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Book

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What determines the gender pay gap in academia?

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Abstract

This paper focuses on two mechanisms that could explain the persistence of the gender pay gap – child penalty and bargaining. We concentrate on academia and use administrative data from the University of Tartu, the largest university in Estonia. The context of the academic sector allows us to control for worker productivity through indicators of research and teaching activities. Administrative data on academic staff from 2012 to 2021 has been linked with the population register and web-scraped data from SCOPUS. We follow the quasi-experimental approach proposed by Kleven et al. (2019a) to identify child penalty and derive outside option wages for all the detailed institutes to estimate the role of bargaining. Despite no penalty in hourly wages, the decrease in the working hours for mothers equals two years of full-time work spread over four years after childbirth. Compared to the penalty for the whole population, the child penalty in academia is shorter-lived, and no statistically significant effect on women's publications or citations was found. Men, in contrast, do not experience any penalties related to children. Women's worse bargaining skills seem to be an important factor behind the gender pay gap in academia, whereas the institute's higher outside option wage is related to relatively higher wages for men and is a less important factor for the wages of women.

JEL Classification: J13, I31, J44

Keywords: Gender wage gap, child penalty, event study, bargaining, outside option, academic sector

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1. INTRODUCTION

The decline in the gender pay gap over time in developed countries is a well-documented fact, and so is the slowing of this convergence process in recent decades (Goldin, 2014; Blau and Kahn, 2017). The most important part of the gender pay gap is assigned to child penalty in developed economies (Bertrand et al., 2010; Kleven et al., 2019a). The part explained by human capital differences or other labour market attributes has declined over time, and the child penalty has become a dominant determinant of the remaining gap (Kleven et al., 2019a). At the same time, a large set of soft factors potentially also affect the gender pay gap but have received less attention from the related literature. Psychological attributes such as attitudes towards negotiations remain an understudied field with little evidence from real labour market performance, and most of the knowledge relies on lab experiments (Bertrand, 2011).[6] Quantitative studies of these issues are more feasible in the case of a single narrowly defined sector, where work performance, promotion decisions and alternative employment options for employees can be more easily investigated. The academic sector is a good case for such an investigation due to its highly competitive work environment, where a high level of commitment is assumed to bring advancement in a career – "up-or-out" using jargon from lawyers (see Park and Rim 2020 for an overview of the up-or-out policy). In such an environment, childbearing may have a detrimental effect on the career of women who may, in the end, delay giving birth to their first child (Solomon 2011), or not have any intention to have children at all (Li and Shen, 2022; also Baker 2012).

This paper aims to understand the role of child penalty and bargaining in the gender pay gap by exploring the context of the academic sector. We focus on a sample of academic workers where worker productivity can be rather accurately measured by the number and quality of publications, teaching feedback and successful grants. Using the event-study approach, we estimate the child penalty for women and men. This quasi-experimental method has emerged as a state-of-the-art tool for estimating child penalty, and it has been applied using data from many countries (Kleven et al., 2019a, Kleven et al., 2019b, Cortés and Pan, 2023, Kleven et al., 2023). The results usually show that all adjustment margins are important for explaining the gender gap in earnings: participation in employment, working hours and hourly wage. Outside academia, sorting into family-friendly jobs is a known mechanism behind the child penalty for women (Kleven et al., 2019a). However, in academia, two additional dimensions of work outcomes can be incorporated into the analysis: scientific publications and citations. Therefore, we can additionally evaluate the effect of parenthood on productivity. While the gendered effects of parenthood in academia have been studied previously (e.g., Lutter and Schröder, 2020), the majority of studies on the gender pay gap in academia have not used such detailed indicators of academic productivity and most importantly, previous studies have not used the event-study approach that allows us to control for selection into parenthood.

The role of negotiations is analysed by deriving the reference wages of each detailed institute (academic discipline) outside academia, which is called the outside option in this paper. The outside option is calculated as the wage of occupations where graduates (of MA and PhD programmes) from the same institute usually work, excluding the academic sector. We estimate how the institute's outside option affects the gender wage gap and whether it affects men's and women's wages differently. The role of bargaining in the gender wage gap is usually estimated as gender differences in rent sharing within firms (Card et al., 2016). Many papers have shown

[6] For a meta-study of the gender gap in bargaining, see e.g. Kugler et al. (2018). For recent evidence on the effects of the transition to individual-level bargaining on an increased gender pay gap, see e.g. Biasi and Sarsons (2022).

that such a bargaining component is economically significant (Card et al., 2016; Sin et al., 2022; Masso et al., 2022), but the mechanism behind bargaining is not explained. Evidence shows that productivity explains a large part of within-firm wage differences (Sin et al., 2022). We contribute to this literature by investigating how the outside option affects men's and women's wages after controlling for individual-level productivity. There is evidence on the role of the outside option on the gender pay gap in academia only for the economics profession (Blackaby et al., 2005), and we study the role of bargaining and the outside option for the whole academic sector.

We use administrative data from the University of Tartu in Estonia, a public university that hosts all the traditional faculties and ranks among the top 1% of universities worldwide. It employs approximately 3,500 employees – half are men and half are women. We observe the wage data of all the academic employees at the University of Tartu for 2012–2021. This database is linked with the population register to obtain information about the children of employees and with the web-scraped SCOPUS data to obtain information about publications and citations of employees. We limited the sample to include only academic employees, which results in approximately 2,000 unique observations yearly. For reference, we also conducted the same child penalty estimates on the whole population of women who became parents during the same period in Estonia. An additional comparison focuses only on a subset of women with master's or PhD degrees in the whole population. These additional estimations allow us to evaluate whether the observed patterns of child penalty are specific to the analysed university or characterise all employees with academic degrees or the whole population. As a robustness check, difference in difference estimations are also presented.

This paper contributes to two strands in the literature. First is the literature on child penalty and so-called nonlinear occupations (Goldin, 2014). As brought out above, the child penalty has remained one of the key factors behind the gender gap in earnings. At the same time, while the child penalty has received substantial attention in the context of the academic sector, to the best of our knowledge, there is no study on child penalty in academia that uses the event-study methodology and includes all parents[7] in the university. There is evidence that women move to lower-status jobs after becoming mothers (Kleven et al., 2019) and that the child penalty is especially large if the education of spouses is higher than that of mothers (Cortés and Pan, 2023). Nonlinear occupations or specific occupations where excessive working hours are highly rewarded and it takes a long time to build expertise are considered to be ‘the last chapter’ on gender convergence (Goldin, 2014). There are already many studies on such occupations, such as business MBAs or lawyers (Bertrand et al., 2010 and Goldin, 2014), and it has been shown that the earnings gap usually emerges when children are born. However, the gender pay gap in academia has not been studied from the perspective of this literature. At the same time, the job requirements and working environment in academia fit the theory of nonlinear occupations very well, while the academic context allows us to control for worker productivity, that has not been feasible in related studies on non-linear occupations.

Second, we contribute to the literature on the role of bargaining and the outside option on the gender pay gap. There are substantial differences between men's and women's wages within the same organisation, even after conditioning on worker and firm fixed effects (Card et al., 2016). Firms share a substantially larger share of their rents with men than with women. However, the mechanisms behind this bargaining component are not clear. There is evidence that women engage less frequently in wage negotiations and lose wages when the role of individual

[7] Data of the birth of the first biologial child is derived from the national register in Statistics Estonia in this study.

negotiations increases in wage-setting (Biasi and Sarsons, 2022). There is also evidence that even if women engage in wage and promotion negotiations as frequently as men do, they are less likely to obtain the desired outcome (Artz et al., 2018). Our data allows us to contribute to this literature due to the unique context of academia. Regular evaluations of academic positions create a setting of equal engagement in wage negotiations. Although in the private sector, most of the within-firm gender differences in rent sharing are related to gender differences in productivity (Sin et al., 2022), this can be ruled out in our data, as we can monitor academic productivity in a very detailed manner. There is also evidence on the occupation of economists that men get their wages increased due to job offers from outside academia, while women do not (Blackaby et al., 2005).

We find a large and short-lived child penalty in wages for women but not for men in academia. The child penalty in wages disappears four years after the birth of the first child for female academic workers, while at the same time, it is still at –50% in the whole population of women. We do not observe any child penalty in hourly wages in academia; the majority of the child penalty in wages is explained by the decline in working hours. The decline in working hours is significant and equals two years of full-time work lost due to the birth of the first child for women. However, we do not observe a statistically significant child penalty in terms of publications or citations for women. Our unconditional estimates show a plateau in women's wages at the time when children are usually born. As wages in academia are related to progress in occupational rank, this suggests that becoming a mother does not reduce hourly wages for women but their progress on the occupational ladder is put on a temporary pause. These results also demonstrate the importance of the chosen methodology in interpreting the child penalty. The fixed effects estimates confirm the decline in publications for individuals after becoming a mother (Lutter and Schröder, 2020). The method used in the current paper conditions on the selection of becoming a mother and identifys the effect of children not over the individual track but over the variation in timing of the event, and it shows that within the group of mothers we cannot confirm an immediate decline in publications.

We find supporting evidence for the role of the bargaining channel in the gender pay gap. The outside option wage has a strong positive effect on the wages of men but a considerably smaller effect on the wages of women in academia. There is a positive correlation between the institute's outside option wage and the average wage the institute pays to its employees, and this originates from the feedback effect of other sectors' wages to academic sector wages enforced by male workers. This can result from men's better knowledge of wages outside academia, better bargaining skills, or higher geographic and job-to-job mobility.

The rest of the paper is organised as follows. In the next section, we provide a short literature review on men and women in academia. Next, we introduce data and descriptive statistics. Section 4 presents our methodology for child penalty and wage bargaining estimates. Finally, we describe and discuss our results in Section 5 before concluding in Section 6.

2. RELATED LITERATURE ON THE GENDER PAY GAP IN ACADEMIA

Being an academic means working in a high-skill occupation that requires intensive concentration in early career to create a strong set of skills (Antecol et al., 2018). This is called the "up-or-out" system that describes career advancement in professional service sectors. The term originates from lawyers who have had to demonstrate professional development and

suitability for partnership to get promoted to partner, and historically, their competitors were dismissed (strategically abandoned) even if their competence and productivity were comparable to the promoted colleagues (Malos and Campion, 1995). In US academia, tenure-track contracts usually include leaving if the faculty member is not promoted by a certain date. This is not prevalent in Europe. However, other aspects that have led to the "up-or-out" system in the US are similar in Europe, as research and teaching involve little firm-specific human capital, and low- and high-level jobs in academia are rather similar; that is, it is mostly the time allocation that is different for professor and associate professor (Ghosh and Waldman, 2010).

Academia has also been described as a hyper-competitive environment (Edwards and Roy, 2017). In academia, similar to some other occupations, there is a nonlinear relationship between earnings and hours – continuous hours are important, and hours at particular times are worth more (Goldin, 2014). Qualitative evidence from interviews in Norway, University of Oslo, indicated that academia as an organisation is greedy[8] with a limitless time culture, and the model of an excellent academic is an unencumbered male worker who can afford long working days, research as a lifestyle, and so on (Thun, 2020). Moreover, the abundant job demands and open-ended nature of the work in a high-demand environment can also lead to a problematic level of overwork in academia (Hynes and Cullinane, 2024).

Academic productivity is measured by publications, grant receipts, and teaching quality. In the UK, all three factors have been shown to affect the wages of academicians (Euwals and Ward, 2005). Many papers have been written about the difference/s in academic productivity between male and female scientists. Authors of a meta-study based on previous papers conclude that there is a gender bias against women in research fields, where women are underrepresented and men succeed more than women only if the productivity proxy involves evaluation committees or other peer recognition; for example, academic positions (Astegiano et al., 2019). However, more recent research comparing elite scientists[9] still shows that men are more productive and more recognised than women: men published 30% more articles and were cited 64% more than women (Sá et al., 2020). Huang et al. (2020) have looked at the academic careers of male and female scientists and claim that gender differences in productivity are related to gender differences in career length measured by publication record in the Web of Science database between 1900 and 2016. In some fields, the difference may be rather large; for example, men's careers that are 19.2% longer in biology and chemistry could lead to a productivity gap of more than 30%. The authors could only look at scientists who had careers ending between 1955 and 2010, but they covered 83 countries and 13 disciplines and referred to the importance of working without gaps in academia. Yet, the 'publish or perish' narrative in academia is persistent, as a recent analysis has shown the strong dominance of research in requirements in academic job ads (Mantai and Marrone, 2023).

A drawback of these productivity measures concerns the gender bias in student feedback on teaching and gender bias in publishing. Evidence shows male professors receive higher student feedback than female professors (Boring, 2017; Mengel et al., 2019). Similarly, there is evidence that for women, it is more difficult to get published in the top economics journals,

[8] Greedy institutions seem highly desirable to their members, to the extent that the members accept long working hours, limiting family time and abandoning community engagements to devote their commitment and energy to activities associated with the institution. Young researchers in academia seem especially prone to rewards for obedience as well as time and energy-intensive work. (Bone *et al.*, 2018)

[9] Three countries were analysed (the US, Canada, and South Africa). Elite scientists (236) are those with chairs because it shows recognized standing in their fields and research output over five years was analysed following the appointment of research chairs. Departmental peers (706) were used as a control group. (Sá *et al.*, 2020)

although the papers written by female authors that are actually published in the top journals prove to have much higher quality, resulting in 25% higher citations than male-authored papers (Card et al., 2020).[10]

Among academic workers in the USA, recent literature has even shown a decrease in the wage gap to a statistically insignificant level (Koedel and Pham, 2022) or men earning less than women considering the specialist field, rank and years of experience (Humphries et al., 2021). However, women have been constantly less present in academia than men (Avolio et al., 2020). This is particularly the case in STEM (science, technology, engineering, and mathematics) fields (Clark Blickenstaff, 2005; Li and Koedel, 2017) and economics, with only 30% being female assistant professors (Lundberg and Stearns, 2019). Among other reasons (e.g. lower productivity, leaky pipeline, gender bias, and self-selection), it has been suggested that the child penalty for women in academia is larger than that for men (e.g. Urmann et al., 2020).

The "up-or-out" system has shown female lawyers to delay their first child until after the promotion decision, while the same does not apply to male lawyers (Park and Rim, 2020). In academia, some men have even been reported to feel pressure to delay their parenthood until after tenure similar to women (Solomon, 2011). Morgan et al. (2021) have shown that parenthood can cause from 87.6 to 95.6% of the productivity gap between tenure-track men and women in the United States and Canada. The same authors have also found that the negative parenthood effect for mothers is the strongest right after the birth of the child and affects their productivity less in the long term. Some researchers have investigated parenthood in more detail and refer to parental engagement that better explains the parental penalty than the existence of children; they claim that men could have similar penalties to women if they also served in lead parenting roles (Derrick et al., 2021).

Finally, in addition to the understanding that wage bargaining is relevant to the pay gap in the private sector (Card et al., 2016), it is also relevant in academia. Namely, the outside option has been shown to be an important factor behind the higher wages of men compared to women in academia. Blackaby et al. (2005) demonstrate that men receive offers from outside academia more often than women. Men who are ordinarily more mobile in labour markets than women also turn these outside offers into higher wages inside academia, while women do not. Their paper uses data from UK academic economists only., while we extend our sample to the whole set of academic disciplines.

3. DATA

We use a unique panel dataset of all academic employees in the University of Tartu in Estonia, covering the years 2012–2021. This particular case is especially interesting for the study of the gender pay gap in academia due to two main reasons. First, Estonia has one of the largest gender pay gaps in the EU, unconditionally and conditionally (see e.g. Leythienne and Ronkowski, 2018), which provides the empirical context for the study where gendered wage differences really matter. Second, the excellent data infrastructure allows the merging of detailed administrative datasets of the university with the data from the national registries. The resulting rich dataset covers a wide set of control variables and a broad range of academic fields. Basic wages, as well as variable components and bonuses, have been recorded in personnel data,

[10] While the (double) blind peer-review proicess may reduce the gender pay gap in reserach relative to teaching evaluations, it is not sufficient to eliminate the gap due to the importance of the editorial decisions in the publication process (via the gender of the authors being revealed to the editors in the review process).

along with personal variables such as gender, age, scientific field, rank and research projects. Hourly and yearly wages are deflated by a harmonised index of consumer prices (HICP) data and are shown in 2012 prices. Wages are always reported in gross terms.

We merge this administrative data with two additional datasets. Scientific submissions and citations from the SCOPUS database have been gathered using web scraping.[11] The resulting time-varying data on publications and citations are merged with individual-level data on wages. Out of all possible submissions recorded in SCOPUS, articles, books, book chapters, conference papers and reviews were considered. In addition, Estonian population register data have been used to exactly identify the years when the first six children were born to individuals working at the University of Tartu.

Naturally, the context of a small country's dominant and diverse research university must be considered. The University of Tartu comprises a substantial share of the academic sector in Estonia (e.g. more than 30% of all university students, but more than 50% of publications in the Web of Science and SCOPUS databases), and it is the most prestigious university (with the highest international ranking, among 1% of the world's most cited universities and research institutions in 15 fields of research). The latter means that, in many cases, that is the only or one of very few potential academic employers. Therefore, for many employees (especially Estonian nationals), the alternative to working at the University of Tartu is (if we exclude going abroad) working outside academia in the public or private sector (although for foreigners, going abroad is a logical alternative). While the University of Tartu is the largest in Estonia (as of 2024 – 14,000 students and 3,500 employees), it is not necessarily so large in international terms. Yet, it is the only classical university in Estonia comprising a broad range of scientific disciplines. Therefore, the diversity of academic fields needs to be considered, for example, when evaluating employee academic productivity (cf. humanities versus natural sciences) and the size of the outside option (salaries outside academia). The very small size of the country, on the other hand, means that the role of geographical mobility in shaping the outside option and the bargaining channel is less relevant than in most other countries. On the other hand, if the parents want to raise their children in a native language environment, it reduces the importance of going abroad as an alternative employment opportunity and bargaining options for parents with children.

Figure 1 shows the dynamics of the gender wage gap in our database. There is a declining trend in the gender wage gap; the gap in hourly wages has declined from 25% in 2012 to 13% in 2021. The gender gap in yearly wages is much larger than in hourly wages because women work fewer hours than men, but all the gaps show a declining trend. The fast decline of the gender wage gap in the hourly wages at the University of Tartu aligns with trends in the population (Figure A1 in the Appendix). Even though Estonia as a whole had the largest gender wage gap in the European Union in 2021 (Eurostat table SDG_05_20), 15%, the gender pay gap in Estonia has declined from the level of 30% in 2012. Only a small part of the national wage gap can be explained by individual characteristics like demographics, education, occupation and sector (Meriküll and Tverdostup, 2023). At the same time, firm-level characteristics such as sorting to organisations and bargaining within organisations are highly relevant determinants of the gap (Masso et al., 2022). This is important for the context of our study as we are analysing the data of one large employer dominant in a particular sector.

[11] Author's first and last name were used for webscraping, also SCOPUS author ID-s that were available.

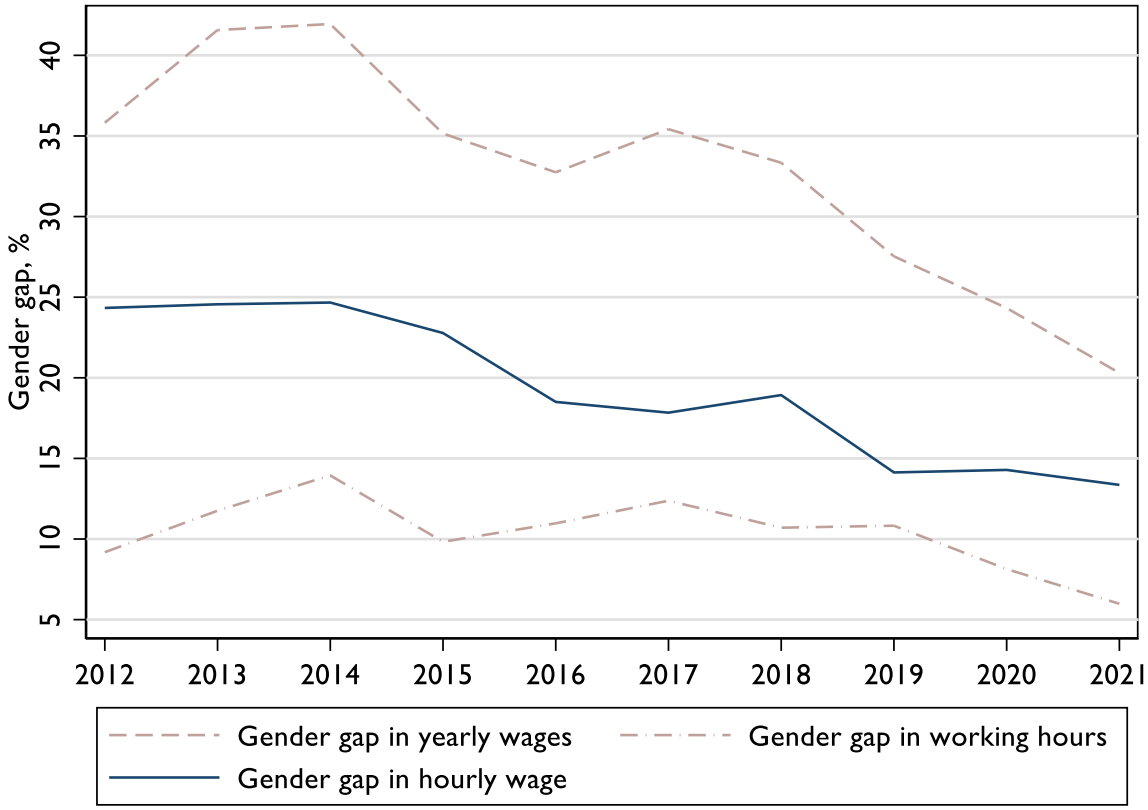

Figure 1. The gender gap in yearly wages, working hours and hourly wages, University of Tartu for 2012–2021 (%).
Source: Authors' calculations from administrative records.

The wage profile by age differs for men and women in academia (see Figure 2). The average hourly wage progresses at a similar pace for both genders until age 35, and then almost a ten-year plateau follows in wage growth for women. Although women's average wages start growing again after age 45, they will never reach the average wages of men. The peak in wage income is in the 50s for both men and women in academia. The wage profile by age is somewhat different in the whole population (see Figure A2 in the Appendix) – the plateau of wages for women starts earlier, in their 30s, and lasts longer, but similarly to wages in academia, there is no catch-up with men. The wage income also peaks earlier in the general population compared to academia, around the end of the 30s and the beginning of the 40s.

The human capital accumulation process is longer in academia, which may also be reflected in the age at which women have their first child. The plateau in wage growth for women in their 30s can be related to the child penalty, whereas their 30s is the age when children are usually born. This indirect evidence of a child penalty indicates that the child penalty is smaller and more short-lived in academia than in the whole population. Descriptive statistics for women in the whole country indicate that the average age when the first child is born is 26.3 years, while for women with MA and PhD degrees, it is slightly higher, 28.6. For all women in the University of Tartu during the analysed period, we record the average age of the birth of the first child to be 27.83, and in the final sample of women who were observed longer, the average age of becoming a mother is even older (34.3 years). Therefore, in raw data, academic women are seen to delay their first child, as described in Park and Rim (2020) or Solomon (2011), and

possibly this is related to the resemblance of academia to the "up-or-out" system (see also Section 2 above).

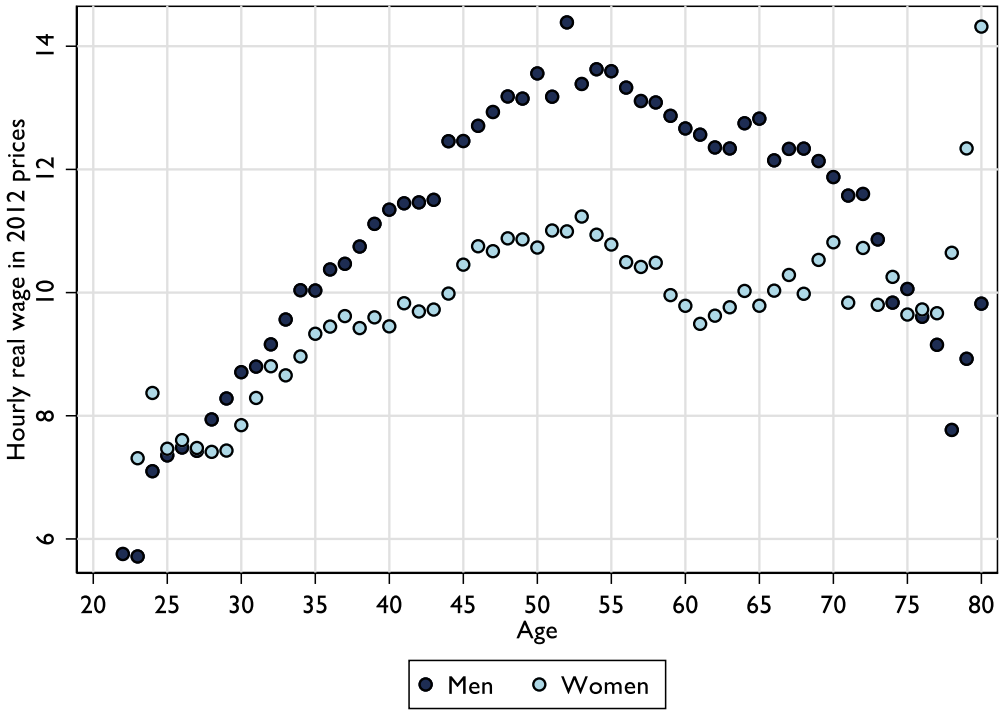

Figure 2. Wage profile by age in the University of Tartu, 2012–2021.
Source: Authors' calculations from administrative records.

Table ***1*** demonstrates descriptive statistics of all the data we use in this paper. The average gender gap in hourly wages is 15.5% for academic workers at the University of Tartu; that is, men earn, on average, 15.5% more than women. Men are also slightly older than women and have more children. Men have better human capital in terms of education; they have obtained PhDs from Estonia and PhDs from abroad more frequently than women; they also have longer tenures than women. The most striking observation is the gender differences by occupation – men are much more likely to work in higher-ranking occupations than women, which holds for both the teaching and research track. The breakpoint is between associate professor and assistant professor for the teaching track and between senior research fellow and research fellow for the research track; that is, between these occupations, male dominance switches to female dominance when moving down in ranks.[12]

Table 1. Descriptive statistics for the sample of academic workers in the University of Tartu, 2012–2021

Variable	Men		Women		Gender gap
	Mean	SD	Mean	SD	
Real hourly wage in 2012 prices; EUR	11.47	6.28	9.69	4.40	0.155

[12] In 2021, the career model in the university was changed to follow the framework of career stages R1–R4 of the European research area. The teaching track and research track (separated in R1 and R2) are combined in the new

Variable	Men		Women		Gender gap
	Mean	SD	Mean	SD	
Log(hourly real wage)	2.27	0.42	2.13	0.36	0.145
Age	46.32	12.58	44.51	11.54	0.039
One child	0.14	0.36	0.19	0.38	-0.357
Two children	0.28	0.46	0.32	0.46	-0.143
At least three children	0.25	0.40	0.20	0.41	0.200
Tenure	13.90	10.45	11.11	9.13	0.201
PhD degree	0.77	0.42	0.61	0.49	0.208
PhD degree from abroad	0.26	0.44	0.12	0.32	0.538
Project, 100 thousand EUR per year	0.211	1.159	0.051	0.270	0.758
PhD defences of students	0.114	0.385	0.050	0.247	0.561
MA and BA defences of students	0.933	1.780	1.045	1.960	-0.120
Teaching load per 100 working hours	0.065	0.169	0.084	0.224	-0.292
Teaching feedback from 0 to 4	3.44	0.30	3.51	0.29	-0.020
SCOPUS publications	2.083	4.298	0.999	1.783	0.520
SCOPUS citations per year / 100	1.018	4.630	0.404	1.881	0.603
Professor Emeritus	0.002	0.044	0.0002	0.014	0.901
Professor	0.154	0.361	0.046	0.210	0.701
Associate professor (teaching track)	0.092	0.288	0.083	0.276	0.098
Associate professor	0.029	0.168	0.022	0.146	0.241
Assistant professor	0.121	0.326	0.193	0.394	-0.595
Junior lecturer	0.005	0.070	0.011	0.105	-1.200
Senior assistant	0.009	0.093	0.007	0.082	0.222
Assistant	0.073	0.261	0.136	0.343	-0.863
Teacher	0.015	0.123	0.046	0.210	-2.067
Leading research fellow (research track)	0.013	0.113	0.002	0.039	0.846
Senior research fellow (research track)	0.179	0.384	0.104	0.306	0.419
Research fellow (research track)	0.240	0.427	0.261	0.439	-0.088
Junior research fellow (research track)	0.069	0.253	0.090	0.286	-0.304
Observations	10 266		10 314		
Age of becoming a parent (OLS sample)	29.53	5.803	27.83	4.93	0.058
Age of becoming a parent (event-study sample)	36.43	5.261	34.34	3.355	0.057
Log (outside option)	2.58	0.266	2.53	0.287	0.05

Source: Authors' calculations from administrative records.

Notes: The gender gap is derived as the value of men minus the value of women divided by the value of men for all the variables except log hourly wages and log outside options, where the gap is shown in log differences.

In the OLS sample, the statistics describe 1,099 men and 1,270 women, event-study estimates include 40 men and 38 women. Duplicates have been removed before calculations. Log outside options are calculated based on 1,014 men and 1,080 women.

To derive the teaching load, the teaching load for each semester is first found, and then an annual average is taken. The teaching load for a semester is found as the sum of the teaching loads for all courses, where the load for each course taught is approximated by the product of the number of academic hours and the number of students, divided by the number of lecturers teaching the course. The workload is calculated by dividing the teaching load indicator by the number of hours worked per year. In the regression analysis, this variable is presented in standardised form, i.e. the mean of the variable is subtracted from each observation and the result is divided by the standard deviation.

system in R3 and R4; therefore, there is no longer the position of senior research fellow. A PhD degree is also required in stage R2.

The strong segregation between occupations aligns with strong gender differences in research activity. The gender differences in publications and citations are striking. On average, during the period 2012–2021, men published 2.1 papers yearly and women 1.0 papers yearly; men also receive on average 102 citations per year and women 40 citations. There are important differences in the four large disciplines, as academics in science and technology publish annually on average slightly over two publications, while academics in arts and humanities publish on average less than one publication per year. At the same time, in arts and humanities, nearly 60% of academics are women, while in science and technology, only 35% are women.

Unlike research activities, teaching activities are much more equally distributed by gender. Women have, on average, a higher teaching workload than men, which is likely related to women's stronger segregation to the teaching track and men's stronger segregation to the research track. There is no substantial gender gap in teaching feedback; women receive, on average, higher feedback than men, but the difference is only 2%. Therefore, unconditionally, our data do not show any gender bias in student feedback. The outside option is calculated at the institute level and the 5% higher log outside option for men is caused by differences in the gender composition of institutes.

In summary, the gender pay gap in our database for academia is of the same magnitude as at the national level. It originates largely from the segregation of men into higher-ranked occupations than women. The descriptive evidence suggests that this segregation results from gender differences in research performance, not teaching performance.

4. EMPIRICAL SPECIFICATION

4.1. Estimating the conditional gender pay gap

The conditional gender pay gap is estimated using a simple approach, where a Mincerian wage regression with a gender dummy is estimated, and explanatory variables are added one by one. The control variables are added following the order where demographics are entered first, then tenure, education, publications and teaching performance until all controls are included. We evaluate the change of a gender dummy in these regressions while extending the set of controls to understand which are the most relevant for the gender pay gap. We prefer this simple Mincerian regression-based approach over standard decompositions for the sake of more efficient presentation and communication of results; the Oaxaca-Blinder type decomposition provides very similar results.

The following regression is estimated:

$$\log(wage_{it}) = \alpha_o + \alpha_1 male_i + \sum_c \beta_c X_{it}^c + \tau + \epsilon_{it}, \quad (1)$$

where the dependent variable is the logarithm of hourly wages for individual *i* in year *t*, *t=2012–2021*, and the set of explanatory variables always includes a male dummy, while the number of control variables can vary from *c=0, … 18* following the set of controls shown in Table 1. The same specification allows us to estimate the unconditional gap with no controls, the gap with a full set of controls where all 18 control variables are added, and everything in between where a smaller set of controls is added. The time fixed effects are controlled for by τ, which denotes year dummies, and some specifications also add institute or occupation dummies.

4.2. Identifying child penalty using the event-study method

We follow Kleven et al. (2019a) to identify the effect of having children on the outcomes of academics. They suggest a quasi-experimental setting and estimate child penalty in an event-study setting. Unlike traditional decomposition exercises, the impact of children on pay is estimated without controlling for education and labour market variables, such as occupation. Therefore, this approach does not test whether equal work is rewarded by equal pay, but it would allow us to quantify the outcome of having children for employees in academia.[13] The following equation is estimated separately for men and women:

$$Y_{it} = \sum_{s=-2}^{S} \alpha_s + \sum_{k=23}^{K} \beta_k age_{it} + \tau + \epsilon_{it} \quad (2)$$

where Y_{it} refers to the outcome variable of total wage, working hours, hourly wages, publications, citations or participation rate; the α_s terms capture the change in outcome variable around the event, where *s=-2, 0, 1, 2, 3, 4* refers to two years before the event, at the event and up to four years after the event when the first child is born; age refers to age k, k=23,…, 49, and τ to year dummies. The constant α_{-1} is set to capture the reference category, which is one year before the event. Our time dimension in the data is shorter than in the original paper by Kleven et al. (2109a): instead of observing parents five years before becoming a parent and ten years after becoming a parent, we observe parents two years before the event and four years afterwards. To increase the sample size, we have included parents who are missing one observation at the end or at the beginning of the seven-year period. However, the reference moment *s=-1* is included for each and every individual. Our results are very similar for effect during the first years after the event if we further increase the sample size and include all parents with at least four observations in a row starting from s=-2 and s=-1.

In the specification for seven years, we observe 38 women and 40 men who have become a parent while working at the University of Tartu. In the database of academics, there are about 282 women who had their first child between 2012 and 2021, and 90% of them also had their second child during the same period. The total number of men (who appear at least once in the database of employees and who had their first biological child during these years) is 262, and 88.5% of these men also had their second biological child in the same period. However, not all these observations can be used in the analysis because of the balanced panel requirement. Individuals who are not working in an academic position for the required years around the birth of the first child cannot be included in the models. Due to the small sample size, in the main analysis, we deviate slightly from the balanced panel requirement and allow employees to miss one year from the beginning or the end of the observed period. We do not replace their wages with 0s but leave them empty.

We also estimate the same specification for the whole population of women in Estonia, including more than 20,000 women who gave birth to their first child within the same period from 2012 to 2021. To conduct this analysis, we merge census data with administrative data on wage income (from payroll tax declarations form TSD). The census collects information on the birth year of the first child for all female residents. We limit the sample to those women who were Estonian residents between 2010 and 2021.

[13] We can find post-child effects with this approach and not pre-child effects, i.e. the human capital accumulation decisions before becoming a parent.

Equation (2) is estimated in levels to maintain the non-positive observations in the sample (i.e. those with zero wage income). The effects of childbirth are shown in the figures, where estimated coefficients are transferred into percentages using $\alpha_s/\widehat{Y^*}$, where $\widehat{Y^*}$ denotes predicted values from equation (2) without the event dummies α_s. The term $\widehat{Y^*}$ captures the counterfactual scenario of not having children given the wage-age profile of women or men who have become parents within the analysed period.

4.3. Identifying child penalty using the difference in differences method

As a robustness check, we also evaluate the child penalty for men and women using the difference in differences method. As the event study does not include non-parents, the difference in differences method allows us to use a larger dataset and include additional controls such as unit, occupation and so on, in addition to age and time dummies. The treatment is still the birth of the first child. The number of children born after the first child is not accounted for. The control group is constructed based on the number of biological children recorded in the population register. In all observed years, the recorded number of children in the control group is zero.

We cannot be sure that the academic employees in the control group will not become parents after the end of the analysis period. Because of the lack of appropriate background variables, we also cannot calculate their probability of becoming a parent as in Kleven et al. (2019a). However, to improve the match between the control and treatment groups, we include in the first of the two groups only men aged between 25 and 54 years and women aged between 25 and 47 years, following the minimum and maximum ages of men and women in the treatment group. As a result, the average age of the control group is still higher than that of the treatment group. Therefore, to account for this age difference in the control group, placebo children are set to be born in (i.e. year t is determined to be) their third year of observation. Alternatively, placebo children could be set to be born randomly in different years dependent on the number of total observations for each person (e.g. if we can observe a non-parent for all ten years the placebo child could also be born in the sixth year and we could still observe the person for four consecutive years after the placebo birth), but in this case the average age of parents at the year of the birth of placebo children would be higher than using our preferred method. Note that placebo births only help us to decide which observations in the subsample of non-parents should be classified as post-treatment years (or respectively pre-treatment years).

For the static difference in differences analysis, we use:

$$Y_{it} = \alpha + \beta T_i + \gamma \tau_t + \delta(\tau_t \times T_i) + \sum_c \eta_c X_{it}^c + \epsilon_{it}, \qquad (3)$$

where ϵ_{it} is a random unobserved error, and the coefficients are unknown parameters with the following interpretation: α is a constant term; β is a treatment group-specific effect that accounts for the average permanent difference between treatment and control; γ is the time trend common to control and treatment groups; δ is the average treatment effect of the treated; η_c is the effect of control variables on the dependent variable Y_{it}.

The treatment variable T_i equals 1 if individual *i* became a mother or father for the first time while working in the University of Tartu in 2012–2021 and could be observed for a certain number of years. The variable equals 0 if individual *i* did not have any biological children during 2012–2021 (i.e. the individual belongs to the group of non-parents). Time variable τ_t is

a dummy that differentiates between post-treatment (denoted by 1) and pre-treatment years (denoted by 0). The set of control variables X_{it}^{c} includes age, age squared/100, tenure, citizenship, PhD degree (dummy) and PhD degree from a foreign country (dummy). The rather small sample size of the treatment and control group requires some adjustments in the control variables compared to our OLS specification in equation (1); therefore, 35 institutes are included as four large disciplines, and instead of exact occupations, four career stages (R1–R4 of the European research area) are used. As all the individuals are observed for six or seven years, we cluster the standard errors by individual and allow for intragroup correlation. We are not using a two-way fixed effects model, but time dummies are also present in the model.

The dynamic difference in differences model that includes leads and lags of the event allows us to check whether the control and treatment groups are comparable on outcome dynamics before the birth of the first (or placebo) child. On the other hand, the persistence of the treatment effect can also be controlled. The dynamic model includes all control variables X_{it}^{c} in equation (3) and year dummies and the standard errors are also clustered by individual, but the variables T_i, τ_t and $(\tau_t \times T_i)$ are replaced with time dummies indicating years to or from the event. The reference moment in the dynamic approach is *t=-1*; that is, one year before the birth of the first (or placebo) child.

4.4. Deriving the outside option for university employees

The role of bargaining in the gender pay gap is studied by deriving the outside option wage for all 25[14] detailed institutes in the sample. A real set of options for each academic worker in the dataset is not directly observable. Often all jobs within the same commuting zone and industry or occupation are considered as an individual's labour market (Caldwell and Danieli 2024). Institutes can serve as a very general proxy for industry, but additional dimensions like occupation or gender are not considered here. Quite a significant amount of the human capital accumulated over the academic career seems to be specific to the academic sector and do not necessarily have the same rate of return in other sectors. At the same time, in certain cases, women of higher occupations in the university may still have higher individual outside options than men of lower occupations in the university; therefore, calculating different outside options by gender that, due to the national gender wage gap, would be significantly lower for all women, would be discriminatory.

For each institute, the outside option wage is calculated as a weighted median wage of the 4-digit ISCO occupations where graduates of the MA and PhD level curricula of the institute work. We only consider the number of occupations that cover at least 66% of all the graduates. All graduates are not included to minimise the number of graduates with a mismatch between their occupation and education. As this exercise aims to obtain the reference wage outside academia, we exclude academic occupations.[15] Focusing on key occupations that employ certain institute's graduates provides a good exogenous proxy for the reference wage and captures the market wage of a graduate if they would have had the most common match with their education and job characteristics. Table A1 in the Appendix indicates the most frequent

[14] The total of 35 institutes present in the database are not all covered in the analysis. If the institute was not responsible for any curricula at MA or PhD level, the outside option could not be calculated. It could be argued that the outside option should be calculated at individual level instead of institute i.e. different for more senior and junior academics. However, a large amount of the human capital accumulated over the academic career is specific to the academic sector that cannot have the same rate of return in other sectors.

[15] Although ISCO group 2310 – university and higher education teachers was removed from the sample, employees recorded as 2113 chemists or 2131 biologists etc who could *inter alia* work in the university are included in the sample.

occupation for each institute, the median wages for each occupation and the outside option for each institute. We use administrative wage data, the national register of education and the employment register[16] to estimate the outside option. As the occupation information from the employment register is available only for the most recent years, we conduct this analysis only for 2021 and only consider graduates from the years 2017–2020.

Figure 3 shows the correlation between the institute's average wage and the median outside option wage in 2021. The correlation between the two measures is positive and of average strength. The institutes with a high average wage also have a high average outside option wage, and institutes with a low average wage also tend to have a low average outside option wage. The correlation between the institute wage and the institute's outside option wage is 0.55 and statistically significant (p=0.004). Outside option wages are the highest for the Faculty of Medicine (MV) and the Institute of Computer Science (LTAT). The outside option wages are the lowest for sports and physiotherapy (MVSF), as well as for Viljandi Culture Academy (HVVK) and Narva College (SVNC) (two regional colleges of the University of Tartu). In these institutes, the average wages are also relatively higher or lower than the average in the university. Therefore, if the market wages of their profession are high, some direct or indirect bargaining mechanism seems to allow academic staff to enforce higher wages in their institute than on average in the university.

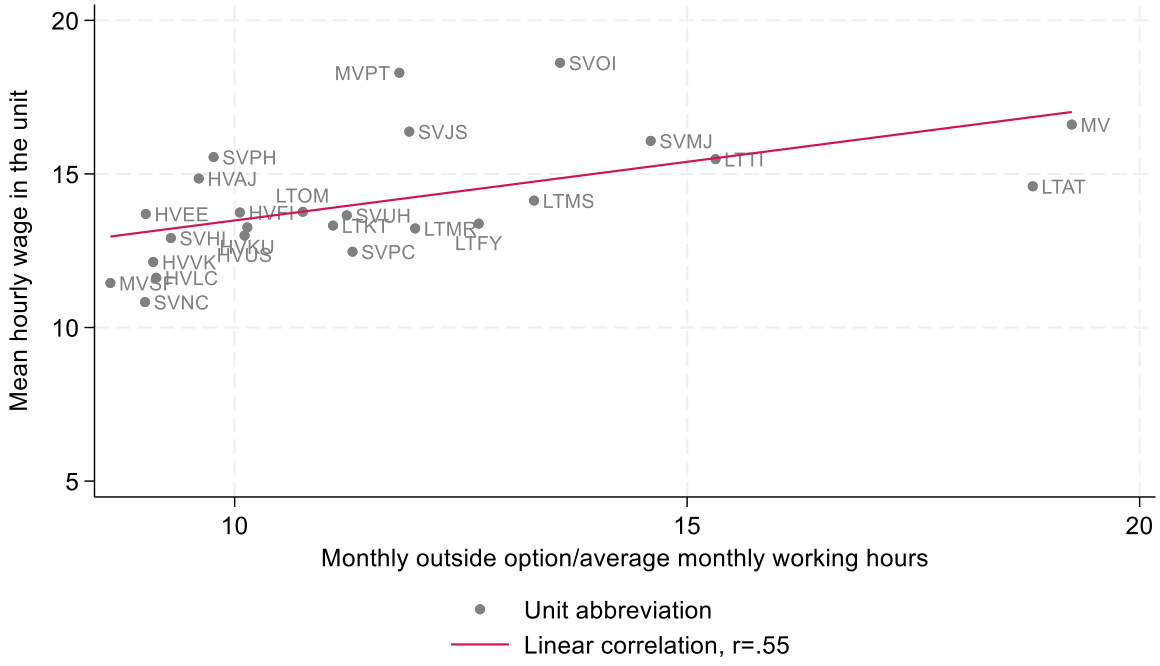

Figure 3. Correlation between the institute's average wage and the outside option of the institute's employees, 2021.
Source: Wages from administrative records of the University of Tartu, outside option wages from the national administrative wage data, TSD, national educational registry, EHIS, and national employment registry, TÖR.

[16] The administrative data on wages is based on Tax and Customs Board declarations of monthly labour income, TSD; the occupational code and working hours are obtained from the Tax and Customs Board employment register, TÖR; and educational information from the Ministry of Education register, EHIS. All the datasets used in this paper, except the administrative data from the University of Tartu, are available from Statistics Estonia, see https://www.stat.ee/en/find-statistics/request-statistics/use-confidential-data-scientific-purposes.

The role of bargaining in the gender pay gap is tested by adding the outside option wage to the wage regression in equation (1). To investigate whether the outside option affects men and women differently, equation (1) is also estimated separately for men and women without the gender variable.

5. RESULTS

5.1. Descriptive evidence on the gender pay gap in academia

Table 2 presents the results of estimates of equation (1). While the unconditional gender gap in hourly wages is 15.6% (note that the estimation without control variables is not shown in Table 2), it is not affected much by demographics or tenure but depends strongly on education and occupation. Obtaining a PhD and reaching a higher-ranked position is the main obstacle to women earning as much as men in academia; controlling for a PhD degree reduces the gap to 5%. Publications, citations, and teaching help to further explain the gender wage gap in academia; these performance variables explain an additional 2pp of the gap.

Controlling for occupation reduced the gender pay gap to a statistically insignificant level; therefore, within the same occupational group, there is no gendered discrimination by wage. However, without controlling for occupation and adding controls for research and teaching, a gender gap of 3% remains. Given that occupational rank is the primary determinant of wage level in the academic sector, this suggests that, conditional on the same research and teaching quality, women have slightly lower chances of getting promoted to occupations with higher pay. Therefore, it is crucial to understand what is preventing women from obtaining a PhD degree and reaching higher ranks in academia.

Table 2. Unconditional and conditional gender gap in wages, University of Tartu, 2012–2021

Dependent: log(real hourly wage)	(1) Demo-graphics	(2) Tenure	(3) Education	(4) Unit	(5) Occu-pation	(6) Publications and teaching
Male. base woman	0.123***	0.112***	0.053***	0.058***	0.005	0.031***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)
Age	0.043***	0.028***	0.011***	0.009***	0.009***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$(Age^2)/100$	-0.038***	-0.026***	-0.014***	-0.011***	-0.014***	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Citizenship, base Estonian						
baas Eesti	0.158***	0.162***	0.072***	0.050***	0.078***	0.084***
	(0.010)	(0.010)	(0.010)	(0.009)	(0.008)	(0.009)
One child, base no children	0.017**	0.018**	0.022***	0.006	0.015**	0.013**
	(0.008)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)
Two children, base no children	0.081***	0.077***	0.071***	0.055***	0.045***	0.057***
	(0.007)	(0.007)	(0.007)	(0.006)	(0.005)	(0.006)
At least three children, base no children	0.098***	0.095***	0.089***	0.073***	0.051***	0.061***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.006)	(0.007)
Tenure		0.016***	0.021***	0.021***	0.000	0.015***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$(Tenure^2)/100$		-0.033***	-0.034***	-0.035***	0.003	-0.024***
		(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
PhD, base no PhD			0.302***	0.333***	0.123***	0.263***
			(0.005)	(0.006)	(0.007)	(0.006)
PhD from abroad, PhD from Estonia or no PhD			0.118***	0.095***	0.048***	0.100***
			(0.008)	(0.008)	(0.006)	(0.007)

Dependent: log(real hourly wage)	(1) Demo-graphics	(2) Tenure	(3) Education	(4) Unit	(5) Occu-pation	(6) Publications and teaching
Number of SCOPUS publications						0.016***
						(0.002)
SCOPUS citations/100						0.000
						(0.001)
Project revenue100 thousand EUR yearly						0.057***
						(0.019)
PhD defences of students						0.176***
						(0.010)
BA and MA defences of students						0.012***
						(0.001)
Teaching load (standardised)						-0.006**
						(0.003)
Teaching feedback dummies						Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Unit FE	No	No	No	Yes	No	No
Occupation FE	No	No	No	No	Yes	No
Obs	20497	20497	20497	20497	20497	20497
R^2	0.218	0.227	0.356	0.441	0.542	0.438

Notes: Heteroscedasticity robust standard errors in parenthesis; *, ** and *** refer to statistical significance at 10, 5 and 1%.
Source: Authors calculations from administrative records.

The negative relationship between teaching load and salary is no longer statistically significant when occupation is included in the variables. Even after controlling for occupation, research activities and projects are positively related to hourly wages. Teaching feedback is included using five dummy variables that, among other things, compare those employees who do not teach with those who have taught but have not received feedback. For those who received feedback, the average score was coded using ranges (0–2.49), (2.5–2.99), (3–3.49), (3.5–4). Using dummies allows all observations to be kept in the sample, and the number of observations does not decrease. Academic employees who did not teach and those who did not receive any feedback do not have a statistically significant difference in pay, other characteristics being equal. Feedback in any of the listed ranges is associated with 6 to 9% higher pay compared to those who do not teach. Differences between these groups are mostly not statistically significant. In the subset of teaching academic employees, teaching feedback as a continuous characteristic did not further explain the wage gap and the coefficient of the characteristic was statistically insignificant.

5.2. Child penalty in academia

The results of the child penalty estimates are shown in the figures in the main text, and the tables with estimates from equation (1) are shown in the Appendix (Table A2 and Table A3). Figure 4 below indicates the child penalty in the yearly wages for men and women at the University of Tartu. There is a 65% decline in yearly wages one year after childbirth for women, while the child penalty for men is statistically insignificant. The child penalty for women starts to decrease fast, and by the third year after the birth of the first child, the penalty becomes statistically insignificant.

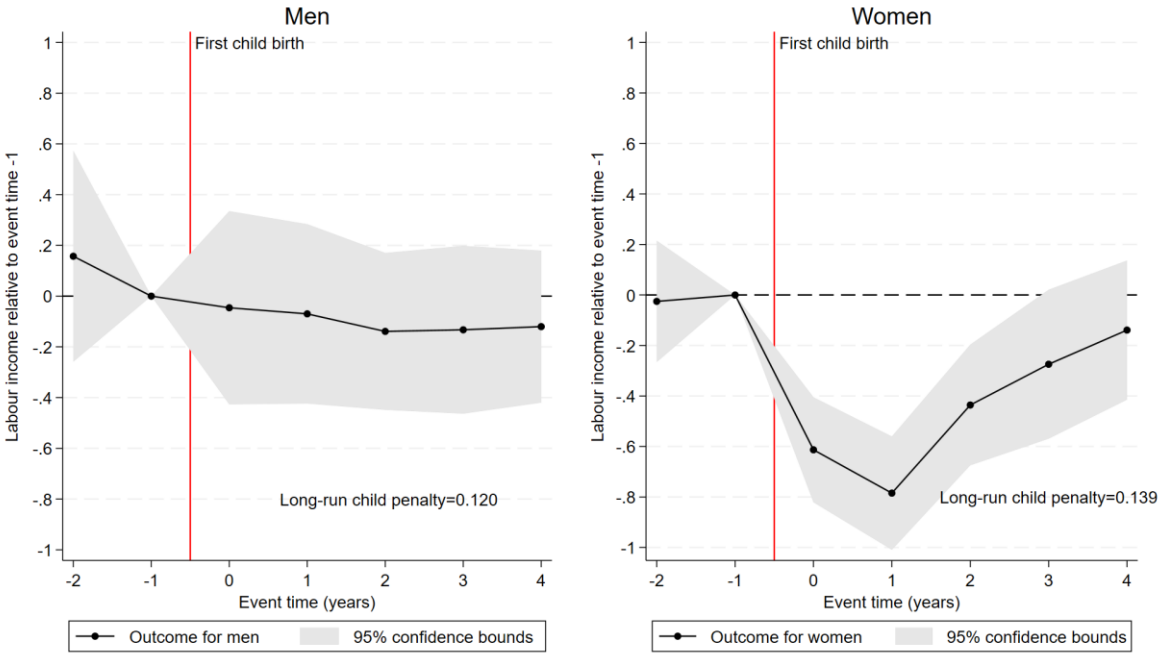

Figure 4. Child penalty in yearly wages in academia, 2012–2021.
Notes: The left panel shows the child penalty for men and the right the child penalty for women. The grey area refers to 95% confidence bounds.
Source: Authors' calculations from administrative records.

The short-lived penalty in academia starkly contrasts with the penalty in the whole population, where women still have 50% lower yearly wages four years after becoming a parent (see Figure A3 and Figure A3 in the Appendix). The initial size of the child penalty is very large and similar to estimations for Austria and Germany, while the recovery dynamics is fast and similar to the recovery estimated for Sweden (Kleven et al., 2019b). The fast recovery in the penalty within the first three years for the University of Tartu is likely a result of the generous parental leave policies in Estonia, as employers are obliged to guarantee a mother can return to her position up to three years after childbirth; the full pre-child wage is also covered for 18 months (see e.g. Masso et al., 2022). The child penalty in the subsample of women holding MA and PhD degrees in the whole population is more similar to the results for women at the University of Tartu (Figure A4 in the Appendix). On average, by the fourth year after the birth of their first child, all women with MA and PhD degrees are earning the wage they earned before becoming a mother. Such a result confirms that despite the relatively small and short sample of women in the University of Tartu, the results of our calculations are reliable.

The majority of the child penalty in yearly wages for women can be explained by the reduction in working hours in academia, while women's hourly wages have a slight short-lived drop for one year after childbirth (see Figure 5 below), and the drop is not statistically significant. This result is related to the wage system at the University of Tartu, which sets minimum wages for eight categories of workers (including administrative staff). These minimum wages are revised and increased regularly, and such a wage increase is mainly guaranteed to all employees, even to women on maternity leave.

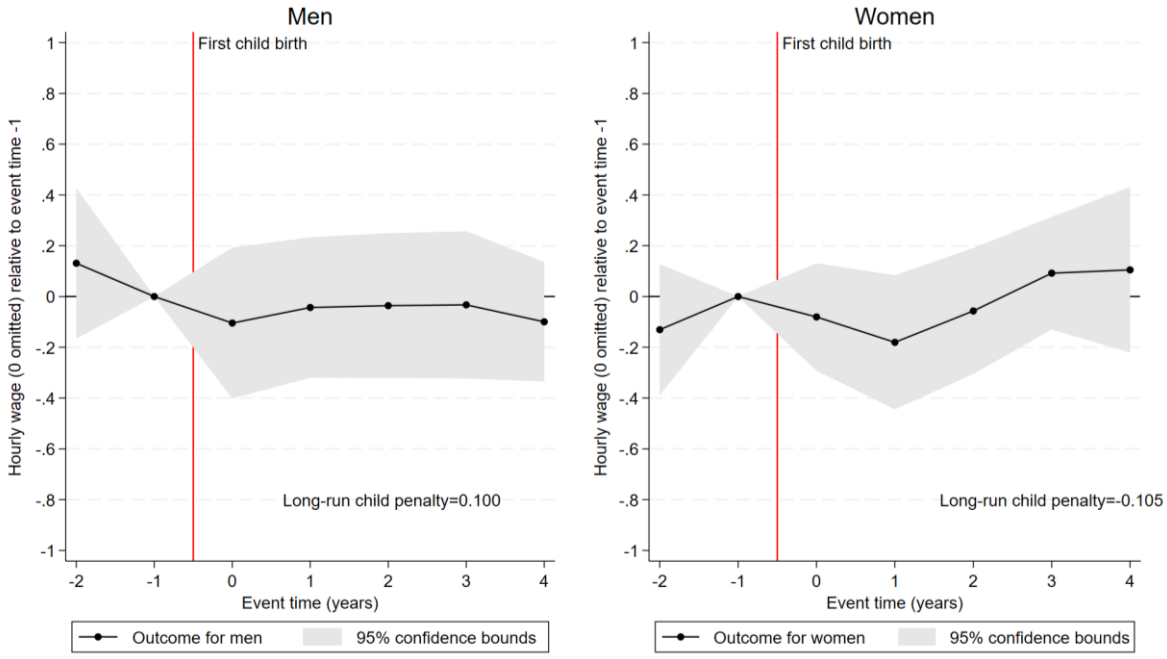

Figure A5

The dynamics of the child penalty in working hours is very close to that in yearly wages (see Figure 6). Our estimates indicate that women in academia have returned to the labour market four years after the birth of their first child and are working the same hours as before without a loss in hourly wages.

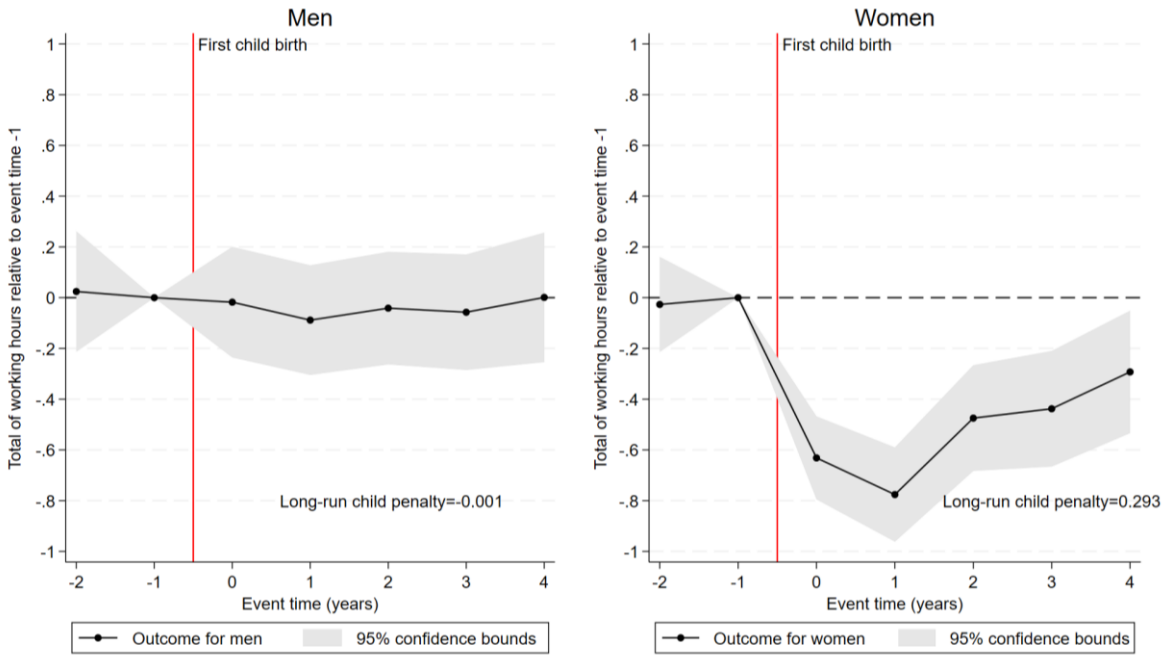

Figure 5. Child penalty in working hours in academia, 2012–2021.
Notes: The left panel shows the child penalty for men and the right the child penalty for women. The grey area refers to 95% confidence bounds.
Source: Authors' calculations from administrative records.

Figure A5 in the Appendix confirms the robustness of our findings for women based on a larger sample. Increasing the sample size by including the parents who could only be observed for

four years in a row around the birth of their first child[17] does not change the main result. The confidence interval for the child penalty for women in academia reaches very close to zero four years after childbirth due to the recovery of their working hours. For men, no penalty for any of the observed outcome variables can be detected.

While we do not observe any penalty in hourly wages for women working in academia, there is a substantial reduction in working hours up to four years after childbirth for women. This can represent slack for women progressing in the occupational rank, where academic promotion is directly related to publications and citations. Our estimates concerning publications and citations do not indicate any statistically significant effect on those performance indicators in our baseline estimates up to four years after childbirth (see Figure 6 and Figure 7); these results are thus different from those of Lutter and Schröder (2020). Increasing the sample size for the first four years as a robustness check does not change the results (see Figure A6). Still no statistically significant child penalty can be detected.

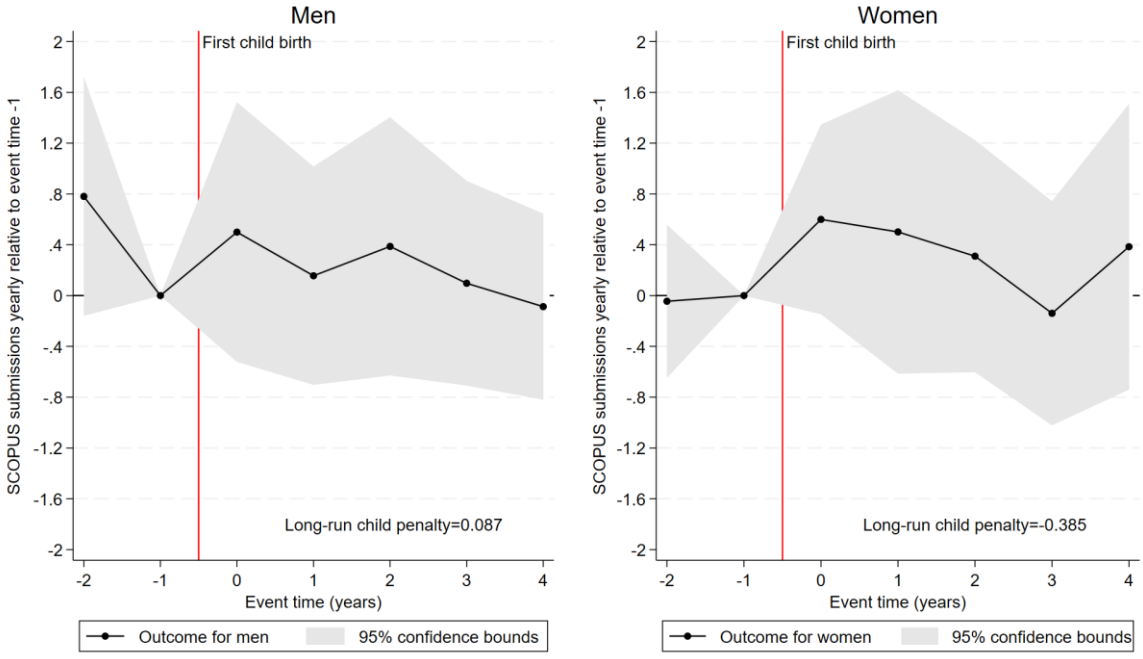

Figure 6. Child penalty in SCOPUS publications in academia, 2012–2021.
Notes: The left panel shows the child penalty for men, and the right shows the child penalty for women. The grey area refers to 95% confidence bounds.
Source: Authors' calculations from administrative records.

[17] Only those parents where the four-year period of observation started with (event–1) or (event–2) were included.

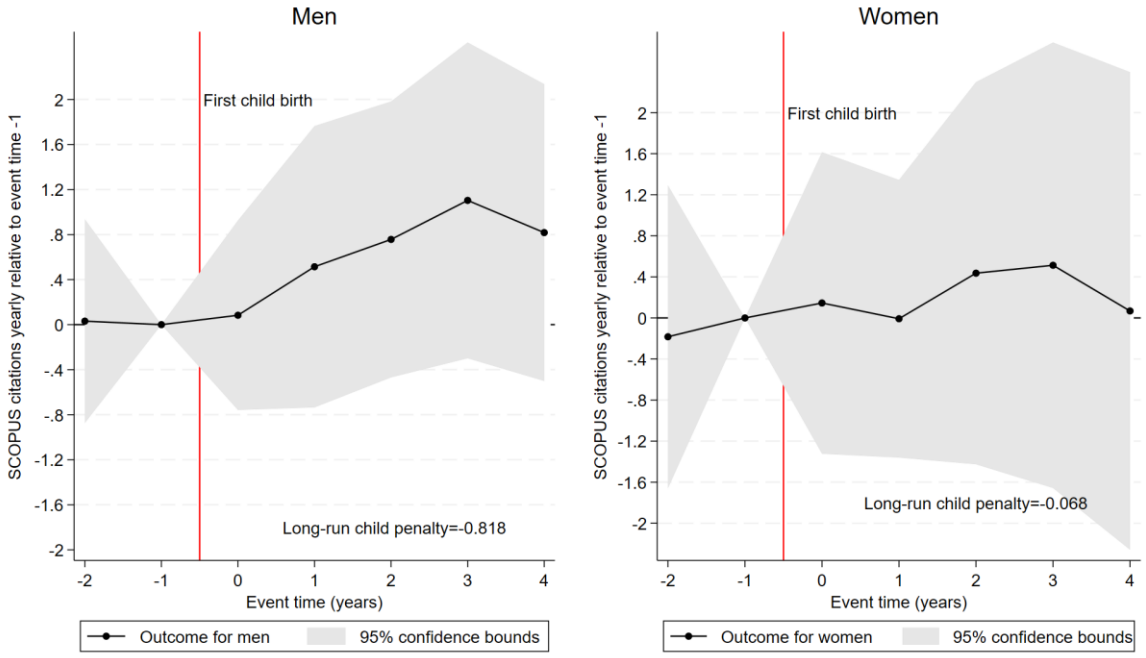

Figure 7. Child penalty in SCOPUS citations in academia, 2012–2021.
Notes: The left panel shows the child penalty for men, and the right shows the child penalty for women. The grey area refers to 95% confidence bounds.
Source: Authors' calculations from administrative records.

Given the reduction in working hours for women after childbirth, which is respectively about 60, 80, 40 and 20% fewer hours worked during the event year and three years after (Figure 5), women work on average 50% less for four years due to childbirth. This equals a loss of two years of full-time work and must also affect women's academic performance. Additionally, the estimation of the participation rate (see Figure 8) indicates that nearly 40% of women do not work at all for a whole year immediately after the birth of their first child. Considering the way academic work also aligns with the "up-or-out" system, the loss of working hours can partly explain why women do not progress to higher occupational ranks in academia and why there is a plateau in women's wages (but not in the wages of men) at the age of 35–45. However, we also note that confidence intervals are rather broad for publications and citations. That cannot be explained by the moderate sample size alone but is probably due to our methodological approach – we identify the effect over a sample of workers who became parents within the timespan of our sample of 10 years. It is likely that within this subgroup of workers there are no effects of parenthood on academic performance, while these effects would emerge compared to the whole set of workers who did not become parents within the window of 10 years.

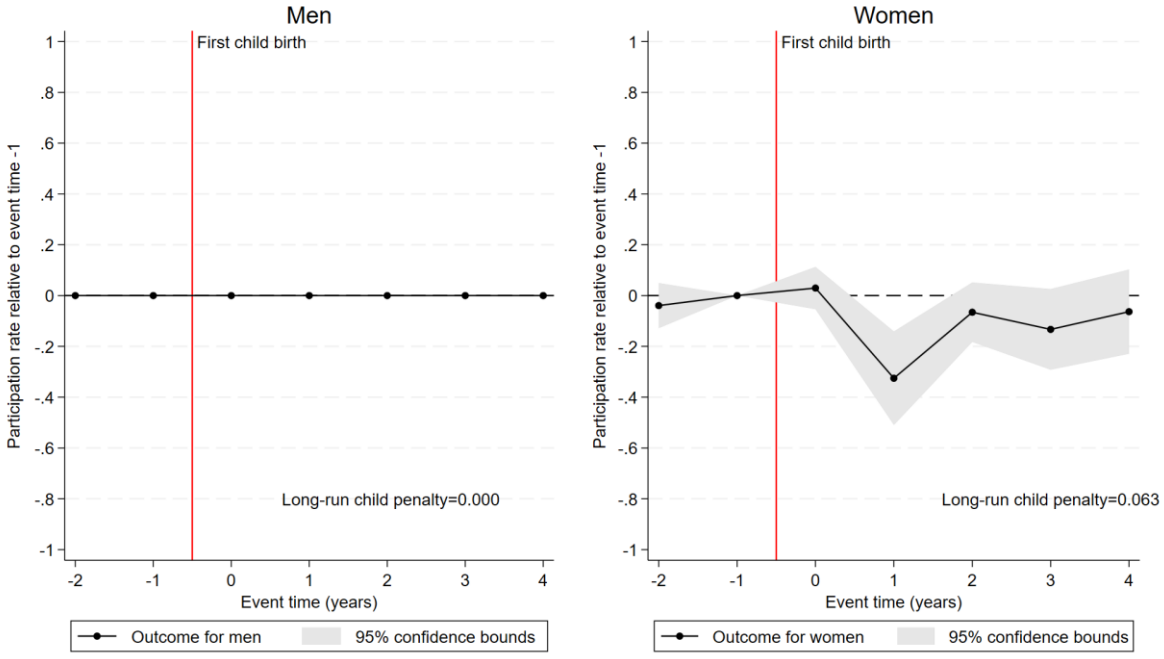

Figure 8. Child penalty in participation rate in academia, 2012–2021.
Notes: The left panel shows the child penalty for men, and the right shows the child penalty for women. The grey area refers to 95% confidence bounds.
Source: Authors' calculations from administrative records.

The robustness check using the difference in differences methodology confirms our conclusions of the event study. In Table A4, the average treatment effect of the treated is negative and statistically significant for women in the equations for labour income and working hours. The total negative effect in terms of yearly income of 7,932 euros is approximately 56% of the average yearly income of the control group, and the negative effect of 681 hours forms about 47% of the average yearly hours of the control group. The results of the dynamic difference in differences analysis are presented as plots of coefficients in Figure A7. The coefficients for *t–2* are close to zero, implying that no statistically significant differences can be found in the second year before the event compared to the moment of reference *t–1*. However, for women (red dots in the graph), labour income and working hours show a statistically significant drop in the years after the event; for income, the confidence intervals return to zero in *t+3* and for working hours in *t+4*. The duration of the effects is similar to the results from the event-study analysis. Again, there are no statistically significant differences, and thus, there is no child penalty in the hourly wages of women who work in academia. Raw averages of dependent variables in the treatment and control groups also indicate large drops for mothers in labour income and working hours (see Figure A8 in the Appendix). Such drops are not clear for the SCOPUS indicators, and the decline in hourly wages is rather small.

5.3. The role of bargaining in academia

The results for the role of bargaining on the gender pay gap in academia are shown in Table 3. We limit the sample to the year 2021 for this exercise, and the raw gap is lower, 10%, in this most recent sample year. Again, controlling for education reduces the gap substantially to 4%, and controlling for the quality of research and teaching reduces it further to 2%. Adding the outside option does not change the estimate of this conditional gender pay gap. As the outside option is an institute-level variable and the institute does not explain the gender wage gap in

academia, this result is not surprising. However, the effect of the outside option is very different for men and women. While a 1% higher outside option wage results in a 0.35% higher wage in academia for men, the effect is nearly 0.12 percentage points smaller for women. This means that a 1% higher outside option wage only results in a 0.23% higher wage for women in academia. In order to check the robustness of our result for the outside option, we have calculated three additional slightly altered versions of outside options (replacing the weighted average of medians with the weighted average of means etc). The coefficients for all versions remained relatively similar to our preferred specification (see also Table A5 in the Appendix).

Table 3. The effect of the outside option on wages in academia, 2021

Dependent: log(real hourly wage)	(1) Raw gap	(2) Base variables	(3) Base + productivity	(4) Outside option	(5) Outside option Men	(6) Outside option Women
Male, base woman	0.098***	0.042***	0.023*	0.023*		
	(0.015)	(0.013)	(0.012)	(0.012)		
Log(outside option[18])				0.282***	0.350***	0.233***
				(0.022)	(0.035)	(0.028)
Age		0.012**	0.010**	0.015***	0.018**	0.014**
		(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
(Age2)/100		-0.015***	-0.011**	-0.015***	-0.018***	-0.014**
		(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Tenure		0.017***	0.011***	0.009***	0.009**	0.008**
		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
(Tenure2)/100		-0.022***	-0.012*	-0.009	-0.003	-0.013*
		(0.007)	(0.007)	(0.007)	(0.010)	(0.008)
One child, base no children		0.006	0.005	-0.012	0.041	-0.048**
		(0.021)	(0.019)	(0.019)	(0.031)	(0.023)
Two children, base no children		0.064***	0.048***	0.030*	0.028	0.030
		(0.019)	(0.017)	(0.017)	(0.026)	(0.023)
Three or more children, base no children		0.052**	0.022	0.021	0.050*	0.002
		(0.021)	(0.019)	-0.012	0.041	-0.048**
PhD, base no PhD		0.290***	0.236***	0.226***	0.247***	0.202***
		(0.017)	(0.015)	(0.015)	(0.025)	(0.020)
PhD from abroad, PhD from Estonia or no PhD		0.120***	0.111***	0.125***	0.114***	0.134***
		(0.020)	(0.019)	(0.019)	(0.025)	(0.030)
Citizenship, base Estonian		0.005	0.003	-0.013	0.025	-0.056**
		(0.021)	(0.019)	(0.019)	(0.027)	(0.026)
Number of SCOPUS publications			0.019***	0.017***	0.014***	0.021***
			(0.003)	(0.003)	(0.004)	(0.004)
SCOPUS citations/100			0.000	-0.001	-0.002	0.006*
			(0.002)	(0.003)	(0.003)	(0.003)
Project revenue100 thousand EUR yearly			0.065***	0.066***	0.062***	0.088***
			(0.013)	(0.012)	(0.014)	(0.029)
PhD defences of students			0.188***	0.186***	0.176***	0.182***
			(0.028)	(0.028)	(0.041)	(0.035)

[18] Outside option is calculated as a median of weighted average wages of ISCO codes of graduates of the same institute, 0.5% of the highest and lowest values of each ISCO code removed

Dependent: log(real hourly wage)	(1) Raw gap	(2) Base variables	(3) Base + productivity	(4) Outside option	(5) Outside option Men	(6) Outside option Women
BA and MA defences of students			0.016***	0.021***	0.026***	0.016***
			(0.003)	(0.003)	(0.006)	(0.004)
Teaching load			0.005	0.008	0.009	-0.001
			(0.007)	(0.006)	(0.006)	(0.020)
Teaching feedback			Yes	Yes	Yes	Yes
N	2265	2265	2265	2094	1014	1080
R^2	0.018	0.297	0.407	0.409	0.419	0.393

Source: Authors calculations from administrative records.

Under the typical Oaxaca-Blinder type of decomposition, the role of bargaining would not emerge from the explained part, given that there are no significant differences in how men and women are distributed between high and low outside option institutes. Instead, the role of bargaining would appear in the unexplained part or in the differences in returns. Given that the differences between the coefficients for men and women in the last two columns of Table 3 are the largest for the bargaining coefficients, it is likely the most crucial part of the unexplained term in the gender pay gap. The returns for men from a higher outside option are much stronger than the returns for women. To control for the statistical significance of the difference in the coefficients in men's and women's equations, we use the technique for large samples proposed by Paternoster et al. (1998). We divide the difference of the two coefficients by the square root of the sum of the squared standard errors of the two coefficients and reach the z-score of 2.62. This corresponds to the one-tailed p= 1- 0.9956 = 0.004. Therefore, the coefficients for the outside option for men and women are also statistically significantly different in the two models.[19]

The positive correlation between the outside option and institute wage observed in Figure 3 seems to be, to a large extent, the result of the bargaining efforts of men. This finding is in line with the findings of Blackaby et al. (2005). We contribute by showing that this regularity holds for a wider set of institutes, and not just for economics, and by demonstrating that the bargaining channel can also be identified at the institute level without access to individual-level data on job offers.

6. CONCLUSIONS

This paper studies the child penalty and outside option as reasons for the gender wage gap in academia. Data from the largest research university in Estonia are used, and teaching and research performance are measured more accurately than in many earlier studies. Administrative data on childbirths are also derived from a national registry. The outside option is analysed by studying whether the wage in alternative non-academic jobs may affect male and female wages differently. We argue that these results would be important beyond academia, whereas academic jobs are just one example of jobs where the expectations of high commitment to a career may be detrimental to women's labour market performance.

[19] We also checked the differences of other coefficients and noticed that the difference in coefficients for the outside option are the largest. The second largest z-score was 2.32 for the dummy of having one child. The third largest z-score was 2.19 for the dummy of citizenship.

Our data clearly indicated that the gender wage gap in the raw data almost disappeared when controlling for occupation, showing that the reasons for the wage gap are very much related to women's disadvantages in academic career progression. However, given that the gender wage gap reduced from 16% to 3% when controlling for demographic variables, education and academic performance, the vast majority of the gender pay gap is due to these differences, and there are no large gender differences in promotion to higher positions.

In the current study, we report that the child penalty in academia is mainly visible in women's rather long drop in working hours after the first child is born. In contrast, there is no such negative effect for the sample of men who become parents for the first time while working in academia. Our estimates also indicate that women in academia have returned to the labour market four years after childbirth and are working the same hours as before without a loss in hourly wages. Compared to all women in the whole population of Estonia and their drop in yearly income after the birth of their first child, the loss of nearly two years of working hours for female academics is relatively small and comparable to the drop in yearly income of all female MA and PhD degree holders in Estonia. This highlights the importance of human capital investments in the materialisation of the child penalty for women, as female workers who have invested more in their education are also more likely to return quickly to the labour market.

Although our results hint at consequences related to scientific productivity, the first child's birth does not seem to result in significantly fewer publications or citations for women in academia. Our results differ from some earlier studies that adopt a different methodological approach by comparing mothers' outcomes with their own pre-motherhood performance and finding a child penalty in academic performance (Lutten and Schröder, 2020). While our sample university does not have a tenure-track system, our results suggest that academic work is similar to the work in "up-or-out" systems or the non-linear occupations in the related literature. Continuous hours seem to be important in these jobs. Therefore, women's lower academic ranks and the wage plateau at a certain age may be partly explained by the significant reduction in working hours after the birth of their first child. We also demonstrate that men are much better wage negotiators and get substantial wage premiums if the outside option wage of their institute is high. We observe a considerably lower premium for women.

Our study has a number of policy implications. First, academic mobility, which enables the reconciliation of work and family life, would be essential. In our data, women have lower academic mobility than men, which is present both during postgraduate studies and in their later academic careers. Second, there is some evidence of a gender bias in promotions. In particular, associate professorships requiring a doctorate are equally occupied by men and women, but men predominate in the progression to professorships. De Paola et al. (2017) show that in the Italian university system, women have a significantly lower (four percentage points) probability of applying for promotions related to their higher risk aversion, lower self-confidence, and fear of discrimination. Similar gender promotion gaps have been found in other fields, such as central banking (Hospido et al., 2022). Although we found no evidence of discrimination driving the gender wage gap, the 3% gender pay gap after conditioning on academic performance shows that there is room for improving equal opportunities for promotion.

Finally, our results on the academic sector (as well as earlier studies on the business sector) indicate the relevance of wage bargaining as the channel of the emergence of the pay gap. Therefore, better availability of information on both academia and alternative sectors might

help to reduce the gender pay gap as the information on outside option wages may not be equally available for males and females across different academic fields.

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APPENDICES

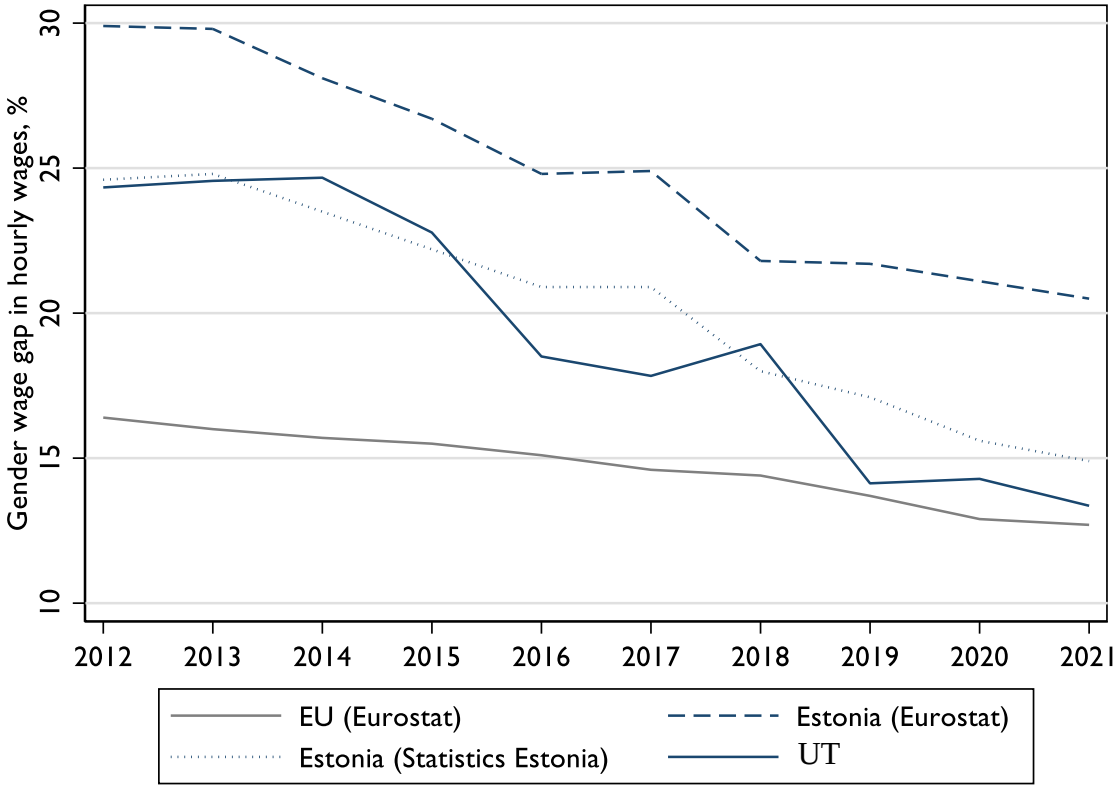


Figure A1. Gender wage gap at the University of Tartu and in the whole population, 2012–2021.
Source: Authors' calculations from administrative records; Eurostat table SDG_05_20; Statistics Estonia Table PA5335.

Figure A2. Wage profile by age in the whole population, 2012–2021.
Source: Authors calculations from administrative records.

Table A1. The most frequent occupations of graduates and outside options for institutes, 2021

Unit (institute) abbrievation	Unit (insitute) name	Hourly wage unit	Most frequent ISCO code	Label of the most frequent ISCO code	Weight of ISCO	Hourly wage ISCO	Outside option
HVAJ	Institute of History and Archaeology	14.85	2341	Primary School Teachers	0.21	9.43	9.60
HVEE	Institute of Estonian and General Linguistics	13.70	2643	Translators, Interpreters and Other Linguists	0.49	8.79	9.02
HVFI	Institute of Philosophy and Semiotics	13.75	2633	Philosophers, Historians and Political Scientists	0.18	10.71	10.06
HVKU	Institute of Cultural Research	13.26	2359	Teaching Professionals Not Elsewhere Classified	0.08	8.63	10.14
HVLC	Institute of Foreign Languages and Cultures	11.62	2643	Translators, Interpreters and Other Linguists	0.35	8.79	9.13
HVUS	School of Theology and Religious Studies	13.00	2636	Religious Professionals	0.29	7.69	10.11
HVVK	Viljandi Culture Academy	12.13	2341	Primary School Teachers	0.66	9.43	9.10
LTAT	Institute of Computer Science	14.60	2512	Software Developers	0.65	20.10	18.82
LTFY	Institute of Physics	13.38	2111	Physicists and Astronomers	0.33	11.90	12.70
LTKT	Institute of Chemistry	13.32	2113	Chemists	0.39	11.01	11.09
LTMR	Institute of Molecular and Cell Biology	13.23	2131	Biologists, Botanists, Zoologists and Related Professionals	0.41	11.31	12.00
LTMS	Institute of Mathematics and Statistics	14.13	2330	Secondary Education Teachers	0.23	10.07	13.31
LTOM	Institute of Ecology and Earth Sciences	13.77	2341	Primary School Teachers	0.17	9.43	10.75
LTTI	Institute of Technology	15.48	2512	Software Developers	0.33	20.10	15.31
MV	Faculty of Medicine in general, no	16.61	2212	Specialist Medical Practitioners	0.66	20.89	19.25
MVPT	Institute of Family Medicine and Public Health	18.30	2221	Nursing Professionals	0.50	10.95	11.82
MVSF	Institute of Sport Sciences and Physiotherapy	11.45	2264	Physiotherapists	0.51	9.35	8.63
SVHI	Institute of Education	12.91	2341	Primary School Teachers	0.42	9.43	9.30
SVJS	Johan Skytte Institute of Political Studies	16.38	2422	Policy Administration Professionals	0.21	13.88	11.93
SVMJ	School of Economics and Business Administration	16.08	2511	Systems Analysts	0.12	17.26	14.60
SVNC	Narva College	10.83	2341	Primary School Teachers	0.50	9.43	9.01
SVOI	School of Law	18.62	2619	Legal Professionals Not Elsewhere Classified	0.56	13.99	13.60
SVPC	Pärnu College	12.47	2431	Advertising and Marketing Professionals	0.10	12.50	11.30
SVPH	Institute of Psychology	15.55	2634	Psychologists	0.69	8.93	9.77
SVUH	Institute of Social Studies	13.65	2635	Social Work and Counselling Professionals	0.28	8.90	11.24

Source: Authors calculations from administrative records, ISCO code 2310 - University and Higher Education Teachers are omitted from calculations.

Table A2. Baseline regressions of child penalty in the academia, University of Tartu, 2012–2021

Men	(1) Labour income	(2) Participation rate	(3) SCOPUS citations	(4) SCOPUS submissions	(5) Working hours	(6) Hourly wage
Event –2	2249.417	0.000	1.334	1.000	32.708	1.247
	(3035.096)	(.)	(19.788)	(0.614)	(163.159)	(1.436)
Event 0	-708.990	0.000	3.888	0.658	-24.388	-1.167
	(3002.392)	(.)	(19.979)	(0.686)	(152.726)	(1.692)
Event +1	-1142.705	0.000	20.486	0.256	-127.437	-0.516
	(2951.856)	(.)	(25.390)	(0.719)	(158.808)	(1.682)
Event +2	-2579.226	0.000	30.885	0.630	-59.689	-0.446
	(2927.362)	(.)	(25.520)	(0.843)	(163.650)	(1.806)
Event +3	-2694.418	0.000	38.581	0.177	-84.222	-0.428
	(3427.934)	(.)	(25.019)	(0.749)	(170.552)	(1.927)
Event +4	-2523.396	0.000	35.322	-0.182	1.532	-1.450
	(3207.945)	(.)	(29.057)	(0.781)	(182.689)	(1.744)
N	247	247	253	253	253	221
R^2	0.282	.	0.233	0.160	0.175	0.431
Women	(1) Labour income	(2) Participation rate	(3) SCOPUS citations	(4) SCOPUS submissions	(5) Working hours	(6) Hourly wage
Event –2	-342.956	-0.039	-14.239	-0.063	-38.672	-1.207
	(1661.457)	(0.045)	(58.454)	(0.432)	(139.174)	(1.216)
Event 0	-8501.415***	0.028	12.258	0.731	-944.563***	-0.796
	(1471.993)	(0.040)	(63.077)	(0.464)	(124.799)	(1.067)
Event +1	-10619.909***	-0.305***	-0.867	0.457	-1124.590***	-2.068
	(1549.864)	(0.088)	(77.421)	(0.518)	(137.283)	(1.541)
Event +2	-6583.632***	-0.065	42.582	0.322	-721.548***	-0.678
	(1842.788)	(0.059)	(92.713)	(0.483)	(161.577)	(1.503)
Event +3	-4066.563*	-0.129	56.457	-0.150	-663.272***	0.992
	(2232.002)	(0.078)	(121.764)	(0.482)	(176.042)	(1.216)
Event +4	-2125.693	-0.059	8.531	0.345	-435.046**	1.030
	(2150.72	(0.079)	(148.658)	(0.515)	(183.020)	(1.628)
N	247	248	256	256	256	90
R^2	0.399	0.208	0.050	0.115	0.432	0.359

Standard errors in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01, year and age dummies were included in the models but are omitted from the output. Base (event–1)

Table A3. Baseline regressions of child penalty in the sample of all resident women in Estonia and MA and PhD degree holders, 2006–2022

	All women in Estonia		All women with MA or PhD degrees in Estonia	
	(1)	(2)	(3)	(4)
	Labour income	Participation rate	Labour income	Participation rate
Event -5	-1260.7***	-0.001	-4021.2***	-0.059*
	(250.8)	(0.014)	(1031.0)	(0.031)
Event -4	-955.5***	-0.012	-3377.6***	-0.052**
	(218.0)	(0.012)	(893.1)	(0.025)
Event -3	-608.2***	-0.020**	-2649.0***	-0.050**
	(180.4)	(0.010)	(736.4)	(0.019)
Event -2	-352.1***	-0.002	-1765.0***	-0.028**
	(128.2)	(0.007)	(513.8)	(0.013)
Event 0	-1861.8***	-0.072***	-2367.4***	-0.011
	(124.2)	(0.007)	(486.5)	(0.012)
Event 1	-7475.7***	-0.487***	-12504.3***	-0.373***
	(161.8)	(0.011)	(637.2)	(0.025)
Event 2	-7608.0***	-0.479***	-11704.9***	-0.396***
	(179.8)	(0.014)	(707.9)	(0.037)
Event 3	-5842.4***	-0.299***	-8067.5***	-0.236***
	(207.7)	(0.017)	(823.5)	(0.046)
Event 4	-4949.5***	-0.230***	-6694.8***	-0.167***
	(246.5)	(0.019)	(1011.4)	(0.053)
Event 5	-4666.9***	-0.191***	-5746.4***	-0.083
	(285.3)	(0.021)	(1190.0)	(0.058)
Event 6	-4570.8***	-0.168***	-5296.8***	-0.084
	(320.0)	(0.023)	(1342.2)	(0.061)
Event 7	-4425.0***	-0.155***	-4137.2***	-0.066
	(353.2)	(0.024)	(1482.5)	(0.065)
Event 8	-4381.3***	-0.144***	-3700.7**	-0.062
	(387.6)	(0.025)	(1633.2)	(0.068)
Event 9	-4515.7***	-0.140***	-4017.4**	-0.054
	(424.7)	(0.026)	(1792.7)	(0.071)
Event 10	-4606.3***	-0.122***	-3812.5**	-0.052
	(459.2)	(0.028)	(1942.1)	(0.073)
N	171352	171352	19405	19405
R^2	0.227	0.156	0.210	0.103

Notes: First child born in 2011 or 2012. Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, year and age dummies were included in the models but are omitted from the output. Base (event -1).
Source: Authors' calculations from administrative records.

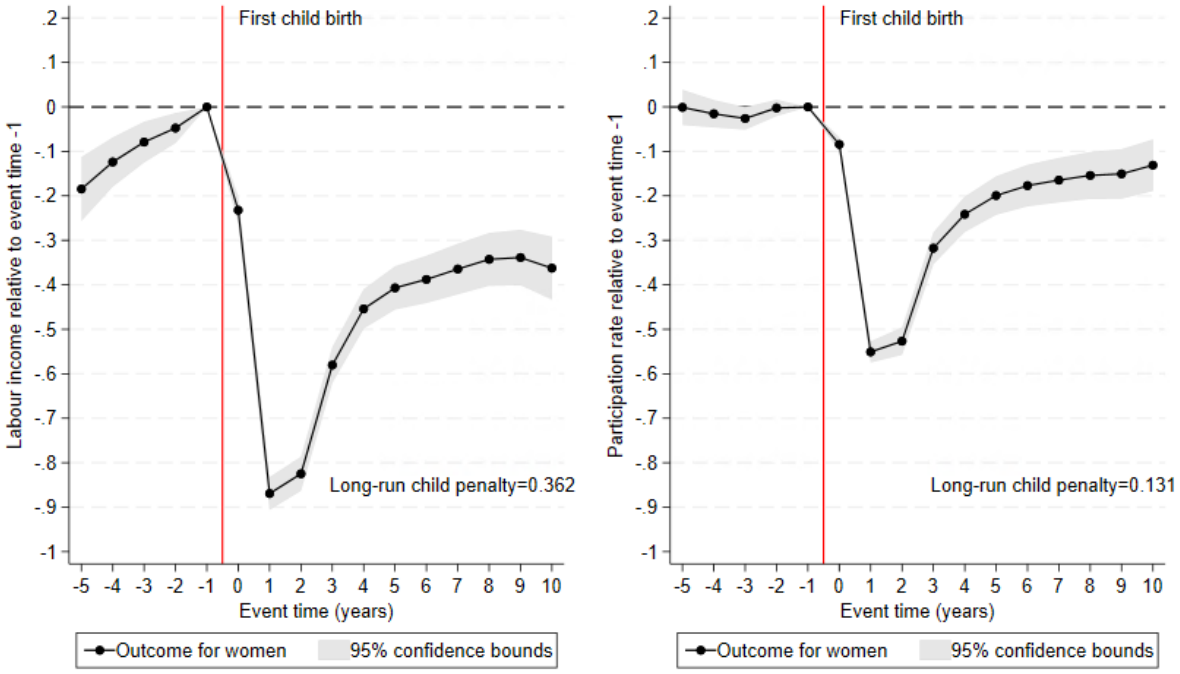


Figure A3. Child penalty in the whole population of women (Estonian residents), 2006–2022.
Notes: First child born in 2011 or 2012.
Source: Authors' calculations from administrative records.

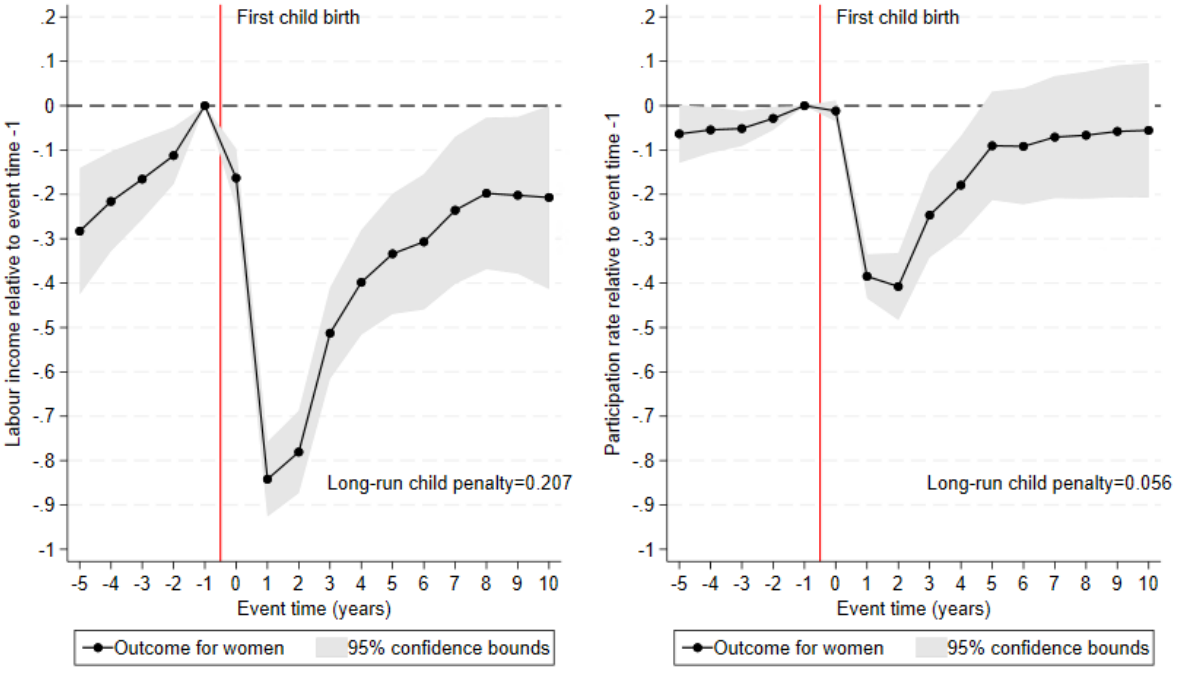


Figure A4. Child penalty in the whole population of women with MA an d PhD degrees, 2006–2022.
Notes: First child born in 2011 or 2012.
Source: Authors' calculations from administrative records.

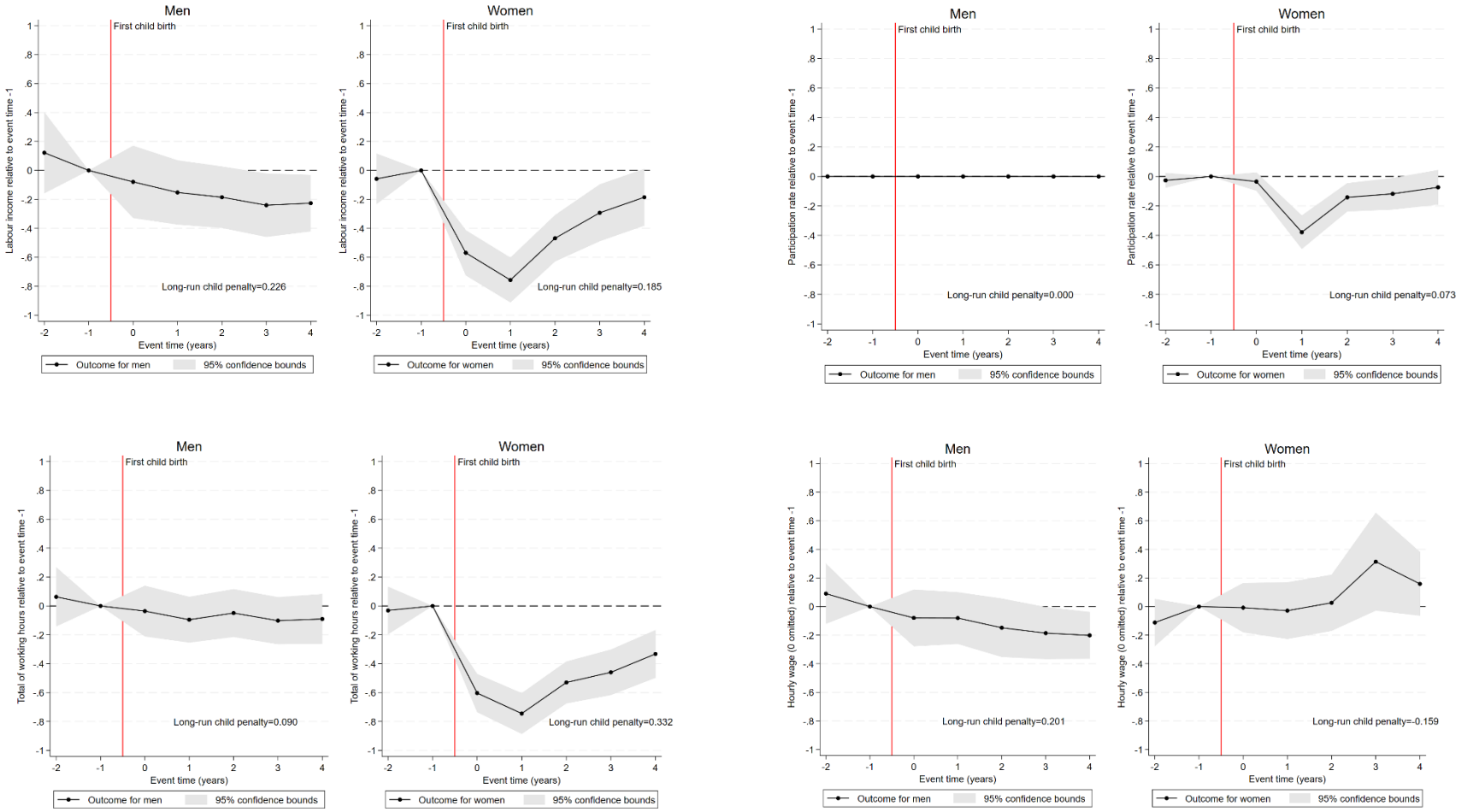


Figure A5. Event study estimates for labour income and hours with a larger sample.
Notes. Employees with at least 4 observations included, additional condition: each person is observed at (event–1).

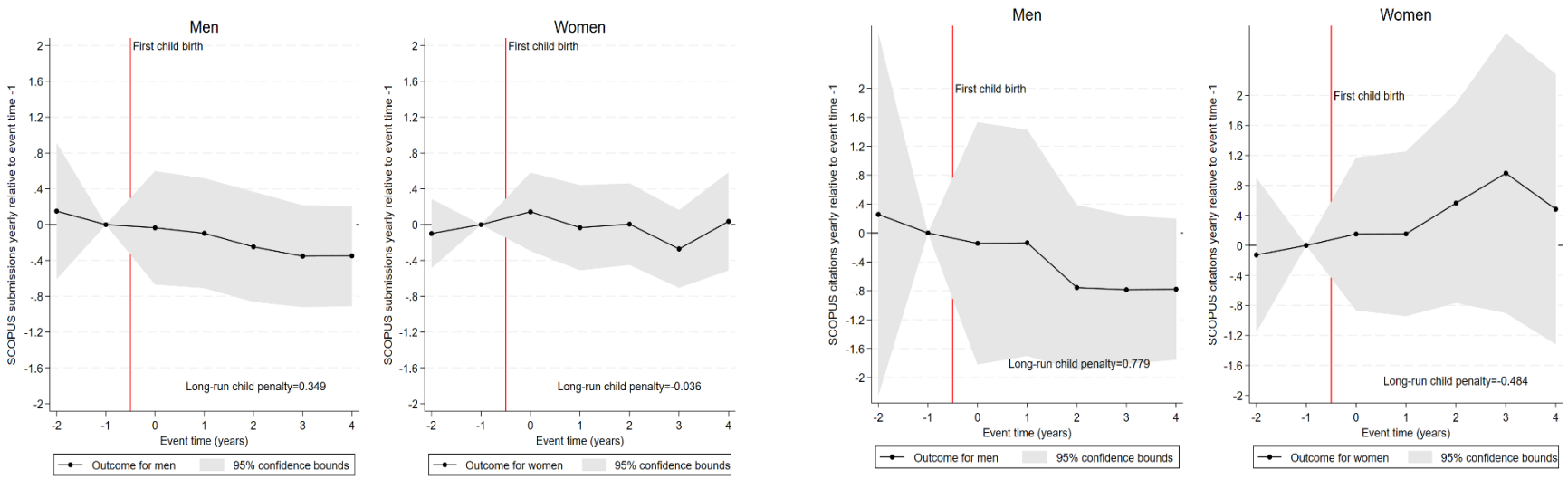


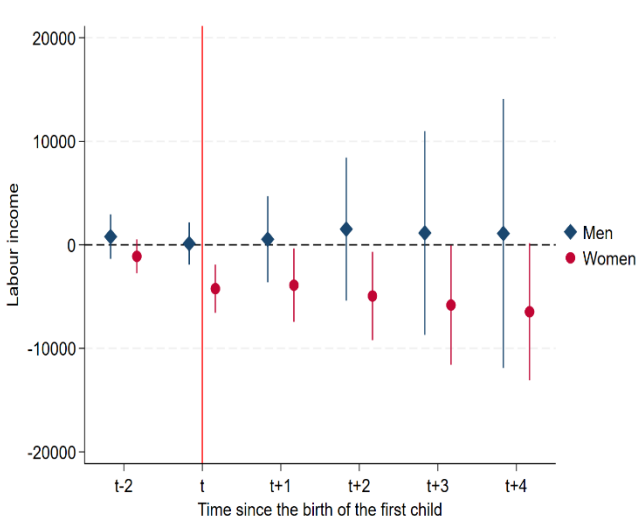
Figure A6. Event study estimates for SCOPUS indicators with a larger sample.
Note. Employees with at least 4 observations included, additional condition: each person is observed at (event–1).

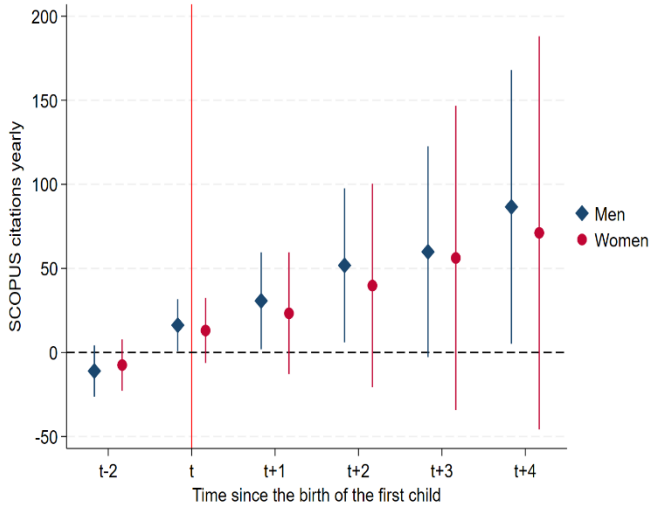
Table A4. Difference in diffences estimation of the effect of the birth of the first child, University of Tartu, 2012–2021

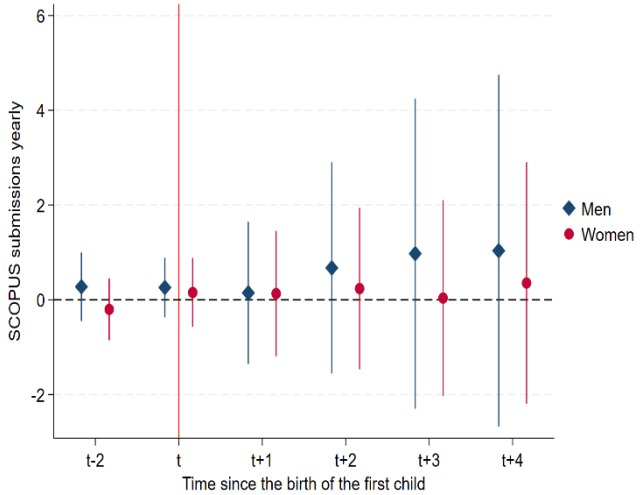
	Labour income		SCOPUS citations		SCOPUS submissions		Number of working hours		Hourly wage	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Treated (base not treated)	152.698	1010.480	11.551	33.312	-0.613	0.420	-48.716	-165.797	1.216	2.075**
	(1872.064)	(1967.708)	(15.417)	(29.404)	(0.385)	(0.516)	(165.832)	(131.227)	(0.863)	(0.957)
Post-treatment (base pre-treatment years)	167.126	350.332	18.462	26.505*	0.217	0.272	-79.847	28.769	0.841	0.001
	(1331.721)	(1673.699)	(18.613)	(13.749)	(0.518)	(0.538)	(83.459)	(61.965)	(0.623)	(0.878)
Treated × post-treatment	-7932.898***	-534.492	-3.447	3.804	0.277	-0.350	-680.864***	8.160	-1.574	0.233
	(1765.821)	(1885.193)	(16.401)	(11.595)	(0.404)	(0.507)	(145.267)	(68.602)	(0.979)	(0.868)
Age	-316.913	1520.596	-6.331	2.972	-0.527*	-0.430	66.271	104.801*	-0.264	0.738
	(1285.859)	(1614.079)	(15.968)	(11.555)	(0.275)	(0.627)	(101.172)	(54.322)	(0.679)	(1.050)
$(Age^2)/100$	198.638	-1806.841	3.056	-1.465	0.507	0.518	-98.267	-124.336*	0.286	-0.771
	(1751.462)	(1922.455)	(20.894)	(14.479)	(0.353)	(0.776)	(128.596)	(65.149)	(0.907)	(1.230)
Tenure	114.882	-117.449	2.728	2.325	0.107	0.043	37.313**	-12.053	-0.176*	0.158
	(217.672)	(361.005)	(3.360)	(4.104)	(0.069)	(0.123)	(15.821)	(16.119)	(0.093)	(0.186)
Citizenship, base Estonian	4062.673	-721.066	74.792**	58.769**	0.575	2.568**	-13.474	-171.879	4.044***	1.748
	(4203.836)	(3720.675)	(31.958)	(28.341)	(0.749)	(1.163)	(246.557)	(103.647)	(0.971)	(2.806)
PhD, base no PhD	2973.961***	-2037.419	3.118	58.809	0.627*	1.781**	326.036***	-254.361	0.480	1.865
	(884.054)	(3915.077)	(18.784)	(45.711)	(0.359)	(0.869)	(95.405)	(250.275)	(0.601)	(2.421)
PhD from abroad, PhD from Estonia or no PhD	-4872.683***	5448.804	-48.362**	-26.660	-0.575	-0.129	-429.670***	193.963	-0.263	1.593
	(1445.010)	(4224.287)	(22.537)	(37.639)	(0.410)	(0.629)	(131.598)	(125.791)	(1.039)	(2.681)
Arts and humanities	-3448.829***	14411.695***	20.444	56.645	-0.599*	3.379***	-260.382*	959.146***	-0.439	-3.400
	(1254.214)	(2974.356)	(13.430)	(34.710)	(0.325)	(1.172)	(145.717)	(104.069)	(0.857)	(2.545)
Science and technology	2466.889*	17948.659***	92.332***	153.176***	0.797	6.430***	131.776	1009.846***	1.308**	-1.929
	(1242.924)	(3917.560)	(30.352)	(48.833)	(0.530)	(1.689)	(97.437)	(139.940)	(0.638)	(2.344)
Medicine	958.213	14634.606***	59.306***	67.986***	0.981	4.513***	173.644	727.697**	-1.005*	-1.828

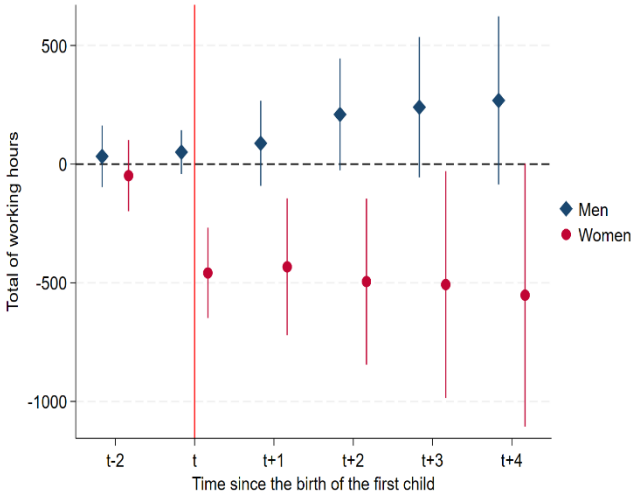
	Labour income		SCOPUS citations		SCOPUS submissions		Number of working hours		Hourly wage	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
	(1518.461)	(4138.624)	(21.205)	(24.901)	(0.634)	(1.432)	(113.023)	(345.369)	(0.576)	(2.361)
Social sciences	0.000	15920.405***	0.000	130.967**	0.000	5.938***	0.000	742.292***	0.000	0.000
	(.)	(5942.773)	(.)	(56.436)	(.)	(1.703)	(.)	(275.698)	(.)	(.)
R2* – recognised researcher (base R1*)	4223.812***	4949.659*	31.453**	9.057	0.733	0.864	145.741	542.080***	2.567***	-2.951
	(1208.212)	(2677.825)	(15.013)	(19.050)	(0.465)	(0.575)	(118.819)	(168.078)	(0.668)	(3.791)
R3 – established researcher (base R1*)	10011.692***	11280.274***	92.985***	53.853**	1.491**	2.052*	114.049	646.895***	6.618***	-0.980
	(1694.132)	(3592.946)	(31.469)	(25.114)	(0.643)	(1.096)	(147.961)	(212.936)	(0.913)	(4.246)
R4 – leading researcher (base R1*)	22837.943***	26472.909***	57.147*	8.540	0.512	0.129	486.681*	744.429***		6.582
	(2609.357)	(5496.134)	(29.271)	(58.842)	(0.812)	(1.323)	(279.705)	(226.181)		(5.630)
N	310	377	310	377	310	377	310	377	224	343
R^2	0.568	0.522	0.332	0.339	0.207	0.286	0.472	0.313	0.582	0.511

Clustered standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01, year dummies included in the model but omitted from the table.
Note: R1 – first stage researcher: junior research fellow, junior lecturer, teacher. R2 – recognised researcher: lecturer, research fellow. R3 – established researcher: associate professor. R4 – leading researcher: professor.









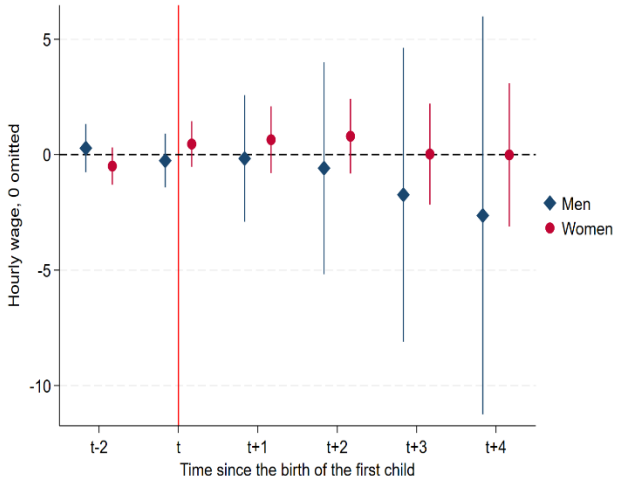


Figure A7. Dynamic difference in differences estimation of the effect of the birth of the first child, coefficients from the models for men and women, base (event – 1).

Notes. All models include the same control variables as the static difference in differences estimation in Table A4.

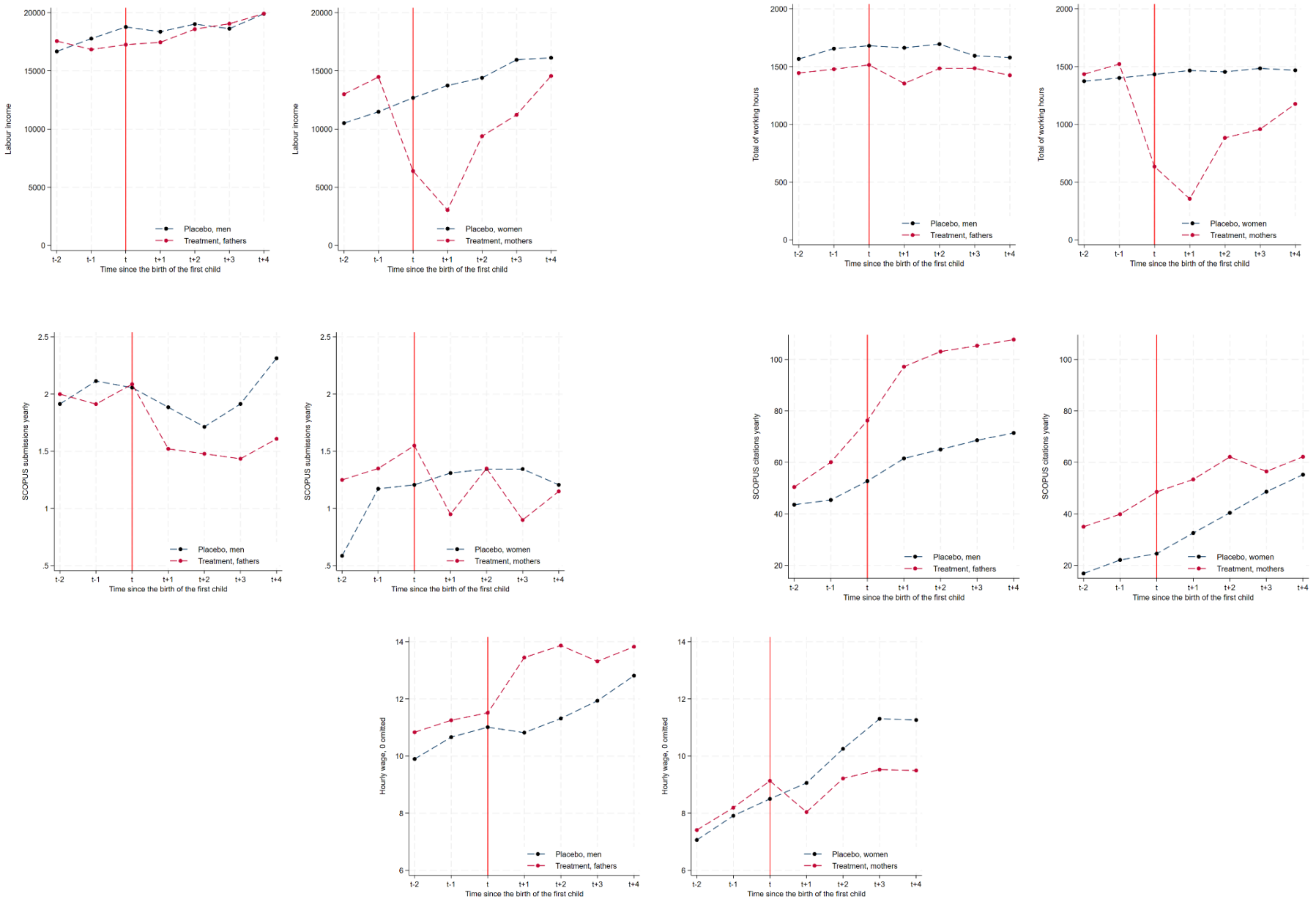


Figure A8. Raw averages of yearly labour income, working hours, SCOPUS submissions and citations and hourly wage for treated and not treated employees.

Table A5. Robustness check, outside options as weighted average of means of ISCO occupations (outside option 1), as weighted average of means of ISCO occupations 0.5% of the highest and lowest values removed (outside option 2), or as weighted average of medians of ISCO occupations (outside option 3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable log hourly wage in 2021	Outside option 1	Outside option 1 Men	Outside option 1 Women	Outside option 2	Outside option 2 Men	Outside option 2 Women	Outside option 3	Outside option 3 Men	Outside option 3 Women
Male, base woman	0.023*	0.000	0.000	0.023*	0.000	0.000	0.023*	0.000	0.000
	(0.012)	(.)	(.)	(0.012)	(.)	(.)	(0.012)	(.)	(.)
Log(outside option 1)	0.270***	0.337***	0.223***						
	(0.021)	(0.034)	(0.027)						
Log(outside option 2)				0.272***	0.339***	0.224***			
				(0.021)	(0.035)	(0.027)			
Log(outside option 3)							0.282***	0.349***	0.232***
							(0.022)	(0.035)	(0.028)
Age	0.015***	0.018***	0.014**	0.015***	0.018***	0.014**	0.015***	0.018**	0.014**
	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)
(Age^2)/100	-0.015***	-0.018***	-0.014**	-0.015***	-0.018***	-0.014**	-0.015***	-0.018***	-0.014**
	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)
Tenure	0.008***	0.008**	0.008**	0.008***	0.008**	0.008**	0.009***	0.009**	0.008**
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
($Tenure^2$)/100	-0.009	-0.003	-0.013*	-0.009	-0.003	-0.013*	-0.009	-0.003	-0.013*
	(0.007)	(0.010)	(0.008)	(0.007)	(0.010)	(0.008)	(0.007)	(0.010)	(0.008)
One child, base no children	-0.012	0.041	-0.048**	-0.012	0.041	-0.048**	-0.012	0.042	-0.048**
	(0.019)	(0.031)	(0.023)	(0.019)	(0.031)	(0.023)	(0.019)	(0.031)	(0.023)
Two children, base no children	0.030*	0.028	0.030	0.030*	0.028	0.030	0.030*	0.028	0.030
	(0.017)	(0.026)	(0.023)	(0.017)	(0.026)	(0.023)	(0.017)	(0.026)	(0.023)
Three or more children, base no children	0.022	0.050*	0.003	0.022	0.050*	0.002	0.021	0.050*	0.002
	(0.019)	(0.030)	(0.025)	(0.019)	(0.030)	(0.025)	(0.019)	(0.030)	(0.025)
PhD, base no PhD	0.224***	0.245***	0.201***	0.224***	0.245***	0.201***	0.226***	0.248***	0.202***
	(0.015)	(0.025)	(0.020)	(0.015)	(0.025)	(0.020)	(0.015)	(0.025)	(0.020)
PhD from abroad, PhD from Estonia or no PhD	0.125***	0.114***	0.134***	0.125***	0.114***	0.134***	0.125***	0.114***	0.134***
	(0.019)	(0.025)	(0.030)	(0.019)	(0.025)	(0.030)	(0.019)	(0.025)	(0.030)
Citizenship, base Estonian	-0.012	0.027	-0.056**	-0.012	0.027	-0.056**	-0.013	0.025	-0.056**
	(0.019)	(0.026)	(0.026)	(0.019)	(0.026)	(0.026)	(0.019)	(0.027)	(0.026)
Number of SCOPUS	0.017***	0.014***	0.021***	0.017***	0.014***	0.021***	0.017***	0.014***	0.021***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
SCOPUS citations/100	-0.001	-0.002	0.006*	-0.001	-0.002	0.006*	-0.001	-0.002	0.006*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable log hourly wage in 2021	Outside option 1	Outside option 1 Men	Outside option 1 Women	Outside option 2	Outside option 2 Men	Outside option 2 Women	Outside option 3	Outside option 3 Men	Outside option 3 Women
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Project revenue100 thousand	0.066***	0.062***	0.088***	0.066***	0.062***	0.088***	0.066***	0.062***	0.088***
	(0.012)	(0.014)	(0.029)	(0.012)	(0.014)	(0.029)	(0.012)	(0.014)	(0.029)
PhD defences of students	0.186***	0.176***	0.182***	0.186***	0.176***	0.182***	0.186***	0.176***	0.182***
	(0.028)	(0.041)	(0.035)	(0.028)	(0.041)	(0.035)	(0.028)	(0.041)	(0.035)
BA and MA defenses of students	0.021***	0.026***	0.016***	0.021***	0.026***	0.016***	0.021***	0.026***	0.016***
	(0.003)	(0.006)	(0.004)	(0.003)	(0.006)	(0.004)	(0.003)	(0.006)	(0.004)
Teaching load	0.008	0.009	-0.001	0.008	0.009	-0.001	0.008	0.009	-0.001
	(0.006)	(0.006)	(0.020)	(0.006)	(0.006)	(0.020)	(0.006)	(0.006)	(0.020)
Teaching feedback	0.197	0.239	0.014	0.197	0.239	0.014	0.196	0.238	0.012
	(0.174)	(0.200)	(0.033)	(0.174)	(0.200)	(0.033)	(0.174)	(0.200)	(0.033)
Feedback (2.5, 3], base [0, 2.5]	0.036	0.034	0.033	0.036	0.034	0.033	0.035	0.033	0.032
	(0.035)	(0.053)	(0.043)	(0.035)	(0.054)	(0.043)	(0.035)	(0.054)	(0.043)
Feedback (3, 3.5], base [0, 2.5]	0.047***	0.033	0.059**	0.048***	0.033	0.060**	0.047***	0.033	0.059**
	(0.018)	(0.026)	(0.026)	(0.018)	(0.026)	(0.026)	(0.018)	(0.026)	(0.026)
Feedback (3.5, 4], base [0, 2.5]	0.079***	0.078***	0.085***	0.079***	0.078***	0.085***	0.078***	0.077***	0.085***
	(0.017)	(0.025)	(0.023)	(0.017)	(0.025)	(0.023)	(0.017)	(0.025)	(0.023)
No teaching or no feedback	-0.018	-0.076	0.030	-0.018	-0.076	0.030	-0.019	-0.076	0.028
	(0.037)	(0.051)	(0.053)	(0.037)	(0.051)	(0.053)	(0.036)	(0.050)	(0.052)
N	2094	1014	1080	2094	1014	1080	2094	1014	1080
R^2	0.447	0.465	0.427	0.447	0.465	0.427	0.448	0.466	0.427

Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$,

KOKKUVÕTE

Mis määrab ära soolise palgalõhe suuruse akadeemilises sektoris?

Soolise palgalõhe vähenemine ajas arenenud riikides, aga ka selle vähenemisprotsessi teatav aeglustumine on erialakirjanduses hästi dokumenteeritud faktid. On täheldatud erinevaid palgalõhe tegureid nagu näiteks erinevused inimkapitalis, perekondlikud tegurid sh laste sündimine peresse, psühholoogilised tegurid nagu valmisolek palgaläbirääkimisteks jm. Nende tegurite roll soolise palgalõhe selgitamisel on sektorite lõikes erinev. Siit tuleneb ka vajadus analüüsida soolist palgalõhet võttes arvesse sektori spetsiifikast tulenevaid tegevusi ja nende mõõtmise võimalusi. Töötulemuste objektiivne mõõtmine loob vajaliku aluse töötajate edutamise otsuste kujundamiseks ning töötajatele uute tööhõivevõimaluste pakkumiseks.

Akadeemilist sektorit töökeskkonnana iseloomustab järjest kasvav konkurents ning karjääriredelil edasi liikumiseks eeldatakse töötamist suure pühendumusega. Perekondlikud põhjused nagu laste saamine võivad oluliselt mõjutada karjääriredelil edasi liikumist ning seega ka palkasid ja võimalikku soolist palgalõhet. Laste saamine võib olla piiranguks naiste edasi liikumisele karjääriredelil ning seetõttu võivad naised ka oma esimese lapse sündimist edasi lükata või laste saamisest üldse loobuda.

Käesolevas artiklis keskendutakse kahele mehhanismile, mis võivad selgitada soolise palgalõhe tekkimist ja ka püsivust akadeemias – laste saamisega seonduv palgakaotus (ehk vanemluslõiv) ja palgaläbirääkimised. Uurimistööks vajalikud andmed töötajate kohta on pärit Tartu Ülikooli andmebaasidest aastatest 2012-2021. Rahvastikuregistri andmetest on lisatud info bioloogiliste laste sünniaastate kohta. Akadeemilises sektoris saab töötajate tootlikkust (tööviljakust) hinnata teadus- ja õppetöö näitajate kaudu, mis tänu erinevate teadus- ja õppetööd iseloomustavatele andmebaasidele on suhteliselt hästi dokumenteeritud ja usaldusväärsed. Töötajate publikatsioone ja tsiteeringuid on käesolevas artiklis analüüsitud tootlikkuse näitajatena akadeemias ning Tartu Ülikooli töötajate andmebaasi on näitajad lisatud SCOPUS-e andmebaasist. Uurimismeetodina on kasutatud andmete analüüsil Kleven et al. (2019a) kvaasi-eksperimentaalset lähenemist, et arvutada välja laste sündimisega seotud palgakaotus, aga ka laste saamisega kaasnevat võimalikku töötundide ja töö tulemuslikkuse vähenemist. Palgaläbirääkimiste rolli hindamiseks soolise palgalõhe tegurina on Tartu Ülikooli instituutide tasandil täiendavalt välja arvutatud hinnangud akadeemilise sektori välistele palkadele.

Tartu Ülikoolis on soolise palgalõhe viimase kümne aasta jooksul olnud langustrendis sarnaselt kogu Eesti soolise palgalõhega. Kui uuritud perioodi alguses ulatus sooline lõhe Tartu Ülikooli akadeemiliste töötajate tunnipalkades 25%-ni, siis perioodi lõpuks oli see langenud alla 15%. Uurides palkade ja palgalõhega seotud tegureid Minceri palgavõrrandiga, osutus muuseas, et kui lisaks teistele tunnustele arvestada ametialasid (nt professor, lektor vms), siis palgalõhe kaob, s.t. oluliseks küsimuseks on naiste karjäärivõimalused. Näiteks doktorikraadi eeldaval kaasprofessori ametikohal töötab võrdselt mehi ja naisi, kuid sealt edasi professori ametikohani jõuavad valdavalt mehed. Kuigi laste saamisega ei pruugi kaasneda naiste tunnipalga langust, toob see sageli kaasa naiste töötundide vähenemise. Uuringust selgub, et nelja aasta jooksul pärast lapse sündimist väheneb uute emade keskmine töötundide arv ulatuses, mis võrdub kahe aasta pikkuse täistööajaga töötamisega. Võrreldes laste sündimisega kaasnevaid mõjusid naiste palkadele Eestis tervikuna ja akadeemilises sektoris, nähtub, et akadeemilistes sektoris on laste sündimise mõju naiste töötundidele lühema kestusega. Laste sündimise statistiliselt olulist seost naiste publikatsioonide ja tsiteeringute arvuga tuvastada ei õnnestunud. Meessoost

akadeemiliste töötajate puhul ei tuvastatud samas statistilist olulist seost perre sündiva lapse ja meeste palkade ega töötundide ega ka publikatsioonide-tsiteeringutega. Võib arvata, et naiste kehvemad läbirääkimisoskused võivad olla üheks oluliseks teguriks selgitamaks soolist palgalõhet akadeemilises sektoris. Uurimistulemustest nähtub nimelt, et konkreetse instituudi (s.t. küllaltki kitsalt defineeritud akadeemilise eriala) kõrgem akadeemilise sektori väline palgatase on positiivselt seotud meeste palgaga Tartu Ülikoolis, samas naiste palga puhul sellist seost ei ilmne.

Uuringu tulemustele tuginedes saab järeldada, et akadeemilises sektoris soolise palgalõhe vähendamiseks tuleb senisest enam tähelepanu pöörata ametikohtade soolise segregatsioonile ning toetada naiste liikumist madalapalgalistelt doktorikraadi mitte-eeldavatelt ametikohtadelt kõrgemapalgalisetele doktorikraadi eeldavatele ametikohtadele. Seega vaja on senisest veelgi enam toetada naiste võimalusi doktorikraadi saamiseks. Samuti on oluline õpetamise „tulususe“ suurendamine palgasüsteemis, sest naised töötavad sagedamini suurema õpetamiskoormusega ametikohtadel. Lähtudes läbirääkimiste kanali olulisusest võib soolise palgalõhe vähendamisele kaasa aidata nii akadeemilist kui ka teisi sektoreid puudutava teabe parem kättesaadavus töötajate, kuna informatsioon võimalike alternatiivsete töökohtade ja nende palgatasemete kohta ei pruugi olla meestele ja naistele erinevates akadeemilistes valdkondades võrdselt kättesaadav.