



Research article

Scientific career tracks and publication performance - relationships discovered in the Hungarian academic promotion system

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ABSTRACT

The paper aims to investigate the research patterns of Hungarian university full professors and career pathways in various disciplines. Hungary has a so-called 'multi-stage' formalized hierarchy that clearly defines the steps leading to achieve the appointment of full professor. Following the theoretical chapter in which different career scenarios – such as 'Top Researcher', 'Outstanding Lecturer' and 'Local Manager' are presented, an empirical analysis is carried out. The sample consists of a group of 327 professors. Our results point out that there are different research patterns and a significant gap can be observed between disciplines rather preferring international publication (scored by SJR) and the ones opting for publishing monographs. As far as career paths concerned, it was found that the number of years until reaching the PhD degree ranges between 6-13 years, 15.5–22 years are needed on average to achieve habilitation, while the time needed for getting the title of full professor ranges between 22-27 years. It is clearly perceivable that the gap in the number of years converges until reaching full professorship in each and every discipline.

1. Introduction

Promotion systems provide motivational points for all members of the given scientific community. These steps are structured differently in each country and are weighted or articulated in a different way, which also adds a lot to the image of any profession.

An academic career covers three major areas of activity. These are education, research and service. Education includes teaching students, teaching classes, course development, and professional development. Research encompasses all activities focused on producing new scientific knowledge, while service includes additional scientific and public activities, administrative and management tasks. The 'hard', quantitative part of performance evaluation is also determined by qualifications, the number of lectures given, scientific publications, and the degree of involvement in each university and academic organization (Fletcher, 2001). Most procedures consider the degree of researcher excellence to be one of the most important aspects (Adomi and Mordi, 2003; Barker, 2007; Ferretti et al., 2018). The amount and proportion of these tasks occur in different ways in the career of each researcher, it is also a kind of a researcher's own decision and orientation according to their skills, abilities, and motivation. However, in general, the pillar of research work

has the largest role in the scientific promotion system, which is prioritized by both the domestic and international scientific community compared to other segments.

In the present study, after reviewing the various academic promotion systems, we examine the advancement of lecturers with a successful university professor application between 2016 and 2018. Our aim is to map the publication performance of the representatives of each discipline at each level of the promotion system, which is eventually culminated in being appointed to be a university full professor. The researchers chosen as a sample have already reached the highest level of the promotion system in higher education, thus unfolding a full career. In our analysis, we also examine how their performance relates to the publication requirements of the new regulations on university professor applications, giving a complete picture to those who are at lower levels in their academic careers.

2. Issues of promotion systems

In his 1977 study, *Discipline and Punish*, Foucault compared departments and lecturers in higher education institutions to the operating model of prisons, where lecturers and researchers are under constant,

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albeit imperceptible, control. As employees do not know exactly when their performance is measured, they keep their behaviour within the designated framework. Within this framework, they seek to maximize their position and reward in exchange for their performance. In light of this, academic reward systems are fundamentally designed to evaluate the professional activities of researchers and lecturers, while the promotion system is one, if not the most important, element of the reward system (Foucault, 1977).

Because of this, researchers and lecturers focus primarily on areas of activity in their work that are specifically labelled and measured by the promotion system. These are all tasks that represent primary values in the promotion system (Tien, 2000, 2008; Tien and Blackburn, 1996). This process makes the behaviour of individual researchers determinable and predictable, which is influenced by external factors (promotions, salaries, and database subscriptions by libraries) as well. There are significant differences between countries in terms of expected publication requirements so there are systems where quality requirements also apply. By defining the qualitative criterion in addition to the quantitative criteria, institutions encourage researchers to actively publish as many articles as possible in well-known and cited journals. Thus, for example, publications in highly regarded international journals (such as Science or Nature) may exempt authors from meeting additional requirements (Jingning, 2013).

Researchers try to maximize their own position along two pillars. One of these is the educational pillar, which also includes gaining individual recognition received for the practical use of knowledge, while the other is the scientific pillar. In his research, Martins (1998) came to the conclusion that the primary factors contributing to advancement were publications and scientific achievements. It is also worth emphasizing here that publications and research grants and projects awarded cannot only determine the individual level of researchers, but they also greatly influence the profile and reputation of the entire department, faculty or institution (Van Eck Peluchette and Jeanquart, 2000). The requirement of publication is a generally accepted practice in the promotion system. Although these systems tend to highlight publications, the real requirements are mostly the number of references given to articles and how widely those articles are read. The case of the Nigerian promotion system is an interesting example to demonstrate the importance of publishing in internationally recognized journals, as for a successful full professor application, up to 10% of the total publication activity of a researcher is required to be performed in international journals (Adomi and Mordi, 2003). It is important to note here that researchers need to follow new global publication models including institutional repositories and open access publishing (Rowlands and Nicholas, 2006).

The work of researchers is international and not limited to the local level. The publications written are therefore intended to reach out for an international readership and their value depends on their ability to capture its interest. It has become a top priority for institutions and it is also required from their researchers and lecturers because, as a result of individual publications, the institutions themselves also gain an international reputation. An advantage of international publishing is that authors are less able to influence the reviewing and publishing process, which also ensures a much higher standard (Creamer, 1998; Mordi, 2002). Of course, the requirement for international publication leaves room for the problems of central and peripheral countries because, while most journals and publishers operate in the developed world and authors from such countries derive a positional advantage and linguistic advantage from it, their peers from less developed, peripheral countries have to overcome these obstacles. International publication also diminishes the value of local journals as authors try to publish their best results in central, internationally-accepted journals, and their own domestic and local journals can carry less real value. This creates the centrifugal, virtuous circle that Garfield (1977) wrote about.

Many types of promotion systems are known (Phelan and Lin, 2001) such as

1. systems based on absolute merit,
2. systems based on relative merit,
3. systems based on seniority,
4. or 'up-or-out' systems.

Each of these systems measures based on different performance, while the first formulates specific requirements and, if a researcher fulfils them, then they are promoted, the system based on relative merit compares the researchers to one another. These schemes are preferred in countries where researchers are looked for certain pre-advertised vacancies. The "up-or-out" system, in turn, says that a scientific career is embedded in a forward-looking system where only a particular researcher can move upward, thus making it similar to the military. In such systems, if a researcher does not step up, they will be dropped out of the system.

The existence of various scenarios in academic career also highlights that individual institutions rationalize and limit opportunities and alternatives for their researchers in accordance with their available resources, thereby increasing the occurrence of different patterns of behaviour (Arthur and Rousseau, 1996; Baruch and Hall, 2004). These scenarios are thus images shaped by institutional values and norms that researchers set up for themselves, thinking about their opportunities and scientific careers. These scenarios therefore largely reflect the environmental and material conditions available for the institutions, and as such do not only reflect the choices and motivations of researchers.

There are basically three general scenarios in a researcher career as listed in a French study (Dany et al., 2011):

1. the 'Star Researcher',
2. the 'Outstanding Lecturer',
3. and 'Local Manager'.

The 'Star Researchers' draw their reputation capital from their scientific work. Unlike the 'Outstanding Lecturers', they are not expected to perform high quality education or administrative and managerial work, which is a "waste of their talent" from their point of view. Those who follow the scenario of the 'Outstanding Lecturer' do not need to perform outstanding scientific work, they are required to show excellence at teaching, covering both education management and administrative tasks. The category of the 'Local Manager' includes lecturers close to their retirement age who take responsibility for the proper functioning of their institution.

It is important to note that the publications have become a currency in scientific communities and researchers try to maximize their research output accordingly (Bu et al., 2018). Kaptay (2020) investigated the question of the value of co-authorship, introducing the "k-index" instead of the h-index. He pointed out that the k-index can measure the individual scientific excellence in better way, taking into account partial citations for each author in a multi-authored paper. However, he also pointed out that researchers who do not benefit from these opportunities due to the scarcity of resources in their country or institution, find it much more difficult to assert themselves in the international system. This is also shown by the phenomenon of "publish or perish" and the Matthew effect. Accordingly, the environmental and material conditions of the primary institution are essential factors and conditions for a successful academic career. These factors also have a significant impact on the quantitative and qualitative indicators of publications written by researchers. With respect to the publication habits, we should emphasize here the phenomenon of "publish or perish" that pushes professors towards manipulation and bias, while at the same time can be prone to torture. The pressure caused by "publish or perish" and the "cult of productivity" encourage bias and hacking in publishing, or even conducting the research itself (e.g. data collection procedure) (Kiai, 2019; Hedding, 2019).

Achieving each step in the promotion system motivates researchers primarily for scientific work (Tien, 2008). This process also assumes that

measuring and achieving explicitly articulated requirements are dimensions that serve participation in scientific research and increase the number of scientific publications and productivity. At the same time, individual researchers socialize into different cultures according to their discipline and institution. While representatives of STEM (science, technology, engineering, mathematics) prefer to place their publications in international journals, representatives of the humanities are more driven to writing books, and social scientists can be found between the two ends of the spectrum (Sasvári et al., 2020). A high proportion of STEM representatives is motivated to increase their scientific productivity for promotion (Smith et al., 2013).

On the other hand, the personal motivations observed cover a wide range: increasing personal benefit, growth in reputation, recognition by students, promotion in the university hierarchy, exhaustion of curiosity, search for scientific challenges, becoming an outstanding figure in the field of research (Vroom, 1964; Csikszentmihalyi, 1988; Tuckman, 1976; Hunter and Kuh, 1987; Butler and Cantrell, 1989; Tien, 2000);

3. A multi-stage formalized model in Hungary

Promotion systems across Europe fall into three models depending on the extent to which they offer formalized and institutionalized systems (Kochen and Himmel, 2000).

- The first model includes countries where there are no regulations at all, so there is no promotion system. Nor can we talk about a formalized scientific career in these countries, which includes Israel, and to some extent Spain follows suit, although competitions are held in these two countries.
- The countries belonging to the second model lead to full professorship by a few steps, here submitting a thesis, previous research and publication performance are all decisive. This model includes most European countries: the Netherlands, Norway, Denmark, Estonia, Iceland, Ireland, Poland, Portugal, Slovenia, Sweden, Turkey and the United Kingdom.
- The third model offers a comprehensive, multi-stage formalized promotion system with a particular emphasis on habilitation. In this system, educational experience and research as well as publication performance also come to the forefront. These include Austria, Belgium, Croatia, the Czech Republic, Finland, Germany, Greece, Hungary, Italy, Slovakia and Switzerland.

In Hungary, education takes place in accordance with the Bologna system, where a three-year-long bachelor's degree is followed by a two-year-long master's degree, except for some undivided five-year-long courses for certain professions. Undergraduate training is followed by PhD studies, which take place in doctoral schools organized and maintained by Hungarian universities. In doctoral schools, under the guidance of lecturers, students acquire the knowledge needed for independent research in an institutionalized form of a research workshop. PhD studies usually last four years, the first two years are the phase of training and research (1–4 semesters), the second two years are the phase of research and dissertation (5–8 semesters). The PhD degree is obtained on the basis of the system of requirements set by the university responsible for organizing the PhD course.

5 years after obtaining the PhD degree, the next step in the promotion system is habilitation. It is a complex process organized by a particular university, focusing primarily on independent educational skills. The habilitation procedure includes the habitus examination, lessons and lectures given in Hungarian and foreign languages. The successfully habilitated applicant thus acquires the right to freely announce a course. Habilitation is a mandatory step before becoming a university full professor.

The culmination of a higher education career is full professorship which can be obtained after the procedure and award of the Hungarian Accreditation Committee on the basis of the recommendation of the

universities. The qualification process for full professorship has undergone significant changes in recent years (Sasvári and Urbanovics, 2019; Sasvári et al., 2020).

In addition to the promotion system designated by higher education institutions, the system created by the Hungarian Academy of Sciences (HAS) can be climbed as a second pyramid. Before the introduction of PhD degrees, the Hungarian Academy of Sciences also awarded the title of candidate (this is no longer relevant), followed by the doctoral degree of the Hungarian Academy of Sciences (DsC). In many universities, especially in the technical faculties, obtaining the title of Doctor of the Hungarian Academy of Sciences is also a prerequisite for becoming a university full professor. The highest academic title that can be awarded by the Hungarian Academy of Sciences is called Member of the Academy of Sciences.

4. Methodology

The advantage of the Hungarian multi-stage system is that it formulates precise requirements for promotion, along which researchers can shape their scientific activities. This defines a kind of career path among the university professors involved in the study, where the typical publication strategies and additional 'cultural' values of the disciplines and scientific fields also prevail. Before presenting the results of the empirical research, it is important to note that, since the sample is not normally distributed, we worked with medians instead of calculating means. Our total sample size was 327, of which two university professors active in the field of theology were not taken into account due to lack of representativeness. The data required for the empirical research were extracted from the Database of Hungarian Scientific Works (MTMT2). Publication in internationally listed journals ranked by the Scimago Journal Ranking (SJR) is emphasized in the research. The SJR system classifies journals into quality categories according to their citation and other indicators. Based on this, the top 25% (Q1), top 25–50% (Q2), 50–75% (Q3) categories, while the lower 25% (Q4) categories are formed. The regulations on university professor applications prioritises Q1 and Q2 articles and sets out minimum publication requirements for them in all disciplines. In terms of publishing, we make a distinction between key authorial roles. These are single, first, last and correspondent authorships. The first author is traditionally the most active researcher in the operational part of the research, the last author is usually the workshop leader or senior researcher, while the correspondent author is responsible for being in contact and administering with the publisher. These authorial roles are also given attention to in regulations on university professor applications, which is why we take them into consideration separately in our analysis.

In our study, a book is considered to be a piece of work when a minimum of 112 pages (following the definition of the Hungarian Academy of Sciences) is written by an individual author, and a further distinction is made between Hungarian and foreign language publications. The Kruskal-Wallis test has been carried out in the case of both journal articles and books, until obtaining the PhD degree, until the habilitation and until the promotion of full professorship in each discipline. The Kruskal-Wallis test (sometimes also called the "one-way ANOVA on ranks") is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable. In every case – as can be observed also in the table – we can state that the differences are not random, but coming from the nature of the given discipline.

5. Research results

Figure 1 shows the number of years elapsed to each degree among the representatives of different disciplines. In addition to absolute numbers, more interesting results are given by comparing the disciplines. We can observe that while the relative largest differences in the number of years

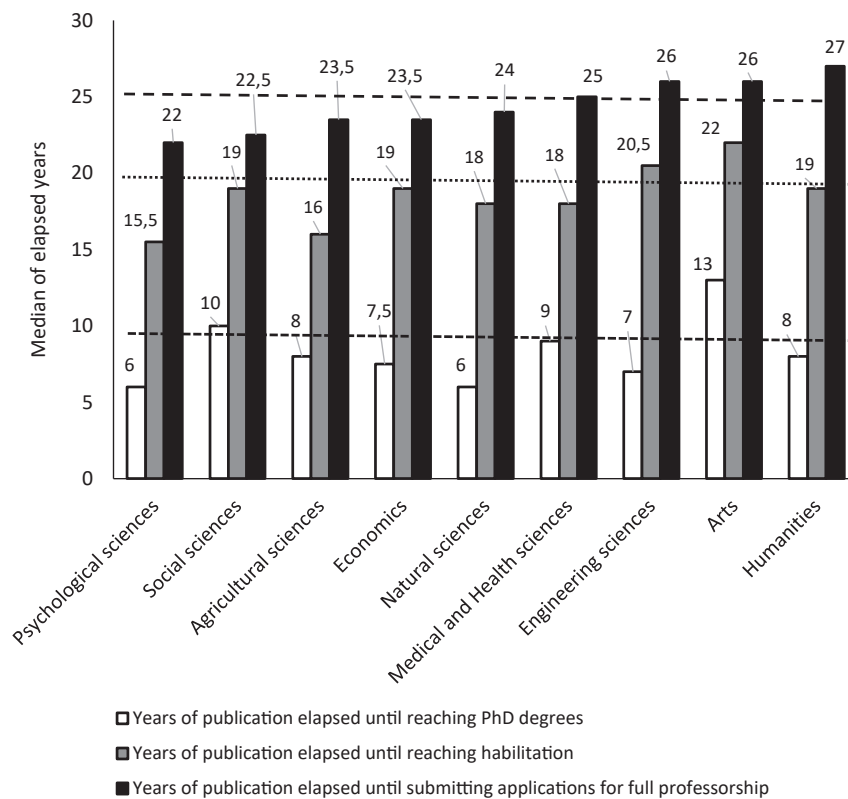


Figure 1. Median of years to reach certain degrees per capita by discipline. Source: MTMT, Doktori.hu.

spent to obtain a PhD degree appear, they disappear along the way to be appointed to become a university full professor and show a better convergence in terms of disciplines. The long career of the arts in comparison with the others and the relatively short career of the field of psychology are outstanding. However, there are also areas that show a significant change in the number of years elapsed between each degree. In the field of social sciences, it takes several years to obtain a PhD degree (10 years), after which habilitation is also one of the longer ones (19 years), while reaching university full professorship proves to be one of the shorter periods (22.5 years). The humanities show the opposite, where it takes 8 years to obtain a PhD degree, after which reaching university full professorship takes the longest time with 27 years. Economics and engineering sciences are characterized by shorter PhDs and then a longer period of reaching habilitation; Medical and health sciences catch up with other disciplines after a longer period of reaching a PhD degree, while a shorter period to reach a PhD degree in natural sciences becomes longer during the course of further promotion. It is clear that the number of years elapsed until reaching full professorship is balanced between disciplines, with a maximum difference of 5 years and a maximum difference of 7 years between PhD degrees.

Figure 2 confirms the results of our previous publication in *Statistikai Szemle* (Statistical Review), in which we explained that significant differences can be observed between Hungarian researchers who were appointed to be university full professors in the last 3 years in terms of writing internationally indexed publications. There is a gap between STEM and HASS (Humanities, arts, and social sciences). Figure 2 also highlights this gap as researchers in the arts and humanities, social sciences and economics have a small number of internationally listed publications (Q1-Q4 according to SJR), while researchers in other disciplines abound.

In the first group, the field of art is not at all typical of writing such publications, while in the field of social sciences, university full professors have one (1 piece). In the case of researchers in the humanities and economics, such publications are already present during habilitation

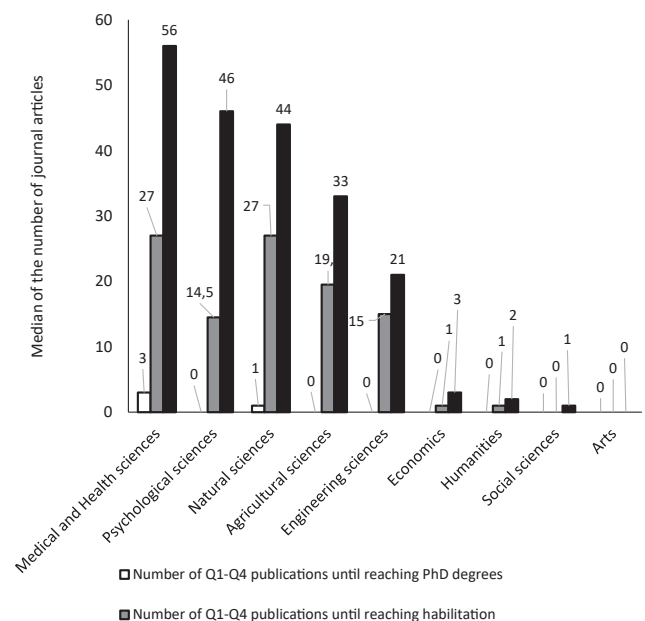


Figure 2. Median number of articles Q1-Q4 per capita by degree and discipline. Source: MTMT, Doktori.hu.

(1-1 pieces), and university full professors typically have them (2 pieces in the case of the former, 3 pieces in the case of the latter).

Within the more active group in terms of international publications, it seems that until the PhD degree, writing of such publications is not typical among the representatives of engineering, psychological and agricultural sciences. Until the habilitation, the leading role is played by medical and health sciences and natural sciences (27-27 pieces), while among university full professors the ranking of disciplines is medical and

health sciences (56 pieces), psychological sciences (46 pieces) and natural sciences (44 pieces). It is worth highlighting the period passing between the habilitation and university full professorship in psychological sciences, the most shocking change can be found here compared to other disciplines.

Table 1 examines the evolution of the Q1-Q4 indexed publications analyzed above in terms of disciplines and individual degrees. Until the PhD degree, only researchers in medical and health sciences typically write such a paper (1 piece of Q1 article). It is noteworthy that they, in turn, immediately target Q1 articles. Until the habilitation is obtained, the researchers involved in the study show a more colorful picture. The disciplines classified in the second group above, humanities, economics, social sciences, and the arts are still shown with no publications, while the disciplines classified in the first group above already show some activity. Among them, we can also distinguish smaller groups in terms of which Q-rated publications are preferred. Of course, all researchers strive for writing Q1 publications but there are disciplines that also seem to motivate it. Advocates for the dominance of Q1 publications include medical and health sciences (15 Q1 and 8 other ranked articles) and natural sciences (20 Q1 and 9 other ranked articles).

Table 2 shows the number of authors specific to the disciplines. In terms of collective authorship, the individual disciplines are also divisive but in general it can be said that where larger Q1-Q4 publication numbers can be found, authors prefer to work in smaller or larger groups. We can see that in the case of humanities, single authorship dominates at the level of all degrees, while in the field of social sciences, single authorship starts spreading only after obtaining a PhD degree, they work in pairs until reaching a PhD degree. Among the more active disciplines in terms of international publication, medium-sized groups of authors can be found in engineering sciences (3 authors), agricultural sciences (4–5 authors) and psychological sciences (4–5 authors). Larger groups are typical of medical and health sciences (6–8 authors) and natural sciences (5–9 authors). The largest grouping is shown by natural sciences. It is also interesting because, on the one hand, larger groups promote higher productivity (since one article requires less energy investment from an individual author), on the other hand, they raise the role of senior professors in creating workshops. In addition to this, they also play a role in the evaluation of publications, with respect to key authorial roles.

Table 3 shows the distribution of Q1-Q4 publications over the career path in each discipline. A total of 9,566 publications were included in the

Table 1. Median of Q1-Q4 articles per capita by quartile, degree, and discipline.

Discipline	Until reaching PhD degrees				Until reaching habilitation				Until reaching full professorship					
	Quartile	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Agricultural sciences	Person	Valid	7	7	7	7	8	8	8	8	10	10	10	10
		Missing	3	3	3	3	2	2	2	2	0	0	0	0
	Median (pcs)	0.0	0.0	0.0	0.0	4.0	3.0	5.0	1.5	9.5	7.5	8.0	6.0	
	Average value (pcs)	1.4	0.4	0.1	0.1	5.3	3.9	4.4	2.5	9.0	8.0	9.6	6.4	
Humanities	Person	Valid	29	29	29	29	29	29	29	39	39	39	39	
		Missing	10	10	10	10	10	10	10	0	0	0	0	
	Median (pcs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.00	
	Average value (pcs)	0.0	0.1	0.0	0.1	1.0	0.7	0.1	0.9	2.3	1.3	1.1	1.5	
Economics	Person	Valid	32	32	32	32	33	33	33	33	34	34	34	34
		Missing	2	2	2	2	1	1	1	1	0	0	0	0
	Median (pcs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	0.0	
	Average value (pcs)	0.1	0.0	0.0	0.1	0.9	0.7	1.0	0.5	1.8	1.4	1.5	0.8	
Engineering sciences	Person	Valid	19	19	19	19	18	18	18	18	21	21	21	21
		Missing	2	2	2	2	3	3	3	3	0	0	0	0
	Median (pcs)	0.0	0.0	0.0	0.0	5.5	5.0	2.0	1.0	8.0	6.0	3.0	1.0	
	Average value (pcs)	0.4	0.2	0.4	0.3	8.2	4.9	3.2	2.2	13.1	6.5	3.9	2.5	
Arts	Person	Valid	31	31	31	31	31	31	31	36	36	36	36	
		Missing	5	5	5	5	5	5	5	0	0	0	0	
	Median (pcs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Average value (pcs)	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.1	0.0	0.3	0.1	
Medical and Health sciences	Person	Valid	65	65	65	65	59	59	59	59	69	69	69	69
		Missing	4	4	4	4	10	10	10	10	0	0	0	0
	Median (pcs)	1.0	0.0	0.0	0.0	15.0	4.0	3.0	1.0	27.0	10.0	7.0	3.0	
	Average value (pcs)	3.2	1.1	1.3	0.8	20.2	6.3	5.8	2.7	30.7	12.9	9.5	4.9	
Psychological sciences	Person	Valid	11	11	11	11	10	10	10	10	11	11	11	11
		Missing	0	0	0	0	1	1	1	1	0	0	0	0
	Median (pcs)	0.0	0.0	0.0	0.0	6.0	3.0	1.5	2.5	20.0	9.0	6.0	7.0	
	Average value (pcs)	0.8	0.5	0.3	0.6	8.2	4.4	2.7	4.1	21.5	9.5	7.4	8.5	
Social sciences	Person	Valid	47	47	47	47	45	45	45	45	50	50	50	50
		Missing	3	3	3	3	5	5	5	5	0	0	0	0
	Median (pcs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Average value (pcs)	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.5	0.4	0.1	0.4	0.8	
Natural sciences	Person	Valid	51	51	51	51	45	45	45	45	55	55	55	55
		Missing	4	4	4	4	10	10	10	10	0	0	0	0
	Median (pcs)	0.0	0.0	0.0	0.0	20.0	5.0	3.0	1.0	26.0	9.0	4.0	1.0	
	Average value (pcs)	2.1	0.6	0.4	0.1	32.6	7.9	3.9	1.4	46.3	11.4	5.6	1.8	

Source: MTMT.

Table 2. Median number of (co-) authors of articles Q1-Q4 for all publications by discipline and degree.

Stages/Discipline	Median/Number	Until reaching PhD	After PhD until reaching habilitation	After habilitation until reaching full professorship	After reaching full professorship
Agricultural sciences	Median number of (co-) authors	4	5	5	5
	Number of authors	3	5	6	6
	Number of publications	15	86	89	39
Humanities	Median number of (co-) authors	1	1	1	1
	Number of authors	5	10	16	9
	Number of publications	9	60	93	16
Economics	Median number of (co-) authors	1	2	4	5
	Number of authors	4	20	21	18
	Number of publications	4	87	66	48
Engineering sciences	Median number of (co-) authors	3	3	3	3
	Number of authors	7	17	14	15
	Number of publications	23	296	91	74
Medical and Health sciences	Median number of (co-) authors	6	7	8	8
	Number of authors	42	53	55	49
	Number of publications	417	1,570	1,152	567
Psychological sciences	Median number of (co-) authors	4	4	4	5
	Number of authors	5	10	9	10
	Number of publications	24	170	283	144
Social sciences	Median number of (co-) authors	2	1	1	1
	Number of authors	2	16	11	7
	Number of publications	4	44	20	12
Natural sciences	Median number of (co-) authors	5	5	7	9
	Number of authors	28	43	39	40
	Number of publications	169	1,802	1,118	689

Source: MTMT.

Table 3. Number of articles in Q1-Q4 and distribution by grade.

Stages/Discipline	Until reaching PhD		After PhD until reaching habilitation		After habilitation until reaching full professorship		After reaching full professorship		Total	
Agricultural sciences	15	6%	86	33%	114	44%	47	18%	262	100%
Humanities	9	5%	60	31%	101	52%	24	12%	194	100%
Economics	4	2%	87	40%	71	33%	56	26%	218	100%
Engineering sciences	23	5%	296	58%	92	18%	97	19%	508	100%
Medical and Health sciences	417	11%	1,570	41%	1,170	31%	633	17%	3,790	100%
Psychological sciences	24	4%	170	27%	283	45%	148	24%	625	100%
Social sciences	4	4%	44	49%	21	24%	20	22%	89	100%
Natural sciences	169	4%	1,802	46%	1,124	29%	785	20%	3,880	100%
Total	665	7%	4,115	43%	2,976	31%	1,810	19%	9,566	100%

Source: MTMT.

study, most of which were written by authors of natural sciences (3,880 pieces) and medical and health sciences (3,790 pieces). Researchers in the social sciences (89) and the humanities (194) are shown with the fewest publications.

The figure clearly shows the dynamics that characterize researchers in a given field of science. It is important to see when these authors are the most active as this is also shown by the most important motivational cornerstones. Apparently, the analyzed disciplines are divided into two groups, one of them reaches the highest publication activity after obtaining a PhD degree and the other reaches the highest publication

activity after the habilitation until reaching university full professorship. The most balanced picture is shown in economics after obtaining a PhD degree, decreasing steadily until after reaching university full professorship, and perhaps the most radical is observed in the case of engineering sciences, where activity in Q1-Q4 publications drops significantly after habilitation.

In terms of international publications, Q1 and Q2 articles have a distinct role as it is shown in Table 4. These are publications that are the pinnacle of the field and profession, and Q1-Q2 articles are required to be published according to the latest regulations on university professor

Table 4. Median number of articles per capita by discipline Q1 and Q2 by discipline and degree.

Discipline	Q1-Q2 journal articles written as a single, first and corresponding author until reaching PhD degrees		Q1-Q2 journal articles written as a single, first and corresponding author until reaching habilitation		Q1-Q2 journal articles written as a single, first and corresponding author until reaching full professorship	
	Median	Average value	Median	Average value	Median	Average value
Agricultural sciences	0.0	1.14	3.5	4.88	10.5	9.50
Humanities	0.0	0.17	0.0	1.62	1.0	3.38
Economics	0.0	0.06	0.0	1.24	1.0	2.35
Engineering sciences	0.0	0.47	8.0	9.56	11.0	15.24
Arts	0.0	0.00	0.0	0.06	0.0	0.06
Medical and Health sciences	1.0	1.58	8.0	10.92	15.0	18.04
Psychological sciences	0.0	0.73	7.5	6.60	19.0	18.55
Social sciences	0.0	0.00	0.0	0.33	0.0	0.52
Natural sciences	0.0	1.29	16.0	18.38	24.0	25.85

Source: MTMT.

applications (see more about it in Sasvári and Urbanovics, 2019). It is therefore worth examining publications with such a classification separately. In this respect, the picture that has reflected the results so far is also outlined. The dominance of STEM researchers is sharply evident. These publication numbers are also significant because they shed light on the role of collectives of authors. In terms of absolute publication numbers, researchers in medical and health sciences dominate, however, this advantage disappears when per capita publication numbers are examined. It shows publications in larger groups of authors, while authors in natural sciences and psychological sciences are better represented in terms of per capita publications. Authors of arts and social sciences have no Q1-Q2 publications until they are appointed to be university full professors, as a result, they are at the other end of the ranking.

In addition to journal publications, the other fundamental pillar of publication activities is book writing. It is important to emphasize that each discipline follows different proportions and weights between journal publications and books. While the areas of STEM dominate in terms of journal publications, especially internationally indexed Q1-Q4 publications, researchers in social sciences and humanities come to the fore in terms of book writing. The reason for this is examined by international and domestic research, but in general it can be said that it is explained by the nature of scientific research, the publishability of its results, and the 'cultural' and socialization peculiarities of the field.

Table 5 shows the median number of books by discipline and degree. We can see that in the case of arts, medical and health sciences, and natural sciences, book writing is not relevant at all. On the other hand, it has a prominent role in social sciences, where the authors already have one volume before reaching a PhD degree, then until the habilitation it is further increased with 6 Hungarian and 1 foreign language books, finally reaching the culmination at becoming a university full professor with 7 Hungarian and 1 volume written in a foreign language. Psychological sciences have a dual picture, on the one hand, they are outstanding in the publication of Q-rated articles, and on the other hand, unlike other fields of science in international publications, book writing is also present in publishing activities.

Figure 3 provides some summary and positioning of each discipline on the axes of international publications and book writing. It turns out that medical and health sciences, and natural sciences move exclusively along the axis of international publications, showing the dominance of Q-rated articles, while on the other axis, social sciences and humanities venture to similar extremes in book writing.

Figure 4 illustrates the development of Q1-Q4 publications as a function of the publication years among the more active disciplines in terms of international publications. With a polynomial fit, we can see the trends that researchers characterize throughout their careers, virtually outlining a career model. As a reference, we also indicated the

curves of all disciplines, peaking before habilitation. It also means that publication activity begins to fall after habilitation. In the three studied - and separately named - disciplines, it can be observed that the greatest activity is achieved by the researchers before or around habilitation. It is also reflected in the number of publications. Researchers in natural sciences reach their peak of activity sooner, after which their performance begins to decline. Researchers in medical and health sciences also reach the peak before habilitation, but much closer to it, and their performance maintains a similar intensity for a long time, while researchers in engineering sciences have the least steep curves. It can also be observed that there is less research work until reaching a PhD degree, then there is much more intensive research in the period between the PhD degree and habilitation. In the period between habilitation and full professorship, a rapid decline is observable among science practitioners, while after reaching full professorship, the intensity curve becomes as steep as in the case of the period before obtaining a PhD degree, albeit with a negative sign.

Figure 5 shows the development of the publication performance of prominent disciplines in the publication of books in terms of publication years. We can observe that in the case of book publications the peak can be made for the period before habilitation, which is also followed by the researchers in social sciences, economics and humanities.

6. Discussion

Generally speaking, the Hungarian phenomenon presented in our research does not differ essentially from some of the publication patterns experienced in Central and Eastern Europe: the criteria of international expectations are met to a more moderate extent and later in the scientific career (Hladchenko and Moed, 2021). In consideration with the fact that with the Bologna Agreement Hungary (and the region) has become part of the European Area of Higher Education (EAHE), structures and funding frameworks have been established that, for instance, allow student and lecturer mobility. There is a lagging behind, though, when it comes to the fact that through mobility among organizations that fit into these structures in the same way, students should see and visiting lecturers should educate the same level of quality of publication performance—now these are only controlled by institutional-level quality assurance.

In the longer term, it seems desirable that after structural integration, EAHE take steps with regard to regulations such as lecturer performance evaluation and career modelling. We can point out several levels of responsibility in this area:

- individual (lecturer) responsibility: lecturers who want to move competitively in the European space build and implement their own publication strategy according to a set of criteria that meet

Table 5. Median number of books per capita by discipline and degree.

Discipline	Book		Until reaching PhD		Until reaching habilitation		Until reaching full professorship	
			Minimum 112 pages	Minimum 112 foreign language pages	Minimum 112 pages	Minimum 112 foreign language pages	Minimum 112 pages	Minimum 112 foreign language pages
Agricultural sciences	Person	Valid	7	7	8	8	10	10
		Missing	3	3	2	2	0	0
	Median (pcs)		0.0	0.0	0.0	0.0	1.0	0.0
	Average value (pcs)		0.0	0.0	0.9	0.0	1.6	0.4
Humanities	Person	Valid	29	29	29	29	39	39
		Missing	10	10	10	10	0	0
	Median (pcs)		0.0	0.0	3.0	0.0	6.0	1.0
	Average value (pcs)		0.8	0.2	4.7	0.9	7.5	2.1
Economics	Person	Valid	32	32	33	33	34	34
		Missing	2	2	1	1	0	0
	Median (pcs)		0.0	0.0	2.0	0.0	2.5	0.0
	Average value (pcs)		0.5	0.1	3.2	0.5	4.3	0.9
Engineering sciences	Person	Valid	19	19	18	18	21	21
		Missing	2	2	3	3	0	0
	Median (pcs)		0.0	0.0	0.5	0.0	0.0	0.0
	Average value (pcs)		0.1	0.1	0.8	0.4	1.0	0.5
Arts	Person	Valid	31	31	31	31	36	36
		Missing	5	5	5	5	0	0
	Median (pcs)		0.0	0.0	0.0	0.0	0.0	0.0
	Average value (pcs)		0.4	0.0	1.1	0.4	1.1	0.4
Medical and Health sciences	Person	Valid	65	65	59	59	69	69
		Missing	4	4	10	10	0	0
	Median (pcs)		0.0	0.0	0.0	0.0	0.0	0.0
	Average value (pcs)		0.0	0.0	0.4	0.1	0.5	0.1
Psychological sciences	Person	Valid	11	11	10	10	11	11
		Missing	0	0	1	1	0	0
	Median (pcs)		0.0	0.0	1.5	0.0	2.0	0.0
	Average value (pcs)		0.6	0.0	1.7	0.0	3.3	0.4
Social sciences	Person	Valid	47	47	45	45	50	50
		Missing	3	3	5	5	0	0
	Median (pcs)		1.0	0.0	6.0	1.0	7.0	1.0
	Average value (pcs)		1.6	0.2	6.6	1.1	9.2	1.8
Natural sciences	Person	Valid	51	51	45	45	55	55
		Missing	4	4	10	10	0	0
	Median (pcs)		0.0	0.0	0.0	0.0	0.0	0.0
	Average value (pcs)		0.1	0.0	1.1	0.3	1.4	0.4

Source: MTMT.

international standards (this is already the case to achieve success in international competitions);

- higher education institutions consciously develop career models and performance evaluation systems that provide (nearly) identical performance standards;
- national higher education policies adapt and require performance measurement and evaluation at a national level according to international standards, they use appropriate systems for obtaining scientific degrees and titles, and application criteria; finally
- they introduce “catching-up” incentives in the transnational space—for example in mobility, or in the matter, for example, that in

international accreditations and university rankings not only should the cumulative institutional performance based on international publication standards be taken into account, but also, for example, the existence and consistent application of systems (which reflect international quality standards) that promote them.

However, in this process of change, it is necessary to assert a sort of tolerance factor: as long as the career of the younger generation needs to be consistently guided and managed according to this, the older generation, which have not built the necessary habits in their early stage of life, should only be challenged by a more moderate, mixed expectation system.

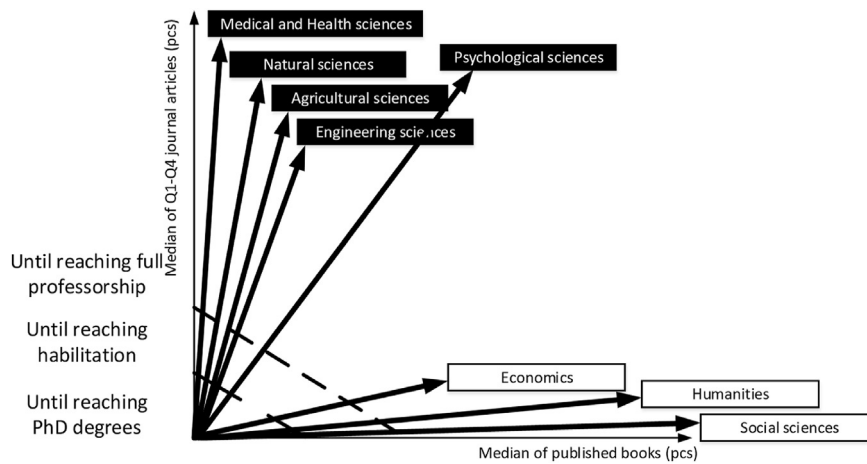


Figure 3. Publication strategies by discipline and degree. Source: MTMT.

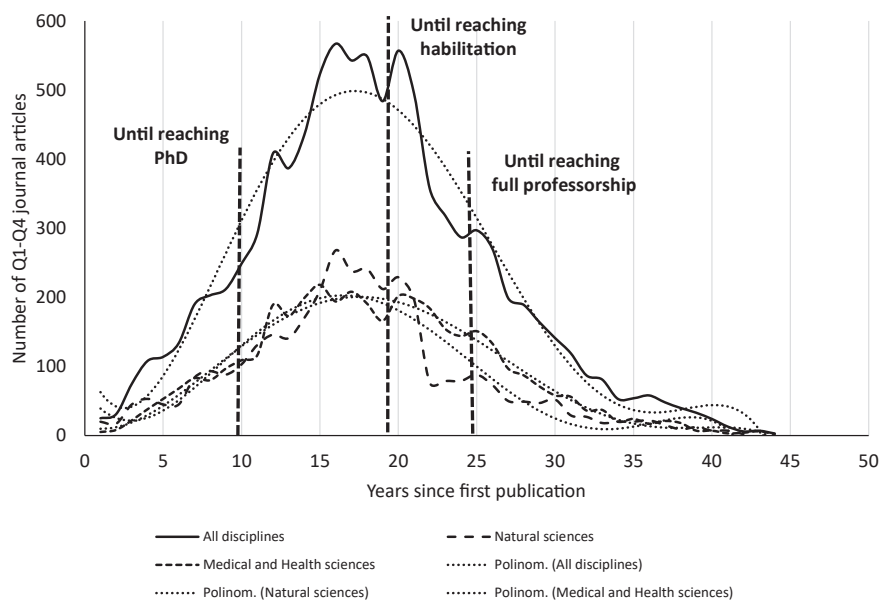


Figure 4. Change in the number of journal articles in Q1-Q4 as a function of publication years. Source: MTMT.

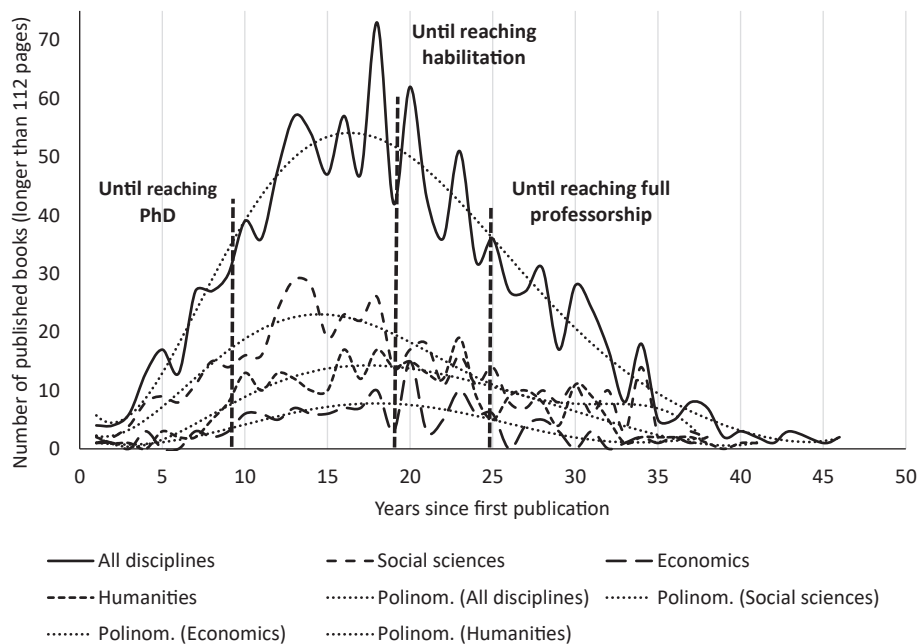


Figure 5. Change in the number of books as a function of publication years. Source: MTMT.

7. Conclusions

In the present study, we examined scientific promotion among the researchers appointed to be university full professors in the last 3 years. In Hungary, the multi-stage formalized promotion system defines a number of measurement points, making it easy to measure the performance of researchers. The total number of sample was 327, of which 325 were examined after purifying data. Our results show a large gap between STEM and HASS.

For researchers in STEM disciplines, the publication of internationally-listed, SJR-indexed publications is crucial. Before obtaining a PhD degree, only researchers in medical and health sciences write articles that are immediately ranked as Q1, while other disciplines are the most active in the following period until reaching habilitation. It is interesting to note that authors active in international publications prefer to work in smaller or larger groups, in this respect medical and health sciences are the largest (with groups of up to 9 authors). Although medical and health sciences dominate in terms of absolute numbers of publications over the entire career path, precisely because of these large collectives of authors, it is preceded by natural sciences and psychological sciences in terms of the number of publications per capita. Regarding international publications, STEM disciplines prefer Q1 publications, with particular emphasis on medical and health sciences, natural sciences, and psychological sciences. Authors in engineering sciences write both Q1 and Q2 articles, and in the case of agricultural sciences, the writing of Q3 articles is dominant. Of these areas, significant book writing activity can be found only in psychological sciences, in the case of the others it is not relevant. In general, their activity peaks before habilitation, a notable case being engineering sciences, where 58% of publications are written in a single well-defined period (after obtaining a PhD degree until habilitation).

In the field of HASS, quite different characteristics can be observed. Among these authors, internationally listed - SJR-indexed - publication is negligible or irrelevant, book writing dominates instead. It is important to note that this means books written in Hungarian that are usually published in Hungary. Q-rated publications can be found after reaching habilitation, mostly in the field of economics. HASS researchers are characterized by single authorship or smaller groups of authors. This can be partly attributed to the peculiarities of book writing. Researchers in the social sciences play a leading role in book writing, they already have a book before obtaining a PhD degree, and until reaching university full professorship, it will be expanded to 7 books written in Hungarian and 1 book written in a foreign language. In terms of their activity, authors in economics and social sciences are the most active until habilitation, while after habilitation, researchers in humanities show the most intense activity. Psychological sciences also show the peculiarities of HASS in terms of book writing, with 1.5 books until habilitation and 2 books until reaching university full professorship.

In terms of the career paths they offer, the disciplines show many similarities. The first period in each case is a PhD degree, in which economics, engineering sciences and natural sciences are shorter and the medical and health sciences longer. The period between habilitation and reaching full professorship shows a similarly diverse picture. The shortest time until becoming a university full professor is observable in psychological sciences and social sciences, and the longest is in engineering sciences, arts and humanities. It is worth noting that in STEM, especially in engineering sciences, the doctoral degree of the Hungarian Academy of Sciences is inserted before reaching university full professorship. However, it can be seen that while the differences in reaching a PhD degree are larger (maximum difference 7 years), the number of years until full professorship shows convergence in all disciplines (22 years–27 years; with a maximum difference of 5 years).

These peculiarities and the different stages of the promotion system should be kept in mind by everyone who is involved in scientific decision-making processes. Several milestones in the career of these full professors can be identified by mapping their publication performance at

these points. These milestones can be used to set up standard requirements in career tracks by taking into account the different disciplinary publication habits. It can be clearly seen that Hungarian researchers reach their peak of activity between reaching a PhD degree and habilitation, which emphasizes the importance of real scientific preparations during PhD courses.

Declarations

Author contribution statement

Peter Sasvari, Gyula Bakacsi, Anna Urbanovics: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

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