The gender pay gap among young academics

The role of precarious employment, childbearing and horizontal segregation

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Abstract

This research article investigates the impact of childbearing and horizontal segregation on income disparities among young academics in Hungary. Using a comprehensive, large-scale survey data set on the demographics and working conditions of academics in Hungary, this research highlights the precarious conditions in the Hungarian academic sector. The findings reveal that researchers and lecturers often rely on multiple sources of income and work extra hours to secure their livelihoods, creating a disadvantageous situation for women with young children, especially during the highly competitive early stages of their careers. The results suggest that the income differences between men and women are to a large extent explained by the so-called fatherhood wage premium and that horizontal gender segregation of the scientific fields has a significant effect on income disparities as well.

Keywords

academia, fatherhood premium, gender wage gap, income sources, segregation

In recent years, academic institutions worldwide have undergone significant changes, marked by the massification of education, the rise of fixed-term contracts, the scarcity of tenured positions and the prevalence of postdoctoral positions (Lynch and Ivancheva 2015; Bozzon et al. 2017; Busso and Rivetti 2014; Shaik and Fusulier 2015; Courtois and O'Keefe 2015). These changes highlight the precarious nature of employment in this field (Rotar 2022; Bozzon et al. 2017; Blackham 2020; Loveday 2018;

Courtois and O'Keefe 2015). Furthermore, academia has traditionally been a male-dominated profession, and the influx of more women has intensified the challenges related to balancing care work and career advancement (Bailyn 2003; Knights and Richards 2003; Ledin et al. 2007; Probert 2005; Ivancheva et al. 2019; Paksi et al. 2022). Numerous studies have identified institutional and extra-institutional barriers that impede women's academic careers; in particular, childbearing (Forster 2001; Hasse and Trentemøller 2008; Preston 2004; Mason and Goulden 2004; Fusulier and Nicole-Drancourt 2015) and segregation (Winslow 2010; Lee and Won 2014; Bain and Cummings 2000; Ochsenfeld 2014; Yang and Gao 2021; Lannert and Nagy 2019) have been identified as factors that impede women's career advancement.

This article aims to analyse how precarious conditions and gender roles contribute to the gender pay gap in Hungarian academia. To address this research objective, we conducted a comprehensive, large-scale quantitative study utilising data on the demographics and working conditions of academics in Hungary aged under 45. Our results highlight the prevalence of precarious conditions in the Hungarian academic sector, with researchers and lecturers relying on multiple sources of income and working extra hours to ensure their livelihoods. Analysing the gender wage gap, we find that having children affects men's and women's income differently; men experience a significant wage premium per child, but the income of women remains unaffected. We theorise that precarious conditions and tensions from childbearing incentivise men with children to supply excess work in secondary jobs and grant applications. In contrast, female academics with children experience a disadvantage in gaining such positions at a highly competitive stage of their career. In addition, horizontal segregation (the concentration of men and women in different scientific fields) appears to have a significant effect on income disparities as well; the gender ratio of a scientific field strongly correlates with obtainable income. Thus, the structural inequalities of masculinised and feminised fields augment income disparities between male and female academics.

In the subsequent section, we summarise the literature on precarious conditions in the academic field and present background information about Hungarian specificities. We then review studies on the gender pay gap in academia and the role of family-related responsibilities in the inequalities of career outcomes. Next, we present existing evidence on the phenomenon of segregation in scientific careers. In the third and fourth sections, we introduce our data set, the variables and the statistical methodology of our analysis. Then, we present the results and discuss the conclusions.

Literature

Precarity in academia

Traditionally, precarious work has been associated with low-skilled workers; however, it is now also associated with highly educated professionals (Blackham 2020; see also the Introduction to this Special Issue). In academia, precarious work is becoming more prevalent globally, with younger academics less protected from economic instability than their older tenured colleagues (Rotar 2022). This trend has been described as a consequence of 'new public management, marketization of knowledge in academia, and neo-liberalism' (Bozzon et al. 2017: 334). It is characterised by 'the decline in tenured positions; the increasingly volatile and internationalized funding context of universities, and a reliance on "soft" grant money; declining turnover among senior academic staff; and a desire to reduce employment costs in universities' (Blackham 2020: 429).

According to Kathleen Lynch and Mariya Ivancheva (2015), tenured positions are increasingly becoming the privilege of a minority of older and established academics. In the USA, the number of tenured positions has been declining since the 1970s, falling from 75 per cent in 1970 to 30 per cent in 2007. In Germany, the number of professors has remained the same while the number of students has increased. This increased demand has been met by hiring temporary faculty, whose number increased by over 45 per cent from 2000 to 2012. Similar trends are observed in Italy (Bozzon et al. 2017; Busso and Rivetti 2014) and in several other Western European countries (Shaik and Fusulier 2015).

Institutions that implement these changes aim to create a more competitive work environment to test and measure individual performance (Blackham 2020; Loveday 2018). The increased focus on research productivity incentivises established senior academics to outsource time-consuming and undervalued tasks to junior staff and graduate students, leading to the 'unbundling' of research and teaching responsibilities (Seymour 2022). This impedes the development of early career staff into 'well-rounded "modern academics", with an integrated portfolio of teaching, research, and leadership skills' (Blackham 2020: 431). These problems lead to lower morale and salaries, less autonomy, work intensification and decreased job security (Rotar 2022). For young and precarious staff, research is a 'labour of love' or an end in itself, and commitment is needed to counter their precarious situation (Bozzon et al. 2017; Busso and Rivetti 2014). As a result, precarious academics often do not openly reflect on the conflict between work and personal life. Precarisation also has emotional consequences, as young academics are unable to make plans, and do not have access to benefits provided to permanent staff, such as housing allowances and rental contracts (Lopes and Dewan 2015: 32). With the decline of permanent positions and the rise of temporary work, low pay and underemployment are no longer transitory and are not exclusively associated with younger academics (Courtois and O'Keefe 2015). Consequently, the employment prospects of precarious academics are likely to diminish before they can retire (Spina et al. 2022). The low financial value of university teaching and research positions also prompts academics to take on secondary jobs to supplement their salary as a lecturer or researcher (Engler et al. 2021).

The Hungarian setting

Hungary, as part of the Eastern Bloc, experienced forty-five years of the Soviet Union's influence on education and scientific activities. The Hungarian higher education system, following the Soviet pattern, exhibited characteristics such as centralised control, low participation rates and a strong emphasis on vocational training. Further, following the Soviet pattern, a network of research institutes was built up, parallel to the university system. However, significant changes occurred with Hungary's participation in the Bologna Process in 1999 and its accession to the European Union in 2004 (Pusztai et al. 2016). By the current time, the previous vocational and theoretical tracking has disappeared and has been fully replaced by the Bologna system at universities. Meanwhile, demand for higher education has risen. Between 1990 and 2003, the number of higher education students quadrupled, and the student-to-teacher ratio increased from 5.9 to 16.5, an increase of more than two and a half times (Pusztai and Szabó 2008).

However, the Hungarian multistage academic system offers an advantage by providing clear promotion requirements that guide researchers in shaping their scientific activities, creating a defined career path where publication strategies and the additional 'cultural' values of disciplines and scientific fields play a significant role (Sasvari et al. 2022). Furthermore, at the time of the survey (2021), researchers and most university teachers still held public servant status in terms of their employment contracts and working conditions[1], which, in principle, limits discrimination.[2] However, academics in Hungary face low salaries, leaving them heavily dependent on secondary income sources like scholarships and funds, and many seek secondary employment within or outside academia, as emphasised by Deák (2015).

According to data from the European Commission Directorate-General for Research and Innovation (European Commission 2021), the proportion of women among doctoral graduates was slightly lower in Hungary (46.23 per cent) than the EU 27 average (48.10 per cent). In the higher education sector, the proportion of women researchers was 40.1 per cent in Hungary and 42.3 per cent in the EU 27. However, across EU countries, one of the most significant differences between women and men working part-time was found in Hungary. For female researchers, the highest proportions of employment under precarious contracts were found in Hungary (16.3 per cent; 9.0 per cent in EU 27).

The gender pay gap in academia

Shaik and Fusulier (2015) reported that female scientists earned significantly less than their male counterparts in each of the seven EU countries studied. They found that in some countries this was due to a higher share of women in fixed or part-time positions (the Netherlands, Belgium and Switzerland). In others, such as Italy, the gender pay gap disappeared after controlling for the field of specialisation and part-time jobs. Other studies have similarly reported that the gender pay gap in academia significantly decreases, or even disappears, when observable characteristics of rank and scientific field are controlled for (Humphries et al. 2023; Chen and Crown 2019). Paul Umbach (2007) found that after controlling for discipline, female faculty earned 10 per cent less than their male counterparts. While faculty members in science, engineering and mathematics (SEM) earned higher salaries than those in non-SEM fields, women in both groups earned less than men (Kelly and Grant 2012).

One might expect that gender disparities would decrease in public universities with more regulated compensation policies, compared to private ones. The findings of Meltem Ucal and associates (2015) support this hypothesis, as they observed a significant wage gap in Turkish private universities, but no significant differences in public ones. Relatedly, less regulated elements of compensation policies, such as bonuses, have been associated with higher gender differences (Bailey et al. 2016).

Besides salaries and bonuses from employment, other important sources of income for academics are grants and scholarships. Although the evaluation of science is generally assumed to be a purely meritocratic system, a recent study by Sayako Sato and associates (2021) reviewed existing literature on gender differences in grant funding and reported that many grant-specific case-like studies have found male favouritism in peer review of grant funding. Maria Caprile and associates (2012) concluded that although women have lower application rates, they generally do not have lower success rates than their male colleagues. They found that women do not obtain prestigious research awards to the same extent as their male colleagues and have higher success rates when applying for small research grants.

Finally, in the Hungarian academic sector, Németh and associates (2023) uncovered significant income disparities between men and women, despite academics holding a public servant status that comes with salaries determined by a uniform scale, theoretically eliminating potential bias in compensation. To address this apparent paradox, in this study we aim to deconstruct this wage gap and examine various income sources. We assume that:

> Hypothesis 1: The gender wage gap in Hungary originates mostly from the income from grants and not from the salary of the main job.

Care work: family vs career

An apparent explanation for gender differences in academic careers and wages is the unequal distribution of family-related burdens between men and women that hinders the progression of female academics. Some of the women in Nick Forster's (2001) study in the UK reported that they had opted to put their careers on hold because of domestic and family responsibilities. A few had resigned themselves to never achieving senior positions because of these commitments. Mary Ann Mason and Marc Goulden (2004) concluded that men with children early in their academic careers are 38 per cent more likely to achieve tenure than women in the same situation.

Numerous scholars have highlighted the conflicts between family responsibilities and the gendered structure of the academic career path

(Bailyn 2003; Knights and Richards 2003; Ledin et al. 2007; Probert 2005). The heightened pressures within an academic career align precisely with the period in which individuals consider starting a family. Consequently, the increased competitive pressures in academia tend to exacerbate the difficulties faced by women, confronting them with an exclusive option (Fuchs et al. 2001; Lind 2008), especially in a context where women bear primary responsibility for caregiving and household tasks (Fusulier and Nicole-Drancourt 2015).

The management of care work and the division of roles within couples, therefore, emerge as two crucial factors. Pierre Bataille and associates (2017) have shown that the aspirations of postdocs to remain in academic employment are directly related to their position within the domestic division of labour and to their combined employment and family-care aspirations. Stefania Albanesi and Claudia Olivetti (2009) showed that equilibria in which women have higher home hours and consequently lower earnings are possible even without pre-existing gender differences. Conversely, equilibria wherein men have higher home hours and lower earnings are also possible, highlighting the incentive problems in the labour market.

Furthermore, Mariya Ivancheva and associates (2019) emphasise that the intersectionality of paid work and care work originates in a globalised academic market, which is characterised by ideals of competitive performance, 24/7 work expectations and geographical mobility. These expectations shape the model of an ideal researcher, which eventually leads women to postpone the time of founding a family (Paksi et al. 2022). Scholars who deviate from these norms often experience labour-led contractual precarity and are over-represented in fixed-term and part-time positions, while fixed-term contracts were found to create traps and profound disadvantages (Bryson 2004). Conversely, one argument posits that part-time and flexible employment provides female academics with additional prospects to enter the labour market while balancing their commitments and childcare responsibilities. Proponents argue that the positive aspects of part-time and fixed-term contracts, supported by favourable policies (Simkin and Hillage 1992), enable women academics to choose fewer working hours voluntarily and attain greater flexibility in managing their workload. Evidence suggests that non-standard contracts are not exclusively preferred by female academics (Gallie et al. 1998); however, relative to men, women neither gain nor perceive any comparative benefits from fixed-term contracts as opposed to open-ended contracts, according to Bryson (2004).

Overall, and for female researchers in particular, balancing work and family responsibilities is a dilemma. In many cases, they resolve this predicament by either abandoning or suspending their careers or deciding against starting a family. A significant number of women leave academic careers after marriage and childbirth (Glover 2001; Ledin et al. 2007; Xie and Shauman 2003), primarily due to challenges in achieving a work–life balance (Forster 2001; Hasse and Trentemøller 2008; Preston 2004).

Consequently, mothers tend to earn less than their childless counterparts, while fathers tend to be paid more than men without children. These wage gaps are often referred to as the 'motherhood penalty' and the 'fatherhood premium', respectively (Glauber 2018). Kelly and Grant (2012) compared these differences in SEM (science, engineering and mathematics) and non-SEM fields. According to their findings, women earn less than men in SEM, regardless of family status. There is no significant difference between the wages of married and unmarried men (there is no fatherhood premium), and the gap between married and unmarried women is small. In contrast, in non-SEM fields, all groups – except single fathers – earn less than the reference group of married fathers. The findings of Xiang Zheng and associates (2022) show that in the North American academic setting, both the 'motherhood penalty' and the 'fatherhood premium' are associated with gender differences in objective career achievements.

It is evident that childbearing and care work play a significant role in the situation of early-career women academics concerning career progression, tenure attainment, contractual precarity, attrition rates and income. Moreover, the postdoctoral and early career phases are critical for establishing a scientific career, coinciding with the period when individuals often begin to form families. The division of household roles during this period significantly impacts career outcomes. Based on these findings, we propose the following hypothesis:

> Hypothesis 2: The gender wage gap in Hungary applies to those who have children.

Segregation

Gender segregation refers to the tendency of women and men to work in different professional categories. There are two types of occupational segregation: Vertical segregation (commonly known as the glass ceiling) 'refers to the under (over) representation of a clearly identifiable group of workers in occupations or sectors at the top of an order based on "desirable" attributes – income, prestige, job stability, etc. – independent of the sector of activity' (European Commission 2009: 32). Horizontal segregation is understood as under- or over-representation of a certain group in occupations or sectors not ordered by any criterion, that is, the concentration of women and men in professions or sectors of economic activity (European Commission 2009).

In EU countries, women account for 34 per cent of the workforce in science (European Commission 2021). However, along the career ladder, the share of women sharply decreases. In Western European countries, for instance, when reaching the level of university professors, the share of women decreases to 5–10 per cent. Female researchers are more likely to be unemployed and, if employed, more likely to be in non-permanent positions. They are also more likely to be employed in non-research positions. Furthermore, even when employed in faculty positions, they spend more time teaching and less time researching than their male colleagues (Winslow 2010).

Vertical segregation was also found to be related to the wage gap. At the senior level (professors), the higher share of women was associated with a decreased wage gap, whereas the share of women among assistant professors was unrelated to the wage gap (Lee and Won 2014). A comparison of different countries revealed that the disadvantage of women in their career advancement was associated with societal factors, such as the empowerment of women in general, or the institutional traditions of the academic sector (e.g. the American system has a weaker glass ceiling effect). Still, a higher share of women in a field was also associated with their higher probability of achieving professorial rank (Bain and Cummings 2000).

Regarding horizontal segregation, Fabian Ochsenfeld (2014) finds that in Germany, the differences in the attractiveness of fields to students with a careerist approach explain most of the association between the discipline's gender composition and wage levels; they conclude that gendered patterns of self-selection that derive from men's socialisation into the breadwinner role underlie the association between fields' gender ratio and wage levels. Xueyan Yang and Chenzhuo Gao (2021) analysed the differences between the involvement of men and women in STEM fields. Similarly, they found that the social construction of gender roles (lower career expectations from parents and gender stereotypes from the culture) and the internalisation of traditional gender role attitudes negatively impacted women's achievement motivation in China.

In Hungary, despite the feminisation of higher education, segregation within the education system has endured. In 2012, a significant change took place in the state funding of higher education. Specifically, in the fields of economics, law and social sciences, the threshold for admission to state-funded places was significantly raised centrally, while in the fields of natural sciences, engineering and IT, it was lowered. In this way, the majors with a significant number of female students were practically made available for tuition fees, while more state-funded places have been provided in the majors with a male student base. For comparison, in 2016, 51.7 per cent of university students were women, with the highest female presence in the fields of teaching and educational sciences (77.3 per cent), while the lowest was in engineering (25.4 per cent) and IT (15.1 per cent) (Lannert and Nagy 2019). We expect that the horizontal gender segregation is related to the wage gap as well.

> Hypothesis 3: The income of Hungarian academics is lower in those fields where the participation rate of women is higher.

Looking at the funding situation of scientific fields in academia, in Norway, the tendency towards larger grant forms has been found to indirectly reinforce gender inequality by allocating most resources to fields, disciplines and subdisciplines with low female representation (Henningsen 2003). Similarly, in Sweden, a substantial portion of the funding that was formerly directed to scientific entities with a high female representation is now reallocated to research entities of excellence with more modest female representations, particularly in the fields of medicine, natural science and technology (Sandström et al. 2010). To examine the funding disparities from the perspective of horizontal segregation in Hungary, we form the following hypothesis:

> Hypothesis 4: The income differences between scientific fields originate from the income from grants and not from the salary of the main job.

Data

In our analysis, we use data from the survey initiated by the Academy of Young Researchers on the perspectives of young Hungarian scientists. The target population of the survey was Hungarian academics under the age of

45. To reach them, an online survey was conducted. Invitations were sent out by the Hungarian Academy of Sciences to all members of the public body of the Academy under the age of 45 (3,190 persons) and to all persons who defended their PhD after 1992 and gave active consent to receive science-related news. In addition, a Facebook campaign helped with the recruitment of respondents. The data collection was implemented by the TÁRKI Social Research Institute in September–October 2021.

The survey consisted of six blocks of multiple-choice questions: (1) demographics; (2) publication and grant application activities; (3) work, income and satisfaction; (4) international mobility; (5) professional relations; (6) the COVID-19 epidemic effect; and an open-ended text block on personal opinions. The questionnaire took almost forty minutes to complete. A total of 2,069 respondents started filling out the questionnaire. The number of completed responses was 1,219, of which we were able to analyse 1,135 after data cleaning.

A unique feature of the survey was that the responses were linked to the respondents' scientometric data. A total of 1,031 respondents gave their active consent to the anonymous linking of their scientometric data, based on their IDs in the Hungarian scientometric system (MTMT). Linking the data was possible for 1,009 individuals. For them, scientometric indicators such as the number of publications, citations and co-author network characteristics were calculated and linked to the survey database. This data was used as a control variable for the scientific success of this study. After linking the data, the data file was deposited to the 'Data Room' of the Centre for Economic and Regional Studies, providing a closed, secure on-site environment for analysing the survey.

The key distributions of the sample are displayed in Table 1. Regarding age, respondents were relatively evenly distributed across the 31–35, 36–40 and 40–45 age groups, with slightly fewer respondents under 30 years. There was a slight majority of men in the sample (55 per cent).[3] Most respondents worked in Budapest (54 per cent), while 46 per cent worked in other cities or towns. Respondents working abroad were excluded from the analysis. Classifying the respondents according to their full-time job, the largest proportion of respondents worked at a university, and about 25 per cent were employees of research institutes. Few respondents came from the corporate, government and medical spheres. In this study, the analysis focuses on the respondents with jobs at universities and research institutes. Most participants in the sample were at the assistant professor or research

Table 1. Key distributions of the sample.

	Sample
Age	
26–30	146 (13.3%)
31–35	315 (28.7%)
36–40	334 (30.4%)
41–45	303 (27.6%)
Total	1,098
Gender	
Male	603 (54.9%)
Female	495 (45.1%)
Total	1,098
Location	
Budapest	504 (53.6%)
Other towns	437 (46.4%)
Total	941

	N	%
Academic rank		
PhD Student	85	8.53
Assistant Lecturer/Junior Research Fellow	172	17.25
Assistant Prof/Research Fellow	470	47.14
Associate Prof/Senior Research Fellow	259	25.98
Full Professor/Scientific Advisor	11	1.10
Position in main job		
Subordinate	932	88.01
Manager	127	11.99
Type of workplace		
Research Institute	261	29.19
University	633	70.81

	Sample	
	man	woman
Number of children		
0	288	261
1	118	97
2	116	94
3	62	33
4	15	5
5	2	1
6	1	
Mean	1.02	0.83

fellow level (47 per cent), but many were associate professors or senior research fellows (26 per cent), assistant lecturers or junior research fellows (17 per cent) or doctoral students (9 per cent), and some university professors or scientific advisors also answered the questions. Most of the respondents were childless (~52 per cent), but there were also researchers with one (~19 per cent), two (~19 per cent) or more (~10 per cent) children. An independent-sample t-test revealed that on average, men in the sample had more children than women ($p = 0.0037$). Respondents were rather diverse with respect to their scientific fields, with most coming from biology (16 per cent), economics and law[4] (15 per cent) and engineering (11 per cent). The distributions according to the scientific field can be found in Table 7.

Table 7 also presents the comparison of the sample with the public body of the Hungarian Academy with respect to scientific field, age, and gender. It shows that women are slightly over-represented in the sample, together with the younger generation (under 30), who typically do not have a PhD yet and therefore are not members of the public body.

Table 2 provides further information on the relevant variables. It shows that Hungarian academics have a considerable amount of extra work. This is true in terms of the number of jobs, which is 1.41 on average, suggesting that many take a secondary job in addition to their positions at universities and research institutes. Furthermore, the average number of self-reported working hours per week is fifty-one, indicating that academics either work overtime on weekends or work more than ten hours on weekdays. Scientometric data shows that the median respondent had fifty-six citations, but its distribution is highly skewed. Because the citation counts vary significantly across fields and increase over time, to create a more reliable indicator of scholarly success, we normalised citation counts by field averages and by publication date, creating a normalised citation index (Table 2).

Table 2. Distribution of job and citation characteristics of the sample.

	Mean	**Standard deviation**	**N**	**5%**	**50%**	**95%**
Number of current jobs	1.41	0.76	1,104	1	1	3
Average working hours per week	51	13.9	1,057	30	50	70
Total citations	262.3	1173.2	772	1	56	910
Normalised Citation Index	52.2	134.4	781	1	22.5	170

Table 3. Income of academics.

	Mean	Std. Dev.	5%	50%	95%
Sum of income (HUF)	386,984.3	185,974.7	175,500	325,500	800,000
Share of income from main job (%)	66.53	32.78	0	75	100
Income from main job (HUF)	256,155.8	169,540.9	0	225,500	600,400
Share of income from grants, scholarships, private business (%)	15.37	24.15	0	0	70
Income from grants, scholarships, private business (HUF)	62,005.3	104,956.2	0	3,255	275,500
Share of income from secondary jobs (%)	8.69	16.83	0	0	48
Income from secondary jobs (HUF)	40,630.5	88,399.72	0	0	225,250

In the survey, regarding the total net monthly income of academics, response options with intervals were provided (rather than exact numbers) to ease the answer and thus increase the response rate. The distributions are displayed in Table 8. For simplicity and ease of interpretation, we transformed this categorical variable into numerical values by substituting each category by the middle of its range. The resulting estimated monthly net income has a mean of HUF 386,984, which is equal to about USD 1,290. The respondents had to indicate the distribution of their total income in percentage points across the different sources, including income from their main job, their secondary job and scholarships, grants and private business. We calculated the estimated income in each category by distributing the estimated total income according to these percentages (Table 3).

To take horizontal segregation into account, we calculated the proportion of women by scientific field using the public listings of the members of the public body of the Hungarian Academy by scientific fields, which are available on the Academy's website. Thus, it reflects the gender ratio of all academics, not just young ones. The results are displayed in Table 4, where significant horizontal segregation can be observed.

Table 4. Share of female academics in scientific fields.

Linguistics and Literature	52%
Philosophy and History	42%
Mathematics	18%
Agriculture	31%
Medical Sciences	31%
Engineering	13%
Chemistry	34%
Biology	37%
Economics and Law	33%
Earth Sciences	27%
Physics	14%

Statistical methodology

To assess the gender wage gap, we analysed wage regressions. These were linear regression models with income as the dependent variable and the characteristics of the individuals and the jobs as independent variables. Once the regressions include key characteristics of the jobs and individuals, the coefficients of the 'gender' variable signify the estimated wage gap between men and women who are similar in terms of the control variables included.

These control variables included academic rank, as in most cases, the base income of Hungarian academics is determined by rank. In addition, an indicator for being in a leader or manager position was added, as these roles are reflected in the wages. Age was also included in the model, which we measured on a category scale with five-year intervals. Workplace type was an indicator variable for whether the respondents worked at a research institute or at a university. The location of the workplace indicated whether the respondents worked in the capital or in another town. The normalised citation index was included as a control variable for scientific success, and dummy variables on the scientific field were included to control wage differences between fields. In addition, variables reflecting the number of jobs held, the number of hours worked and the type of job, whether part-time or full-time, were included in the different models.

To assess the hypotheses, we specified the models as follows: First, to establish a baseline model that assesses the gender wage gap, we specified a wage regression with total income as the dependent variable and gender and the above control variables as independent variables. To test Hypothesis 1, we examine two elements of income separately: income from the main job and income from grants, scholarships and private business. We ran the wage regressions separately on these dependent variables with the appropriate controls and compared the wage gap indicated by the coefficient of the gender variable.

Hypothesis 2 concerns the role of children in the gender wage gap. To address this question, we added an independent variable for the number of children and one on the interaction of 'gender = women' and the number of children. The coefficients of these indicate the 'impact' of having children for men and women respectively. Meanwhile, the coefficient of the gender variable indicates the size of the gender wage gap that remains after accounting for children; thus, it shows the wage gap between childless academics in this model.

Hypotheses 3 and 4 address the role of horizontal segregation in the gender wage gap. To analyse these, we included an independent variable on the share of men in the specific scientific fields in the regressions instead of the scientific field dummies.

Results

In Table 5, Model 1, we can see that, regarding total income, women earn HUF 48,222 less than men, which is a 12.46 per cent difference compared to the average total income of HUF 386,985. Someone not located in the capital earns HUF 61,528 less, and if they are in a managerial position, they earn HUF 75,738 more. One category of academic rank increases income by HUF 52,653, and one additional job brings in an additional HUF 63,143. Higher scientific performance in terms of citations is also associated with significantly higher income.

In Model 2, including the number of children and the interaction of gender and the number of children in the equation, the gender dimension becomes insignificant. Thus, we do not observe a statistically significant gender wage gap among childless academics. However, men earn an average wage premium of HUF 46,546 per child, and this premium is HUF 32,893 lower for women. Therefore, we conclude that the gender wage gap applies to those who have children (Hypothesis 2). If we exclude parental benefits from income, the men's wage premium is HUF 41,401 per child, and women experience a HUF 945 penalty per child. (The regression table for income without parental benefits is included in Table 11.)

In Models 3–4, we examine the income from the main job. Model 3 shows that there is no significant gender difference in the monthly salaries, and in Model 4, we can see that there is a slightly significant difference in income between those who have children and those who do not. The determinants of the income from the main job are the type of academic institution, the location of the workplace, academic rank, scientific performance, managerial position and whether the person has a part-time or a full-time contract.

Models 5 and 6 show the determinants of income from grants, scholarships and private business. We observe that women have on average HUF 31,681 less income than men (Model 5). Model 6 reveals that this gap applies to those who have children; men have a HUF 20,376 monthly income premium per child, HUF 19,635 more than women do. Thus, the results support our Hypothesis 1, that the gender wage gap originates from supplementary income sources, and not from the main jobs of academics (and Hypothesis 2, that it emerges in relation to academics with children).

Considering the control variables, scientific success contributes to higher income from the primary job and to higher income from grants, scholarships and private business. However, the coefficients for these two sources of income are different depending on the type of workplace; academics at universities earn less from their primary job and more from grants, scholarships and private business compared to employees of research institutes.

To assess the impact of horizontal segregation, in Table 6, we first consider our baseline specifications again those that were presented in Table 5, Models 1, 3 and 5. However, in Table 6 we present a different section of the coefficients of the same regressions, namely the coefficients of scientific fields that were suppressed in Table 5. Next, in Models 2, 4 and 6, we replace scientific field dummies with the share of men in the given field.

In Table 6, Model 1, we can see the differences in the sum income by scientific fields. Our baseline category is the field of linguistics and literature. Academics in the fields of medicine, engineering, physical sciences, and economics and law have a higher average monthly net sum income than academics in the baseline category. In Model 2, we replace the scientific

Table 5. Income sources.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Predictors	*Total income*		*Income from main job*		*Income from grants, scholarships, and private business*	
Gender[a]	−48,222*** (12,532)	−11,575 (16,136)	−15,397 (9,687)	−1,122 (13,132)	−31,681*** (9,192)	−10,259 (12,328)
Age group[b]	−3,962 (7,905)	−17,131** (8,158)	−3,270 (6,169)	−4,527 (6,600)	−6,432 (5,852)	−11,015* (6,184)
Type of workplace[c]	−22,195 (14,109)	−16,814 (13,607)	−52,069*** (10,938)	−51,444*** (10,974)	32,139*** (10,358)	34,077*** (10,280)
Location of workplace[d]	−61,528*** (12,646)	−58,797*** (12,266)	−28,134*** (9,894)	−28,532*** (9,949)	−18,681** (9,384)	−17,767* (9,338)
Academic rank[e]	52,653*** (10,270)	47,674*** (10,030)	41,594*** (8,011)	41,384*** (8,110)	6,330 (7,399)	4,057 (7,418)
Normalised Citation Index	22,634*** (4,917)	20,905*** (4,752)	12,571*** (3,808)	12,276*** (3,82)	12,342*** (3,589)	11,653*** (3,564)
Position at main job[f]	75,738*** (20,110)	68,921*** (19,434)	83,876*** (15,718)	81,496*** (15,787)		
Number of current jobs	63,143*** (9,037)	58,879*** (8,761)				
Weekly working hours	1,166** (466.5)	1,454*** (459.6)				
Part-time contract			−187,587*** (18,582)	−188,660*** (18,870)		
Number of children		46,546*** (6,807)		9,462* (5,480)		20,376*** (5,111)
Women × Number of children		−32,893*** (10,683)		−13,752 (8,604)		−19,635** (8,036)
Scientific field dummies	YES	YES	YES	YES	YES	YES
Constant	13,239 (64,979)	7,008 (64,186)	49,237 (47,203)	35,370 (49,435)	67,151* (36,921)	49,669 (39,693)
Observations	570	568	590	588	595	593
R-squared	0.424	0.467	0.401	0.401	0.095	0.119

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
a 1 = male, 2 = female;
b 1 = 25–30 years, 2 = 30–35 years, 3 = 35–40 years, 4 = 40–45 years;
c 1 = research institute, 2 = university;
d 1 = capital, 2 = other town;
e 1 = PhD Student, 2 = Assistant Lecturer/Junior Research Fellow, 3 = Assistant Prof./Research Fellow, 4 = Associate Prof./Senior Research Fellow, 5 = Full Professor/Scientific Advisor;
f 1 = subordinate, 2 = manager.

Table 6. Horizontal segregation.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Predictors	*Sum income*		*Income from main job*		*Income from grants, scholarships and private business*	
Philosophy and History	5,145 (31,363)		−10.39 (24,474)		−836.6 (23,279)	
Mathematics	38,340 (40,367)		81,775*** (29,432)		−38,313 (27,732)	
Agriculture	26,861 (33,947)		52,636** (26,127)		−25,494 (24,684)	
Medical Sciences	94,752*** (30,866)		70,582*** (24,081)		7,729 (22,932)	
Engineering	154,996*** (30,543)		90,076*** (23,787)		18,228 (22,657)	
Chemistry	45,171 (29,574)		14,657 (22,980)		8,562 (21,884)	
Biology	36,637 (28,190)		46,453** (21,911)		−12,545 (20,846)	
Economics and Law	81,993*** (27,915)		43,911** (21,705)		−22,767 (20,640)	
Earth Sciences	22,468 (30,899)		42,688* (23,798)		−18,530 (22,560)	
Physics	94,226*** (34,223)		91,058*** (26,345)		−15,396 (25,087)	
Proportion of men in the field		16,381*** (3,201)		11,920*** (2,459)		1,711 (2,332)
Constant	13,239 (64,979)	−11,762 (61,423)	49,237 (47,203)	47,857 (44,263)	67,151* (36,921)	48,843 (33,389)
Observations	570	569	590	589	595	594
R-squared	0.424	0.398	0.401	0.387	0.095	0.077

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Controls included in every model: Gender, age group, research institute or university, Budapest or another city, academic rank, and normalised citation index.
Controls included in Models 1–4: Position at main job.
Controls included in Models 1–2: Number of current jobs, average number of working hours per week.
Controls included in Models 3–4: Part-time contract.

field indicators with the proportion of men in the scientific field as a continuous variable. We see that one unit (100 percentage points) increase in the share of men in the field comes with HUF 16,381 additional income for all members of the field, which supports our hypothesis (Hypothesis 3), even though the magnitude of this effect is substantially lower than the direct gender wage gap.

In Model 3, considering the income from the main job we find more significant income differences; only academics in the fields of philosophical and historical sciences, chemical sciences and earth sciences do not have a higher monthly income from their main job than academics in the field of linguistics and literature. In Model 4, similarly to Model 2, there is a significant and positive correlation between average wages and the proportion of men in the given scientific field, even after controlling for measures of career progression and demographics. This allows us to conclude that there is a significant income consequence of horizontal gender segregation across scientific fields.

In Models 5–6, there is no significant correlation between the income from grants, scholarships and private businesses and the gender ratio of the field. This means that income differences between male-dominated and female-dominated fields do not originate from grant funding (or business) opportunities, contrary to our hypothesis (Hypothesis 4).

Discussion

In our analysis, we identify a significant gender wage gap amounting to 12 per cent of the total income for young Hungarian academics. We also find that the income differences between men and women are explained to a large extent by the fatherhood premium, but we do not find a motherhood penalty, as Glauber (2018) did. A man earns on average HUF 46,546 more per child, compared to those who are childless, while women earn only HUF 13,653 more per child in comparison to those who are childless. This explains most of the gender differences in the sum income (HUF 48,222), considering that men have more children in our sample. It is important to note that for women this additional income comes from parental benefits and not from job-related income. We could not find gender-related wage differences in the income from the main job, which supports our assumptions that the gender wage gap originates from the additional income sources and not from the main job salary.

The fact that there is a significant wage gap between men and women with children may originate from two mechanisms. One is that economic tensions from childbearing and generally low wages incentivise male academics with children to supply excess work in secondary jobs and grant applications; and the second is that female academics with children experience a disadvantage in gaining such positions. The fact that male academics have a positive fatherhood premium in these income sources, but the estimation of the motherhood penalty in these sources is around zero (but not positive), suggests that the former mechanism dominates. Thus, we conclude that the response of young academics with children to precarity and low wages plays out in gendered ways. The added pressures and challenges associated with balancing childcare and work commitments exacerbate income disparities between male and female academics. As a result, fathers tend to earn more.

Our models also uncovered a significant and positive correlation between average wages and the gender ratio of the given scientific field, even after controlling for career progression measures and demographics. This allows us to conclude that there is a significant income consequence of horizontal gender segregation across scientific fields, but not as we expected. The income differences between scientific fields related to the gender ratio come from the main job salary and not from the income from grants, scholarships and extra jobs. This underlines the assumptions of Judit Lannert and Beáta Nagy (2019) that previous policies in Hungary, which gave preference to STEM fields in contrast to social sciences and humanities (e.g. introducing tuition fees for university students and eliminating or limiting specific study programmes), may have augmented inequalities between male and female academics.

Altogether, we conclude that traditional gender roles and gendered socialisation have a significant impact on the wage differences of young Hungarian academics as well. Based on these results, we believe that the following policy directions are worth considering. First, at the level of central government, providing a satisfactory wage level as the basic salary of academic staff, regardless of their position or job title, would contribute to the success and research ecosystem of Hungary, and would also decrease the need for secondary income sources for academics with families. Second, at the institutional level, application for EU funding already requires the creation of gender equality plans that most institutions have fulfilled. Taking this task seriously and calculating basic statistics for gender ratios and wages by academic ranks and non-academic positions would itself be a powerful tool for uncovering hidden inequalities and raising the attention of leaders and stakeholders. Third, higher education institutions have already taken a big step towards the neoliberal system since our data was collected, which comes with a more liberal (increased) wage policy, and more emphasis on performance evaluation. Despite the merits of these measures, they often tend to distort incentives by valuing easy-to-measure indicators like scientific performance, with unintended consequences such as the unbundling of teaching activities to less prestigious staff, which leads to precarisation. Thus, it is crucial to put increased emphasis on the valuation of these activities by institutions.

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Notes

1. The recent process of outsourcing universities into public trusts and liberalising employment conditions was then in an 'experimental' phase that only concerned one medical and one business school out of the major science universities.

2. Public servant salaries in the academic sector were determined by a uniform scale (based on academic rank and position), theoretically eliminating potential bias in compensation.

3. Three response options were available in the survey: 'Male', 'Female' and 'Do not wish to answer'. Only six respondents did not or did not want to identify themselves as male or female, so we used these two categories in our estimations (self-identify as male or female). We refer to the category as 'gender', even though in the original language of the survey (Hungarian), sex and gender are expressed by the same word.

4. The category of 'economics and law' includes all social sciences.

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Appendix

Table 7. Comparison of respondents to the members of the Hungarian Academy of Sciences' public body.

	HAS public body	Sample
Age		
26–30	47 (1.3%)	146 (13.3%)
31–35	609 (16.9%)	315 (28.7%)
36–40	1,183 (32.9%)	334 (30.4%)
41–45	1,761 (48.9%)	303 (27.6%)
Total	3,600	1,098
Gender		
Male	2,143 (59.5%)	603 (54.9%)
Female	1,457 (40.5%)	495 (45.1%)
Total	3,600	1,098
Location		
Budapest	1,536 (42.7%)	504 (53.6%)
Other	2,064 (57.3%)	437 (46.4%)
Total	3,600	941
Scientific Field		
Linguistics and Literature	258 (7.5%)	81 (7.4%)
Philosophy and History	314 (9.2%)	96 (8.8%)
Mathematics	106 (3.1%)	31 (2.8%)
Agriculture	352 (10.3%)	62 (5.7%)
Medical Sciences	237 (6.9%)	108 (9.9%)
Engineering	446 (13.1%)	116 (10.6%)
Chemistry	339 (9.9%)	101 (9.2%)
Biology	388 (11.4%)	171 (15.6%)
Economics and Law	621 (18.2%)	162 (14.8%)
Earth Sciences	204 (5.9%)	89 (8.1%)
Physics	143 (4.2%)	73 (6.6%)
Total	3,408	1,090

Table 8. Categories of income in the survey.

Income categories	N
–100,000	9
101,000–150,000	29
151,000–200,000	90
201,000–250,000	147
251,000–300,000	140
301,000–350,000	136
351,000–400,000	126
401,000–500,000	129
501,000–600,000	87
601,000–700,000	48
701,000–800,000	35
801,000–	74
Total	1,050

Table 9. Full regression output.

Predictors	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Total income		*Income from main job*		*Income from grants, scholarships and private business*	
Gender	−48,222*** (12,532)	−11,575 (16,136)	−15,397 (9,687)	−1,122 (13,132)	−31,681*** (9,192)	−10,259 (12,328)
Age group	−3,962 (7,905)	−17,131** (8,158)	−3,270 (6,169)	−4,527 (6,600)	−6,432 (5,852)	−11,015* (6,184)
Type of workplace	−22,195 (14,109)	−16,814 (13,607)	−52,069*** (10,938)	−51,444*** (10,974)	32,139*** (10,358)	34,077*** (10,280)
Location of workplace	−61,528*** (12,646)	−58,797*** (12,266)	−28,134*** (9,894)	−28,532*** (9,949)	−18,681** (9,384)	−17,767* (9,338)
Academic rank	52,653*** (10,270)	47,674*** (10,030)	41,594*** (8,011)	41,384*** (8,110)	6,330 (7,399)	4,057 (7,418)
Normalised Citation Index	22,634*** (4,917)	20,905*** (4,752)	12,571*** (3,808)	12,276*** (3,820)	12,342*** (3,589)	11,653*** (3,564)
Philosophy and History	5,145 (31,363)	4,610 (30,470)	−10.39 (24,474)	1,781 (24,710)	−836.6 (23,279)	991.8 (23,246)
Mathematics	38,340 (40,367)	40,956 (39,911)	81,775*** (29,432)	83,600*** (30,197)	−38,313 (27,732)	−36,246 (28,119)
Agriculture	26,861 (33,947)	22,239 (32,885)	52,636** (26,127)	53,464** (26,297)	−25,494 (24,684)	−25,912 (24,604)
Medical Sciences	94,752*** (30,866)	80,885*** (30,065)	70,582*** (24,081)	70,390*** (24,367)	7,729 (22,932)	4,092 (22,951)
Engineering	154,996*** (30,543)	140,009*** (29,729)	90,076*** (23,787)	89,229*** (24,102)	18,228 (22,657)	13,581 (22,712)
Chemistry	45,171 (29,574)	37,345 (28,873)	14,657 (22,980)	16,364 (23,332)	8,562 (21,884)	8,079 (21,972)
Biology	36,637 (28,190)	38,985 (27,406)	46,453** (21,911)	49,139** (22,161)	−12,545 (20,846)	−10,044 (20,858)
Economics and Law	81,993*** (27,915)	78,152*** (27,295)	43,911** (21,705)	45,966** (22,067)	−22,767 (20,640)	−21,640 (20,754)
Earth Sciences	22,468 (30,899)	12,257 (30,292)	42,688* (23,798)	44,285* (24,328)	−18,530 (22,560)	−20,803 (22,802)
Physics	94,226*** (34,223)	78,959** (33,150)	91,058*** (26,345)	89,598*** (26,519)	−15,396 (25,087)	−19,942 (24,988)
Position at main job	75,738*** (20,110)	68,921*** (19,434)	83,876*** (15,718)	81,496*** (15,787)		
Number of current jobs	63,143*** (9,037)	58,879*** (8,761)				
Weekly working hours	1,166** (466.5)	1,454*** (459.6)				
Part-time contract			−187,587*** (18,582)	−188,660*** (18,870)		
Number of children		46,546*** (6,807)		9,462* (5,480)		20,376*** (5,111)
Women × Number of children		−32,893*** (10,683)		−13,752 (8,604)		−19,635** (8,036)
Constant	13,239 (64,979)	7,008 (64,186)	49,237 (47,203)	35,370 (49,435)	67,151* (36,921)	49,669 (39,693)
Observations	570	568	590	588	595	593
R-squared	0.424	0.467	0.401	0.401	0.095	0.119

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10. Full regression output.

Predictors	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Sum income		*Income from main job*		*Income from grants, scholar-ships and private business*	
Gender	−48,222*** (12,532)	−46,912*** (12,603)	−15,397 (9,687)	−15,569 (9,658)	−31,681*** (9,192)	−29,848*** (9,141)
Age group	−3,962 (7,905)	−8,449 (7,909)	−3,270 (6,169)	−4,473 (6,126)	−6,432 (5,852)	−6,724 (5,799)
Type of workplace	−22,195 (14,109)	−14,126 (13,593)	−52,069*** (10,938)	−53,362*** (10,411)	32,139*** (10,358)	37,833*** (9,846)
Location of workplace	−61,528*** (12,646)	−66,416*** (12,376)	−28,134*** (9,894)	−23,435** (9,582)	−18,681** (9,384)	−21,221** (9,071)
Academic rank	52,653*** (10,270)	58,111*** (10,012)	41,594*** (8,011)	42,082*** (7,755)	6,330 (7,399)	4,287 (7,150)
Normalised Citation Index	22,634*** (4,917)	22,874*** (4,872)	12,571*** (3,808)	13,289*** (3,750)	12,342*** (3,589)	13,145*** (3,522)
Position at main job	75,738*** (20,110)	77,574*** (20,268)	83,876*** (15,718)	82,897*** (15,704)		
Number of current jobs	63,143*** (9,037)	66,743*** (9,044)				
Weekly working hours	1,166** (466.5)	1,262*** (470.6)				
Part-time contract			−187,587*** (18,582)	−184,741*** (18,502)		
Philosophy and History	5,145 (31,363)		−10.39 (24,474)		−836.6 (23,279)	
Mathematics	38,340 (40,367)		81,775*** (29,432)		−38,313 (27,732)	
Agriculture	26,861 (33,947)		52,636** (26,127)		−25,494 (24,684)	
Medical Sciences	94,752*** (30,866)		70,582*** (24,081)		7,729 (22,932)	
Engineering	154,996*** (30,543)		90,076*** (23,787)		18,228 (22,657)	
Chemistry	45,171 (29,574)		14,657 (22,980)		8,562 (21,884)	
Biology	36,637 (28,190)		46,453** (21,911)		−12,545 (20,846)	
Economics and Law	81,993*** (27,915)		43,911** (21,705)		−22,767 (20,640)	
Earth Sciences	22,468 (30,899)		42,688* (23,798)		−18,530 (22,560)	
Physics	94,226*** (34,223)		91,058*** (26,345)		−15,396 (25,087)	
Proportion of men in the field		16,381*** (3,201)		11,920*** (2,459)		1,711 (2,332)
Constant	13,239 (64,979)	−11,762 (61,423)	49,237 (47,203)	47,857 (44,263)	67,151* (36,921)	48,843 (33,389)
Observations	570	569	590	589	595	594
R-squared	0.424	0.398	0.401	0.387	0.095	0.077

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11. Full regression output: Income without parental benefits.

Predictors	Model 1	Model 2
	Income without parental benefits	
Gender	−61,279*** (12,545)	−16,164 (16,293)
Age group	−3,702 (7,913)	−12,160 (8,237)
Type of workplace	−19,371 (14,123)	−15,183 (13,740)
Location of workplace	−62,766*** (12,658)	−62,185*** (12,385)
Academic rank	46,733*** (10,280)	42,870*** (10,127)
Position at main job	81,956*** (20,129)	74,122*** (19,623)
Number of current jobs	64,077*** (9,046)	59,804*** (8,846)
Weekly working hours	1,789*** (466.9)	1,946*** (464.1)
Normalised Citation Index	23,203*** (4,922)	21,686*** (4,799)
Philosophy and History	13,646 (31,394)	15,379 (30,766)
Mathematics	38,302 (40,406)	43,792 (40,299)
Agriculture	35,952 (33,980)	34,018 (33,205)
Medical Sciences	101,964*** (30,897)	92,998*** (30,358)
Engineering	153,516*** (30,573)	143,882*** (30,019)
Chemistry	45,487 (29,603)	43,249 (29,154)
Biology	46,974* (28,217)	51,814* (27,673)
Economics and Law	81,644*** (27,943)	83,042*** (27,561)
Earth Sciences	23,265 (30,929)	20,667 (30,587)
Physics	93,623*** (34,256)	81,546** (33,473)
Number of children		41,401*** (6,873)
Women × Number of children		−42,346*** (10,787)
Constant	−15,906 (65,042)	−41,496 (64,811)
Observations	570	568
R-squared	0.442	0.475

Notes: Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$