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Exploring gender and geographic wage inequalities based on full career sequences

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ABSTRACT
Substantive literature examined the gender wage gap, its components and how it changes over time. The decisions that workers make in their career paths when changing occupations, entering new industries or moving to another municipality, have a major impact on the evolution of their wage trajectories. Women and men follow different typical paths across industries and occupations. If changes in career paths are accompanied by geographical moves, these job-related relocations may have an additional wage effect, as different sizes of settlements offer different labor market opportunities. Larger cities or metropolitan areas typically offer higher wages than smaller municipalities. The wage returns to career changes and geographical relocation may differ by gender, affecting the wage gap between women and men. In our study, we examine the wage effects of occupational and geographical mobility by exploring gender differences over individual's careers. We identify complete career sequences from Hungarian administrative data and use these career sequences as explanatory variables to examine the urbanization wage premium and the wage effects of moving. Our results show that the wage effects of different types of shifts differ between the two sexes: both in terms of immediate wage benefits and in terms of the long-run expected wages of potential career paths that open up with shifts.

JEL codes: J16 J31 J61 J62
Keywords: administrative data, career path, gender wage gap, geographical mobility, wage premium

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Nemek közti és földrajzi bérkülönbségek vizsgálata teljes karrierszekvenciák segítségével

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ÖSSZEFOGLALÓ

Számos tanulmány vizsgálja a nemek közötti bérkülönbségeket, azok összetevőit és e bérszakadék időbeli változását. A munkavállalók karrierútjukban hozott döntései – amikor foglalkozást váltanak, új iparágban helyezkednek el vagy másik településre költöznek – alapvetően befolyásolják bérpályájuk alakulását. A nők és férfiak az iparágak és foglalkozások terében más jellemző útvonalakat járnak be. Ha a karrierútban történő váltások földrajzi költözéssel is együtt járnak, akkor annak további bérhatása lehet, mivel a különböző településtípusok munkaerőpiaci lehetőségei eltérnek egymástól. A nagyobb városokban vagy a fővárosban jellemzően magasabb béreket lehet elérni, mint kisebb településeken. A földrajzi költözésnek a bérhozadéka nemenként eltérhet, ami befolyásolja a nők és férfiak közti bérszakadék alakulását. Tanulmányunkban a munkaerőpiaci és földrajzi mobilitás bérhatását vizsgáljuk – feltárva a nemek szerinti különbségeket. Magyar adminisztratív adatokból teljes karrierszekvenciákat tárunk fel és e karrierszekvenciákat magyarázóváltozóként használjuk az urbanizációs bérprémium, valamint a költözés bérhatásainak vizsgálatában. Eredményeink azt mutatják, hogy a különböző típusú váltások bérhatása eltér a két nem között: mind az azonnali bérelőnyökben, mind a váltásokkal megnyíló potenciális karrierpályák hosszú távú várható béreiben

JEL: J16 J31 J61 J62

Kulcsszavak: adminisztratív adatok, karrierutak, nemek közötti bérszakadék, földrajzi mobilitás, bérprémium

1. Introduction

The career path of a worker is typically viewed as a sequential progression through various jobs. Each stage in such a career trajectory, the jobs in the sequence, can be characterized by its occupational and industrial classification, the characteristics of the organization and its geographical location. Changes in the course of career paths may have a significant impact on the labor market position of workers, in particular on their wages. Switching occupation, shifting to a different industry or moving to a different geographical location could affect wages in the short term, but these transitions may open up new opportunities for long-term career and wage advancement as well. For example, it is often observed that moving to larger cities leads to an increase in wages (D'Costa and Overman 2014), and this gain may persist even if one later returns to smaller towns (De La Roca and Puga 2017). However, the impact of career changes may exhibit heterogeneity among individuals, with emerging evidence suggesting gender-based disparities.

The gender wage gap has fallen significantly over the last 40-50 years, but it remains far from being eliminated and the pace of the convergence process has slowed down considerably (Adamecz-Völgyi and Shure 2022a; Bertram 2011; Blau and Kahn 2008, 2017; Buser, Niederle, and Oosterbeek 2014; Croson and Gneezy 2009; Flory, Leibbrandt, and List 2015; Heckman and Kautz 2012; Niederle and Vesterlund 2007; Solnick, Babcock, and Laschever 2004; Weichselbaumer and Winter-Ebmer 2005). Wage convergence has been most pronounced in the middle and lower parts of the income distribution, whereas at the top, the gap has narrowed less markedly. By the last decade, the trends that had been driving most of the gender wage convergence had been reversed, including an increase in women's labour market participation and a reduction in their accumulated disadvantage in educational attainment and labor market experience (Blau and Kahn 2017). However, occupational segregation persisted, with a higher share of women working in lower-paid occupations and less well-paid industries. Therefore, it is particularly important to examine how women and men move across occupational, industrial and geographical space in their careers, and how these changes affect the gender pay gap.

In this study, we analyze the gender and settlement type wage differentials along the career paths followed. We use Hungarian labor market data to examine the size of wage differentials, in particular gender and urban wage differentials, and gender differences in the returns to geographical mobility. In contrast to most of the previous literature, we do not only control for current occupations, but also take into account the impact of the entire previous labor market history. Indeed, workers' wages are also affected by previous jobs through the knowledge, skills and experience acquired in previous jobs. It is assumed that the accumulated human capital is not only determined by the set of previous jobs, but also by the sequence of jobs.

To estimate the wage gaps, we use fixed-effects panel regressions on the logarithm of wages, and in doing so, we examine how the results are affected by including fixed effects of the career sequence, where career sequences are defined as a series of industry-occupation cells describing the labour market history of individuals. This is used to estimate whether the average wage changes of individuals differ by gender, type of settlement and geographical mobility when there is a change in career path (moving to new industry-occupation cells). First, we start by estimating fixed effect panel regressions on the logarithm of wages and assess whether the average wage gains of individuals differ by gender, or urbanization of the local labor market, and whether there age gender differences in the wage gains by urbanization. Our second research question analyses the impact of geographic mobility and career change on wages, in particular, the differences in the wage gains by gender and urbanization, when individuals change job when moving to new places. The interaction of these is also examined, i.e. whether there is a difference between men and women in terms of the urban age gains in these situations. In our empirical setup, career paths (sequences) are defined as the sequence of jobs captured as industry-occupation cells, thus career changes will be captured as mobility events of individuals moving to new industries and/or occupations. To account for the selection of individuals along career paths with different wage levels, we include career sequence fixed effects. Career transitions are also assumed to be guided by strategic considerations, i.e. individuals consider not only the immediate benefits of a change, but also the long-term career opportunities that a change of occupation or a move opens up. Thus, our third research question examines the long-term expected wage effects of occupational and geographical shifts in career paths.

Accordingly, using career sequences, we try to estimate the long-run expected wage gains of potential career paths that open up with switching, and the differences in the long-run expected gains associated with switching by gender and by type of settlement. Examining this can be instructive because decisions to move are often family and household decisions. And for intra-household decisions, the bargaining power, interests and preferences of household members may differ. Finding differences in the wage premium for moving between women and men may confirm the findings of household economics research that men are more often the main decision-makers in the family's long-term decisions about income and wealth, and that the husband's career prospects are more likely to be emphasized in decisions about moving. A deeper understanding of this issue can be gained by also disaggregating the effects by the type of settlement in which the move is made. The rest of the paper is structured as follows. After this introduction, we review the relevant literature on the most important contributors of gender and urban wage premia. Then, we introduce our data and estimation strategy, followed by the presentation of our results. Finally, we conclude the paper with a discussion.

2. Literature review

2.1. Gender wage gaps in the labor market

The components of gender differences in the labor market have been extensively studied in recent decades (e.g. Blau and Kahn 2017; Weichselbaumer and Winter-Ebmer 2005). There are several explanations for the gender wage gap, and the literature contains a number of studies that empirically attempt to investigate the extent to which different factors contribute to the observed disparities. The gender wage gap can arise from differences in human capital, such as differences in education and labour market experience (Blau and Kahn 2017; Goldin 2014; Mincer and Polachek 1974; Polachek 1981), differences in the division of labor within the family and in parenting (Becker 1985, 1993; Hersch and Stratton 1997, 2002; Ribar 2004), discrimination against women (Bertrand, Goldin, and Katz 2010; Ceci et al. 2014; Goldin 2014; Goldin and Rouse 2000; Lazear and Rosen 1990; Noonan, Corcoran, and Courant 2005; Weiss and Gronau 1981), and gender-related occupational segregation (Beller 1982; Bianchi and Rytina 1986; Blau, Brummund, and Liu 2013; Blau and Kahn 1997; Jacobs 1989).

In addition, recent research also investigates the role of further factors in gender pay inequalities. Examples include non-cognitive abilities, social roles and norms, and psychological characteristics, preferences and attitudes (Adamecz-Völgyi and Shure 2022b; Bertram 2011; Blau and Kahn 2017; Buser et al. 2014; Croson and Gneezy 2009; Flory et al. 2015; Heckman and Kautz 2012; Niederle and Vesterlund 2007; Solnick et al. 2004).

Taking into account trends in gender wage inequality, the wage gap for women has decreased significantly since the 1970s, but it has not disappeared completely (Blau and Kahn 2008, 2017; Weichselbaumer and Winter-Ebmer 2005) . The OECD (based on the most recent available data for countries (2019-2022)) estimates the gender pay gap (the difference between median earnings of men and women compared to median earnings of men) at 12.1% on average, with significant variance: the lowest in Belgium (1.2%), the highest in Korea (31.2%), while Hungary is slightly above average at 13.1% (OECD 2024). Other estimates also range between 13 % (Penner et al. 2022) to 15% (Köllő 2017) or 16% (Boza 2021) with the within-workplace gender gap being around 10-12% (Boza 2021; Penner et al. 2022).

The reduction in the gender wage gap was mainly driven by an increase in women's labour market participation and a reduction in their human capital factor disadvantage (increase in their education and labour market experience) (Blau and Kahn 2008, 2017; Weichselbaumer and Winter-Ebmer 2005). Wage convergence between men and women was strongest in the 1970s-1980s, then slowed down in the following decades and many of the trends behind wage

convergence have stalled, including the increase in women's labor market participation and the decline in occupational segregation by gender (Adamecz-Völgyi 2018; Arulampalam et al. 2007; Blau and Kahn 2008, 2017; Weichselbaumer and Winter-Ebmer 2005). Another important feature of these processes is that differences in traditional human capital variables (education and labor market experience) are less and less the cause of gender pay gaps. This is due to the gradual reversal of the gender gap in educational attainment in recent decades and the significant reduction in the gender gap in labor market experience (Goldin, Katz, and Kuziemko 2006; Parro 2012; Schofer and Meyer 2005; Varga 2018; Vincent-Lancrin 2008).

In contrast, differences in the labor market position of women and men persisted, notably in the occupational and industrial distribution of the sexes, which continue to explain a significant part of the wage gap. For example, Blau and Kahn (1997, 2008, 2017), looking at the US labour(Blinder 1973; Folbre, Gornick, and Munzi 2013; Fuchs 1990; Hirsch and Manzella 2015; Levanon, England, and Allison 2009; Oaxaca 1973). The negative impact of occupational segregation on women's wage disadvantage is also amplified by changes in the wage structure, as rewards for different skills and bonuses for employment in high-wage occupations and industries have also changed, typically increasing. Gender wage inequalities, especially at the top of the distribution, were already widened in the 1980s by the rise in market rewards for skills and for participation in high-wage sectors typically employing men (Blau and Kahn 1997, 2017). Although the increase in female employment has contributed to narrowing the gap, part of this effect has been offset by adverse changes in the distribution of women and men within the occupational hierarchies and in the returns to occupations (to the detriment of women) (Varga 2018).

2.2. Geographical aspects and urban wage premium

Several studies have documented that workers in larger cities earn more than workers in smaller cities and rural areas (De La Roca and Puga 2017; Glaeser and Maré 2001; Glaeser and Resseger 2010; Moretti 2004; Yankow 2006). Empirical evidence shows that both workers (Glaeser and Gottlieb 2009; Hsieh and Moretti 2019) and firms(Combes et al. 2010, 2012; Henderson 2003) are more productive in cities. One source of the urban hiring advantage is the agglomeration benefits from the spatial concentration of economic activities (agglomeration economics), which results in higher productivity of firms concentrated in urban and especially metropolitan areas (Duranton and Puga 2004; Holmes 2005; Puga 2010; Rosenthal and Strange 2004). In urban areas, as opposed to rural areas, the available career paths may differ due to the abundance of firms and opportunities as innovation and technology are concentrated in such areas. Recent studies have shown that the local level of market concentration correlates with the wage premium that can be achieved by moving there (Gibbons et al. 2019; OECD 2021). Related

research typically emphasizes the role of spatial selection of productive workers and the importance of agglomeration economies as an important source of the urban wage premium (Combes, Duranton, and Gobillon 2011; Duranton and Puga 2004; Glaeser and Maré 2001). Spatial densification of economic activities increases worker productivity and leads to a more efficient matching of employers and workers. Thus, differences in the spatial density of economic activities can lead to geographical wage differentials (between different types of settlement). In addition, there is also a selection effect between metropolitan and rural labour markets, whereby workers who are inherently more productive tend to choose metropolitan labour markets more often. The concentration of workers with tertiary education or higher skills related to their occupation in larger cities has been documented by several studies (e.g. (Bacolod 2017; Berry and Glaeser 2005; Combes et al. 2012; Davis and Dingel 2020; Gobillon, Magnac, and Selod 2011; Moretti 2012). Movers are often young, highly skilled workers (Brian L. Levy, Ted Mouw, and Anthony Daniel Perez 2017; Kennan and Walker 2011; Saks and Wozniak 2011), whose earnings were already higher than those of non-movers before the move (Gabriel and Schmitz 1995; Rodgers and Rodgers 2000).

Beyond sorting of firms and workers, recent literature has also shown evidence that in bigger labor markets employer-employee matches are better. Workers have more options in bigger cities, and consequently, they earn higher wages (Papageorgiou 2022). Because of wider opportunities, young workers change jobs more often in big cities (Bleakley and Lin 2012). They also find new employment quicker, if they laid off, and these new jobs are also more long-lasting (Moretti and Yi 2024). Another reason for the wage premium in big cities may be that they make it easier to gain experience and learn. The larger a municipality, the more opportunities it provides for workers to gain more valuable experience (De La Roca and Puga 2017; Duranton and Puga 2001; Ellison and Glaeser 1999).

Geographical mobility associated with job mobility provides predominantly positive career prospects, as it offers access to new labor markets and a wider range of job opportunities and is therefore considered an important factor in expected career progression. According to extensive literature, geographic mobility is often associated with short- and long-term wage advantages (Kratz, and Brüderl, 2013; Lehmer and Ludsteck 2008; Purcell 2020; Yankow 2003). These wage advantages stem from the fact that migrating workers are more likely to choose geographic destinations with better local labor market conditions and wage levels (Glaeser and Maré 2001), or places where their skills and occupations are better compensated (Borjas, Bronars, and Trejo 1992; Kaplan and Schulhofer-Wohl 2017). (Boza et al. 2023) find empirical evidence that geographic mobility is associated with significant wage premium even comparing new hires of the same firms, and argues that it is due to better employer-employee matching.

The intersection of gender and geography is also relevant: if the returns to geographic mobility differ between the sexes, then the differential wage advantages of geographic mobility have an impact on the wage gaps between men and women. Moreover, moving decisions are generally not individual but a joint action of a family or household. A more recent strand of household economics examines processes and decisions within the household, revealing that there may be power and interest differences between its members. The distribution of wage returns resulting from geographical migration may be affected by which spouse drives family decisions, i.e. whose career prospects are at the forefront of decisions. The not very rich empirical literature on intra-household decision-making shows that men are the main decision-makers in a larger share of households, especially for investment or long-term decisions related to income generation and wealth accumulation, but that women's participation in decision-making increases as their income approaches or exceeds that of their husbands (Bertocchi, Brunetti, and Torricelli 2014; Elder et al. 2003; Friedberg and Webb 2006). Some studies have found that women are more likely to participate in decisions if they have higher educational attainment or occupational status (Bertocchi et al. 2014; Elder et al. 2003) and if the household is located in a larger city (Lührmann and Maurer 2007). In the case of migration decisions, it is also common for women to follow their partners in their geographical moves (Bonney and Love 1991; Shihadeh 1991). Several studies reveal that men's careers are more important in the migration decision, and that women therefore tend to lose out in terms of their labour market position when moving with their families. Some studies suggest that this is only because the potential gains for men from migration exceed the potential losses for women (Mincer 1978; Nivalainen 2004a) . In contrast, several sociological studies argue that the relative importance of a husband's and wife's work depends not only on income or labour market position in general, but also on gendered family roles(Bielby and Bielby 1992; Bird and Bird 1985; Jürges 2006; Morrison and Lichter 1988; Shihadeh 1991).

The individual labor market impact of migration differs significantly between men and women. Married men who move are less likely to become unemployed after the move and enjoy higher wages. In contrast, women are less likely to find a job, more likely to give up a higher-skilled occupation or earn less after moving (Boyle et al. 2001; Büchel n.d.; Duncan and Perrucci 1976; Jürges 2006; Maxwell 1988; Spitze 1984). Several studies confirm that migration reduces women's earnings and labor market participation (Boyle et al. 2001; Cooke et al. 2009; Jacobsen and Levin 2000; Nivalainen 2004b; Shihadeh 1991) . However, the post-move earnings of married men do not change or do not increase enough to compensate for the wife's losses, contrary to the predictions of microeconomic theory (Blau and Kahn 2017; Cooke 2003; Jacobsen and Levin 2000) finds that while family migration causes an increase in the husband's income, it does not change the wife's income, even if the wife's earning potential is larger than

the husband's. The characteristics of the occupations chosen by men and women, although different, do not fully explain the difference in migration effects between married men and women.

3. Data

In the present study, we use data from the Databank of the HUN-REN Centre for Economic and Regional Studies. The Linked Administrative Panel datasets have been created using a dataintegrational method. The Hungarian administrative micro-data (Admin3) cover 50% of the population on a monthly level between 2003-2017. The data from all waves consolidates all research-relevant registers that are available and can be linked at the time of data integration. Consequently, the latest Admin3 dataset includes linked individual- and firm-level data from the National Insurance Fund Administration, the Hungarian State Treasury, the Educational Authority, the Ministry of Finance, and the National Tax and Customs Administration. Our sample is restricted to those individuals who were born in 1984 or later (N= 773,157 individuals, Table 1), as we wish to observe the career of individuals from the age of 18. Consequently, we can only observe the first part of individuals' careers; those born in 1984 are only 33 years old in 2017 when our observation period ends. The distribution of the sample by gender and urbanization is shown in Table 1.

Table 1. Descriptive Statistics

	Capital	Urban	Rural	Total sample
WOMEN				
Number of observations	47 640	101 310	219 061	368 011
By/within settlement (percent)	13,0	27,5	59,5	100,0
By/within gender (percent)	49,1	47,9	47,2	47,6
MEN				
Number of observations	49 463	110 194	245 489	405 146
By/within settlement (percent)	12,2	27,2	60,6	100,0
By/within gender (percent)	50,9	52,1	52,8	52,4
TOTAL SAMPLE	97 103	211 504	464 550	773 157
By settlement (percent)	12,6	27,4	60,1	100,0

Notes: We defined Urban as residents of a district that contains a city with county status. We define Rural as those who live in a district that does not have a city with county status. We defined as Capital those who reside in Budapest.

4. Methods

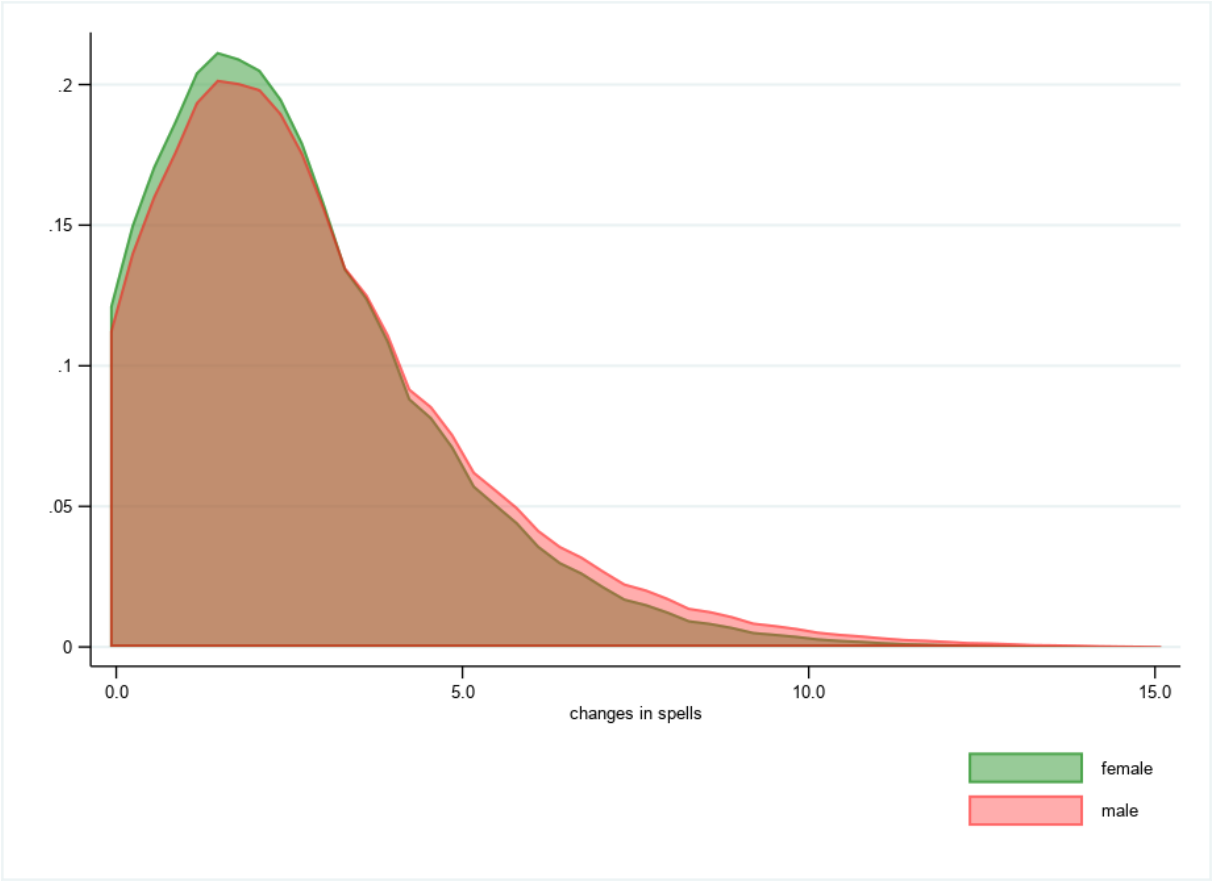
In our analysis, we consider individual career paths (career sequences) as a series of job spells ordered in time. For example, a $J_{1\rightarrow2\rightarrow3}$ career sequence represents a career path that involves jobs 1, 2, and 3 in this order. We define jobs as a combination of industry and occupation: each stage of the career path is defined by the job's industry classification (NACE) and the individual's occupational classification (ISCO) together. Thus, job changes will represent events when someone changed either industry or occupation. Cases where individuals started working for

new employers but remained in the same occupation and industry are not considered as job switches. We construct the career paths of individuals as the sequence of jobs in their labour market history. In this, each job is described by a 4-digit identifier, in which the 2-digit harmonized ISCO classification of the occupation is merged with the 2-digit NACE industry classification of the job.

We also tested alternative specifications of our models, where we only defined jobs based on occupations, instead of occupation-industry combinations, and find our results remaining robust. In our sample, we observed a total of 59,761 different career sequences using the combined occupation and industry definition.

Figure 1 displays the number of observed job changes over the (observed) career paths by gender. We see that the number of job changes in the sample is relatively low in average, and we do not find significant differences by gender.

Figure 1. Average number of job changes in career paths by gender



4.1. Empirical strategy

4.1.1. Short-term wage gains

First, we present our short-term model, which aims to quantify the direct impact of job changes on wages, the potential wage differentials by gender and urbanization, and the gains from geographic mobility. We use fixed-effects linear panel regressions, where our dependent variable is the logarithm of monthly earnings normalized by annual levels (w_{it}). Beyond the variables generally used in traditional wage regressions, we include the career sequence of individuals that have been completed by the time of observation in the model as a fixed effect. This allows us to compare the wages of individuals who have followed similar career paths. Then, we extend this basic model by including the aspects of gender, urbanization and geographic mobility, and the interaction effects between these. This is summarized in the equation below:

(Eq.1)

$$w_{it} = \alpha + \beta_1 gender_i + \beta_2 urban_{it} + \beta_3 move_{it} + \beta_{12}(gender_i \times urban_{it}) + \beta_{13}(gender_i \times move_{it}) + \beta_{23}(urban_{it} \times move_{it}) + \beta_{123}(gender_i \times urban_{it} \times move_{it}) + D_{it}^{Seq} + Controls_{it} + \varepsilon_{it},$$

Where D_{it}^{Seq} stands for the job sequence fixed effects, while $urban_{it}$ corresponds to dummies describing the urbanization level of the person's residence ("capital" for Budapest, "urban" if the LAU-1 district includes a city with county rights and "rural" otherwise). As we are interested in the impact of geographic mobility associated with job changes, $move_{it}$ will only capture residential movements that took place within a two-months period surrounding the job changes.[1] We do not consider movements within the same districts, as in such cases individuals could still commute to their workplace easily. $Controls_{it}$ cover observable firm (industry, region, size, ownership, exporting) and individual characteristics (proxy for education[2] and work experience). Our left-hand wage variable has been normalized by year, thus excluding the effects of trends over time.

4.1.2. Long-term wage gains

After analyzing the immediate, short-term impact of career changes on wages, we move on to exploring the long-term consequences of career and geographical mobility. In doing so, we estimate how a step forward in the individuals' career sequence changes their long-term

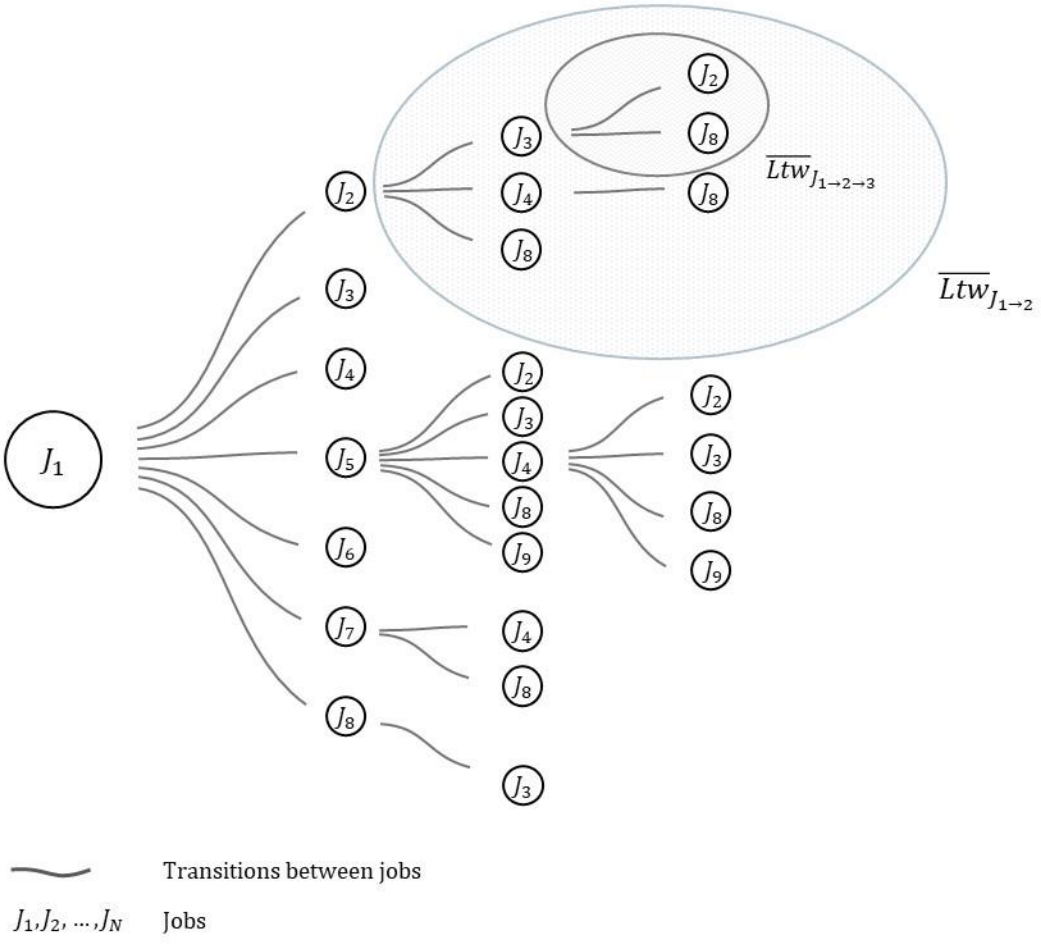
[1] Although the capital Budapest is divided into several districts in the official NUTS classification, we treat it as one.

[2] As the actual level of education is not available for the entire sample, we include an approximate measure of education defined on the basis of the occupation in the individual's entire work history that requires the highest level of education.

expected wage benefits, and how this varies by gender and geography. These models may reveal, for instance, that moving to a city or changing occupation may not be beneficial immediately, but they may open up new career opportunities that will be beneficial in the long run.

Long-term wage prospects are calculated separately for each career change by averaging the observed future earnings of individuals who moved through the same set of jobs and made the same career change (i.e. followed the same sequence). The calculation of the long-run wage prospects is illustrated in Figure 2, which shows all possible career paths starting from the job J_1 (i.e. the J_1 industry and occupation combination). When individuals start their career at this job, all branches of the tree are potential career options for them. As career paths progress over time, the number of career options becomes (mechanically) more limited. Let's consider the career described by the J_1- J_2- J_4-J_8 sequence. Once one moves from her first job to J_2, the number of potential career options will narrow to those included in Figure 2's the bigger circle. If she moves further to job J_4, only one viable alternative remains for progression. These potential options following each sequence are defined based on the observed career mobility of the population.

Figure 2. Representation of job sequences



The long-run expected wages associated with a given career sequence are denoted as $\underline{Ltw_J}$. These are computed by taking the average of empirically observed wages that are possible after a given choice within the career (i.e., where one either changes occupation or industry). Therefore $\overline{Ltw}_{J_{1\to2\to3}}$ in Figure 2, is the average wage of persons who previously worked in jobs 1, 2 and 3 and then continued in jobs 2 or 8. In calculating the wage averages, we take into account the gender and regional characteristics of individuals, i.e. to obtain the long-term expected wages of an individual, we averaged only the wages of those others having similar gender and living in similar urbanization. In the average calculation, we weighted the wage averages according to the number of people in the sample who choose a particular pathway at a given shift and the number of months they work at this stage of the sequence. The (gender- and urbanization-specific) long-term expected wages after a career sequence are thus calculated according to the following formula:

(Eq. 2)

$Ltw_{J(l,n)} = \frac{\sum w_{J(l,n)}}{n_{J(l,n)}}$, where

$w_{J(l,n)}$ is the time-normalized log wages in the pattern with similar gender (l) and urbanization (n) to the individual, and $n_{J(l,n)}$ is the number of individual-month observations on the given pattern with similar gender and urbanization to the individual.

We estimate long-term wage gains using a similar style wage regression to the direct short-term wage gains, where our dependent variable is the logarithm of the average wage expected from the sequence (Eq. 3).

(Eq. 3)

$$Ltw_{it(O,l,n)} = \alpha + \beta_1\, gender_i + \beta_2 urban_{it} + \beta_3 move_{it} + \beta_{12}(gender_i \times urban_{it}) + \beta_{13}(gender_i \times move_{it}) + \beta_{23}(urban_{it} \times move_{it}) + \beta_{123}(gender_i \times urban_{it} \times move_{it}) + D_{it}^{JobSeq} + \beta_4 L_i + \beta_5 \frac{l_{it}}{L_i} + \beta_6(gender_i \times \frac{l_{it}}{L_i}) + \delta Controls_{it}$$

Similarly to our first approach, we control for individual (estimated education, work experience), and firm characteristics (industry, region, size, ownership, exporting) and include the already completed career sequences of individuals as fixed effects. In addition, we also account for the number of jobs the individuals are having altogether throughout their (observed) careers (L_i), and the sequential number of the individuals' current job in comparison to the number of jobs they will have altogether ($\frac{l_{it}}{L_i}$) and its interaction with gender. We exclude yearly differences by normalizing the dependent variable over the years. As long-term expected wages are calculated

for those points in time when individuals changed jobs, only those observations where a change in career path was observed are used for the estimation.

5. Results

5.1. Short-term models

The results of the regression models assessing direct wage gains are presented in Table 2. The first four columns represent models with career sequence fixed-effects, where we have included the gender- and urbanization-related variables and their interaction terms sequentially. Thus, the results of full equation (Eq. 1) are presented in column 4. To gain insight on the explanatory power of career histories over temporal information on the individuals' new jobs, we compare these estimates with a conventional wage regression model including the same variables but using only occupation and sector fixed effects (column 5).

Table 2. Results of short-term models

	(1)	(2)	(3)	(4)	(5)
	Baseline	Gender x Urban	Gender x Urban + Movement	Gender x Urban x Movement	Gender x Urban x Movement
Gender: Man	0.069***	0.072***	0.072***	0.072***	0.077***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Urbanization: Urban	0.004***	0.003	0.003*	0.003*	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Urbanization: Capital	0.027***	0.037***	0.038***	0.037***	0.055***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Man x Urban		0.002	0.002	0.002	0.000
		(0.002)	(0.002)	(0.002)	(0.002)
Man x Capital		-0.019***	-0.019***	-0.019***	-0.028***
		(0.003)	(0.003)	(0.003)	(0.002)
Moved (+ changing job)			0.038**	0.010	-0.005
			(0.014)	(0.015)	(0.011)
Man x Moved			0.036	0.066*	0.060**
			(0.023)	(0.029)	(0.018)
Urban x Moved				0.007	-0.000
				(0.026)	(0.022)
Capital x Moved				0.109**	0.122***
				(0.033)	(0.024)
Man x Urban x Moved				-0.008	0.011
				(0.041)	(0.031)
Man x Capital x Moved				-0.114*	-0.049
				(0.049)	(0.036)
Observations	22,396,375	22,396,375	22,282,077	22,282,077	22,280,394
R-squared	0.697	0.697	0.699	0.699	0.540
Occupation FE	No	No	No	No	Yes
Sector FE	No	No	No	No	Yes
Sequence FE	Yes	Yes	Yes	Yes	No
No of clusters	676,181	676,181	675,366	675,366	53

Note: All models control for: industry (2-digit NACE), region, educational attainment, firm size (no. of employees) and revenue, firm ownership and export, length of individuals' full observed career sequence (no. of changes over the observed career) and the ratio of the current sequence length to the length of the full observed career sequence. Robust standard errors in parentheses. *** $p<0.001$, ** $p<0.01$, * $p<0.05$

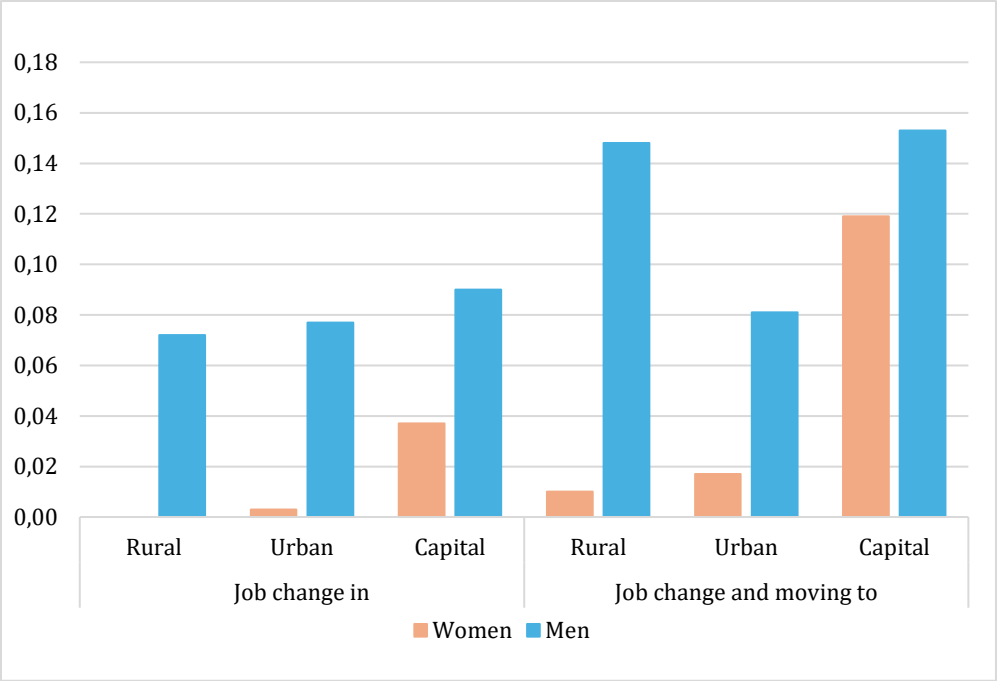
The results of the "short-term" regressions suggest that men enjoy substantial wage premium (approx. 7%), which is consistent around all specifications. Living in the capital provides 3-4% percentage point benefit in our first set of models (columns 1-4) and 5.5% in the second setting (Model 5), thus we can observe a moderate level of urban wage premium. Our first research question considered the gender differences in this wage premium. Column (2) indicates that an urban wage premium is only present in case of the capital, but not for regional centers. Further,

this premium is more significant for women (3.7%), whereas men enjoy only about half of this benefit, resulting in a smaller gender wage gap in the capital compared to rural areas.

Considering our second research question, in case of joint changes of jobs and residence, denoted by the variable “Moved”, we observe a positive effect of about four percent on average for the whole population (column 3). However, we find significant differences between men and women when we consider the urbanization level of the destination of the move (column 4). For women, the largest wage increase (around 11-12% depending on the specification) is found, when a job change is combined with a move to the capital (columns 4 and 5). For men, moving to a city or rural area generates the largest wage gains (7%), while moving to the capital brings no additional short-term wage benefits for them. To see, how, how all these effects add together, and because overview of the multiple interactions is not very straightforward, we created a visualization of the total effects of our coefficients of interests from the full model specification (Table 2 Column 4) in Figure 3. From this viewpoint it becomes visible, that there is still an extant female wage penalty in each cases, that is moving or urban residence never compensates the male wage premium. It is also visible, consistent to the above discussion that this gender wage gap decreases along the urbanization ladder, and that women earn a significant premium if moving to the capital.

These findings are consistent with the literature on tied movers in the sense that if couples' movement decisions are determined according to the preferences of the male partner, then women will have more limited opportunities in smaller places and will therefore be better off when the couple moves to a denser labor market, such as the capital. While men will also enjoy wage gains in smaller labor markets.

Figure 3. Total effects of the gender, urbanization, and moved coefficients and their interactions in the full model specification



When we compare our sequence fixed-effects model with the traditional occupation-industry fixed-effects models, we find that the full labor market trajectory improves the prediction of wages, indicated by the increased explained variance of the. Further, the urbanization and gender coefficients are relatively stable across the conventional models with occupation-industry controls (column 5) and the sequence fixed-effects models (column 4). We see minor differences in two cases. For the wage premium of the capital and its gender difference, the coefficients with sequence fixed effects are smaller, suggesting that the wage difference observed here is partly explained by the difference in the urban and rural sequences. In case of the interaction of moving to Budapest and gender, we see the opposite difference, i.e. if occupational history is not taken into account, the smaller wage advantage of men in Budapest is partly masked by the difference in their occupational history in model (5).

5.2. Long-term models

Next, corresponding to our third research question, we turn to the assessment of long-term wage gains (Table 3). In this analysis, our dependent variable is the expected average income (log wage) that persons have when changing jobs. Analogous to the short-term setting, columns 1-4 show the career sequence fixed-effect models, followed by the model with the separable occupation and industry fixed effects as comparison (column 5).

Regardless of the model specification chosen, we find a wage premium for men of around 10 percentage points. Residents of the capital (Budapest) enjoy a sizable wage premium, about 3.5 percentage points (column 2), which is heterogeneous across gender: women living in the

capital have an estimated wage premium of almost 7 percentage points (column 2), while men receive nothing.

Compared to the short-term models, the pattern is therefore similar, with gender pay gaps being larger in rural areas than in the capital. Considering the urban wage premium, the gender differences are slightly larger in the long-term models. The positive effect of the capital on women's wages is more significant, and we also see a slight wage advantage for regional centers compared to rural areas.

The opposite trend is observed when job change is associated with geographical mobility. Women experience no improvement (column 3) or even negative impact on their long-term expected wages when they move to rural areas (column 4), while it is positive for men. Unlike the findings from the short-term models, in the long run, men realize the largest wage increases (11% and 12%) when they relocate to the capital and change jobs at the same time. This pattern is consistently observed in both the sequence fixed effects model (column 4) and the model with separable industry-occupation fixed effects (column 5).

Table 3. Results of long-term models

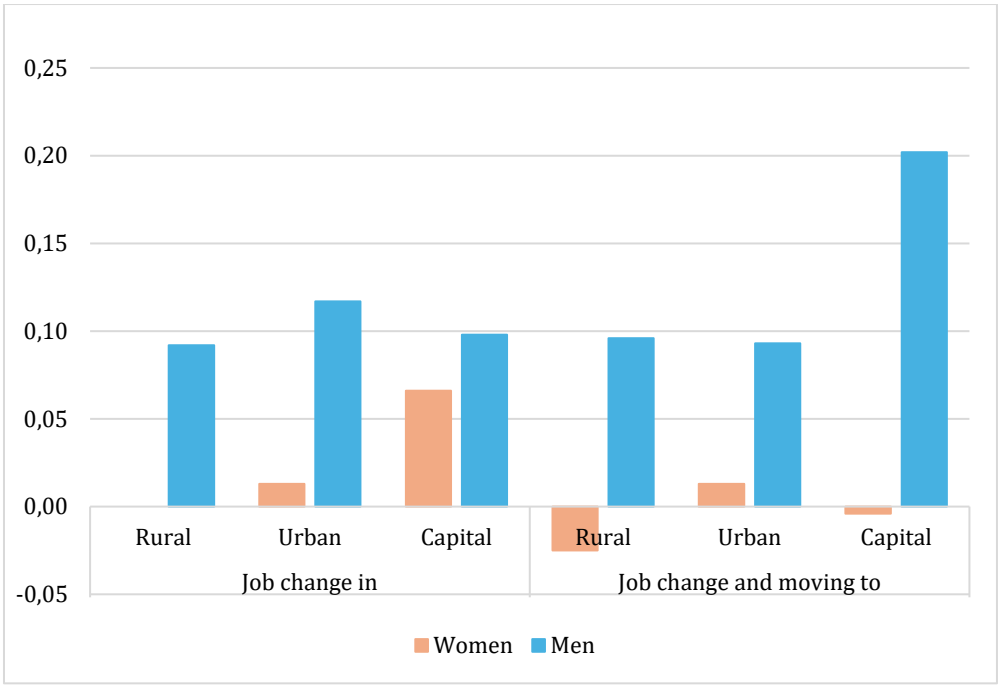
	(1)	(2)	(3)	(4)	(5)
	Baseline	Gender x Urban	Gender x Urban + Movement	Gender x Urban x Movement	Gender x Urban x Movement
Gender: Man	0.087***	0.092***	0.092***	0.092***	0.106***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Urbanization: Urban	0.020***	0.013***	0.013***	0.013***	0.013***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Urbanization: Capital	0.035***	0.066***	0.066***	0.066***	0.071***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Man x City		0.012***	0.012***	0.012***	0.012***
		(0.001)	(0.001)	(0.001)	(0.002)
Man x Capital		-0.060***	-0.060***	-0.060***	-0.061***
		(0.002)	(0.002)	(0.002)	(0.003)
Moved (+ changing job)			-0.011	-0.025**	-0.027*
			(0.007)	(0.009)	(0.010)
Man x Moved			0.042***	0.029*	0.044**
			(0.011)	(0.013)	(0.016)
Urban x Moved				0.038*	0.031
				(0.018)	(0.021)
Capital x Moved				0.021	0.039
				(0.021)	(0.024)
Man x Urban x Moved				-0.012	-0.011
				(0.028)	(0.035)
Man x Capital x Moved				0.110**	0.122**
				(0.038)	(0.041)
Constant	-0.483***	-0.485***	-0.485***	-0.485***	-0.313***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	689,686	689,686	689,686	689,686	498,199
R-squared	0.475	0.476	0.476	0.476	0.362
Occupation FE	No	No	No	No	Yes

Sector FE	No	No	No	No	Yes
Sequence FE	Yes	Yes	Yes	Yes	No
No of clusters	41,091	41,091	41,091	41,091	49

Note: The database used for estimation only includes observations when individuals changed jobs (occupation and/or industry) within their careers. industry (2-digit NACE), region, educational attainment, firm size (no. of employees) and revenue, firm ownership and export, length of individuals' full observed career sequence (no. of changes over the observed career) and the ratio of the current sequence length to the length of the full observed career sequence. Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05

For the easier overview of the effects, we again created a figure when we add all relevant main and interaction effects together, which is Figure 5 for the long-term models. Comparing it to Figure 3 of the short-term models, we see similarities and differences. Patterns regarding the non-movers are consistent on the decreasing gender wage-gap by urbanization. The results considering the geographic mobility however show that career changes accompanied by a move to the capital may provide substantial immediate wage benefits for women, but these gains disappear in their long run expected wages. In contrast, men do not accumulate substantial benefits in the short run if they move to the capital, but they benefit from it considering their long-term wage prospects.

Figure 4. Total effects of the gender, urbanization, and moved coefficients and their interactions in the full model specification



6. Discussion

In our study, we used administrative micro-data to map gender and geographic differences in the short- and long-term wage effects of career changes by estimating wage regressions that control for individual career histories through fixed effects. Our regression results are broadly in line with the international literature on the average wage gap between men and women. Compared to other studies in Hungary, we find a smaller difference than Adamecz-Völgyi (2018) and Takács (2021). A possible explanation may be that unlike these studies, we do not exclude the public sector and firms smaller than 20 employees from the sample, while controlling for full career histories.

When comparing our career sequence fixed-effect model to the traditional industry-occupation fixed effects models, we observe a substantial contribution of previous work histories to the prediction of wages, indicated by the increased R^2 statistics. However, the observed wage differentials measured between urbanization levels and gender are quite stable across all specifications. Adding information on the full career history of individuals, instead of controlling for the occupation and industry of the new jobs, slightly reduced the wage differences between men and women, reinforcing the conclusion of Ilyés and Lőrincz (2022) that differences in career trajectories explain part of the gender wage gap, but they contribution is relatively small.

We also show that the gender wage gap is less pronounced in the capital than in smaller centers and rural areas, a finding that holds regardless of assessing wage outcomes in the short or long run. Given that both the career sequence and occupation-industry fixed effects used eliminate the effect of occupational segregation, the measured gender gap in Budapest is present among people in the same occupation. This finding is consistent with the results of other studies, such as Bacolod (2017), who found smaller differences in the gross wage gap in larger cities. Buchholz (2023) measured a larger wage gap in cities, which however was no longer significant within occupations. Nisic (2017) also found a smaller gender wage gap in large cities in Germany when controlling for both occupation and job characteristics. A proposed explanation for this tendency is that women, are less willing to travel long distances for work due to their caring responsibilities, so firms in denser areas (i.e. in big cities) have less monopsony power over them (Hirsch, König, and Möller 2013).

Our finding that residential mobility is more likely to provide wage benefits for men is consistent with the results of other studies in developed countries (Purcell 2020). However, an intriguing finding of our study is that women do not typically experience long-term wage gains from moving to the capital, while men do. This may suggest that men strategically investing in new, opportunity-rich career paths when they move to the capital, resulting in more substantial gains in the long run. However, when interpreting the results, it is important to note that the observed wage disparities may not solely reflect differences in individual preferences for career planning

or actual career choices. They could also represent average outcomes of decisions made under constraints (due to limited opportunities). Therefore, the worse long-term outcomes of women who relocate could simply reflect the constraints they experience in such situations. It must be also kept in mind that our coefficients on geographical mobility may also capture some selection effects. While our models include controls for individual characteristics, positive sorting of movers in terms of expected benefits could still be present (Rabe 2011).

The fact that we only observed the early part of the careers in our data (between the ages of 19 and 33), however, may also influence the gender difference observed in our long-term models. Given that in Hungary the average age of mothers at the birth of their child is 30 years, our observations of career paths presumably end in this period for a significant proportion of women. This may be a reason for the result that we do not see a long-term advantage for women when starting a new career Budapest. This also raises the opportunity for further research, for example by explicitly investigating the impact of childbearing on the gender differences in wages and in the long-term perspective wages.

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