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Working from home, productivity and the spatial diffusion of urban wage premiums

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Working from home, productivity and the spatial diffusion of urban wage premiums

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Abstract

This paper examines urban wage premiums in Sweden using population-wide matched employer–employee data covering the period 2016–2023, while tracking city-specific experience and job changes back to 1986. The results indicate that large and dense cities continue to benefit from agglomeration advantages after the pandemic. Focusing on different groups of workers, we find a particularly high earnings premium from starting to work in the centre of Stockholm city for workers with high-skilled work-from-home (WFH) jobs. Relative to working in small cities, towns, or rural areas, these workers receive an initial earnings premium of around 4%, with the earnings gap increasing to about 24% after ten years. This dynamic effect is driven by a higher accumulated value of work experience and job changes in the centre of Stockholm city. The results also reveal a substantial dynamic earnings premium from working in the centre rather than in the more peripheral areas of Stockholm city for workers with high-skilled WFH jobs (21%). We further find a positive, though smaller, dynamic earnings premium for workers with high-skilled WFH jobs who start working in the centres of Gothenburg and Malmö (7–13%). These findings suggest that a WFH-induced increase in the supply of labour to high-productivity locations can raise aggregate productivity in the economy and contribute to the geographical diffusion of large-city wage premiums to the outskirts of metropolitan areas, as well as to smaller cities, towns, and rural areas hosting WFH residents.

Keywords: Working from home, productivity, urban wage premium, agglomeration, spatial diffusion

JEL classification: R12, R23, J24, R31

1. Introduction

This study examines how working from home (WFH) can increase aggregate productivity in the economy and contribute to the spatial diffusion of large-city wage premiums. Extensive research shows that large cities benefit from agglomeration economies, which raise productivity and wages (see Rosenthal and Strange 2004, Puga 2010, Moretti 2011, Combes and Gobillon 2015 for summaries of empirical findings). Workers' access to high-productivity locations is, however, constrained by limited housing supply and high housing costs (Glaeser et al. 2006, Saks 2008, Glaeser and Gyourko 2018). WFH may facilitate a decoupling of productive big-city work from big-city living. By reducing the need for frequent commuting, remote work arrangements allow workers to access high-productivity cities from greater distances. This can potentially have three positive consequences (cf. Monte et al. 2018). First, workers in WFH-compatible occupations can increase their wages without having to pay the high cost of living in large cities. Second, a WFH-induced increase in the supply of labour to high-productivity locations may raise aggregate productivity in the economy. Third, large-city wage premiums may spread to smaller cities, towns, and rural areas hosting WFH residents.

International surveys of working arrangements indicate that working from home is here to stay (Aksoy et al. 2022, Barrero et al. 2023, Bick et al. 2023). According to the latest waves of the US Survey of Working Arrangements and Attitudes, the share of fully paid days worked from home has stabilised at around 25 percent. Hybrid work – defined as a combination of days worked at home and onsite – now dominates, with one or two days per week spent working from home being the most common arrangement. Evidence from the Swedish Labour Force Survey tells a similar story. In 2024, the share of work undertaken from home among all employees was approximately 17 percent. Among workers who reported working remotely, one or two days per week from home was the predominant pattern.

The existence of an urban wage premium can be explained either by non-random spatial sorting of workers or by the presence of agglomeration economies. Two important explanations for the productivity advantages of large cities are matching and learning (Duranton and Puga 2004, Moretti 2011). With regard to learning, working from home reduces workers' physical presence at the workplace, which may limit opportunities for productive interactions at or near the workplace and thereby reduce localised knowledge spillovers. However, in a hybrid work setting – where work undertaken from home is devoted to tasks requiring focus and concentration, while onsite work is oriented towards collaboration and networking – opportunities for personal interaction may be less adversely affected.[1] With regard to matching, WFH arrangements enable more workers to search for jobs in large cities and allow firms in these cities to attract and screen a broader pool of applicants. This may improve the quality of worker–firm matches and, in turn, strengthen productivity advantages of large cities (Helsley and Strange 1990, Dauth et al. 2022, Papageorgiou 2022).

[1] With improvements in technology, some interactions in physical space can also be substituted by interactions in virtual space.

The analysis is based on population-wide matched employer–employee data covering the period 2016–2023, while tracking workers' city-specific experience and job changes back to 1986. Using detailed occupational information and Dingel and Neiman's (2020) binary categorisation of WFH potential, workers are classified as having skilled and unskilled WFH jobs, and skilled and unskilled onsite jobs. We group Sweden's 67 travel-to-work areas – hereafter referred to as cities – into seven main categories based on employment size, and further split each category into a core and a peripheral part based on employment density.

The results indicate that large and dense cities continue to benefit from agglomeration advantages after the pandemic. Focusing on different groups of workers, we find a particularly high earnings premium from starting to work in the centre of Stockholm city for workers with high-skilled WFH jobs. Relative to working in smaller cities, towns, or rural areas, these workers receive an initial earnings premium of about 4%, and the earnings gap increases to around 24% after ten years. This dynamic effect is driven by a higher accumulated value of work experience and job changes in the core of Stockholm city. The results also reveal a substantial dynamic earnings premium associated with working in the centre of Stockholm city rather than in more peripheral areas of the city for workers with high-skilled WFH jobs (around 21%). In addition, we find a positive dynamic earnings premium for workers with high-skilled WFH jobs who start working in the centres of Gothenburg and Malmö, although the effect is smaller (around 7–13%). Overall, these findings suggest that a WFH-induced increase in the supply of labour to high-productivity locations can raise aggregate productivity in the economy and, moreover, contribute to a geographical dispersion of large-city wage premiums to the outskirts of metropolitan areas as well as to smaller cities, towns, and rural areas hosting WFH residents.

The remainder of the paper is organised as follows. Section 2 reviews related studies and outlines the paper's contributions to the existing literature. Section 3 describes the data. Section 4 reports the empirical results. Section 5 concludes.

2. Existing literature and contribution

This paper relates to several strands of literature. First, it contributes to the rapidly growing literature on the effects of WFH on cities and productivity. A growing body of research shows that the widespread shift to WFH following the pandemic has led to an outflow of residents from large city centres to suburbs as well as to smaller towns and rural areas (Ramani and Bloom 2021, Liu and Su 2021, Althoff et al. 2022, Eliasson 2025). Other studies have focused explicitly on how WFH has affected home-to-work distances (Coskun et al. 2024, Eliasson 2024, Nilsson et al. 2024, Akan et al. 2025). These studies find that workers with WFH-compatible jobs have increased their home-to-work distances after the pandemic, and that the effect of WFH potential on commuting distances is primarily driven by workers taking up new jobs located in large cities. This paper contributes to this literature by examining the earnings effects for workers with WFH-compatible occupations who switch to jobs in large cities, and by exploring how this may provide an opportunity for more peripheral locations to benefit from the wage premiums of big cities.

Another strand of the literature examines the effects of WFH on individual productivity (Bloom et al. 2015, Bloom et al. 2023, Emmanuel et al. 2023, Bloom et al. 2024, Emanuel and Harrington 2024, Choudhury et al. 2025). These studies typically focus on specific firms, and many are carefully designed randomised controlled trials. The findings are mixed. The impact of fully remote work appears broadly neutral, whereas the effect of hybrid work tends to be more positive. This study complements this literature by using population-wide data to examine the effect of WFH potential on individual earnings in a spatial context.

A small number of papers focus specifically on how WFH affects the urban wage premium and the spatial dispersion of wages. Liu and Su (2024) use wage data from job postings and report a substantial decline in the urban wage premium for occupations with high WFH potential after the pandemic, alongside a shift of employment away from large cities. Agrawal and Brueckner (2025) use occupational wage data to test the hypothesis that, for fully remote workers – for whom residence and workplace are decoupled – wages should converge across cities. Although the results are mixed, they find some evidence in support of this hypothesis.

The paper also contributes to the extensive literature on agglomeration economies and the urban wage premium. Following the influential paper by Glaeser and Maré (2001), many studies have confirmed that labour productivity is higher in large and dense cities. Studies examining whether agglomeration effects differ across individuals with varying levels of human capital find that the urban wage premium increases with measures of cognitive skills or ability and with workers' educational attainment (Wheeler 2001, Rosenthal and Strange 2008, Bacolod et al. 2009, Carlsen et al. 2016, Korpi and Clark 2019, Eliasson and Westerlund 2023). Andersson et al. (2014) further show that the urban wage premium is higher for workers performing non-routine job tasks. This study complements this literature by focusing on differences in the urban wage premium across jobs with different WFH potential and across skill levels. Recent studies have moved beyond static agglomeration effects to examine dynamic mechanisms, showing that work experience acquired in large cities is more valuable than work experience acquired in

smaller cities (Carlsen et al. 2016, De la Roca and Puga 2017, Eliasson and Westerlund 2023). This study contributes to this literature by analysing the dynamic effects of city-specific experience and job changes for workers in occupations with different WFH potential and at different skill levels.

3. Data

Based on various registers maintained by Statistics Sweden, we construct population-wide matched employer–employee data covering the period 2016–2023, while tracking city-specific experience and job changes back to 1986. The analysis is restricted to individuals born between 1966 and 2003. The oldest cohort is therefore observed from age 20 to age 58, while the youngest cohort is observed at age 20. The main sample consists of 1,823,626 workers and 9,091,433 annual observations.

The data include information on sex, marital status, children living at home, compulsory school grade point average, level and field of education, as well as industry and occupation.

Importantly, using information on employment status, workplace, and workplace location, we calculate accumulated overall and city-specific work experience and job changes for each individual over their working lives. Individuals are assigned to cities based on the location of their workplace.

The classification of occupations by WFH potential is based on Dingel and Neiman's (2020) binary categorisation of occupations as either possible or not possible to perform from home. This classification is applied at the most detailed level of the International Standard Classification of Occupations (ISCO-08), which, in the Swedish version of the classification, contains 429 distinct occupations.[2] We refer to these two occupation types as WFH-compatible jobs and onsite jobs, respectively. Studies indicate that, within occupations, the share of tasks performed from home increases with workers' skill level (Adams-Prassl et al. 2022, Bick et al. 2023). The literature on agglomeration economies also shows that the urban wage premium tends to be higher for workers performing cognitive and non-routine job tasks. To account for potential heterogeneity along these dimensions, we further classify occupations by skill level. Skill levels in ISCO-08 are defined with reference to the complexity and range of tasks and duties normally performed in an occupation. We classify occupations at skill levels 3 and 4 as high-skilled, and those at skill levels 1 and 2 as low-skilled. Occupations at skill levels 3 and 4 typically involve complex technical and practical tasks that require extensive theoretical and factual knowledge in a specialised field. In all, this leaves us with four groups of workers: those in low-skilled onsite jobs, low-skilled WFH-compatible jobs, high-skilled onsite jobs, and high-skilled WFH-compatible jobs. As a robustness check, we also report estimates in which WFH-compatible and onsite jobs are differentiated by workers' educational attainment rather than by occupational skill level.

The dependent variable in the analysis is annual gross labour earnings.[3] This earnings measure excludes income transfers such as unemployment and social security benefits.

[2] We find a strong positive correlation between actual WFH reported in the Swedish Labour Force Survey (SLFS) and WFH as measured using Dingel and Neiman's approach. The correlation coefficient between regional WFH shares based on the SLFS and the corresponding shares based on Dingel and Neiman's classification is 0.95.

[3] Earnings are expressed in 2023 prices using the national CPI as the deflator.

Following the existing literature, we focus on nominal earnings.[4] Economists often prefer hourly earnings to annual earnings, as the former are presumed to better reflect individual worker productivity. Unfortunately, Swedish register data do not include information on the number of hours worked per year. We draw on results in Antelius and Björklund (2000) showing that by dropping observations in the bottom quartile of the earnings distribution, the impact of labour supply on annual earnings is substantially reduced. As a robustness check, we apply alternative earnings restrictions.

We exclude foreign-born workers because we cannot observe their full labour market histories and because of missing information on other key variables, such as school grades and educational attainment. As we focus on labour earnings, we also exclude job spells as self-employed. In addition, we exclude job spells in the primary sector (agriculture, forestry, fishing, and mining) and in the public sector. The former relies heavily on natural resource endowments, while wage setting in the latter is less market-oriented. As a robustness check, we also report estimates that include job spells in the public sector.

The geographical units in the analysis are travel-to-work areas (TWAs). As defined by Statistics Sweden, a TWA consists of a central municipality or group of municipalities and surrounding municipalities with high commuting rates to the centre. In 2023, Sweden was divided into 67 TWAs, and we keep this division fixed over time. For simplicity, we refer to the TWAs as cities. Many studies present estimates of the urban wage premium based on continuous measures of city size or density. To facilitate comparisons with this literature, we report results based on population size or density across the 67 cities. Our main results, however, are based on the following grouping of cities: Stockholm, Gothenburg, Malmö, medium-sized cities, small cities, small towns, and rural areas. A number of studies show that agglomeration economies are not evenly distributed across space but attenuate sharply with density or distance from the centre (Ihlanfeldt 1992, McMillen and Singell 1992, Rosenthal and Strange 2008, Andersson et al. 2016). To account for this, we further distinguish, within each city category, between the denser central municipality or municipalities (the core) and the less dense surrounding municipalities (the periphery). We remind that workers are assigned to city types based on the location of their workplace.

Table 6 in the Appendix presents variable definitions and details on the classification of occupational groups and city types.

[4] If there are firms producing traded goods in every city and workers can move between the tradable and non-tradable sector, average productivity must be higher in cities where nominal wages are higher. Otherwise, firms in the tradable sector would relocate to lower-wage cities (Moretti 2011).

4. Results

4.1 The urban wage premium before and after the pandemic

Suppose there are only two cities, one large and one small. We can then estimate the urban wage premium (UWP) for the large city using the following equation:

$$\ln w_{ict} = \alpha_1 L_c + \delta_1 Exp_{it} + \delta_2 Exp_{it}^2 + X_{it}\beta + \gamma_t + \mu_i + \varepsilon_{ict} \quad (1)$$

where w_{ict} is the wage of worker i in city c at year t, L_c is a dummy variable for the large city, Exp_{it} is overall work experience acquired by worker i up until year t, X_{it} is a vector of time-varying individual and job related characteristics, γ_t is year fixed effects, μ_i is a worker fixed effect, and ε_{ict} is an error term. The parameter of interest is α_1, which captures the wage premium of working in the large city. In practice, we will estimate corresponding parameters for cities at different positions in the urban hierarchy (i.e. not only large vs. small cities). The UWP estimated by equation (1) represent a mix of static and dynamic effects. In Section 4.2, we will try to disentangle potential sources of the wage premium.

Many studies begin by examining how much of the raw UWP that is explained by observed worker and job-related characteristics, as well as by unobserved characteristics. We follow this approach and report results from progressively more demanding specifications of Equation (1).

Table 1, columns (1) to (4), report simple pooled ordinary least squares estimates of the urban wage premium for different city types. Rural areas serve as the excluded reference category. The raw UWP ranges from about 30% in the core of Stockholm city to under 5% in small cities and towns (column 1).[5] Controlling for observed worker and job-related characteristics leads to a sharp dop in the estimated wage premiums (compare columns 1 and 4). In relative terms, the reduction is largest at the lower end of the urban hierarchy. This decline is driven primarily by controls for compulsory school GPA, educational attainment, industry, and occupation. By contrast, controlling for overall work experience and basic demographic characteristics has only marginal effects.

To account for sorting across cities on unobserved characteristics, we introduce worker fixed effects in the regression model (column 5). This removes bias in the estimates arising from unobserved time-invariant worker heterogeneity. The within transformation of the fixed-effects model means that the estimated parameters for the different city types are identified by movers between the city types (i.e. individuals who change workplace location), while all other parameters in the model are identified from changes over time for both movers and stayers. The introduction of worker fixed effects leads to a sharp decline in the estimated UWP. Unobserved worker attributes play a relatively larger role at the top of the urban hierarchy (compare columns 4 and 5). In particular, the estimated UWP for the core of Stockholm city drops from 14.6% to 4.6%. Small cities and towns

[5] For simplicity, we interpret the estimates as approximate percentage premiums.

appear to offer no wage premium relative to rural areas once worker fixed effects are included in the model. As expected, log earnings are concave in overall work experience.

Comparing the estimated UWP between the centres and more peripheral parts of cities (column 5), we find that wage premiums in the central parts of Stockholm and Malmö are about twice as large as those in the peripheral areas. Peripheral locations in Gothenburg offer no wage premium relative to rural areas. In medium-sized cities, the wage premium is slightly higher in central areas, but the absolute level remains low. Overall, the results indicate that the UWP attenuates sharply with distance from the centre, particularly in the largest cities.

Table 1 Estimation of urban wage premiums by city type

	Ln annual earnings				
	(1)	(2)	(3)	(4)	(5)
Stockholm core	0.302**	0.320**	0.202**	0.146**	0.046**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Stockholm periphery	0.095**	0.101**	0.058**	0.043**	0.027**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Gothenburg core	0.188**	0.193**	0.093**	0.065**	0.022**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Gothenburg periphery	0.045**	0.040**	0.017**	0.012**	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Malmö core	0.182**	0.184**	0.083**	0.056**	0.021**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Malmö periphery	0.060**	0.055**	0.027**	0.022**	0.010**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Medium-sized city core	0.078**	0.077**	0.018**	0.011**	0.006**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Medium-sized city periphery	0.038**	0.025**	0.008**	0.003**	0.005**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Small city core	0.048**	0.047**	0.012**	0.004**	0.004**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.002)
Small city periphery	0.027**	0.012**	-0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Small towns	0.038**	0.023**	0.001*	-0.002**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Experience		0.024**	0.023**	0.018**	0.040**
		(0.000)	(0.000)	(0.000)	(0.000)
Experience^2		-0.000**	-0.000**	-0.000**	-0.001**
		(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	Yes	Yes	Yes	Yes
GPA controls	No	No	Yes	Yes	–
Education controls	No	No	Yes	Yes	Yes
Industry fixed effects	No	No	No	Yes	Yes
Occupation fixed effects	No	No	No	Yes	Yes
Worker fixed effects	No	No	No	No	Yes
Observations	9,091,433	9,091,433	9,091,433	9,091,433	9,091,433
Workers	1,823,626	1,823,626	1,823,626	1,823,626	1,823,626
R^2	0.09	0.24	0.36	0.51	0.12

Notes: See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 value in column (5) is within workers. Robust standard errors (clustered by workers) are given in parentheses. ** and * indicate significance at the 1% and 5%, respectively.

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Many studies report UWP estimates based on continuous measures of city size or density. To facilitate comparisons with this literature, Table 7 in the Appendix reports estimates of the UWP with respect to the logarithm of employment density and employment size across all 67 cities, using the full fixed-effects version of Equation (1). The estimated elasticities for WFH workers are around twice as large as those for onsite workers: 1.7% compared with 0.8% for employment density, and 1.1% compared with 0.6% for employment size.

Table 2 Estimation of urban wage premiums by work from home potential

	Ln annual earnings	
	WOS	WFH
	(1)	(2)
Stockholm core	0.031**	0.048**
	(0.001)	(0.001)
Stockholm periphery	0.021**	0.022**
	(0.001)	(0.002)
Gothenburg core	0.020**	0.020**
	(0.001)	(0.002)
Gothenburg periphery	0.001	-0.001
	(0.001)	(0.002)
Malmö core	0.014**	0.019**
	(0.002)	(0.002)
Malmö periphery	0.008**	0.008**
	(0.001)	(0.002)
Medium-sized city core	0.007**	0.001
	(0.001)	(0.002)
Medium-sized city periphery	0.003*	0.002
	(0.001)	(0.002)
Experience	0.023**	0.070**
	(0.001)	(0.001)
Experience^2	-0.000**	-0.001**
	(0.000)	(0.000)
Year fixed effects	Yes	Yes
Demographic controls	Yes	Yes
Education controls	Yes	Yes
Industry fixed effects	Yes	Yes
Occupation fixed effects	Yes	Yes
Worker fixed effects	Yes	Yes
Observations	5,179,522	3,911,911
Workers	1,222,487	852,799
R^2	0.11	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. Robust standard errors (clustered by workers) are given in parentheses. ** and * indicate significance at the 1% and 5%, respectively.

Table 2 reports separate earnings premiums for workers with WFH-compatible jobs and for workers in jobs that must be performed onsite (WOS), using the full fixed-effects version of Equation (1). Given the very small estimated premiums for small cities and towns (see column (5) in Table 1), we include these city types in the excluded reference category together with rural areas. The UWP associated with working in the core of Stockholm city is higher for WFH workers than for onsite workers (4.8% compared with 3.1%). The UWP of working in the peripheral areas of Stockholm city is lower and broadly similar for onsite and WFH workers (around 2%). The earnings premium of working in Malmö follows a similar pattern, although at a lower level. In Gothenburg, the UWP of working in the city core is around 2% for both groups of workers, while there appears to be no premium associated with working in peripheral locations of the city. Estimated premiums for medium-sized cities are generally very small. Finally, the returns to overall work experience are substantially higher for workers with WFH jobs.

We now turn to examining how the urban wage premium has been affected by the widespread shift to WFH following the pandemic. In the introduction, we noted that WFH reduces workers' physical presence at the workplace, which may limit opportunities for productive interactions. By contrast, the quality of worker–firm matches may improve if WFH enables more workers to search for jobs in large cities and allows firms to screen a larger pool of job applicants.

To examine how WFH has affected the UWP, we continue with the simple two-city example and specify the following equation:

$$\begin{aligned}\ln w_{ict} = {} & \alpha_1 L_c + \alpha_2 (L_c \times WFH_{it}) + \alpha_3 (L_c \times After_t) + \alpha_4 (L_c \times WFH_{it} \times After_t) \\ & + \alpha_5 After_t + \alpha_6 WFH_{it} + \alpha_7 (After_t \times WFH_{it}) \\ & + \delta_1 Exp_{it} + \delta_2 Exp_{it}^2 + X_{it}\beta + \gamma_t + \mu_i + \varepsilon_{ict} \end{aligned} \quad (2)$$

where WFH_{it} indicate that worker i has a WFH-compatible job in year t and $After_t$ is a dummy variable for the period after the start of the pandemic (i.e. 2020 to 2023). Everything else is the same as in Equation (1). To simplify terminology, we refer to workers with WFH-compatible jobs as the treatment group and to workers in jobs that must be performed onsite as the comparison group.

Given this, the parameter α_1 represents the pre-pandemic UWP (i.e. the wage premium of working in the large city) for the comparison group, α_2 represents the pre-pandemic difference in the UWP between the treatment and the comparison group, α_3 represents the change in the UWP after the start of the pandemic for the comparison group, and α_4 represents the difference in the change in the UWP between the treatment and comparison group after the start of the pandemic.

Table 3 presents estimates of the parameters in question in two different settings. Column (1) reports estimates of the UWP associated with working in the core of Stockholm city (i.e. the top of the urban hierarchy), relative to working in any of the other city types. Column (2) reports estimates of the UWP with respect to employment density across all 67 cities.

The results indicate that, prior to the pandemic, workers with WFH jobs received a slightly larger wage premium from working in the core of Stockholm city than workers with onsite jobs. There are virtually no pre-pandemic differences between the two groups in terms of the UWP with respect to employment density across all cities. After the start of the pandemic, workers with onsite jobs experienced an increase in the UWP (1.9% and 0.5%, respectively, in the two settings). The post-pandemic rise in the UWP was even larger for workers with WFH jobs – by 1.5 percentage points in the case of working in the core of Stockholm city and by 1 percentage point with respect to employment density across all 67 cities.

Table 3 Estimation of urban wage premiums by work from home potential before and after the pandemic

	Ln annual earnings			**Ln annual earnings**
	(1)			(2)
Stockholm core	0.006**		Ln employment density	0.008**
	(0.001)			(0.000)
Stockholm core × WFH	0.008**		Ln employment density × WFH	-0.001*
	(0.001)			(0.000)
Stockholm core × After	0.019**		Ln employment density × After	0.005**
	(0.001)			(0.000)
Stockholm core × WFH × After	0.015**		Ln employment density × WFH × After	0.010**
	(0.001)			(0.000)
Experience	0.028**		Experience	0.028**
	(0.000)			(0.000)
Experience^2	-0.001**		Experience^2	-0.001**
	(0.000)			(0.000)
Year fixed effects	Yes		Year fixed effects	Yes
Demographic controls	Yes		Demographic controls	Yes
Education controls	Yes		Education controls	Yes
Industry fixed effects	Yes		Industry fixed effects	Yes
Occupation fixed effects	Yes		Occupation fixed effects	Yes
Worker fixed effects	Yes		Worker fixed effects	Yes
Observations	9,091,433		Observations	9,091,433
Workers	1,823,626		Workers	1,823,626
R^2	0.11		R^2	0.11

Notes: See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. Robust standard errors (clustered by workers) are given in parentheses. ** and * indicate significance at the 1% and 5%, respectively.

The results suggest that large and dense cities continue to benefit from agglomeration advantages that contribute to higher productivity and wages. There is no indication that these advantages have diminished since the onset of the pandemic.[6]

[6] Simple employment statistics also indicate that large cities continue to be attractive locations for firms. There is no evidence of employment shifting away from Stockholm city after the pandemic. The share of jobs located in the core of Stockholm city increased by 0.8 percentage points between 2019 and 2023 (from 20.6% to 21.4%). This increase was driven primarily by a rise in the share of WFH-compatible jobs, which increased by 1.3

4.2 Dynamic wage effects across city types and occupational groups

Two explanations for large cities' productivity advantages that have been suggested in the literature are matching and learning (Duranton and Puga 2004, Moretti 2011). In the presence of worker and firm heterogeneity, the quality of worker–firm matches may be higher in large cities, where many workers are searching for jobs and many firms are looking to hire. By working in large cities, workers can also learn from colleagues, exchange ideas, and accumulate valuable experience over time. These two mechanisms are presumably particularly important for specialised and highly skilled workers.

In this section, we examine how these mechanisms affect the evolution of the urban wage premium over time. In particular, we focus on the contribution of accumulated city-specific work experience and job changes and distinguish between four groups of workers: those with low-skilled onsite jobs, low-skilled WFH-compatible jobs, high-skilled onsite jobs, and high-skilled WFH-compatible jobs.

Continuing with the simple two-city example, and starting with the role of city-specific experience, we specify the following equation:

$$\ln w_{ict} = \alpha_1 L_c + \delta_1 Exp_{it} + \delta_2 Exp_{it}^2 + \delta_3 Exp_{it\_}L_c + \delta_4 Exp_{it\_}^2 L_c + X_{it}\beta + \gamma_t + \mu_i + \varepsilon_{ict} \quad (3)$$

where $Exp_{it\_}L_c$ is work experience accumulated by worker i in city c up until year t. Given that overall work experience (Exp_{it}) is included in the model, the parameter δ_3 indicate whether work experience acquired in the large city is more valuable than experience accumulated in the small city (excluding the parameters on squared experience for simplicity). That is, if $\delta_3 > 0$, then work experience acquired in the large city is more valuable than experience accumulated in the small city. Note that while α_1, which now captures the initial wage premium associated with working in the large city, is still identified by movers between city types (i.e. individuals who change workplace location), the returns to work experience are identified based on both movers and stayers, as they accumulate overall and city-specific experience over time.

Table 4 presents results for the core and periphery of Stockholm, while Table 8 in the Appendix reports results for all city types. The reference category consists of small cities, towns, and rural areas. The initial earnings premium associated with working in the core of Stockholm city is 3.7% for workers with high-skilled WFH jobs. We interpret this premium as primarily reflecting a higher quality of the initial job match when starting to work in the centre of Stockholm rather than in the reference cities. For workers with high-skilled WFH jobs, a first year of experience in the core of Stockholm increases earnings by 2.4% relative to having worked that year in the reference cities. Note that this represents a dynamic premium that contributes to the evolution of earnings as additional years of work experience are accumulated.

percentage points (from 33.8% to 35.1%), and to a lesser extent by onsite jobs, which increased by 0.2 percentage points (from 13.6% to 13.8%). A similar pattern emerges if we broaden the perspective and focus on the entire Stockholm metropolitan region (core and periphery).

The initial UWP associated with working in the centre of Stockholm is lower for the other three categories of workers (around 2.5%), and the dynamic effect of work experience in Stockholm is also smaller for these groups.

The initial UWP of working in the more peripheral areas of Stockholm is about 2% for all worker groups. However, the value of accumulated work experience in peripheral locations of the city do not appear to differ substantially from that in the reference cities.

Table 4 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience

	Ln annual earnings			
	Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.024**	0.025**	0.028**	0.037**
	(0.001)	(0.004)	(0.003)	(0.001)
Stockholm periphery	0.019**	0.019**	0.022**	0.020**
	(0.001)	(0.004)	(0.003)	(0.002)
Experience	0.018**	0.036**	0.037**	0.064**
	(0.001)	(0.003)	(0.002)	(0.001)
Experience^2	-0.000**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Experience in Stockholm core	0.009**	0.014**	0.007**	0.024**
	(0.000)	(0.001)	(0.001)	(0.000)
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Experience in Stockholm periphery	0.003**	0.001	0.003**	0.001**
	(0.000)	(0.001)	(0.001)	(0.000)
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	3,989,626	477,567	1,189,896	3,434,344
Workers	960,943	160,267	338,784	755,510
R^2	0.10	0.14	0.13	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. Robust standard errors (clustered by workers) are given in parentheses. ** and * indicate significance at the 1% and 5%, respectively.

Turning to the other city types (see Table 8 in the Appendix), the central parts of Gothenburg and Malmö offer an initial UWP of around 1–2% and a small dynamic premium associated with accumulated work experience (approximately 0.5% per year). Differences across worker categories are generally small. For medium-sized cities, both the initial and dynamic earnings premiums relative to the reference cities are marginal.

In summary, the earnings premium associated with accumulating work experience in the centre of Stockholm city is substantial, particularly for workers with high-skilled WFH jobs. One possible interpretation of the large dynamic earnings premium for this group is that it reflects learning effects. However, the premium may also capture higher-quality of worker–firm matches for highly specialised workers in larger and thicker labour markets.

To test the hypothesis of higher match quality in larger and thicker labour markets, we focus on the value of city-specific job changes. A job change is defined as a change in workplace affiliation between two consecutive years, conditional on being employed in both years and excluding job changes due to mobility between city types.

Continuing with the simple two-city example, we specify the following equation:

$$\begin{aligned}\ln w_{ict} = {} & \alpha_1 L_c + \delta_1 Exp_{it} + \delta_2 Exp_{it}^2 + \delta_3 Exp_{it}\_L_c + \delta_4 Exp_{it}^2\_L_c \\ & + \eta_1 JC_{it} + \eta_2 JC_{it}\_L_c + X_{it}\beta + \gamma_t + \mu_i + \varepsilon_{ict}\end{aligned} \quad (4)$$

where $JC_{it}\_L_c$ is the number of job changes done by worker i in the large city up until year t. Given that the number of overall job changes (JC_{it}) is included in the model, the parameter η_2 indicate whether job changes in the large city is more valuable than job changes in the small city.

Table 5 reports results for the core and periphery of Stockholm, while Table 9 in the Appendix presents results for all city types. For workers with WFH jobs, both low-skilled and high-skilled, a job change in the core of Stockholm city increases earnings by about 1% relative to a job change in the reference cities. As with the premium associated with city-specific work experience, this represents a dynamic premium that contributes to the evolution of earnings with each additional job change. Note that introducing job changes into the specification leads to a minor reduction in the estimated effect of work experience in the centre of Stockholm. This is expected if the previous estimates partly captured unmeasured positive effects associated with job changes.

Table 5 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience and job change

	Ln annual earnings			
	Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.024**	0.026**	0.028**	0.039**
	(0.001)	(0.004)	(0.003)	(0.001)
Stockholm periphery	0.019**	0.019**	0.022**	0.019**
	(0.001)	(0.004)	(0.003)	(0.002)
Experience	0.017**	0.034**	0.036**	0.062**
	(0.001)	(0.003)	(0.002)	(0.001)
Experience^2	-0.000**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Experience in Stockholm core	0.009**	0.012**	0.006**	0.021**
	(0.000)	(0.001)	(0.001)	(0.000)
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Experience in Stockholm periphery	0.003**	0.001	0.002**	0.003**
	(0.000)	(0.001)	(0.001)	(0.000)
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Job change	0.007**	0.011**	0.010**	0.012**
	(0.000)	(0.002)	(0.001)	(0.001)
Job change in Stockholm core	-0.001	0.010**	0.001	0.010**
	(0.001)	(0.003)	(0.002)	(0.001)
Job change in Stockholm periphery	-0.001	-0.004	0.001	-0.006**
	(0.001)	(0.004)	(0.002)	(0.002)
Observations	3,989,626	477,567	1,189,896	3,434,344
Workers	960,943	160,267	338,784	755,510
R^2	0.10	0.14	0.13	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. Robust standard errors (clustered by workers) are given in parentheses. ** and * indicate significance at the 1% and 5%, respectively.

Turning to the other city types, there is a positive effect of job changes in the centre of Gothenburg for workers with high-skilled jobs. Apart from this, the effects of job changes are mixed and generally small in absolute terms (see Table 9 in the Appendix).

4.3 Graphical illustrations of dynamic wage premiums

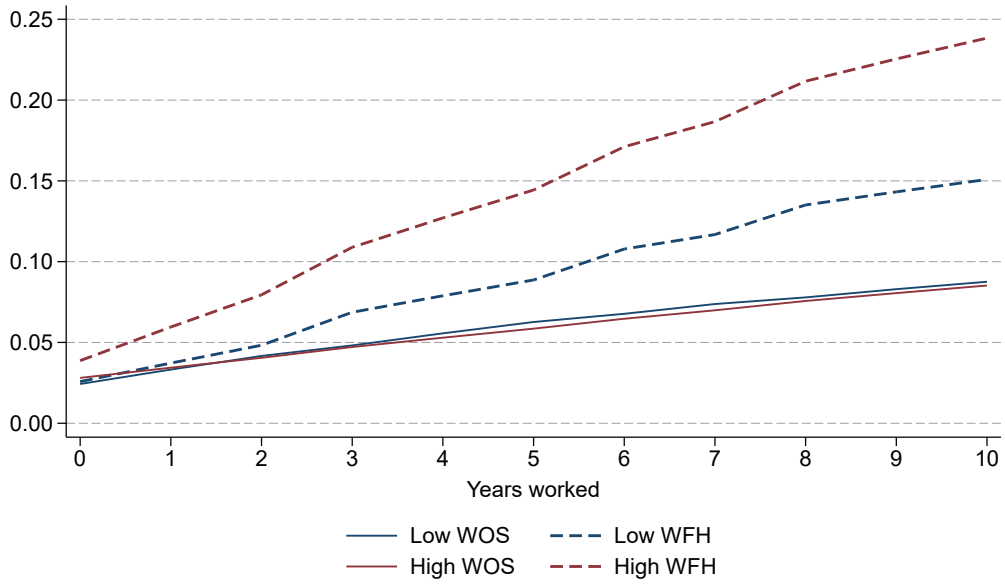
A straightforward way to illustrate the results from the previous section is to plot the evolution of earnings for workers across different city types. We focus on earnings

trajectories over the first ten years of work experience, including three job changes occurring after three, six, and eight years, respectively.

Based on the estimated coefficients in Table 5, Figure 1 compares workers who start working in the core of Stockholm city with workers who instead start working in small cities, towns, or rural areas. The intercept captures the initial earnings premium, while the slope captures the dynamic earnings premium associated with accumulated work experience and job changes. Importantly, the earnings profiles do not show how earnings increase in absolute terms when working in the centre of Stockholm city; rather, they show how much faster earnings increase when working in the core of Stockholm city compared with the reference cities.

The earnings premium for workers with high-skilled WFH jobs starts at around 4% and increases gradually to about 24% after ten years. The other worker categories also receive an earnings premium from working in the centre of Stockholm city, but the combined effects of the static and dynamic premiums are smaller. For workers with low-skilled WFH jobs, the earnings gap relative to the reference cities reaches around 15% after ten years, compared with about 9% for workers with onsite jobs.

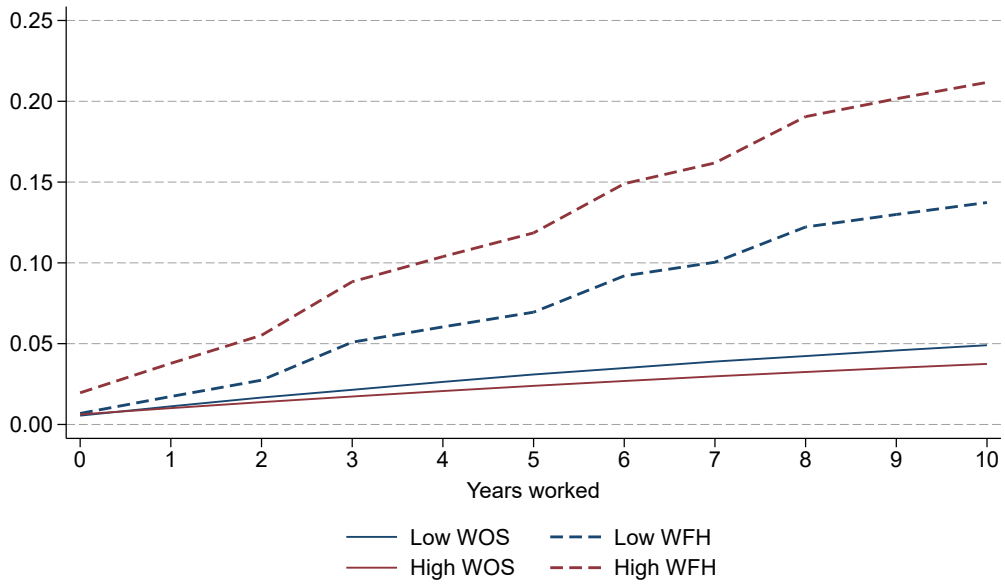
Figure 1 Starting to work in the core of Stockholm city rather than in small cities, towns, or rural areas



Notes: Based on the estimated coefficient in Table 5.

Figure 2 shows a similar comparison between workers who start working in the centre of Stockholm city and those who instead start working in the more peripheral parts of the city. It is evident that working in the city centre rather than in peripheral areas provides a substantial earnings premium. For workers with high-skilled WFH jobs, the earnings gap relative to the peripheral parts reaches about 21% after ten years. The corresponding number is around 14% for workers with low-skilled WFH jobs and only about 4–5% for workers with onsite jobs.

Figure 2 Starting to work in the core rather than in the peripheral parts of Stockholm city



Notes: Based on the estimated coefficient in Table 5.

Figures 3 to 5 in the Appendix present corresponding earnings trajectories for the other city types over the first ten years of work experience, allowing for three job changes. The results indicate a relatively high earnings premium from starting to work in the centres of Gothenburg and Malmö, compared with working in the peripheral parts of these cities or in smaller cities, towns, or rural areas. For workers with high-skilled WFH jobs, the dynamic earnings premium reaches around 7–13% after ten years. The corresponding number is around 5–8% for workers with high-skilled onsite jobs and 1–8% for workers with low-skilled jobs. Medium-sized cities appear to offer only a marginal earnings premium relative to the reference category of small cities, towns, and rural areas, at below 2% after ten years.

4.4 Additional results and robustness

This section presents results based on alternative sample restrictions, alternative classifications of worker groups, and separate analyses for men and women. In all cases, the results are based on the specification in Equation (4), that is, the full worker fixed-effects specification, including accumulated city-specific work experience and job changes.

First, we estimate the UWP including job spells in both the private and public sectors. The results are very similar to those obtained when restricting the sample to job spells in

the private sector only (see Table 10 in the Appendix). Second, we relax the earnings restriction and estimate the UWP using all observations above the bottom decile of the earnings distribution. The results are similar to those based on the stricter earnings restriction (see Table 11 in the Appendix).

When estimating separate effects for men and women, we find that the initial earnings premium associated with working in the core of Stockholm city for workers with high-skilled WFH jobs is higher for men than for women. Men with high-skilled WFH jobs also receive a larger dynamic premium from work experience acquired in the core of Stockholm city (see Table 12 in the Appendix). By contrast, women with low-skilled WFH jobs receive a higher initial earnings premium from working in the core of Stockholm city than men, as well as a higher dynamic premium from job changes, but a lower dynamic premium from accumulated work experience.

Finally, we test an alternative classification in which WFH-compatible and onsite jobs are differentiated by workers' educational attainment rather than by the skill requirements of the occupation. Specifically, we distinguish between workers with a university education and those with upper-secondary or lower levels of education. Using this approach yields qualitatively similar results to those obtained when jobs are classified by skill level (see Table 13 in the Appendix).

5. Summary and discussion

International surveys indicate that working from home (WFH) is here to stay. This study examines how WFH can increase aggregate productivity in the economy and contribute to the spatial diffusion of large-city wage premiums. Extensive research shows that large cities benefit from agglomeration economies, which raise productivity and wages. Workers' access to high-productivity locations is, however, constrained by limited housing supply and high housing costs. WFH provides an opportunity to decouple productive big-city work from big-city living. By reducing the need for frequent commuting, remote-work arrangements allow workers to access high-productivity cities from greater distances.

The study is based on population-wide matched employer–employee data covering the period 2016–2023, while tracking city-specific experience and job changes back to 1986. Using detailed occupational data, workers are classified as having skilled or unskilled WFH jobs, or skilled or unskilled onsite jobs.

The results indicate that large and dense cities continue to benefit from agglomeration advantages after the pandemic. Focusing on different groups of workers, we find a particularly high earnings premium from starting to work in the centre of Stockholm city for workers with high-skilled WFH jobs. Relative to working in smaller cities, towns, or rural areas, these workers receive an initial earnings premium of around 4%, with the earnings gap increasing to about 24% after ten years. This dynamic effect is driven by a higher accumulated value of work experience and job changes in the core of Stockholm city. The results also reveal a substantial dynamic earnings premium from working in the centre rather than in the more peripheral areas of Stockholm city. For workers with high-skilled WFH jobs, the earnings gap reaches about 21% after ten years. In addition, we find a relatively high earnings premium from starting to work in the centres of Gothenburg and Malmö compared with working in the peripheral areas of these cities or in smaller cities, towns, or rural areas. For workers with high-skilled WFH jobs, the dynamic earnings premium reaches around 7–13% after ten years.

These findings suggest that a WFH-induced increase in the supply of labour to high-productivity locations can raise aggregate productivity in the economy and, moreover, contribute to the geographical dispersion of large-city wage premiums to the outskirts of metropolitan areas, as well as to smaller cities, towns, and rural areas hosting WFH residents.

The results have two important policy implications. First, given the well-documented difficulties of increasing housing supply in large cities, measures that facilitate WFH are important, as they can increase labour supply to high-productivity locations without further straining already tight housing markets in these areas. Second, place-based policies aimed at attracting remote workers to exurbs, smaller cities, towns, and rural areas can increase population, local consumption, and tax bases in these locations.

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Appendix

Table 6 Variable definitions

Variable	Definition
Earnings	Annual gross labour earnings. Expressed in 2023 prices using the national CPI as the deflator.
Experience	The number of years the individual has been registered as employed, starting from the age of 20 and accumulated over the individual's working life. Overall and city-specific (see city classification below).
Job change	The number of job changes, starting from the age of 20 and accumulated over the individual's working life. A job change is defined as a change in workplace affiliation between two consecutive years, conditional on being employed in both years and excluding job changes due to mobility between city types. Overall and city-specific (see city classification below).
Sex	Dummy coded as 1 if female.
Married/cohabiting	Dummy coded as 1 if married or cohabiting.
Children	Dummies for children in four age groups living at home (0–3, 4–6, 7–15, 16+).
Compulsory school grade point average	Dummies for cohort specific decile rank of compulsory school grade point average.
Level of education	Dummies for six categories (from primary education to doctoral level).
Field of education	Dummies for one-digit ISCED field of education.
Industry	Dummies for two-digit SNI-2007 industry (SNI-2007 is compatible with NACE Rev. 2).
Occupation	Dummies for three-digit SSYK-2012 occupation (SSYK-2012 is compatible with ISCO-08).
Work-from-home potential and skill level of jobs	Based on Dingel and Neiman's (2020) binary categorisation of occupations as either possible or not possible to do from home – here referred to as work from home-compatible jobs (WFH) and onsite jobs (WOS), respectively. This categorisation is applied at the most detailed level of ISCO-08, which in the Swedish version contain 429 different occupations. The two groups are further differentiated by ISCO-08 skill level. We classify occupations at skill level 3 and 4 as high skilled jobs and occupations at skill level 1 and 2 as low skilled jobs.
City classification	67 travel-to-work areas (TWA), as defined by Statistics Sweden in 2023, grouped into 12 city types based on employment size and density: • Stockholm core (Stockholm, Solna and Sundbyberg municipalities) • Stockholm periphery (rest of Stockholm TWA) • Gothenburg core (Gothenburg and Mölndal municipalities) • Gothenburg periphery (rest of Gothenburg TWA) • Malmö core (Malmö and Lund municipalities) • Malmö periphery (rest of Malmö TWA) • Medium-sized city cores (single core municipalities in TWAs with employment>100,000) • Medium-sized city peripheries (surrounding municipalities in TWAs with employment>100,000) • Small city cores (single core municipalities in TWAs with employment>50,000) • Small city peripheries (surrounding municipalities in TWAs with employment>50,000) • Small towns (TWAs with employment>15,000) • Rural areas (TWAs with employment<15,000) Workers are assigned to the different city types based on the location of their workplace.

Table 7 Estimation of urban wage premiums by city density and size

	Ln annual earnings			
	WOS	WFH	WOS	WFH
	(1a)	(1b)	(2a)	(2b)
Ln employment density	0.008**	0.017**		
	(0.000)	(0.001)		
Ln employment size			0.006**	0.011**
			(0.000)	(0.000)
Experience	0.023**	0.071**	0.023**	0.071**
	(0.001)	(0.001)	(0.001)	(0.001)
Experience^2	-0.000**	-0.001**	-0.000**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	5,179,522	3,911,911	5,179,522	3,911,911
Workers	1,222,487	852,799	1,222,487	852,799
R^2	0.11	0.16	0.11	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. Robust standard errors (clustered by workers) are given in parentheses. ** and * indicate significance at the 1% and 5%, respectively.

Table 8 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience

	Ln annual earnings			
	Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.024**	0.025**	0.028**	0.037**
Stockholm periphery	0.019**	0.019**	0.022**	0.020**
Gothenburg core	0.022**	0.022**	0.009**	0.016**
Gothenburg periphery	0.002	0.013*	0.000	0.000
Malmö core	0.009**	0.008	0.013**	0.017**
Malmö periphery	0.006**	0.007	0.016**	0.007**
Medium-sized city core	0.008**	0.001	0.005	0.003
Medium-sized city periphery	0.002	0.009	0.005	0.003
Experience	0.018**	0.036**	0.037**	0.064**
Experience^2	-0.000**	-0.001**	-0.001**	-0.001**
Experience in Stockholm core	0.009**	0.014**	0.007**	0.024**
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.000**
Experience in Stockholm periphery	0.003**	0.001	0.003**	0.001**
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000	0.000*
Experience in Gothenburg core	0.002**	0.006**	0.006**	0.006**
Experience in Gothenburg core^2	-0.000*	-0.000*	-0.000	-0.000*
Experience in Gothenburg periphery	0.002**	-0.003*	0.000	-0.003**
Experience in Gothenburg periphery^2	-0.000**	0.000**	-0.000	0.000**
Experience in Malmö core	0.007**	0.004**	0.006**	0.008**
Experience in Malmö core^2	-0.000**	-0.000	-0.000**	-0.000**
Experience in Malmö periphery	0.002**	0.003*	0.001	0.001
Experience in Malmö periphery^2	-0.000**	-0.000	-0.000	0.000
Experience in Medium-sized city core	0.001**	-0.002	-0.001	-0.003**
Experience in Medium-sized city core^2	-0.000**	0.000	0.000	0.000**
Experience in Medium-sized city periphery	-0.002**	-0.003*	-0.002*	-0.003**
Experience in Medium-sized city periphery^2	0.000**	0.000**	0.000	0.000**
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	3,989,626	477,567	1,189,896	3,434,344
Workers	960,943	160,267	338,784	755,510
R^2	0.10	0.14	0.13	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. ** and * indicate significance at the 1% and 5%, respectively (based on robust standard errors, clustered by workers).

Table 9 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience and job change

	Ln annual earnings			
	Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.024**	0.026**	0.028**	0.039**
Stockholm periphery	0.019**	0.019**	0.022**	0.019**
Gothenburg core	0.022**	0.022**	0.010**	0.017**
Gothenburg periphery	0.002	0.013*	0.000	-0.000
Malmö core	0.009**	0.009	0.013**	0.017**
Malmö periphery	0.006**	0.007	0.016**	0.006**
Medium-sized city core	0.008**	0.002	0.006*	0.003
Medium-sized city periphery	0.003*	0.009	0.005	0.003
Experience	0.017**	0.034**	0.036**	0.062**
Experience^2	-0.000**	-0.001**	-0.001**	-0.001**
Experience in Stockholm core	0.009**	0.012**	0.006**	0.021**
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.000**
Experience in Stockholm periphery	0.003**	0.001	0.002**	0.003**
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000	0.000
Experience in Gothenburg core	0.001**	0.006**	0.004**	0.005**
Experience in Gothenburg core^2	-0.000	-0.000*	-0.000	-0.000*
Experience in Gothenburg periphery	0.002**	-0.003*	-0.000	-0.003**
Experience in Gothenburg periphery^2	-0.000**	0.000**	-0.000	0.000**
Experience in Malmö core	0.006**	0.003*	0.006**	0.008**
Experience in Malmö core^2	-0.000**	-0.000	-0.000**	-0.000**
Experience in Malmö periphery	0.001**	0.003	0.001	0.002*
Experience in Malmö periphery^2	-0.000**	-0.000	-0.000	-0.000
Experience in Medium-sized city core	0.000	-0.003*	-0.001*	-0.003**
Experience in Medium-sized city core^2	-0.000**	0.000	0.000	0.000**
Experience in Medium-sized city periphery	-0.002**	-0.003	-0.001	-0.002**
Experience in Medium-sized city periphery^2	0.000**	0.000*	0.000	0.000**
Job change	0.007**	0.011**	0.010**	0.012**
Job change in Stockholm core	-0.001	0.010**	0.001	0.010**
Job change in Stockholm periphery	-0.001	-0.004	0.001	-0.006**
Job change in Gothenburg core	0.004**	0.003	0.010**	0.008**
Job change in Gothenburg periphery	-0.002	0.003	0.003	-0.006*
Job change in Malmö core	-0.001	0.007	0.003	0.004*
Job change in Malmö periphery	0.000	0.005	-0.002	-0.000
Job change in Medium-sized city core	0.002*	0.012**	0.005*	0.002
Job change in Medium-sized city periphery	0.002	-0.001	-0.003	0.002
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	3,989,626	477,567	1,189,896	3,434,344
Workers	960,943	160,267	338,784	755,510
R^2	0.10	0.14	0.13	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R2 values are within workers. ** and * indicate significance at the 1% and 5%, respectively (based on robust standard errors, clustered by workers).

Table 10 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience and job change. Private and public sector

	Ln annual earnings			
	Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.026**	0.025**	0.034**	0.038**
Stockholm periphery	0.019**	0.016**	0.027**	0.021**
Gothenburg core	0.021**	0.021**	0.011**	0.013**
Gothenburg periphery	0.002	0.013**	0.003	0.001
Malmö core	0.009**	0.008	0.008**	0.014**
Malmö periphery	0.005**	0.002	0.009**	0.006**
Medium-sized city core	0.008**	0.004	0.002	0.003*
Medium-sized city periphery	0.003**	0.007	0.002	0.007**
Experience	0.015**	0.028**	0.025**	0.052**
Experience^2	-0.000**	-0.000**	-0.000**	-0.001**
Experience in Stockholm core	0.008**	0.011**	0.006**	0.020**
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.000**
Experience in Stockholm periphery	0.003**	0.002*	0.004**	0.003**
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000**	0.000
Experience in Gothenburg core	0.001**	0.005**	0.004**	0.006**
Experience in Gothenburg core^2	-0.000	-0.000**	-0.000	-0.000**
Experience in Gothenburg periphery	0.001**	-0.002*	0.002**	-0.001**
Experience in Gothenburg periphery^2	-0.000**	0.000**	-0.000*	0.000**
Experience in Malmö core	0.005**	0.003**	0.004**	0.006**
Experience in Malmö core^2	-0.000**	-0.000	-0.000**	-0.000**
Experience in Malmö periphery	0.001**	0.003**	0.001**	0.002**
Experience in Malmö periphery^2	-0.000**	-0.000	-0.000**	-0.000
Experience in Medium-sized city core	0.000	-0.002**	0.001*	-0.002**
Experience in Medium-sized city core^2	-0.000**	0.000	-0.000	0.000**
Experience in Medium-sized city periphery	-0.002**	-0.002*	-0.002**	-0.002**
Experience in Medium-sized city periphery^2	0.000**	0.000**	0.000	0.000**
Job change	0.006**	0.009**	0.004**	0.012**
Job change in Stockholm core	0.001	0.012**	0.010**	0.013**
Job change in Stockholm periphery	0.001	-0.000	0.006**	-0.004**
Job change in Gothenburg core	0.005**	0.000	0.005**	0.006**
Job change in Gothenburg periphery	-0.001	-0.000	0.003**	-0.002
Job change in Malmö core	0.000	0.004	0.007**	0.003*
Job change in Malmö periphery	0.001	0.003	0.004**	0.000
Job change in Medium-sized city core	0.002*	0.008**	0.002*	0.005**
Job change in Medium-sized city periphery	0.003**	-0.005*	0.000	0.001
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	5,331,131	724,221	3,287,669	5,108,048
Workers	1,242,060	227,329	751,125	1,058,472
R^2	0.11	0.14	0.17	0.16

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. ** and * indicate significance at the 1% and 5%, respectively (based on robust standard errors, clustered by workers).

Table 11 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience and job change. All observations above the bottom decile of the earnings distribution

	Ln annual earnings			
	Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.030**	0.031**	0.032**	0.041**
Stockholm periphery	0.025**	0.022**	0.026**	0.018**
Gothenburg core	0.029**	0.021**	0.012**	0.019**
Gothenburg periphery	0.002	0.011	-0.002	-0.002
Malmö core	0.008**	0.019**	0.011*	0.016**
Malmö periphery	0.003	0.007	0.019**	0.007**
Medium-sized city core	0.009**	0.002	0.007	0.003
Medium-sized city periphery	0.004*	0.011	0.004	0.003
Experience	0.039**	0.061**	0.067**	0.082**
Experience^2	-0.001**	-0.001**	-0.001**	-0.001**
Experience in Stockholm core	0.013**	0.015**	0.008**	0.024**
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.001**
Experience in Stockholm periphery	0.003**	0.000	0.002*	0.003**
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000	-0.000
Experience in Gothenburg core	0.001*	0.008**	0.008**	0.007**
Experience in Gothenburg core^2	-0.000**	-0.000**	-0.000**	-0.000**
Experience in Gothenburg periphery	0.002**	-0.002	-0.001	-0.003**
Experience in Gothenburg periphery^2	-0.000**	0.000	-0.000	0.000**
Experience in Malmö core	0.010**	0.010**	0.006**	0.010**
Experience in Malmö core^2	-0.000**	-0.000**	-0.000**	-0.000**
Experience in Malmö periphery	0.003**	0.005**	0.002	0.001
Experience in Malmö periphery^2	-0.000**	-0.000**	-0.000*	0.000
Experience in Medium-sized city core	0.001	-0.002	0.000	-0.002**
Experience in Medium-sized city core^2	-0.000**	0.000	-0.000	0.000
Experience in Medium-sized city periphery	-0.002**	-0.001	-0.003**	-0.003**
Experience in Medium-sized city periphery^2	0.000**	0.000	0.000*	0.000**
Job change	0.011**	0.013**	0.010**	0.014**
Job change in Stockholm core	-0.004**	0.014**	0.002	0.012**
Job change in Stockholm periphery	-0.004**	-0.007	0.002	-0.008**
Job change in Gothenburg core	0.006**	0.008	0.013**	0.011**
Job change in Gothenburg periphery	-0.001	-0.000	0.004	-0.009**
Job change in Malmö core	-0.002	0.007	0.006	0.004*
Job change in Malmö periphery	-0.000	0.006	-0.005	0.001
Job change in Medium-sized city core	0.002	0.012*	0.011**	0.003
Job change in Medium-sized city periphery	0.003**	0.004	-0.001	0.004
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	5,112,251	583,137	1,297,957	3,650,429
Workers	1,218,213	192,949	366,829	794,326
R^2	0.09	0.13	0.14	0.17

Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. ** and * indicate significance at the 1% and 5%, respectively (based on robust standard errors, clustered by workers).

Table 12 Estimation of dynamic urban wage premiums by work from home potential and skill level, including city specific experience and job change. Men and women

	Ln annual earnings							
	Men				Women			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
	WOS	WFH	WOS	WFH	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Stockholm core	0.026**	0.016*	0.028**	0.043**	0.018**	0.030**	0.026**	0.027**
Stockholm periphery	0.019**	0.009	0.022**	0.023**	0.016**	0.024**	0.020**	0.011**
Gothenburg core	0.024**	0.019	0.009**	0.018**	0.016**	0.025**	0.012*	0.015**
Gothenburg periphery	0.001	0.018	0.000	0.002	0.004	0.012*	0.001	-0.005
Malmö core	0.011**	-0.003	0.014**	0.016**	0.003	0.013*	0.009	0.019**
Malmö periphery	0.007**	-0.000	0.017**	0.005	0.000	0.010	0.013*	0.009*
Medium-sized city core	0.008**	-0.005	0.007*	0.004*	0.006*	0.004	0.003	0.001
Medium-sized city periphery	0.002	0.013	0.006	0.002	0.005	0.007	0.005	0.003
Exp	0.017**	0.035**	0.040**	0.062**	0.017**	0.034**	0.025**	0.061**
Exp^2	-0.000**	-0.001**	-0.001**	-0.001**	-0.000**	-0.001**	-0.000**	-0.001**
Exp in Stockholm core	0.009**	0.016**	0.008**	0.024**	0.010**	0.010**	0.006**	0.018**
Exp in Stockholm $core^2$	-0.000**	-0.000**	-0.000**	-0.001**	-0.000**	-0.000**	-0.000*	-0.000**
Exp in Stockholm periphery	0.003**	-0.001	0.003**	0.002**	0.003**	0.002	0.001	0.002**
Exp in Stockholm $periphery^2$	-0.000**	0.000	-0.000**	0.000	-0.000**	-0.000*	0.000	0.000
Exp in Gothenburg core	0.002**	0.008**	0.004**	0.006**	-0.001	0.005**	0.005**	0.005**
Exp in Gothenburg $core^2$	-0.000**	-0.000	-0.000*	-0.000**	0.000*	-0.000	0.000	-0.000
Exp in Gothenburg periphery	0.003**	-0.005	-0.001	-0.002*	0.001	-0.002	0.001	-0.004**
Exp in Gothenburg $periphery^2$	-0.000**	0.000	-0.000	0.000**	-0.000	0.000	-0.000	0.000**
Exp in Malmö core	0.007**	0.008**	0.006**	0.009**	0.005**	0.001	0.005**	0.005**
Exp in Malmö $core^2$	-0.000**	-0.000	-0.000**	-0.000**	-0.000**	-0.000	-0.000	-0.000**
Exp in Malmö periphery	0.002**	0.003	-0.000	0.003**	0.001	0.002	0.001	-0.000
Exp in Malmö $periphery^2$	-0.000**	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
Exp in Medium-sized city core	0.000	-0.004	-0.002*	-0.003**	0.000	-0.002	-0.001	-0.002**
Exp in Medium-sized city $core^2$	-0.000**	0.000	0.000	0.000**	-0.000*	0.000	0.000	0.000**
Exp in Medium-sized city per.	-0.002**	-0.001	-0.002*	-0.003**	-0.002**	-0.003	-0.001	-0.000
Exp in Medium-sized city $per.^2$	0.000**	0.000	0.000	0.000**	0.000	0.000*	0.000	0.000
JC	0.008**	0.012**	0.010**	0.010**	0.005**	0.010**	0.011**	0.013**
JC in Stockholm core	-0.003*	0.003	0.001	0.010**	0.001	0.012**	0.000	0.011**
JC in Stockholm periphery	-0.002	-0.016*	0.000	-0.006*	0.001	-0.001	-0.000	-0.008**
JC in Gothenburg core	0.003	-0.008	0.011**	0.009**	0.008**	0.006	0.009*	0.006**
JC in Gothenburg periphery	-0.002	-0.008	0.004	-0.004	-0.001	0.005	-0.000	-0.009*
JC in Malmö core	-0.001	-0.004	0.002	0.007**	0.001	0.011*	0.004	-0.001
JC in Malmö periphery	-0.000	-0.004	-0.004	-0.001	0.002	0.008	-0.000	0.001
JC in Medium-sized city core	0.001	0.012	0.005	0.003	0.006**	0.012**	0.004	-0.001
JC in Medium-sized city per.	0.001	-0.004	-0.006	0.004	0.004	0.000	0.003	-0.003
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,012,316	144,173	763,204	2,169,265	977,310	333,394	426,692	1,265,079
Workers	656,011	52,462	205,776	456,568	304,932	107,805	133,008	298,942
R^2	0.10	0.12	0.12	0.16	0.12	0.15	0.16	0.19

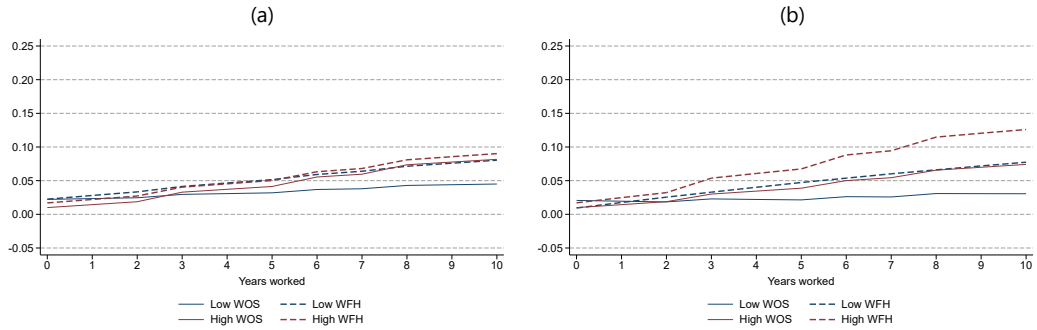
Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. ** and * indicate significance at the 1% and 5%, respectively (based on robust standard errors, clustered by workers).

Table 13 Estimation of dynamic urban wage premiums by work from home potential and educational attainment, including city specific experience and job change

	Ln annual earnings			
	Upper sec. or lower		University	
	WOS	WFH	WOS	WFH
	(1)	(2)	(3)	(4)
Stockholm core	0.026**	0.035**	0.027**	0.040**
Stockholm periphery	0.019**	0.019**	0.023**	0.021**
Gothenburg core	0.023**	0.018**	0.010**	0.017**
Gothenburg periphery	0.001	0.001	0.002	0.001
Malmö core	0.011**	0.019**	0.008**	0.016**
Malmö periphery	0.007**	0.007*	0.010**	0.007*
Medium-sized city core	0.008**	0.006*	0.005*	0.001
Medium-sized city periphery	0.004**	0.001	0.003	0.004
Experience	0.017**	0.052**	0.032**	0.062**
Experience^2	-0.000**	-0.001**	-0.000**	-0.001**
Experience in Stockholm core	0.008**	0.013**	0.011**	0.024**
Experience in Stockholm core^2	-0.000**	-0.000**	-0.000**	-0.001**
Experience in Stockholm periphery	0.003**	0.001*	0.004**	0.003**
Experience in Stockholm periphery^2	-0.000**	-0.000	-0.000**	0.000
Experience in Gothenburg core	0.001**	0.004**	0.006**	0.006**
Experience in Gothenburg core^2	-0.000	-0.000	-0.000*	-0.000**
Experience in Gothenburg periphery	0.002**	-0.001	0.001	-0.004**
Experience in Gothenburg periphery^2	-0.000**	0.000	-0.000	0.000**
Experience in Malmö core	0.005**	0.006**	0.008**	0.008**
Experience in Malmö core^2	-0.000**	-0.000**	-0.000**	-0.000**
Experience in Malmö periphery	0.001**	0.000	0.002**	0.003**
Experience in Malmö periphery^2	-0.000**	0.000	-0.000*	-0.000
Experience in Medium-sized city core	0.000	0.001	0.001	-0.004**
Experience in Medium-sized city core^2	-0.000**	-0.000	-0.000**	0.000**
Experience in Medium-sized city periphery	-0.002**	-0.001	0.000	-0.003**
Experience in Medium-sized city periphery^2	0.000**	0.000	-0.000	0.000**
Job change	0.007**	0.008**	0.011**	0.013**
Job change in Stockholm core	-0.004**	0.011**	0.002	0.009**
Job change in Stockholm periphery	-0.001	-0.004	0.001	-0.004
Job change in Gothenburg core	0.003**	0.008**	0.008**	0.006**
Job change in Gothenburg periphery	-0.001	-0.005	0.000	-0.001
Job change in Malmö core	-0.001	0.003	0.001	0.003
Job change in Malmö periphery	-0.000	0.002	0.001	-0.001
Job change in Medium-sized city core	0.002	0.002	0.005*	0.003
Job change in Medium-sized city periphery	0.001	0.002	-0.002	0.001
Year fixed effects	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Education controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
Observations	3,938,010	1,436,461	1,241,512	2,475,450
Workers	882,274	326,032	359,024	532,867
R^2	0.10	0.12	0.13	0.19

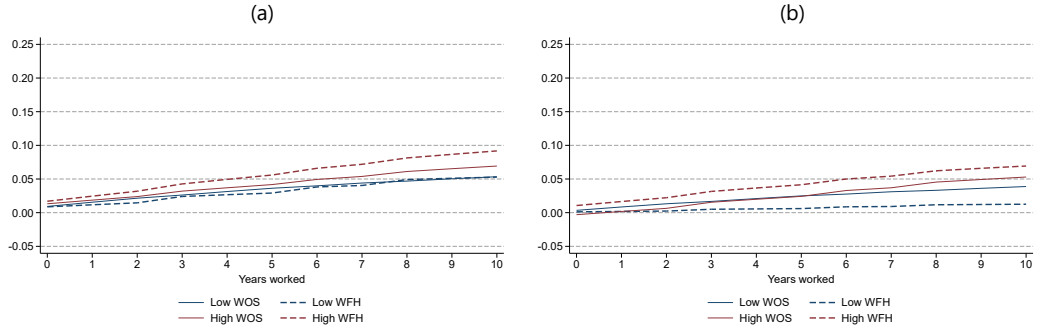
Notes: WOS and WFH denote work onsite and work from home jobs, respectively. See Table 6 in the Appendix for variable definitions. All specifications include a constant term. The reported R^2 values are within workers. ** and * indicate significance at the 1% and 5%, respectively (based on robust standard errors, clustered by workers)

Figure 3 Starting to work in the core of Gothenburg city rather than in small cities, towns, or rural areas (a); rather than in the peripheral parts of Gothenburg city (b)



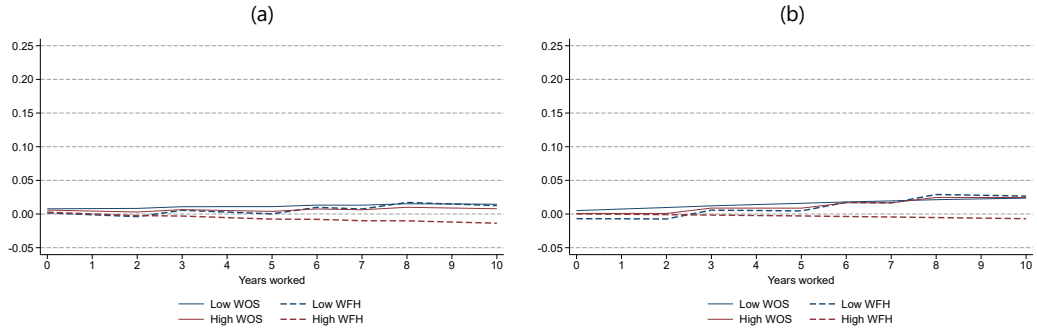
Notes: Based on the estimated coefficient in Table 9.

Figure 4 Starting to work in the core of Malmö city rather than in small cities, towns, or rural areas (a); rather than in the peripheral parts of Malmö city (b)



Notes: Based on the estimated coefficient in Table 9.

Figure 5 Starting to work in the core of medium-sized cities rather than in small cities, towns, or rural areas (a); rather than in the peripheral parts of medium-sized cities (b)



Notes: Based on the estimated coefficient in Table 9.

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