stratifying criteria, and mirrored simple random sample in every other way. Random sampling was used to obtain the elements from each stratum.

The relatively low response rate in the United Kingdom, Poland, Austria, Switzerland, and Portugal may have been caused by the increasing number of surveys to which the academic profession is routinely exposed (Mesch 2012). The response rates in these countries have been similar to response rates in several countries studying the academic profession in the last decade: studies in Canada report 17 percent (Jones et al. 2014: 348), in Hong Kong 13 percent (Rostan, Finkelstein, and Huang 2014: 25), in the Republic of Korea 13 percent (Shin et al. 2014: 183), and in Croatia 10 percent (Teichler and Höhle 2013: 8). No groups of academics were systematically excluded from the sampling frame (so 'sampling bias' did not occur: no members of the sampling frame had no or limited chances for inclusion in the sample, Bryman 2012: 187). However, it is not possible to state to what extent the pool of respondents differs from the pool of non-respondents and, consequently, to state whether 'non-response bias' occurs (Stoop 2012: 122). 'Non-response bias' can occur when certain groups of respondents fail to respond or are less likely than others to participate in the survey or answer certain survey questions (Hibberts et al. 2012: 72) or when survey participation is correlated with survey variables (Groves 2006). However, non-response biases are only indirectly related to non-response rates: a key parameter is 'how strongly correlated the survey variable of interest is with response propensity, the likelihood of responding' (Groves 2006: 670). It is conceivable, for instance, that highly productive academics—studied in this chapter—are prone to refuse to participate in the survey because they are very busy; however, they may be inclined to participate in the survey because of a sense of civic (academic) duty, social norms producing a sense of obligation to provide help in the belief that this serves the common (academic) good, combined with a feeling that their answers count (Stoop 2012: 126–128).

In order to explore highly productive academics specifically, we divided the sample of all European academics into two complementary subsamples: academics reporting research involvement and those not reporting this. Then the subsample of research-involved academics was divided into two further subgroups: the first was 'research top performers' (henceforth referred to as 'top performers'), identified

Table 1.1 The distribution of the sample population, by country

	All (Large N)	*Full-time employed*	*Employed in the university sector*	*Full-time employed in the university sector (N)*	*Involved in both teaching and research*	*Full-time employed in the university sector involved in both teaching and research*
Austria	1,492	977 65.5%	1,492 100%	977	1,412 94.6%	954 63.9%
Finland	1,374	1,116 81.2%	1,049 76.3%	837	1,193 86.8%	792 57.6%
Germany	1,215	851 70.0%	1,030 84.8%	708	1,098 90.4%	660 54.3%
Ireland	1,126	1,017 90.3%	825 73.3%	742	1,125 99.9%	742 65.9%
Italy	1,711	1,651 96.5%	1,711 100.0%	1,651	1,711 100.0%	1,651 96.5%
Netherlands	1,209	677 56.0%	416 34.4%	298	646 53.4%	266 22.0%
Norway	986	869 88.1%	905 91.8%	809	922 93.5%	766 77.7%
Poland	3,704	3,515 94.9%	1,726 46.6%	1,669	3,659 98.8%	1,643 44.4%
Portugal	1,513	1,236 81.7%	547 36.2%	468	1,174 77.6%	372 24.6%
Switzerland	1,414	827 58.5%	638 45.1%	372	1,245 88.0%	354 25.0%
United Kingdom	1,467	897 61.1%	438 29.9%	356	840 57.3%	266 18.1%
TOTAL	**17,211**	**13,633** **79.2%**	**10,777** **62.6%**	**8,886** **51.6%**	**15,025** **87.3%**	**8,466** **49.2%**

as academics ranked among the top 10 percent (cut-off points permitting) of academics with the highest research performance in each of the 11 national systems (separately) and in all the five major research field clusters (also separately). The second subgroup was that of the remaining 90 percent of academics involved in research. The distribution of the sample population is shown by country in Table 1.1.

Procedures: the top performers through surveys and its limitations

We use two complementary approaches: statistical inference (independent-samples t-tests for the equality of means and z tests for the equality of fractions performed on the two independent samples applied to almost universal variables in research productivity studies: long research hours and high research role orientation); as well as a multi-dimensional logistic regression model. While most previous studies rely on linear regression models in studying research productivity, this chapter relies on a logistic regression model in seeking country-specific predictors of becoming highly productive. The data relate to the academic behaviors, attitudes, and research productivity of the subpopulation of highly productive academics (the upper 10 percent), contrasted with the subpopulation of the remaining 90 percent of academics; in both cases referring only to those indicating both teaching and research involvement.

To begin with, we shall discuss top performers through a bivariate analysis of the working time distribution and the teaching/research role orientation. Specifically, we shall use statistical inference using t-tests (for the equality of means) and z tests (for the equality of fractions). An independent samples t-test is used when we want to compare the means of two independent populations (research top performers and the rest of academics): by using the sample data we test whether the mean time spent on various categories of academic activity is equal for both populations of academics. The z test for the equality of fractions is used to test the hypothesis that two populations have equal proportions (research role orientation among research top performers and the rest of academics). Although bivariate analyses are limited insofar as they do not control for other important factors that might affect research productivity (Teodorescu 2000: 203), the two selected variables emerge as key in most qualitative and quantitative productivity studies. Therefore, they need separate treatment.

However, a study of multi-dimensional relationships requires a model approach, and therefore odds ratio estimates by logistic regression for belonging to European highly productive academics will be presented, following inferential analyses. Inferential analyses and logistic regression analyses are viewed here as complementary: both approaches are useful for our research purposes.

More specifically, in the section on the working time distribution, an independent two-sample t-test is used. When the variance in the compared populations is equal (Levene's test of homogeneity of variance is used), then Student's t-test is used; otherwise, Welch two sample t-test is used. The test statistic has a t-distribution. Consistent with previous research on the 'working time distribution' in academia (Bentley and Kyvik 2013), we focus here on annualized weekly hours in both teaching periods of the academic year and in non-teaching periods: we assume that 60 percent for the former and 40 percent for the latter time is a good approximation for the vast majority of the European systems studied. Most previous studies of working time patterns are either single-nation or comparative and descriptive (exceptions include Bentley and Kyvik 2013 and Gottlieb and Keith 1997). In the section on teaching/research role orientation, in order to compare fractions, a two-proportion z test is used. The test statistic has a standardized normal distribution. All tests are conducted with a significance level of $\alpha = 0.05$. The details of the multivariate analysis are given in Section 4.2 on logistic regression analysis.

The chapter seeks to contrast research top performers with the rest of academics across 11 European systems, proceeding as follows: first, it identifies top performers by country in the sample; second, it examines their average research productivity (by several proxies) compared with that of the remaining 90 percent of academics, again by country, and third, it examines their share in the total research output—in all three steps, by major clusters of academic disciplines. In these introductory procedures only research productivity data are used. There is a trade off between a disadvantage of using self-reported data (rather than the Scopus or Web of Science data) and publication numbers as the only measure of research performance (rather than a combination of publications, citations, H-index, or other measures used in bibliometrics) in introductory procedures—and an advantage of using individual-level data. Detailed individual-level data can be collected only through a survey instrument. Therefore, in the next set of procedures, behavioral and attitudinal data derived from survey questionnaires can be used as the chapter seeks to compare the working time distribution (with average time investments in teaching, research, service, administration, and other academic duties) and academic role orientation (interests lying primarily in teaching, research or both) of the two classes of academics.

Finally, the chapter seeks to find odds ratio estimates by logistic regression for being in the top 10 percent in research productivity by country, with blocks of different individual and institutional variables. Blocks of individual variables include, for instance, 'socialization to academia' (with such variables as intensive faculty guidance and research projects conducted with faculty), 'internationalization and collaboration' (with such variables as research international in scope or orientation and collaborating domestically), and 'overall research engagement' (with such variables as being a peer reviewer or being an editor of journals/book chapters). The two blocks of institutional variables are 'institutional policies' (for instance, strong performance orientation) and 'institutional support' (availability of research funds and supportive attitude of administration). These variables can be accessed through survey methodology only; the major drawback of this approach being the imprecise nature (compared with detailed bibliometric datasets) of self-reported productivity data.

However, to strengthen the robustness of our productivity analyses, apart from peer-reviewed articles (PRA), three additional measures were used: peer-reviewed article equivalents (PRAE for short), internationally co-authored peer-reviewed article equivalents (IC-PRAE), and English language peer-reviewed article equivalents (ENG-PRAE). Publication counts were converted into article equivalents. The PRAE measure is calculated as the weighted sum of self-reported articles in books or journals (the value of one article equivalent), edited books (the value of two article equivalents), and authored books (the value of five article equivalents) published over the 3-year reference period. The same procedure was used in Røstad and Aksnes 2015: 319; and Bentley 2015: 870; most survey-based studies equate four to six articles to one full monograph. An individually provided share of peer-reviewed publications is applied to each observation (following Bentley 2015). The advantage of using the PRAE measure in this multi-disciplinary study is that it captures publishing through various outlets and does not focus on articles, leaving room for authored books (and edited books), which are still an important outlet in the social sciences and humanities. As Bentley (2015: 870) emphasizes, 'using article equivalents and weighting of books more heavily reflects the relative contribution of the different publication types,' minimizing differences across disciplines.

The internationally co-authored PRAE measure applies the individually provided share of publications co-authored with international colleagues, and the English-language PRAE measure applies the individually provided share of publications published in a foreign language (the language in question in the countries studied is predominantly English). The question about the number of scholarly contributions was thus combined with the question about the percentage of peer-reviewed publications, English-language publications, and internationally co-authored publications. The conversion of publication counts into article equivalents is used in research productivity analyses (especially those focused on productivity correlates) based on survey data in order to make fairer comparisons of productivity across academic fields with dissimilar publication patterns (Kyvik and Aksnes 2015). So the PRAE measure was used to be able to explore more comprehensively cross-disciplinary differences in publication patterns between top performers and the rest of academics, and the IC-PRAE and ENG-PRAE measures were used to explore internationalization patterns in publishing research results between the two groups.

A substantial proportion of publishing in the humanities and social sciences in Europe consists of books and edited books, as opposed to publishing in natural sciences. Article equivalents were used specifically in multi-disciplinary studies involving major clusters of academic disciplines rather than merely science, technology, engineering, and mathematics clusters. (Examples include Ramsden 1994: 213; Gulbrandsen and Smeby 2005: 938; Kyvik and Aksnes 2015: 1441; Teichler et al. 2013: 146–147; Kyvik 1989: 206; Piro et al. 2016: 945; Bentley 2015: 870; and Røstad and Aksnes 2015: 319.) In Poland, the notion of article equivalents has been routinely used in parameterization (a Polish version of a research assessment exercise) and assessments of individual research output for about a decade: currently, a conversion system is used in which most Polish articles as well as all book chapters have a point value of 5 and Polish monographs have a value of 25.

The exact formulation of the productivity question was as follows: 'How many of the following scholarly contributions have you completed in the past *three* years?' (Question D4), with the separate entries for 'scholarly books you authored or co-authored' (D4/1), 'scholarly books you edited or co-edited' (D4/2), 'articles published in an academic book or journal' (D4/3), 'research report/monograph written for a funded project' (D4/4), 'paper presented at a scholarly conference' (D4/5), and 'professional article written for a newspaper or magazine' (D4/6). However, the exact definitions were not provided, assuming their self-explanatory nature. The next question was formulated as follows (D5): 'Which percentage of your publications in the last three years were—peer-reviewed' (D5/6), 'published in a language different from the language of instruction at your current institution' (D5/1), and were 'co-authored with colleagues located in other (foreign) countries' (D5/3)? The questionnaire was explicit about different types of publications and, importantly, European academics are used to routinely counting different publication types for reporting purposes. Survey respondents marked one of a number of nationally determined disciplines. Academics were grouped in five clusters of academic disciplines—that best represent the current structure of the academic professions across Europe (it is difficult to accept the formulation of 'the European academic profession': as Höhle and Teichler (2013: 268) conclude their study on the 'European profession' vs. 'professions in Europe,' 'given the responses to about 50 questions examined in this chapter, we note very few themes which would allow us to talk about a "European" academic profession'). The total number of valid responses was 17,211; however, in this research, academics from 'other disciplines' and those whose work contract did not involve research were excluded. Cases from 'other disciplines' were useless for cross-disciplinary analyses due to their specificity and teaching-only observations were useless for research productivity analyses. Finally, 7,030 observations from five major clusters of academic disciplines (938 top performers and 6,092 lower-performing academics) were used for the analyses.

There are several limitations in this chapter; some of them are more generic and refer to other chapters as well—and others refer to the study of highly productive academics only. First, all the publication data are self-reported and the differences in reporting them can be between nations, academic disciplines, and genders: consequently, to different degrees, respondents 'may present an untrue picture to the researcher, for example answering what they would like a situation to be rather than what the actual situation is' (Cohen, Manion, and Morrison 2011: 404). Although self-reported publication data are not perfect, they do not seem to be subject to any systemic error or systemic bias. Second, due to the anonymization of the collected data, we were unable to study any differences between top performers from institutions of lower academic standing and those from the most prestigious ones. The third limitation comes from a tacit assumption that the major concepts used in the survey instrument in all systems have a somehow similar definition. These terms may have different meanings in the academic perceptions of different countries (for instance, 'teaching' and 'research' may be closely intertwined in such activities as the supervision of doctoral dissertations).

Another limitation is inherent to the structure of the dataset used: in regression analysis, no distinction can be made between single-authored and multiple-authored publications and between national and international publications (except through various proxies like, for instance, 'internationally co-authored publications' or 'publications in English'). Finally, there are two major European systems missing: the French and the Spanish, for which no data in a comparable format were collected.

The top perfomers: a statistical overview

Frequencies of the selected demographic characteristics of the top performers are presented in Table 1.2. About three-quarters are men (73.2 percent), they are predominantly older (seven in ten are at least 40 years old, 69.9 percent), and more than 70 percent (71.1 percent) have at least 10 years of academic experience (calculated as working full-time in the higher education sector beyond teaching and/or working as a research assistant). The mean age of top performers is 47 (standard deviation: 9.96, Figure 1.1). The dominant age groups of top performers differ by academic discipline clusters. On average, the top performers are substantially younger in professions and engineering, and older in the three other clusters (top performers under 40 account for about a quarter of the top

Table 1.2 Sample description: frequencies of selected demographic characteristics, all countries

		Rest (90%)		*Top performers (upper 10%)*		*Total*	
		N	%	*N*	%	*N*	%
Gender	Male	3,721	61.1	687	73.2	4,408	62.7
	Female	2,371	38.9	251	26.8	2,622	37.3
Age groups	Under 30	702	11.2	51	5.3	753	10.4
	30 to 39	1,982	31.5	240	24.8	2,222	30.6
	40 to 49	1,552	24.6	329	34.0	1,881	25.9
	50 to 59	1,263	20.1	238	24.6	1,502	20.7
	60 and older	798	12.7	109	11.2	906	12.5
Academic experience*	Under 10	2,464	41.7	270	28.9	2,733	39.9
	10 to 19	1,521	25.7	311	33.3	1,832	26.8
	20 to 29	991	16.8	191	20.5	1,183	17.3
	30 to 39	788	13.3	130	14.0	919	13.4
	40 and more	151	2.5	31	3.3	182	2.7
Academic disciplines	Life sciences and medical sciences	2,036	32.3	316	32.7	2,352	32.4
	Physical sciences, mathematics	1,037	16.5	149	15.4	1,186	16.3
	Engineering	716	11.4	107	11.0	822	11.3
	Humanities and social sciences	1,708	27.1	262	27.1	1,971	27.1
	Professions	800	12.7	*133*	*13.8*	*934*	12.9

Note: **Academic experience* means the number of years since one's first full-time job (beyond research and teaching assistant in the higher education/research sector, Question A6).

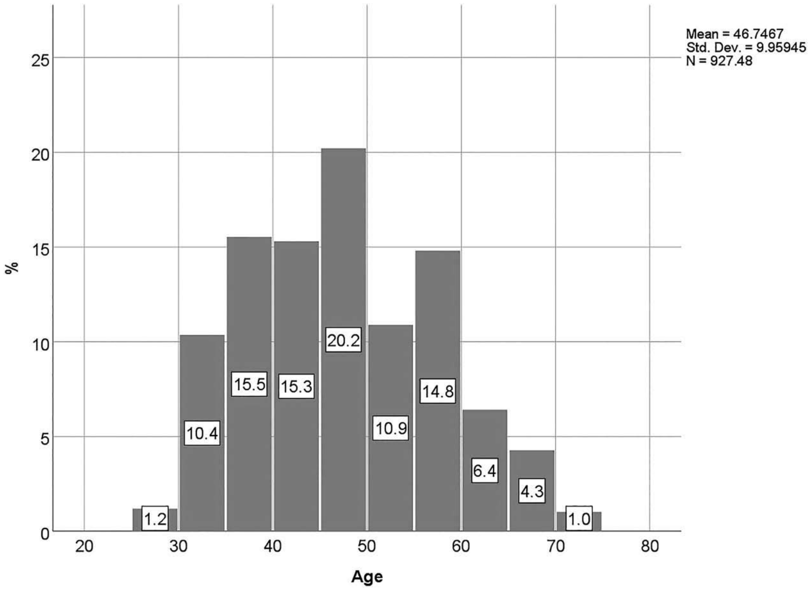

Figure 1.1 Research top performers by age group, all clusters of academic disciplines, and frequency, all countries combined.

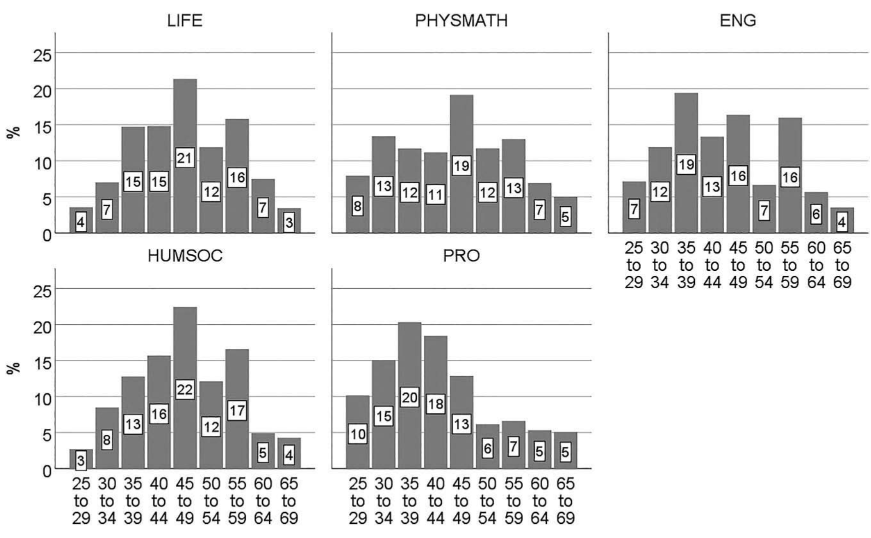

Figure 1.2 Research top performers by age group and cluster of academic disciplines, frequency, all countries combined.

performers in life sciences, physical sciences and mathematics, and humanities and social sciences, compared with 42 percent in professions and one third in engineering; also in professions the share of academics aged 55 and more is the lowest, reaching about one-fifth, see Figure 1.2).

Top performers compared with their lower-performing colleagues share several common features and represent a common professional profile: top performers tend to be male academics with a mean age of about 47, are full professors who collaborate more often nationally and internationally, and publish abroad more often (than the other academics). The top performers' research tends to be international in scope or orientation, they work longer hours and longer research hours, and they are substantially more research-oriented. They focus on basic and theoretical research (somewhat understandably), they sit on national and international committees and boards, and they are peer reviewers and editors of journals or book series more often than their colleagues.

The top perfomers and the national research output

Detailed statistics showing average research productivity through the three article equivalent types (PRAE, IC-PRAE, and ENG-PRAE) by academic disciplines cluster and by group studied (top performers versus the other academics) are shown in Tables 1.3, 1.4, and 1.5.

The mean research productivity in terms of all measures for top performers is, on average, much higher in all clusters of disciplines: about five to ten times higher than for the other academics (see Kwiek 2018b specifically on Poland). Figure 1.3 shows the percentage of the average number of internationally co-authored peer-reviewed articles (IC-PRA) and article equivalents (IC-PRAE) in the average number of peer-reviewed articles (PRA) and article equivalents (PRAE) published in a 3-year reference period for top performers and the rest of academics, by cluster of academic disciplines. For each cluster there are four columns: the first one for the PRA measure, and the remaining three for the PRAE measure. By far the biggest difference in average productivity is in the simplest measure of peer-reviewed articles (PRA), which is reduced substantially if an article equivalent measure is applied (PRAE). Big difference in average productivity is also shown for internationally co-authored publications (IC-PRAE), which shows a powerful role of internationalization in research for productivity: in all clusters, the difference between the four groups of academics is about seven to eight times, and in one (professions) about ten times. Interestingly, top performers produce much more articles and article equivalents, and much more articles and article-equivalents co-authored with international colleagues, but there are significant cross-disciplinary variations rather than intra-disciplinary differences between the two classes of academics (with PHYSMATH and LIFE clusters with a high percentage, and

Table 1.3 Research productivity: peer-reviewed articles (PRA) published in the 3-year reference period, research top performers (10%) vs. the rest (90%). All countries combined

	Rest (90%)						*Top performers (upper 10%)*					
	Mean PRA	*95% confidence interval, lower band*	*95% confidence interval, upper band*	*Median*	*Standard Deviation*	*N*	*Mean PRA*	*95% confidence interval, lower band*	*95% confidence interval, upper band*	*Median*	*Standard Deviation*	*N*
LIFE	3.3	3.1	3.5	2.0	4.1	2,036	22.5	21.2	23.8	20.0	11.9	316
PHYSMATH	3.6	3.3	3.8	2.0	4.0	1,037	21.8	19.6	24.1	20.0	13.8	149
ENGITECH	1.7	1.5	1.9	0.3	2.6	716	17.2	14.4	20.1	13.6	14.7	107
HUMSOC	1.2	1.1	1.3	0.0	1.9	1,708	11.8	10.8	12.9	10.0	8.9	262
PRO	1.2	1.1	1.4	0.0	1.9	800	12.3	11.0	13.6	10.0	7.7	133

Table 1.4 Research productivity: internationally co-authored peer-reviewed articles (IC-PRA) published in the 3-year reference period, research top performers (10%) vs. the rest (90%). All countries combined

	Rest (90%)						*Top performers (upper 10%)*					
	Mean IC-PRA	*95% confidence interval, lower band*	*95% confidence interval, upper band*	*Median*	*Standard Deviation*	*N*	*Mean IC-PRA*	*95% confidence interval, lower band*	*95% confidence interval, upper band*	*Median*	*Standard Deviation*	*N*
LIFE	0.9	0.8	1.0	0.0	2.0	2,036	8.1	7.2	9.0	5.7	8.3	316
PHYSMATH	1.3	1.2	1.5	0.0	2.4	1,037	11.2	9.0	13.4	8.0	13.7	149
ENGITECH	0.3	0.3	0.4	0.0	1.1	716	5.4	4.1	6.7	2.6	6.8	107
HUMSOC	0.2	0.1	0.2	0.0	0.6	1,708	2.5	2.0	3.1	0.4	4.6	262
PRO	0.2	0.1	0.2	0.0	0.6	800	3.3	2.4	4.1	1.3	4.9	133

Table 1.5 Research productivity: English language peer-reviewed articles (ENG-PRA) published in the 3-year reference period, research top performers (10%) vs. the rest (90%). All countries combined (without Ireland and the UK)

	Rest (90%)						*Top performers (upper 10%)*					
	Mean ENG-PRA	*95% confidence interval, lower band*	*95% confidence interval, upper band*	*Median*	*Standard Deviation*	*N*	*Mean ENG-PRA*	*95% confidence interval, lower band*	*95% confidence interval, upper band*	*Median*	*Standard Deviation*	*N*
LIFE	2.8	2.7	3.0	0.8	4.0	1,824	19.9	18.5	21.3	18.0	11.9	283
PHYSMATH	3.4	3.2	3.7	2.0	4.1	946	21.2	18.7	23.7	19.0	14.6	131
ENGITECH	1.3	1.1	1.5	0.0	2.5	649	14.8	12.1	17.4	12.2	13.1	97
HUMSOC	0.5	0.4	0.6	0.0	1.2	1,540	6.8	5.7	7.9	5.0	8.5	235
PRO	0.5	0.4	0.6	0.0	1.2	681	7.1	5.7	8.4	6.0	7.2	113

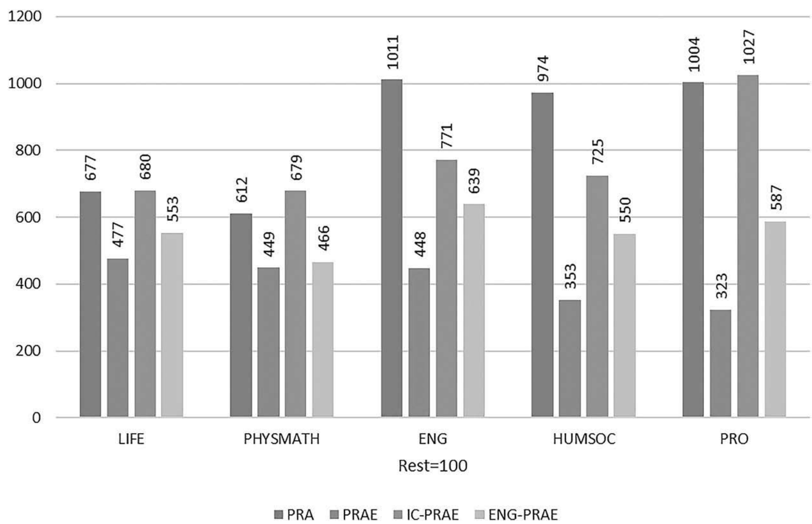

Figure 1.3 Research productivity by cluster of academic disciplines: top performers vs. other academics (productivity of top performers as percentage of productivity of other academics: the Rest = 100%). The average number of peer-reviewed articles (PRA), peer-reviewed article equivalents (PRAE), internationally co-authored peer-reviewed article equivalents (IC-PRAE), and English language peer-reviewed article equivalents (ENG-PRAE) published in a 3-year reference period. For all clusters, the results are statistically significant (in %). All countries combined.

HUMSOC and PRO clusters with very low percentages, no matter which class we analyze). The percentage of IC-PRAE in PRAE and of IC-PRA in PRA is generally similar in all clusters—which may mean that overall structure of academic production by top performers and by the rest of academics is not substantially different: the numbers are radically different but the shares are not (see Figure 1.4, with the highest difference between the two classes for PRO cluster).

The subsample of academics involved in research from the five major clusters of academic disciplines was divided into two subgroups: research top performers (or top performers henceforth), identified as academics ranked among the top 10 percent (cut-off points permitting, from 9.9 percent to 10.5 percent) of academics with the highest research performance in each major cluster of academic disciplines (separately). The second subgroup was the remaining 90 percent of academics involved in research. The distribution of the sample population by cluster and the threshold number of publications (the minimum number of publications to be classified as a top performer) in terms of peer-reviewed articles (PRA) are presented in Table 1.6. The use of both PRA and PRAE measures reflects a role played by the two outlets other than articles and book chapters: books and edited books.

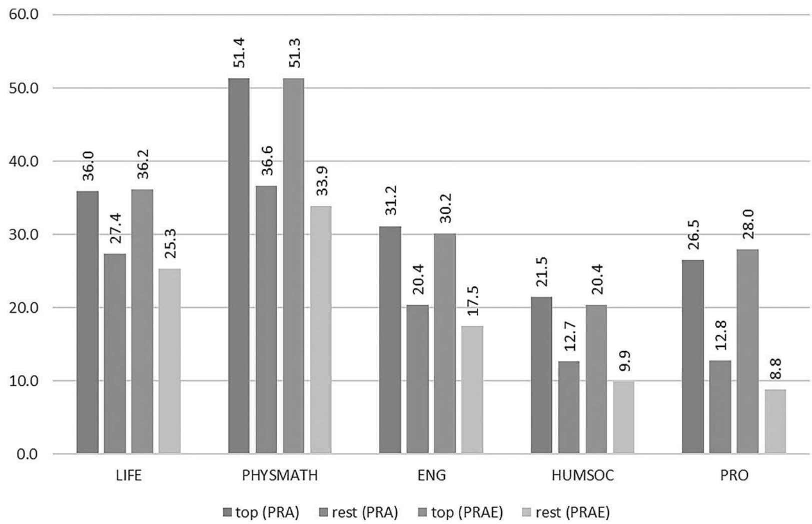

Figure 1.4 Research productivity by cluster of academic disciplines: top performers vs. other academics. The percentage of IC-PRA (and IC-PRAE) in PRA (and PRAE): the percentage of the average number of internationally co-authored peer-reviewed articles and article equivalents in the average number of peer-reviewed articles and article equivalents published in a 3-year reference period. For all clusters, the results are statistically significant (in %). All countries combined.

Table 1.6 The distribution of the threshold number of publications (the minimum number to be classified as a top performer) in the sample, in terms of peer-reviewed articles (PRA), by cluster of academic discipline and by country

Threshold number of publications (PRA)	*AT*	*FI*	*DE*	*IE*	*IT*	*NL*	*NO*	*PL*	*PT*	*CH*	*UK*
LIFE	17	12	15	12	20	20	15	9	12	13.5	11.25
PHYSMATH	12	12	12.6	8	18	17	12	9	6	15	12
ENGITECH	5.6	6	3	11	12	16	5	9	15	8	10
HUMSOC	2	6.5	4.8	12.63	6.3	10	7	8	7	5	8
PRO	2.22	5.94	4.8	10	5	6	6.6	11	7	5.4	6.4

The average research productivity distribution in the case of all academics for all clusters is highly skewed to the right (Figure 1.5). The figure shows the percentage of authors on the vertical axis and the number of papers (in brackets) published on the horizontal axis (see the long tail of productivity on the right across all clusters; see also a very high percentage of research non-performers among European academics, all countries combined).

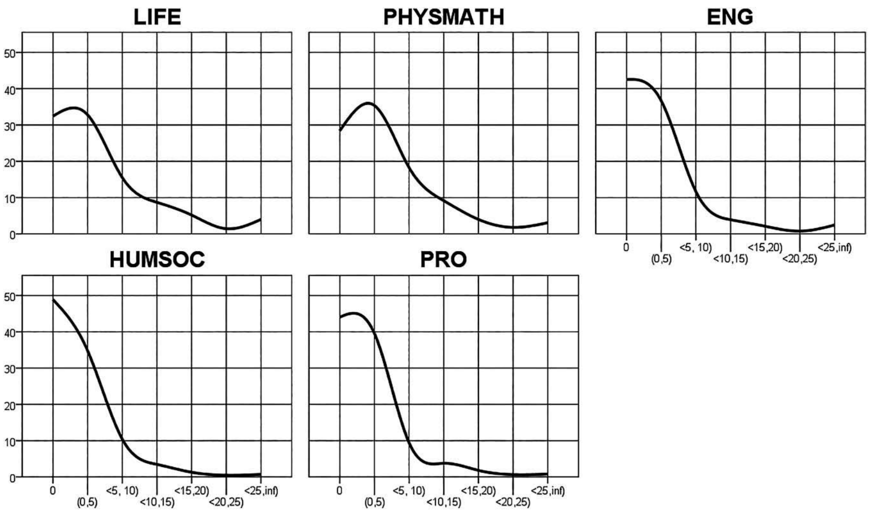

Figure 1.5 All European academics: the distribution of peer-reviewed articles (PRA) published during the 3-year reference period, by cluster of academic disciplines and publication number groups (in percentage). Vertically: percentage of authors, horizontally: number of papers published.

Top performers, as defined in this chapter, provide substance to European research production: without them, it would lose about 40–50 percent of it, depending on the different approaches to defining productivity. The three approaches tested here—the number of articles, peer-reviewed articles, and article equivalents published in the 3-year timeframe studied—lead to slightly different results (see the last three columns in Table 1.7). First, using sheer articles (A), on average, consistently across all European systems studied, slightly less than half (45.9 percent) of all academic research production comes from about 10 percent of the most highly productive academics. In four systems, the share is close to, or exceeds, 50 percent (Austria, Finland, Poland, and Portugal). Second, using peer-reviewed articles (PRA), the share is higher, reaching 53.4 percent, with the share lower than a half for only 3 out of 11 (Italy, Norway, and the UK); and, third, using article equivalents (that is, both peer-reviewed articles, book chapters, books authored and books edited), the share goes down to 37.8 percent, with only Poland reaching a half (50.1 percent). The Polish case is symptomatic for a system in which the traditional role of authored books is very important in moving up the academic ladder (for a doctoral degree, habilitation degree, and the professorship title) and in which edited books are used extensively as a national research communication channel.

This difference is discussed here to show that different approaches to mesasuring productivity lead to different results, both for European academics as a

Table 1.7 Numbers and percentages of journal articles (A), peer-reviewed journal articles (PRA), and peer-reviewed article equivalents (PRAE) produced in the 3-year reference period, by top performers and by the rest of academics, by country (in %)

	Top performers (numbers)			*The rest (numbers)*			*Total (numbers)*			*Top performers (percentage)*		
	Journal articles (A)	*Peer-reviewed journal articles (PRA)*	*Peer-reviewed journal article equivalents (PRAE)*	*Journal articles (A)*	*Peer-reviewed journal articles (PRA)*	*Peer-reviewed journal article equivalents (PRAE)*	*Journal articles (A)*	*Peer-reviewed journal articles (PRA)*	*Peer-reviewed journal article equivalents (PRAE)*	*Journal articles (A)*	*Peer-reviewed journal articles (PRA)*	*Peer-reviewed journal article equivalents (PRAE)*
Austria	3,330	2,227	2,833	1,206	545	3,805	4,536	2,772	6,637	73.4	80.3	36.1
Finland	2,445	1,830	1,640	2,435	1,331	2,356	4,880	3,161	3,997	50.1	57.9	37.0
Germany	2,702	1,898	2,013	3,506	1,616	2,528	6,208	3,514	4,542	43.5	54.0	40.1
Ireland	2,419	1,937	1,712	2,684	1,693	2,436	5,103	3,630	4,148	47.4	53.4	40.7
Italy	5,096	4,089	5,281	10,162	5,844	13,630	15,259	9,933	18,911	33.4	41.2	28.0
Netherlands	1,513	1,267	1,190	1,647	1,131	1,348	3,160	2,398	2,538	47.9	52.8	39.7
Norway	1,902	1,577	1,606	2,340	1,751	2,798	4,243	3,329	4,404	44.8	47.4	37.8
Poland	6,767	5,702	3,224	6,831	3,831	3,116	13,599	9,533	6,340	49.8	59.8	50.1
Portugal	1,992	1,686	1,054	1,952	1,234	1,341	3,945	2,920	2,395	50.5	57.7	35.1
Switzerland	2,798	2,160	1,701	3,304	1,864	1,638	6,102	4,024	3,339	45.9	53.7	41.9
UK	1,740	1,471	687	2,475	1,726	872	4,215	3,196	1,559	41.3	46.0	37.9
TOTAL	**32,706**	**25,844**	**22,943**	**38,543**	**22,567**	**35,867**	**71,248**	**48,410**	**58,809**	**45.9**	**53.4**	**37.8**

whole and for academics in individual countries studied. Cross-country differences vary, depending on major communication channels used and the extent to which they are peer-reviewed. For our purposes here, the most useful approach is through peer-reviewed journal articles (PRA).

The top perfomers: a gender distribution

The gender differential in academic productivity rates and the gender stratification in science are highly important issues from the perspectives of public policy (Leathwood and Read 2009; Fitzgerald 2013) and equity, as well as women's status in higher education (Allan 2011). 'No other area in the sociological treatment of scientific careers has received more attention than that of gender. Even in the larger context of stratification research on science, the area of gender has remained the most active' (Hermanowicz 2012: 225).

In this section we explore briefly gender differences in research productivity and, specifically, the gender distribution of research top performers. From a gender perspective, early differences in motivation between male and female academics can have far-reaching consequences for their productivity rates in the future: as Cole and Cole argued (1973: 150–151), even receiving the doctorate may have a qualitatively different meaning for male and female academics. Historically, until a few decades ago, while for male academics, PhD degrees may have been just entry cards to the academic profession, for female academics to have earned the degree was 'in some measure, a triumph.' In some countries, and Poland is the best example, only a minority of women entering the academic profession (as studied through the category of 'new entrants,' or those holding the doctoral degree for no more than 10 years) show a preference for research, compared with the majority of men entering the profession. Polish women academics in the 'new entrants' category show the lowest research interest across all the systems studied. Consistent with the accumulative advantage theory (Allison et al. 1982; Allison and Stewart 1974) and, even more so, consistent with what the Coles referred to as the reinforcement of research activity by the reward system, an early lack of success leads to smaller chances of later scientific success. This is the darker side of the accumulation of rewards in science—it is 'the accumulation of failures—the process of "accumulative disadvantage"' (Cole and Cole 1973: 146; Cole 1979: 78–81). Productivity is heavily influenced by the recognition of early work and, consequently, as the Coles argue: 'if women fail to be as productive in the years immediately following their degree, the social process of accumulative disadvantage may take over and contribute to their falling further behind in the race to produce new scientific discoveries' (Cole and Cole 1973: 151). In other words, as Jonathan R. Cole argued in *Fair Science. Women in the Scientific Community*, the skewed distribution of scientific productivity and of subsequent rewards also results from the process of 'the poor getting poorer':

> the growing inequality between the 'haves' and 'have-nots' of science results in part from a decline in productivity among those scientists who started

> their careers as moderately productive researchers, while the elite remain moderately or highly prolific researchers. Potentially, this process can influence the careers of women scientists.
>
> (Cole 1979: 8)

While the 'glass ceiling' for women in science appears to have already been broken (Cummings and Finkelstein 2012: 76 in a US context), globally, academic men have better academic networks and use them more often. Consequently, 'the traditional gender differences in academic work seem to be reproduced through international academic activities' (Vabø et al. 2014: 202). Internationalization in research (for instance, distant conferences, sabbatical leaves abroad, generating international funding with international colleagues)—powered by the opportunities provided by globalization—tends to favor male academics who are less constrained in large-scale international collaboration. As there is a strong correlation between internationalization in research and individual research productivity (see Abramo, D'Angelo, and Solazzi 2011a, 2011b for Italy and Chapter 4), the research productivity of female academics—who are generally more 'internationalized at home' (for instance, in teaching) but less 'internationalized abroad' (for instance, in international collaborative research projects) than male academics—is more affected by the mounting pressures of internationalization than that of male academics. In simple terms, male academics are able to use new internationalization opportunities more effectively.

Not surprisingly, based on the CAP data, Michel Rostan, Flavio A. Ceravolo, and Amy Scott Metcalfe (2014: 130) conclude that

> the prototypical academic figure in international research collaboration is a man, in his mid-50s or younger, working as a professor in a field of the natural sciences at a university in a small, non-Asian and non-English speaking country with a mature economy.

Jisun Jung concluded her study of gender differences in research in China, Australia, the United States, Brazil, and the United Kingdom as follows: 'male academics prefer research, invest much more time in research, have higher publication rates, have diverse funding sources, and are involved in a greater number of international collaborations and academic service activities' (Jung 2015: 176).

The gender gap in research productivity continues and gender differences and inequalities still remain, with 'the permanence of some barriers to women's careers' (Goastellec and Pekari 2013: 76). In general, though, sex differences in productivity are not immune to social change: while women academics used to publish at '50–60 percent' of the male academic rate, now they do so at around '70–80 percent' rate, as Yu Xie and Kimberlee A. Shauman conclude in their *Women in Science. Career Processes and Outcomes* (2003: 182–183) in a US context. The reasons for what Cole and Zuckerman (1984: 218) termed 'the productivity puzzle,' as explored through a systematic multivariate approach, are as follows:

> Women scientists publish fewer papers than men because women are less likely than men to have the personal characteristics, structural positions, and facilitating resources that are conductive to publication. There is very little *direct* effect of sex on research productivity. … Women and men scientists are located in different academic structures with different access to valuable resources. … Once sex differences in such positions are taken into account … net differences between men and women in research productivity are nil or negligible.
>
> (Xie and Shauman 2003: 191–193)

However, as a comparative analysis of micro-level data from nine countries for 1992 and 2007 show, the proportion of women in academia increases and the proportion of full professors who are women also increases (Cummings and Bain 2016: 297). The implications for the scientific productivity of both male and female academics in the Coles' cumulative advantage and reinforcement theories are clear, as Stephan and Levin (1992: 29) emphasize: 'Success breeds success. Consequently, those who enjoy success continue to be productive throughout their lives; those who have less success become discouraged and eventually look to other pursuits for satisfaction.'

The academic career is highly demanding, especially when most young people consider marriage as well as childbirth: 'those who actually decide to build families tend to experience considerable strain, finding they do not have as much time to devote to their work as their colleagues' (Cummings and Finkelstein 2012: 67–68). Gendered patterns of academic work and life can be analyzed both quantitatively (as in our example of male and female top perfomers below) and qualitatively. Qualitative explorations show wider socio-cultural contexts in which statistical findings need to be embedded. A perfect summary of the underlying foundations of the (decreasing but still powerful) academic gender gap as studied through a series of interviews in Anglo-Saxon countries is as follows:

> the academic gender gap has been diminishing for decades, yet it is nonetheless perpetuated by institutional priorities, academic practices, collegial relations, variations in family circumstances, and gendered priorities. Despite major educational, social, and institutional changes, men are still more likely than women to work in departments with a stronger research culture, to receive informal mentoring early in their career, to marry a supportive spouse who takes on most of the household chores, to view themselves as experts, and to receive acknowledgement and recognition for their research and scholarship from editors, publishers, managers, colleagues, and family members.
>
> (Baker 2012: 173)

From a gender perspective applied to our data, the proportion of male academics among research top performers as defined in this chapter is higher than that of female academics but 'productivity concentration indexes' for both genders (linking the percentages of male and female top performers to the percentages of all male and all female academics in national systems) clearly show that the role of highly productive female academics is much higher than traditionally assumed in the literature on gender implications of the social stratification in science.

The mere *share* of women among our top performers as defined in this chapter is not a fair measure. To explore the inequality in academic knowledge production along gender lines, a more sophisticated measuring instrument is needed. Following Abramo et al. (2009a: 143) who focused on 'star scientists' in Italy based on large-scale bibliometric data, we have constructed a similar 'productivity concentration index' for all European countries, for both genders.

The concentration index is a 'measure of association between two variables' based on frequencies data and varying around the neutral value of 1: the percentage of male top performers divided by the percentage of all male academics in a given system, or the share of male academics among top performers divided by the share of male academics among all academics. 'The index of concentration, equaling 1.60, indicates that the relative frequency of this profile among star scientists is over 60% greater than the frequency of the same profile in the entire population' (Abramo et al. 2009a: 143–144). That is, in the case of male academics from the UK (Table 1.8), the productivity concentration index of 1.3 for male academics shows that the relative frequency of male research top performers among all research top performers is 30 percent higher than the frequency of male academics among all academics. Similarly, in the case of female academics from the UK, the productivity concentration index of 0.5 for female academics shows that the relative frequency of female research top performers in all research top performers is 50 percent lower than the share of female academics in all academics.

Universally, across most systems, male productivity concentration indexes are slightly higher than 1 (from 1.1 in Germany, Poland, and Portugal to 1.3 in the UK and Ireland) and female productivity concentration indexes are lower than 1 (from 0.5 in Germany and the UK to 0.9 in Austria, the Netherlands, Poland, and Portugal). In two countries (Austria and the Netherlands), the male productivity concentration index is 1. So, in most countries, male academics are over-represented among top performers, and female academics are under-represented—which is not surprising in the context of the over-representation of male academics in senior ranks for which higher productivity is traditionally reported. In other words, what matters in our analysis is not only the gender distribution of top performers, as shown in the 'frequency' line in Table 1.8 (and the *share* of male top performers, ranging from two-thirds to four-fifths) but also the *relative* presence of male and female academics in the subpopulation of research top performers as measured by a productivity concentration index by genders, as shown in the 'concentration' line in the same table. The concentration

Table 1.8 Gender distribution of top performers by country (numbers and percentages), for all countries. The productivity concentration index is the percentage of male top performers/divided by the percentage of male researchers in a given country; the same applies to female top performers

Items/Countries	*AT*		*FI*		*DE*		*IE*		*IT*		*NL*		*NO*		*PL*		*PT*		*CH*		*UK*	
	M	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
Number	74	31	59	21	74	10	48	22	143	33	35	7	56	14	101	79	24	18	51	11	23	6
Frequency	70.2	29.8	73.2	26.8	88.4	11.6	68.6	32.4	81.4	18.6	83.1	16.9	80.3	19.7	56.1	43.9	58.1	41.9	82.5	17.5	78.7	21.3
Concentration	1.0	0.9	1.2	0.7	1.1	0.5	1.3	0.7	1.2	0.6	1.0	0.9	1.2	0.6	1.1	0.9	1.1	0.9	1.2	0.6	1.3	0.5

of men among top performers is precisely twice that of the concentration of women among top performers in Italy, Norway, Switzerland (1.2 vs. 0.6) and it is slightly lower in Finland, Ireland, and Poland. It is the lowest in Austria and the Netherlands, and the highest in the UK, with a male concentration two and a half times higher.

In the context of the traditional sociology of science and social stratification literature (Wilson 1995; Hagstrom 1965; Merton 1973; Cole and Cole 1973; Zuckerman 1996; Cole 1979), these research results strongly support the argument of the historically growing role of female academics in academic knowledge production: in almost all countries studied, the difference between the *relative* presence of male and female academics in the subpopulation of research top performers is only by a factor of two or less. In the emerging, consistent patterns of inequality in knowledge production, the high role of women academics among highly productive academics is undeniable. The gender productivity gap among research top performers (and the under-representation of female academics in this group) is clearly much lower than expected. However, female academics may find themselves increasingly disadvantaged in the future as a consequence of new public management reforms which are found to have affected them (as the Dutch case shows) more than male academics through a skewed allocation of different academic tasks, with female academics spending more time on teaching and male academics spending more time on research (Leišyte and Hosch-Dayican 2017: 102–103).

There is a long list of caveats in this section, though, leading to reservations of various natures. We will focus on two. First, the research productivity data are self-reported and male academics in some systems may tend to overestimate the number of articles they produce, while female academics may tend to underestimate their number. In other words, different national academic cultures may lead to different levels of overestimation and underestimation of research production contingent on the gender factor. Second, the various systems studied here are differently populated by female academics in general (20–50 percent), and by female academics in the university sector in particular (15–55 percent). Also, there are gender-based choices of research problems, of academic disciplines, and of research styles; including publication patterns, and matters relating to research productivity (Baker 2012). Differences in research styles (for instance, publishing less frequently) between men and women scientists may be linked to the issue of women being 'latecomers to the academic world' (Fisher 2005: 275) and to women frequently embracing a more perfectionist approach to research (Hermanowicz 2012: 229). As Hermanowicz comments on a possible distinctive style adopted by women, 'the perception of a marginal status compels them to adopt extra-high standards of conformity in order to be viewed as legitimate members of the scientific community' (2012: 229)

Not surprisingly, our research shows that female academics already in the top academic ranks are often on average more productive than men in the same ranks, work longer total weekly hours, longer weekly research hours, and are more research-oriented: to reach the highest levels of academic recognition, they had to work in often hostile academic environments (Cole and Cole 1973: 127). Still, as noted above, it would be fundamentally unfair to disregard in our study of highly performing academics the findings from qualitative empirical research on gendered patterns of university-based academic work. There are persistent features of the academic systems studied that are detrimental to gender equality: male and female academics are still unequally distributed in the academic hierarchy and there are gender differences in terms of access to full-time positions in prestigious higher education institutions, access to specific fields, obtaining higher ranks and salaries, or having high publication rates (Goastellec and Pekari 2013: 55). The workload imbalance disadvantaging research in the case of female academics may mean 'stagnation or disruption of an academic career path, especially for women in mid-career levels such as assistant and associate professor, where the criteria for career progression are particularly demanding with respect to research outputs' (Leišyte and Hosch-Dayican 2017: 104). By way of example, this is how the gender gap, including the gender high productivity gap, can be contextualized through qualitative empirical material:

> Men tend to search for full-time positions in high-profile research universities, which provide them with opportunities to carry out funded research, gain scholarly publications, and attain high salaries and esteem from their peers. Conversely, women doctorates express more ambivalence about striving for high-pressure careers and sometimes accept jobs that pay less but are located closer to parents, partners, and friends or that better enable them to manage care work. Because working full-time and being promoted through the ranks require long hours and measurable indicators of research productivity, female PhDs with infants or toddlers may initially accept temporary and part-time positions to help them manage their domestic workload. Others choose employment in teaching universities with less publishing pressure in order to accommodate childrearing without undue stress.
>
> (Baker 2012: 160–161)

Working time distribution and teaching and research role orientation

The first question in this section is whether the working habits of top performers are different from those of the remaining 90 percent of research-involved academics. The second question is whether top performers are more research-oriented (both consistent with the research literature on research productivity, see especially Fox 1992; Bentley and Kyvik 2013; and Shin and Cummings 2010).

We explore here the five dimensions of academic work which were captured by the CAP/EUROAC datasets: teaching, research, service, administration, and 'other' academic activities. The mean for the annualized total working time differential between top performers and the rest of academics is 5.7 hours, ranging from 3.7 hours in Italy to 7.4 hours in Germany and 8.0 hours in Norway. In other words, for example, German top performers, when compared with the rest of (research-involved, as in the whole book) German academics, spend on average an additional 42.6 full working days in academia per year (7.4 hours times 46 working weeks divided by 8 hours per day), and Norwegian top performers spend on average an additional 46 full working days.

We know from previous research productivity studies that longer working hours, and especially research hours, substantially contribute to high productivity: our study shows (with powerful results: p-value <0.001) what exactly 'longer hours' mean for the upper 10 percent of highly productive academics, and shows it from a comparative cross-national perspective. A ticket to enter the class of national top performers differs from country to country, though; and even more so, differs by cluster of academic discipline.

We are interested in the differences in the means of total working hours, and especially the means of research hours, between the two subpopulations in each country and the significance of the results (Table 1.9). Our results are based on two-sided tests assuming equal differences in arithmetic means with a significance level $\alpha = 0.05$. For each pair with a mean difference significantly different from zero, the symbol of the larger category ('Top' for top performers or 'Rest' for the rest of academics) appears in the column. Tests are adjusted for all pairwise comparisons within a row for each innermost sub-table using the Bonferroni correction. T-tests for the equality of two arithmetic means (Top vs. Rest) were performed for each country for each of the five types of academic activities studied.

As clearly seen in Table 1.9, longer research hours for top performers are statistically significant for a pool of six countries ('Top' symbols in the line of 'research'). But also for a pool of eight countries, longer administration hours for top performers are statistically significant ('Top' symbols in the line of 'administration'). The same applies to service hours (two countries) and hours spent on 'other' academic activities (four countries). Not surprisingly, the same also applies to total working hours in *all* the countries studied. In two countries (Norway and Switzerland), their longer teaching hours are also statistically

Table 1.9 Results of t-tests for the equality of means, top performers (Top) vs. the rest of academics (Rest), all countries. 'How long do you spend on various academic activities?', only full-time academics in universities involved in research (mean per year, 60 percent when classes are in session and 40 percent when classes are not in session)

	AT	*FI*	*DE*	*IE*	*IT*	*NL*	*NO*	*PL*	*PT*	*CH*	*UK*
Teaching				Rest	Rest		Top	Rest		Top	
Research			Top	Top	Top			Top	Top		Top
Service					Top		Top				
Administration	Top	Top	Top		Top	Top	Top	Top		Top	
Other	Top		Top	Top			Top				
Total	Top	Top	Top	Top	Top	Top	Top	Top	Top	Top	Top

significant. Top performers tend to spend more time on all activities, not only on research. There is a standard working pattern for top performers in most of the countries studied: the time they spend on research is higher. Top performers also spend more time on teaching and on service hours. Specifically, they also spend much more time on administration. ‘Science takes time’; and much more scientific production takes much more time. Top performers work (much) longer hours: week by week, month by month, and year by year. Their longer total working time is statistically significant for all countries.

The results of the z test for the equality of fractions performed for all countries (Table 1.10) are based on two-sided tests with a significance level of $\alpha = 0.05$. Tests are adjusted for all pairwise comparisons within a row for each innermost sub-table using the Bonferroni correction.

Z tests for the equality of fractions (Top vs. Rest) were performed for each country for each of the four categories of teaching and research orientation. Correspondingly, as before, for each pair with a fraction difference significantly different from zero, the symbol for the larger category (‘Top’ for research top performers or ‘Rest’ for the rest of academics) appears in the column.

As clearly seen in Table 1.10, the research role orientation (answer 3) among top performers is statistically significant in a pool of seven countries (‘Top’ symbols in the line for ‘in both, but leaning toward research,’ with no exceptions). Additionally, in a pool of five countries, the strong research role orientation (answer 4) for top performers is also statistically significant, again with no exceptions. The division in role orientation between top performers and the rest of academics is clear (and all differences are statistically

Table 1.10 Results of z tests for the equality of fractions, all countries. Preferences for teaching/research (Question B2: ‘Regarding your own preferences, do your interests lie primarily in teaching or in research?’), research top performers (Top) vs. the rest of academics (Rest)

	AT	*FI*	*DE*	*IE*	*IT*	*NL*	*NO*	*PL*	*PT*	*CH*	*UK*
Primarily in teaching		Rest	Rest	Rest	.a	.a	.a	Rest	Rest		.a
In both, but leaning toward teaching		Rest		Rest	Rest	Rest	Rest	Rest	Rest	Rest	Rest
In both, but leaning toward research		Top	Top	Top		Top		Top	Top	Top	
Primarily in research				Top	Top			Top	Top		Top

Note: .a This category is not used in comparisons because its column proportion is equal to zero or one.

significant): in all the systems studied, top performers are more research-oriented than the rest of academics. Being interested 'primarily in teaching' virtually excludes such European academics from the class of research top performers: their share attains a maximum of 1.1 percent in Ireland. In addition, being interested 'in both, but leaning toward teaching' again almost excludes such European academics from the same class: their share is about 3–8 percent in Finland, Ireland, Italy, the Netherlands, Norway, and the UK, and more in three other countries: Switzerland (10.7 percent), Poland (13.2 percent), and Portugal (21.8 percent). Poland and Portugal are clearly teaching-focused systems, as shown in Chapter 5. Also, the share of top performers whose interests lie 'in both, but leaning toward research' is consistently similar across Europe (about 57–73 percent). Our results show that a research role orientation is a powerful indicator of belonging to the class of the European research elite: as could be expected, being research-oriented is virtually a must for European academics and being teaching-oriented virtually excludes them from this class.

However, the above results about the working time distribution and the teaching/research role orientation among highly productive academics and the rest of academics are not multi-dimensional (the conclusions from the t-test and z test analyses are independent of each other). A study of multi-dimensional relationships requires a model approach with a number of dependent variables, including research hours and research orientation, among several others. Therefore, we present a regression analysis below.

Top performers are examined through a bivariate analysis of the working time distribution and the teaching or research role orientation. Although bivariate analyses are limited as they do not control for other important factors that might affect research productivity (Teodorescu 2000: 203), the two selected variables have emerged as key in numerous productivity studies (Bentley 2015; Bentley and Kyvik 2013; Drennan et al. 2013; Jung 2014; Marquina and Ferreiro 2015; Shin and Cummings 2010). However, a study of multi-dimensional relationships requires a model approach, and, therefore, odds ratio estimates with logistic regression of being a highly productive academic are presented, following inferential analyses.

The class of top performers and how to enter it

In the next step of analysis, we have developed an analytical model to study research productivity based on the research literature, especially quantitative studies of American social scientists by Mary Frank Fox (1992: 295–297), of Australian academics by Paul Ramsden (1994: 211–212), and of academics from ten countries by Daniel Teodorescu (2000: 207). Following Ramsden (1994), we have assumed that 'any sensible explanation of research output must take into account personal (individual) and structural (environmental) factors, and preferably also the interaction between them.' Following the research literature, independent variables are grouped as 'individual' and 'institutional' characteristics in eight clusters (see Table 1.11).

Table 1.11 Faculty research productivity: variables in the model (survey question numbers in parentheses)

Individual variables	***Institutional variables***
Personal/Demographics	*Institutional policies*
Female (F1)	Strong performance orientation (E4)
Mean age (F2)	Research considered in personnel decisions (E6)
Full-time (A7)	*Institutional support*
Professor (A10)	Availability of research funds (B3)
Socialization	Supportive attitude of administration (E4)
Intensive faculty guidance (A3)	
Research projects with faculty (A3)	
Internationalization and collaboration	
Collaborating internationally (D1)	
Collaborating domestically (D1)	
Publishing in a foreign country (D5)	
Research int'l in scope or orientation (D2)	
Academic behaviors	
Annualized mean research hours (60% in session and 40% not in session) (B1)	
Academic attitudes and role orientation	
Research-oriented (only answer 4) (B2)	
Scholarship is original research (B5)	
Basic/theoretical research (D2)	
Overall research engagement	
National/int'l committees/boards/bodies (A13)	
A peer reviewer (A13)	
Editor of journals/book series (A13)	

There are two questions related to the overall research approach taken. The first question is why estimate a regression model for each of the 11 countries rather than pooling the sample and control for country. The argument for the choice of 10 percent top performers per country (and per major cluster of academic discipline) is that the approach of selecting merely the upper 10 percent of academics, regardless of the country, does not fit the purpose of highlighting cross-national differences among top performers. The factors important in predicting high research productivity in some countries might be irrelevant in other countries. However, we have also developed a single model controlling for country fixed-effects and the two models will be compared briefly in the 'Discussion'

Table 1.12 Odds ratio estimates by logistic regression for being in the top 10 percent in research productivity (by PRA), all countries

	Austria	*Finland*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*Norway*	*Poland*	*Portugal*	*Switzerland*	*United Kingdom*
Nagelkerke's R^2	0.155	0.308	0.210	0.270	0.256	0.207	0.298	0.292	0.672	0.362	0.364
Individual predictors											
Personal/demographics											
Female					0.474*						
Age			0.453*		0.936**						
Full-time			6.203*								
Professor		2.046*	2.98**	5.003***	5.008***		4.242***	2.494**			3.963***
Socialization											
Intensive faculty guidance					0.457*						
Research projects with faculty											
Internationalization and collaboration											
Collaborating internationally		5.371**						1.84**			
Collaborating domestically			2.804**		3.536**		3.979**				4.85**
Publishing in a foreign country	4.272*			5.275*			7.434*	2.469***		6.508**	
Research int'l in scope or orient.	2.596**	2.401*							7.538**		
Academic behaviors											
Annualized mean weekly research hours (60% in session, 40% not in session)				1.038**			0.942***	1.028**			1.03*

(*Continued*)

	Austria	*Finland*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*Norway*	*Poland*	*Portugal*	*Switzerland*	*United Kingdom*
Academic attitudes and role orientation											
Research-oriented	1.908*										
Scholarship is original research											
Basic/theoretical research											
Overall research engagement											
Nat/int'l committees/ boards/bodies	2.416**							2.399***			
A peer reviewer		4.778**		9.65*	2.153*	9.641*		2.726***		26.285**(1)	8.029*
Editor of journals/book series										2.203*	2.707**
Institutional predictors											
Institutional policies											
Strong performance orientation											
Research consid. in HR decisions											
Institutional support											
Availability of research funds										3.497***	
Supportive attitude of admin.											

Note: Results that are not statistically significant are not shown in the Table. '-' – no usable data available (question was not asked); ***p<0.001; **p<0.01; *p<0.05. (1)—These odds ratios need to be treated with caution.

section. The second question is why the regression model is not controlled for academic discipline as a potentially important source of variation: unfortunately, the number of observations per discipline was too small in many cases (often less than 10–15 per cluster of disciplines per country).

In this multivariate analysis, we have dichotomized all category variables through a recoding procedure. We started with 42 personal and institutional characteristics, grouped in eight clusters. We then conducted Pearson Rho's correlation tests to find significantly correlated predictors of the dependent variable. The predictors were entered into a four-stage logistic regression model (as in Cummings and Finkelstein 2012). Multicollinearity was tested using an inverse correlation matrix and no independent variables strongly correlated with others were found. The predictive power of the fourth model (as measured by Nagelkerke's R^2) was the highest for Portugal (0.67), the UK, and Switzerland (both 0.36); for Norway, Ireland, Finland, and Poland, it was in the about 0.27–0.31 range. The predictive power of the models of research productivity estimated by other researchers is not substantially higher (for instance, the average variance demonstrated for 12 European countries studied recently by Drennan et al. (2013: 129) is about 30 percent; and about 30 percent for ten globally studied countries in Teodorescu 2000: 212). In Table 1.12 we present the results of the final, fourth model.

Statistically significant individual and institutional variables

The collection of individual variables emerges as more important than the collection of institutional variables, both in terms of the frequency of occurrence and the size of regression coefficients.

In the first block of individual predictors ('personal/ demographics'), there are four variables: 'female,' 'age,' 'full-time,' and 'professor.' Being a female academic entered the equation in one country only: it is a strong predictor of *not* becoming a top performer in Italy, where the odds ratio value indicates that female academics are about half as likely as male academics to be a top performer. In all other countries, being a male academic is not a predictor of becoming a top performer. While the finding for Italy is consistent with the gender-focused analysis of Italian 'star scientists' in Abramo et al. (2009a), overall, our findings are clearly different from the findings from linear regression analyses in which being a female academic has traditionally been negatively correlated with research productivity.

While in most single-nation and cross-national studies, age is not a statistically significant variable, our model shows that 'age' is a powerful predictor of high research performance in two countries. A one-unit increase (that is, 1 year) in Germany and Italy decreases the odds of becoming a top performer. The two cases demonstrate that the traditional mechanisms of 'accumulative advantage' in academic careers, combined with prior mechanisms of 'reinforcement' in science

(Cole and Cole 1973; Zuckerman 1996; Zuckerman 1988; Allison et al. 1982), do not seem to be at work in all European systems: the traditional long-term accumulation of prestige and resources which comes with age, and which is preceded by prior recognition of academic work, is not so clearly visible in Germany and Italy.

Finally, being a 'professor' (or academic seniority) emerged as the single most important variable in the model, with statistical significance in seven countries. In four of them (Ireland, Italy, Norway, and the UK), being faculty at senior ranks increases the odds of becoming a top performer four to five times, in Germany slightly less than three times, in Poland two and a half times and in Finland twice. This finding confirms the conclusions from previous productivity studies—although certainly academics in European higher education are more likely to be promoted to higher ranks if they are highly productive. Productivity affects being a professor and the relationship may be 'reciprocal' (Teodorescu 2000: 214). Strictly speaking, almost all non-demographic independent variables in our model could also be dependent variables in separate analyses. But as Ramsden (1994: 223) argued, 'identifying correlates of high productivity does not mean that we have identified causal relations.'

In the second block of individual predictors ('socialization': receiving intensive faculty guidance during PhD studies and working with faculty in research projects), to great surprise, especially in the context of the US literature, both variables are either statistically insignificant or, as in Italy, they actually *decrease* the odds of becoming top performers (inconsistent with findings in Horta and Santos 2016 who focused on the impact of publishing during doctoral studies on future productivity). Unfortunately, the following could not be tested: a long line of research in which current affiliation matters (through contacts or halo effects), whether graduates of major universities are more likely to be highly productive than graduates of minor universities, and whether the next generation's most productive scientists come from a highly selected group of previous top scientists (Crane 1965). A common explanation for the two systems could be that in 'academic oligarchy' types of systems, doctoral students receive faculty guidance more by working for senior faculty, possibly as a cheap academic labor force, rather than independently working with them. According to the 'reinforcement' theory (Zuckerman 1996; Fox 1983), later productivity is substantially influenced by the early recognition of research work, so young academics receiving intensive faculty guidance in specific Polish and Italian systems may have lower odds of becoming top performers later in their careers due to not pursuing their independent research strongly enough early in their careers.

The third block of individual predictors ('internationalization and collaboration') emerges as the single most important grouping in predicting high research productivity: each of the four variables at least doubles the odds of becoming a top performer. The four variables are as follows: 'collaborating internationally,' 'collaborating domestically,' 'publishing in a foreign country,' and 'research international in scope or orientation.' These variables enter the equation in all countries except one (the Netherlands).

Domestic collaboration influences high research productivity in four countries (Germany, Italy, Norway, and the UK). 'Publishing in a foreign country' emerged as a powerful predictor in five smaller or peripheral higher education systems: Austria, Ireland, Poland, Switzerland, and Norway, as with small academic markets it makes it more necessary for prolific academics to publish internationally. Also, 'research international in scope or orientation' increases the odds in three countries. In the block of 'academic behaviors,' contrary to previous research conclusions from linear regression models (most recently in Cummings and Finkelstein 2012: 58; Shin and Cummings 2010: 590; and Drennan et al. 2013: 127), annualized mean weekly research hours emerged as determinative predictors only in three countries (Ireland, Poland, and the UK): a unit increase of 1 hour (in annualized research hours per week) increases the odds of being a top performer by a 2.8–3.8 percent on average (*ceteris paribus*). In other words, in these three countries, an increase of 10 annualized research hours per week leads to an increase in the odds by between a quarter and one-third. In Norway, surprisingly, annualized mean weekly research hours emerged as predictors decreasing the odds. In all the other countries, a high research time investment is not a determinative predictor of becoming a top performer.

Again, in the block of 'academic attitudes and role orientation,' contrary to the findings from previous linear regression models, research orientation emerged as a powerful predictor of research productivity in only one country, with Exp(B) = 1.91 for Austria. In all other countries, it was not a determinative predictor. Also, the view of scholarship as 'original research' and the emphasis on 'basic/theoretical research' do not emerge as correlated with high research productivity in any country.

Surprisingly, while in descriptive statistics (as in Postiglione and Jung 2013) and in inferential analyses based on t-tests for the equality of means and z tests for the equality of fractions presented above, both long research hours (academic behaviors) and high research orientation (academic attitudes) emerge as important characteristics of top performers, following the almost universal findings in the research productivity literature, here, a multi-dimensional model approach supports these findings in selected countries only. Finally, and understandably in the context of previous literature, being a peer reviewer (in the block of 'overall research engagement') emerges as a powerful predictor of becoming a top performer: it increases the odds in six countries—five times in Finland, eight times in the UK, and nine times in the Netherlands and Ireland. It may effectively mean at least two things: first, it pays off to be a reviewer; and, second, reviewers are the right persons in the right place in the current science systems.

The importance of variables differs from country to country, but the overall determinative power of individual-level predictors (blocks 1 through 6) is much stronger than those of institutional-level predictors (blocks 7 and 8), consistent with previous research on productivity (Ramsden 1994: 220; Shin and Cummings 2010: 588; Teodorescu 2000: 212; and Cummings and Finkelstein 2012: 59). As Drennan et al. (2013: 128) concluded in their recent study, 'institutional factors were found to have very little impact on research productivity.' This finding is also consistent with the conclusion about the American professoriate that 'intrinsic motivations' rather than 'institutional incentive structures' (Finkelstein 1984: 97–98, Teodorescu 2000: 217) stimulate research productivity. In general, the institutional-level predictors are statistically significant in only one case in one country (Switzerland). Surprisingly in the context of previous research (Wanner et al. 1981; Fox 1983), two institutional predictors are not statistically significant in any of the countries studied: 'availability of research funds' and 'supportive attitude of administration' (except for Switzerland in the case of research funding). This might mean that, generally, neither institutional policies nor institutional support substantially matter in becoming a top performer.

Interestingly, while the conclusions from linear regression models indicate that institutional-level predictors of research productivity are weak, in our logistic regression model the conclusions indicate that they are actually statistically insignificant. In particular, research funds and academic climate (good academic-administration relationships) do not enter the equations in any country in the model. Also, the strong performance orientation of institutions is statistically insignificant in all countries except Switzerland. Institutional variables are more applicable to public policy than individual variables because they may be amenable to change—to learn more about the optimal conditions for highly productive academics, 'management patterns can be changed more easily than individual interests and attitudes' (Ramsden 1994: 224).

Discussion

We have used two complementary approaches to explore the unique class of European research top performers: statistical inference and a multi-dimensional logistic regression model. The findings from statistical inference show two clear cross-national patterns applicable to top performers: longer working hours (in most working time categories) and higher research orientation. In only three countries do the rest of academics actually spend more time than top performers on any of the studied activities: this is teaching in Ireland, Italy, and Poland. The results from these three countries provide strong support for a thesis about an antagonistic or competitive relationship between teaching and research (as argued by Fox (1992) who discussed 'mutuality' and 'competition' between teaching and research), at statistically significant levels: while highly productive academics in these countries spend more time on research, the rest of academics spend more time on teaching. In these countries, as Fox (1992: 303) argued, teaching and research 'are at some odds with each other.' Top performers work (much) longer total hours every week, all year round. Their longer total working time is statistically significant for all countries. From a statistical inference approach, top performers are also more research-oriented than the rest of academics. The most salient difference between the two sub-populations can be seen in three structurally similar systems having a similar teaching/research time distribution: in Ireland, Portugal, and Poland only about half of the 'rest' of academics are research-oriented. They are nominally involved in research but they are not research-oriented in their self-declared role preferences. In general, the distribution of research role orientation is almost universal across all the countries studied. Consequently, highly productive academics are almost universally more intra-nationally different from 'average' academics, and almost universally more similar to top performers in other countries.

Our study draws attention to the fact that there are important differences in those conclusions from linear regression models detailed in previous studies, both single-nation and cross-national, and the conclusions derived via a multiple regression model from predictors of belonging to a distinctive group of the European research elite as defined in this chapter. The internationalization of research, national and international research collaboration, international publishing, academic seniority, as well as high levels of overall research engagement emerge as powerful correlates of high research productivity. Also, in both cases, the overall determinative power of individual-level predictors is stronger than that of institutional-level predictors (as in Ramsden 1994: 223; Shin and Cummings 2010: 586; and Cummings and Finkelstein 2012: 58).

While in t-test and z test analyses, both research hours and research orientation strongly characterize top performers, a multi-dimensional model approach through regression analysis, surprisingly, supports these findings in selected countries only. From among individual variables, both age and academic seniority (being a professor) are important predictors of high research productivity. However, surprisingly, neither annualized research hours, nor research orientation (traditionally, the two most important predictors of research productivity) emerged as powerful predictors of high research productivity in more than three and two countries, respectively. This is perhaps the most perplexing result of our research: while in inferential analyses, these are critical variables in all the systems studied, in multi-dimensional analyses, their role is considerably smaller than expected. The specific case of working time distribution and research role orientation clearly shows that a combination of several approaches is more fruitful than a reliance on any of them separately.

There is also an interesting tension between the conclusions drawn from 11 multiple regression models and the single model controlling for country fixed-effects. The difference is in focus: highly productive academics being explored as nested in the context of national systems or explored independent of the context. While in the first model, in the block of personal/demographic variables, both age and gender entered the equation in two countries; in the single model for European academics being female was statistically insignificant but mean age was also significant, decreasing the odds of becoming a top performer (Exp(B) = 0.984). While in the first model working full-time was statistically significant only in one country (Germany), in the single model being employed full-time is statistically insignificant; also, while in the first model being a professor (or academic seniority) increases the odds in most countries from two to five times, in the single model it increases the odds by 140 percent. The two socialization variables were not significant in either of the models (except for Italy in the former). The internationalization and collaboration variables increase the odds by between 180–380 percent (depending on the country) in the first model, and by a mere 30–50 percent in the second model. In both models, research being international 'in scope or orientation' increases the odds. Also in both models, higher mean weekly research hours increase the odds (Exp(B) = 1.038–1.030 and Exp(B) = 1.012, respectively). However, self-declared research role orientation in the first model is statistically significant in only one country, and in the second, single model, it is statistically significant, increasing the odds by 26 percent. Also, the research engagement variables increase the odds in the first model by 65–240 percent and in the single model by a mere 55–100 percent. As for institutional-level variables, in the first model they are statistically significant in only two countries and in the single model they are statistically insignificant. In the single model, with Poland as a reference category, being a German, Norwegian, or Austrian academic increases the odds by 115–865 percent. Nagelkerke's R^2 is 0.204.

The differences in conclusions from our two different logistic regression models (with top performers differently defined; in Europe as a whole or separately in European systems) are smaller than expected: in the context of previous single-nation studies, the insignificance of gender in the single model comes as a surprise. The emergence of academic seniority as a predictor of high research productivity in the single model is consistent with previous studies; the statistical significance of the research role orientation in only one country in the first model (and its significance in the single model) come as a surprise. This may imply that there is a growing tension between self-declared research role orientation and research productivity in Europe. While European academics increasingly view themselves as research-oriented, research orientation emerges as a much less statistically significant predictor of becoming a top performer than expected from previous research. In contrast, research time investments emerge as significant predictors in both the first model (in three countries) and in the single model.

The overall relative insignificance of institutional predictors in the first model and its small significance (Exp(B) = 1.267) in the second model in the case of highly productive academics may provide further support for the 'sacred spark' theory of productivity (Cole and Cole 1973): regardless of administrative and financial institutional settings, some faculty—and they may be our 'research top performers'—will always show greater inner drive toward research than others. Also, Peter James Bentley and Svein Kyvik, in their global study of 13 countries, found more support for this theory than for the competing 'utility maximization theory' (Stephan and Levin 1992). As the Coles (1973: 71) argued, 'to be successful, a scientist must have the self-discipline to work long hours and to work productively. Such self-discipline and motivation probably explains at least as much variance in scientific success as native ability.' Top performers as defined in this chapter seem to fit this description perfectly. The 'accumulative advantage' theory (combined with 'reinforcement theory') found only partial support in the study: age is not a significant predictor in most systems studied, and academic seniority (or professorships), although a significant predictor in most systems, is reciprocally linked to productivity.

Concluding reflections

In this chapter we have followed several research paths. First, we have focused on the rare scholarly theme of highly productive academics. Their role in knowledge production across all 11 European systems studied is pivotal: without these 10 percent of academics, national academic outputs would be halved. Second, we have presented an international comparative study based on solid quantitative material rather than the single-nation studies that dominate previous research. Third, in contrast to bibliometric studies of research productivity, we focused on academic attitudes, behaviors, and perceptions as the predictors of becoming research top performers. Our study provides a large-scale and cross-national corroboration of the systematic inequality in knowledge production, suggested for the first time by Alfred Lotka (1926) and Derek de Solla Price (1963). What we may term the '10/50 rule' holds strongly across Europe (with the upper 10 percent of academics producing 50 percent of all peer-reviewed publications).

European highly productive academics are a highly homogeneous group of academics whose high research performance is driven by structurally similar factors which cannot be easily replicated through policy measures. The variables increasing the odds of entering this class are individual rather than institutional. From whichever institutional and national contexts they come, they work according to similar working patterns and they share similar academic attitudes. Highly productive academics, as they emerge from this study, are similar from a European cross-national perspective and they substantially differ intra-nationally from their lower-performing colleagues. They are a universal academic species and they share roughly the same burden of academic production across Europe.

Our study draws attention to the fact that there are important differences in those conclusions from linear regression models with the correlates of research productivity detailed in previous studies and the conclusions from a multiple regression model with predictors of belonging to the European research elite. Our study shows the gender of academics as a very weak predictor, their age as a powerful predictor, and academic seniority and internationalization as the most important predictors. Contrary to most previous findings based on linear regression models, both annualized mean weekly research hours and research role orientation only emerged as powerful predictors of becoming a research top performer in several countries. In line with most previous research, though, institutional-level predictors emerged as statistically insignificant.

The study also shows a considerable tension between the conclusions from inferential results and logistic regression results. Surprisingly, while in inferential analyses both long research hours and high research orientation emerge as critical characteristics of top performers, a multi-dimensional model approach supports these findings in selected countries only. While in inferential analyses, these are crucial variables in all the systems studied, in multi-dimensional analyses, their role is small. We conclude, therefore, that a combination of several approaches provides a better empirical insight into the European research elite. It is hard to entirely disregard the finding that being research-oriented is virtually a must to enter to the class of research top performers in Europe and being teaching-oriented virtually excludes European academics from this class. This finding has strong policy implications, especially for hiring new academic staff.

Therefore, based on the combination of inferential and multiple regression findings, European research top performers emerge in this study as much more cosmopolitan (the power of internationalization in research), much more hard-working (the power of long overall working hours and long research hours), and much more research-oriented (the power of a single academic focus) than the rest of European academics, despite differentiated national contexts.

The European academic knowledge production hinges on European top performers. Kyvik (1989: 209) came to similar conclusions about the skewness of Norwegian productivity (the most prolific 20 percent of the faculty produced 50 percent of the total research output) and Abramo et al. (2009a: 143) presented similar findings about Italian productivity patterns (12 percent of authors accounted for 35 percent of the total research output, averaged among the disciplinary areas).

This research shows that consistently across major clusters of academic disciplines, top performers produce about half (53.4 percent) of all European peer-reviewed publications (as well as 45.6 percent of publications in English and 50.2 percent of internationally co-authored publications). Their mean research productivity across major clusters is much higher (on average, 8.56 times) than that of the other academics. Strong cross-disciplinary differences are observed, however.

Interestingly, the average research productivity distribution is highly skewed (with a long tail on the right) not only for all European academics in the sample, which could have been expected, but also for its segment of top performers. The upper 10 percent of academics is as internally stratified as the lower-performing 90 percent, with a very small number of very high publishers: the right tail of the productivity distribution tends to behave exactly as the entire productivity distribution. This result is consistent with recent findings by Yair et al. (2017: 5) who showed in a sample of Israel Prize laureates that the tail of excellence may behave as the entire productivity distribution. In a similar vein, Abramo, D'Angelo, and Soldatenkova (2017a: 334) found the same pattern in the Italian national research system: 'research productivity distribution for all fields is highly skewed to the right, both at overall level and within the upper tail.' This is also the case across Europe.

The most instructive example comes from life sciences (with 2,352 cases and the highest number of statistically significant differences between the two subpopulations among several academic activities studied). The top performers in life sciences, on average, seem to follow all traditional accounts of productive academics in the sociology of science. On average, they work many more hours per week and, specifically, they have the traditional working time distribution attributed to high publishers (Fox 1983; Hagstrom 1974) according to which research-time allocations compete directly with teaching-time allocations (Fox 1992; Kyvik 1990; Ramsden 1994), or the only relevant difference is in general between research time and non-research time (Stephan 2012). Their average weekly teaching time is much shorter, and their research time is much longer; in addition, they spend more hours on administration (presumably more research involves more research grants, which require more administrative work; alternatively, these academics are more often heads of research groups or medium-level administrators, such as directors and deans).

However, limitations of the dataset used mean that three streams of research studied in literature could not be followed in this chapter. First, it was not possible to study differences between top performers from institutions of lower academic standing and those from the most prestigious institutions, knowing that minor and major universities (as in Agrawal et al. 2017; and Crane 1965) may provide more and less favorable academic settings and attract more and less talented students and academics, respectively. Location and affiliation may matter not only for recognition but also for high research productivity, which could not be verified with the dataset used. It could not be studied whether top performers gravitate toward institutions and departments in which research is a priority. Neither within-department (and institution) nor between-department (or institution) variability could be studied, as in Perianes-Rodriguez and Ruiz-Castillo (2015) and in Becker and Toutkoushian (2003).

Second, top performers could not be linked to individual institutions. For this reason, a study of the impact of highly productive academics on the general productivity of their academic units—or of the asymmetry of knowledge production between the within-unit top performers and the within-unit other academics across different institutions—could not be performed (following Piro et al. 2016 who studied Norwegian universities, with the conclusion that their overall productivity impact on units is modest). Top performers may increase the productivity of those present in the organization, and they may also increase the productivity of newly hired members due to their reputation (Agrawal et al. 2017). However, with the instrument used, this could not be explored. And, third, only a cross-sectional study could be performed; thus, no changes over time could be analyzed (for instance, the identification of the persistence of top performance over time as in Kelchtermans and Veugelers (2013), or the length of periods of the stardom of stars as in Abramo et al. (2017b) could not be explored).

Based on the Carnegie dataset of the academic profession, Philip G. Altbach and Lionel S. Lewis (1996: 24) argued, without much further detail, that 'actual productivity is in fact limited to a minority of the profession.' Paul Ramsden's (1994: 223) conclusions in his study of research productivity based on surveys of

890 academics from 18 Australian institutions were similar: 'most publications are produced by a small proportion of the total number of staff.' Also, Mary Frank Fox (1992: 296), based on surveys of 3,968 American social science academics, argued that 'few people produce many articles and many publish few or none.' Therefore our guiding research puzzle was as follows: is this the case across European systems too? Our findings consistently show that such productivity distribution patterns strongly hold for almost all European higher education systems and for all five major clusters of academic disciplines.

Consequently, our empirical findings show that there are different 'academic professions' in European universities, with a small share of highly productive researchers and a large share of relatively middle to low productive academics. Cross-national similarities among highly productive academics are as strong as the intra-national differences between them and the remaining research-involved academics in their national systems.

The distribution of academic knowledge production in Europe is highly skewed toward highly productive academics. The policy implications for this historically consistent pattern of research productivity are more important in systems in which research funding is increasingly based on individual research grants (such as Poland following the 2008–2012 wave of reforms) than in systems with primarily institutionally based research funding (such as Italy, Abramo et al. 2011a), and are different for competitive and non-competitive systems in Europe (or with strong 'up or out' vs. 'once in—forever in' employment policies). A major emergent policy dilemma is whether to support more high-performing academics (wherever they are located) or highly ranked institutions, with the option of concentrating high-performing academics in highly ranked institutions, leading to a growing national research concentration in selected institutions only. Additionally, the tension between teaching and research is likely to increase in systems in which more competitive research funding systems are introduced.

Policy conclusions regarding knowledge production as viewed through the proxy of publishing articles and book chapters are perplexing: if European systems dismissed its top performers (the upper 10 percent of their research-active academics), they would lose on average about half of their national academic production. And if European systems dismissed the bottom half of their research-active academics in terms of research productivity, they would lose less than 6 percent of their national knowledge production (in the case of research-active academics employed full-time in the university sector, the loss would be 8.5 percent).

Consequently, a new typology of the academic profession across Europe emerges, based on the measurable contribution to knowledge production: in the research-active segment of the academic profession, there are research top performers, research middle performers (high-middle and low-middle), and research non-performers, or no-publishers. (These are the Coles' 'silent scientists,' whose share among full-time academics employed in the university sector ranges from less than 10 percent in Ireland, Italy, the UK, and the Netherlands to more than 40 percent in Poland.)

On top of that, both higher education institutions in general and universities in particular are populated by non research-active faculty, an additional segment of research non-performers. The academic behaviors and academic attitudes of research top performers are worlds apart from those of both middle performers and non-performers. And in terms of research productivity, there is no single 'academic profession' (as has always been the case in the last half a century), only 'professions' in the plural. 'Academic professions' in the plural appear in a similar vein in Enders and Musselin (2008: 127) when they refer to the growing internal differentiation of the academic profession; in Marginson (2009: 110) when he summarizes the impact of globalization on the stratification 'between those with global freedoms and those bound to the soil within nations or localities'; and in Teichler (2014b: 84) when he explores the validity of the traditional Humboldtian teaching-research nexus in Germany and restricts it solely to a group of German 'university professors.' The growing stratification of academics across Europe is the name of the game in town, and the persistent inequality in academic knowledge production is one of its major dimensions.

We have explored in this chapter a distinctive subgroup of highly productive academics from a cross-European comparative perspective to show the complexities inherent in the 'academic profession' concept. The disaggregated picture of faculty research performance in Europe highlights a powerful divide between research top performers and the rest of academics, which does not seem to have been studied so far from a European comparative perspective.

Note

1 We worked on the final data set dated June 17, 2011 created by René Kooij and Florian Löwenstein from the International Centre of Higher Education and Research—INCHER-Kassel.

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