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Access to Jobs and Individual Labor Market Outcomes

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Access to Jobs and Individual Labor Market Outcomes *

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Access to Jobs and Individual Labor Market Outcomes

Andreas Mense, Wolfgang Dauth, Matthias Wrede

Abstract

We investigate the employment effects of job access within cities. To overcome the endogeneity of residential location choices, we exploit the quasi-random allocation of applicants across affordable housing units in five German cities and propose a novel IV strategy. Our job access measure combines proximity to jobs in both geographical and skill space, taking into account potential competition from other workers. We compile a unique administrative dataset comprising the complete labor market biographies of individuals who moved into affordable housing. A one-standard-deviation increase in job access reduces the unemployment hazard of unskilled workers by 3.4 percentage points. We do not find similar effects for skilled workers, who are more likely to own a car and are therefore less geographically constrained. Simulations show that full segregation, with all unskilled allocated to central neighborhoods, would reduce the city-wide unemployment rate of the largest city in our sample, Munich, by 1.3 percentage points.

JEL classification: I31, I38, J13, R23, R38.

Keywords: Job access, unemployment, urban labor markets, labor supply, affordable housing.

1 Introduction

The geography of labor markets matters. An individual's residence determines the concrete number and quality of job opportunities available to them. Despite decades of theoretical and empirical work on spatial labor market frictions, the causal identification of job access effects on employment outcomes remains elusive. A core challenge is that workers do not settle randomly: Those with stronger labor market attachment, higher skills, or greater ambition tend to select into areas with better job access, confounding any naive comparison across locations. Another core challenge is that housing costs are typically higher in locations with better job access, giving rise to income or wealth effects on labor supply. To overcome these identification problems, this paper exploits rare institutional features of Germany's affordable housing system: Affordable rents are location-invariant within cities, and applicants from long waiting lists are allocated to units quasi-randomly on a first-come-first-serve basis.¹ We use this random allocation to estimate the causal effect of job accessibility on labor market outcomes of low-income workers at a very fine geographical scale.

This paper makes three main contributions. First, we exploit this unique institutional setting in a novel identification approach, which effectively breaks the link between the residential location and individual preferences, worker characteristics, and labor market expectations, holding constant housing costs. This allows us to cleanly identify causal job access effects by comparing workers' labor market outcomes across residential locations.

Second, we construct a new, composite measure of job accessibility that accurately captures the labor market environment a worker faces at their residential location. Our measure integrates geographic distance and occupational skill relatedness into a single index and accounts for both the number of potential job opportunities and competing workers nearby.

All else equal, better access to jobs causes the unemployment hazard to fall. This effect is driven entirely by unskilled workers, i.e., workers without vocational training degree: Increasing an unskilled worker's job access by one standard deviation reduces their unemployment hazard by 3.4 percentage points (18 percent of the sample mean), improves the worker-to-job fit, as measured by the proximity in skill space, and reduces the worker's commuting distance. By contrast, we do not find employment effects for skilled workers. This is consistent with the fact that skilled workers are more likely to own a car, which makes them less geographically constrained. However, better job access also reduces the commuting distance of skilled workers.

Third, we use simulations to investigate the quantitative importance of job access at the aggregate (city) level, using the largest city in our sample, Munich, as a case study. This exercise shows that the residential patterns of the various skill groups can explain a substantial fraction of unemployment rates in cities: Full segregation of skilled and unskilled workers, with the unskilled allocated to city-center neighborhoods – where job accessibility is high – would reduce the city-wide unemployment rate by 1.3 percentage points, or 24 percent of the baseline unemployment rate. The simulations account for the fact that the number of job opportunities

¹ In a survey, Gobillon and Selod (2014) note the lack of natural or controlled experiments on this topic and point out that the public housing assignment in the European institutional setting represents an opportunity to overcome the challenge of non-random selection into neighborhoods.

and competing workers change simultaneously when relocating workers, with the change in competing workers attenuating the impact on the aggregate unemployment rate.

Our paper is motivated by the Spatial Mismatch Hypothesis, originally advanced by Kain (1968) in the context of racially segregated American cities. Kain observed that the suburbanization of employment, combined with the residential confinement of Black workers to inner-city neighborhoods systematically separated low-income workers from the job opportunities that would otherwise be most suitable for them. According to the spatial mismatch hypothesis, residential immobility, when combined with geographic distance from employment centers, translates directly into worse labor market outcomes. Although Kain's original focus was on ethnic discrimination, the underlying economic mechanism, that frictions in the housing market carry over to the labor market, is much more general. It is particularly relevant whenever high housing costs prevent low-income households from living in locations with good access to suitable jobs. This interrelation also affects the labor supply elasticity to the firm because accessibility shapes the set of potential employers that are considered by an individual worker (Caldwell et al. 2026).

Our empirical strategy combines two complementary approaches for identification. The primary design exploits the quasi-random assignment of applicants to affordable housing units across neighborhoods, comparing labor market outcomes of otherwise similar individuals who were allocated to units with differential job accessibility. We draw on a unique administrative data set of 465 subsidized rental housing projects in five major cities in Bavaria, Germany, and link the subsidized projects to the Integrated Labor Market Biographies of the Institute for Employment Research (IAB), based on geocoded building-level address information. The underlying administrative data cover the complete employment biographies of the universe of workers in Germany subject to social security contributions, as well as all persons registered as unemployed.

Units are assigned by a central housing office as they become vacant, a process the applicants cannot influence at all. Since there are long waiting lists, and since the implicit rent subsidy is substantial, it is very unlikely that applicants systematically turn down particular offers, suggesting that the allocation to a specific residential location within the city is as good as random. We test this conjecture by carefully investigating whether pre-treatment outcomes and worker characteristics predict the location the worker was assigned to.

There may be the residual concern that even within the social housing assignment process, individuals with a higher labor force attachment may selectively decline offers if these provide poor job access, or that landlords may refuse candidates with particularly poor labor market prospects. To address this, we use the distance between the affordable housing unit and the city center as an instrument for job access. This instrument builds on the idea that the density of jobs is highest in the city center. The exclusion restriction requires that, conditional on job accessibility, the distance to the city center does not independently affect individual labor market outcomes. This assumption is supported by our finding that various measures of neighborhood quality are orthogonal to centrality in our setting. Hence, the combination of a difference-in-differences framework with this IV approach allows us to isolate the causal effect of residential location on labor market outcomes with greater confidence than has been possible in the prior literature. Since our main results for this IV approach are similar to those of the less

demanding OLS specification, it seems that the quasi-experimental variation generated by the affordable housing allocation scheme already provides the exogenous variation needed to estimate the causal effect of job accessibility.

Our results can be summarized as follows. We find that greater worker-specific job access causes a lower number of days in unemployment in a given year. This effect is entirely driven by unskilled workers, whereas we do not find comparable effects on unemployment for skilled workers. We show that the worker-specific access measure explains the variation in the data better than a plain geography-based measure that ignores the skill profiles of workers. Moreover, we find positive accessibility effects on employment but a statistically insignificant (yet positive) impact on wages and labor income. The latter could be due to compositional effects, with unskilled workers being more likely to work, but in different types of jobs. To corroborate this conjecture, we show that unskilled workers with better job access tend to take up jobs closer to their skill profiles, the latter measured through the time-discounted history of jobs held in the past ten years. This indicates that unskilled workers are less likely to switch into occupations that are distant in skill space when job accessibility is high, improving worker-to-job fit. Our theoretical bargaining model predicts that, with a better match, working hours will increase and total earnings will rise, but that employees may be willing to accept such jobs even without an hourly wage raise. Both skilled and unskilled workers take advantage of better job access by reducing their commuting distance.

We conduct several robustness checks. First, we show that the affordable housing location is not related to the individual's current job. Second, we explore the possibility that some workers may have managed to stay in their neighborhood, but excluding short moves does not affect the estimated coefficients much. Third, affordable housing for larger families could be systematically farther away from the city center, and labor supply may be lower among parents, but our results still hold when controlling for household size and composition. Fourth, our results are robust to varying the distance decay factor used in the calculation of the job accessibility measure. Overall, these robustness checks lend support to our interpretation of the estimates as capturing the causal effect of job access.

We also examine the mechanisms behind our results in depth. First, we question whether job access is truly determined by the combination of physical distance and distance in skill space—or whether geographic distance alone is sufficient to explain our results. A horse race between the two measures shows that the suitability of job opportunities as captured by the combination of geographical and skill distance is the relevant factor, whereas geographical distance alone is not.

Second, we examine why our results differ between unskilled and skilled workers. This difference is consistent with car ownership being much more common among skilled workers (Gautier and Zenou 2010). Drawing on a large survey conducted by the Federal Ministry of Transport and Digital Infrastructure, we document that unskilled workers in Germany are less likely to own a driver's license and to have access to a car, especially in cities. Commuting by car reduces the importance of pure geographical distance for job access. We also examine the role of access to rail-based public transport, as living close to a transit stop may be a substitute for spatial proximity to suitable jobs, especially among unskilled workers. Indeed, when controlling for access to public transport, our results become slightly more pronounced, in line

with the conjecture that unskilled workers who are not connected to the rail-based public transport system benefit more strongly from spatial proximity to jobs.

Finally, we explore whether our results are driven by the possibility that the centrality of the location – and hence job access – may correlate with other neighborhood characteristics. This does not seem to be the case in our setting: We find virtually identical results when controlling for different measures of neighborhood quality, including income.

Interestingly, we do not find meaningful differences in the effects of job access on unemployment hazard by gender. Yet, consistent with the literature on gender-specific commuting patterns (e.g., Le Barbanchon et al. 2021), we document that living more centrally causes women to take up part-time work as well as jobs within walking distance – presumably alleviating difficulties in reconciling childcare responsibilities with commuting and statistical discrimination against women who live far from job opportunities (Becker et al. 2026).

This paper addresses several strands of the literature. First, we contribute to the literature on spatial mismatch and job accessibility. A large number of studies in the wake of Kain (1968) document that workers living in neighborhoods with poor job accessibility experience higher unemployment rates and lower wages (e.g., Andersson et al. 2018, Marinescu and Rathelot 2018, Åslund et al. 2010, Damm 2014, Hellerstein et al. 2008, Weinberg et al. 2004, Stoll 1999, Cutler and Glaeser 1997).² Although there is strong evidence that job seekers prefer local jobs (Marinescu and Rathelot 2018) and that laid-off workers living in higher-access neighborhoods are more likely to be re-employed (Andersson et al. 2018), the average job seeker in the US lives relatively close to job opportunities, implying that the aggregate impact on unemployment rates is modest (Marinescu and Rathelot 2018). However, this may not necessarily hold for unskilled workers, as rising housing demand pushes them out of the highly productive locations that provide the best job opportunities (Couture et al. 2024). In particular, minorities have been found to suffer economically from segregation (Cutler and Glaeser 1997) despite job-searching broadly (Stoll 1999), with the distance to suitable jobs being an important driver (Stoll 1999, Hellerstein et al. 2008).³ Yet, in this literature, selection into residential locations remains a concern.

Situations in which access to jobs is exogenous are rare. However, the allocation of refugees in Denmark provides an opportunity to study the effects of residential locations and job access, as refugees could not easily select into particular locations.⁴ Åslund et al. (2010) document a 2.9

² Relatedly, Haltiwanger et al. (2024) study public housing residents displaced after demolitions. They find positive effects of leaving the public housing environment and attribute this mainly to improved access to jobs at the new residence.

³ Card et al. (2024a, 2024b) take a different approach to overcome the issue of endogenous location choices. Rather than tackling the problem directly, they focus on wages and proximity to high-paying firms among Black and White workers in the US. Blacks employed full-time do not live systematically farther away from high-paying firms than White full-time workers, suggesting a small role for spatial mismatch when conditioning on employment. While this is consistent with our finding of insignificant effects on wages and incomes, especially among skilled workers, our results also suggest that the employment-nonemployment margin is much more relevant in this context and that low job accessibility among minorities could still explain a large part of the difference in unemployment rates.

⁴ One prominent alternative approach to address the selectivity of the residence exploits the Moving to Opportunity (MTO) experiment, in which households in high-poverty public housing projects were randomly assigned housing vouchers to relocate to lower-poverty neighborhoods. Katz, Kling, and Liebman (2001) and a huge number of subsequent studies find mixed results for labor market outcomes, with effects on employment and earnings being

percentage points higher employment probability even nine years after the allocation when doubling the number of available jobs within a five-kilometer radius at the initial residence. However, although refugee migrants were assigned to municipalities largely independently of their characteristics, better-educated immigrants in fact settled in locations with substantially higher levels of job accessibility (Åslund et al. 2010).

We address several gaps in this literature: The unique institutional setting allows us to effectively overcome selection into neighborhoods and to rule out income or wealth effects due to differences in housing costs across locations – the latter because, within cities, affordable rents are independent of location. Moreover, we separate the impact of job access from effects of neighborhood quality and residence-based information networks, with the latter being especially important among refugees. Finally, the rich job classification data enables us to construct a more refined measure of job accessibility than measures used in previous studies.

Second, our paper relates to the literature on imperfect competition in labor markets, by providing causal evidence for one of the central mechanisms explaining why employers may have wage-setting power especially with regard to unskilled workers. Canonical models attribute monopsony power to search frictions (Manning 2003) and idiosyncratic tastes over job amenities (Card et al. 2018). Both are closely related to workers’ outside options (Caldwell and Danieli 2024) and hence to the geographical proximity between potential alternative workplaces and residence: Having many job opportunities nearby reduces the costs of searching for jobs, and short commutes are valued highly by workers (Landeghem et al. 2024). Moreover, if a worker strongly prefers jobs in the close proximity to their residence, only nearby job opportunities are going to be in the worker’s consideration set (Caplin et al. 2019, Caldwell et al. 2026), rendering local job accessibility an important determinant of the worker’s residual labor supply elasticity. Through these channels, better job access mitigates employers’ monopsony power (Amer 2026), in particular among populations that face high commuting (time) costs per mile (Datta 2024). Our results provide an empirical underpinning for the argument that unskilled workers are particularly exposed to monopsony power of employers.⁵ These workers face stronger spatial constraints – plausibly because they rely more heavily on public transit – and benefit disproportionately from proximity to well-suited jobs.

Third, we contribute to the extensive literature on commuting (Van den Berg and Gorter 1997, Phillips 2020, Le Barbanchon et al. 2021, Liu and Su 2024, Becker et al. 2026) and the spatial extent of labor markets (Manning and Petrongolo 2017). The individual disutility of commuting severely limits the distance within which individuals are willing to search for and accept jobs, particularly for women with children (Van den Berg and Gorter 1997). Consequently, higher commuting costs of women explain a significant share of the gender earnings gap (Le Barbanchon et al. 2021), with the disadvantages from high per-mile commuting costs being mitigated by job access (Liu and Su 2024). Not surprisingly, the likelihood of a job seeker

weaker and less consistent than those on health and educational attainment. Yet, while the MTO design effectively randomizes residential locations, its intent was to improve neighborhood quality rather than job access, implying much smaller variation in job access than in neighborhood quality. The MTO design therefore does not lend itself to studying job access effects in isolation.

⁵ In this sense, the spatial mismatch and monopsony effects may interact, as frictions on the housing market (including discrimination) translate into reduced job access. This suggests that minorities’ labor market outcomes are hampered by discrimination in both markets (Black 1995).

applying to a particular job already drops at distances as short as a few kilometers and job seekers are deterred by the possible competition from other job seekers, suggesting that dense urban locations do not necessarily improve employment outcomes (Manning and Petrongolo 2017). Employers may also be reluctant to select certain applicants who live farther away, in an attempt to filter out workers who are unable to cover the respective commuting distance. Thus, higher distance to an open position translates into lower callback rates among low-skilled (Phillips 2020) and female higher-skilled (Becker et al. 2026) workers. We contribute to this literature by documenting that job opportunities are higher in central locations relative to competition, and by showing that access to these locations improves outcomes for unskilled workers who cannot easily reach more distant employers. We also show that unskilled women react to improved access differently than unskilled men, namely by taking up part-time work and jobs within walking distance.

Fourth, our paper relates to the literature on the skill dimension of job search. Even if vacancies are abundant, they may be out of reach for job seekers if they lack the required skills. In a seminal contribution, Gathmann and Schönberg (2010) quantify the degree of occupational similarity. They show that the costs of job reallocation increase in the distance between occupations. This intuition is applied by Macaluso (2025), who introduces the concept of skill-remoteness, i.e., the distance in skill space of a worker with a given job to other jobs in the labor market. She documents that workers cope more easily with job loss if they are less skill-remote in their local market. The mechanism she identifies is occupational switching: Workers from skill-remote jobs are forced to transition into occupations that are less well matched to their human capital, and to accept lower wages. We show that this mechanism is also relevant at the much finer geographical level of residential areas within cities: Individuals benefit from being close to many jobs with skill requirements that fit the worker’s skill profile and tend to choose better-fitting jobs if access is higher. Moreover, our design addresses the concern that more able workers are likely to select systematically into locations that offer a thick market for their skills.

The remainder of the paper proceeds as follows. Section 2 of the paper sketches a theoretical model to guide the empirical analysis. In Section 3, we briefly present the institutional background, explain the construction of our composite measure of job accessibility, and discuss the data and the empirical approach. We present the empirical results in Section 4 and simulations to assess their quantitative importance for city-wide unemployment rates in Section 5. Section 6 offers conclusions.

2 Theoretical Framework

To motivate our empirical analysis, we develop a stylized spatial framework, which we describe in more detail in Online Appendix A. Jobs are distributed across workplace locations and job classes, with job density assumed to be higher near the center. Residential locations in a city differ in distance to the city center and thus to workplaces. Workers are either unskilled or skilled. Unskilled workers face higher variable commuting costs than skilled workers, making their employment prospects more sensitive to residential location and job access.

The labor-market side combines directed search, skill-specific matching frictions, and commuting costs. Jobs differ by workplace and class, while workers differ in their skill fit for each job class. A match is technologically feasible only if its surplus is nonnegative. Efficient

hours and bargained wages are determined at the match level and do not directly depend on the worker's residence. Residence matters through participation: a worker accepts a job only if the worker's share of match surplus is sufficient to cover commuting costs. Thus, centrality does not mechanically raise wages within a given match, but it can expand the set of acceptable jobs, especially for unskilled workers with high variable commuting costs.

The key labor-market object is effective job access. For each worker type and residence, effective access is measured as the mass of acceptable jobs, discounted by the mass of potential competitors weighted by the share of their acceptable job opportunities that also belong to the focal worker's acceptable job set. Job-finding probabilities increase with effective job access and, assuming exogenous separation rates, unemployment risk falls with the job-finding rate.

Under the assumption that more central residential locations have weakly shorter commuting distances to the relevant distribution of jobs and that competition does not rise proportionally, effective job access is higher in more central locations. Hence, the job-finding rate is higher and unemployment risk is lower for central residential locations than for areas closer to the outskirts. For skilled workers, variable commuting costs are lower, so job-finding rates are less responsive to commuting distance, implying a smaller unemployment response to residential centrality.

The model implies that employment gains need not translate into higher hourly wages or compensation, conditional on employment. Since wages and hours are determined at the match level and not directly by residence, average hourly wages change only if improved access changes the composition of accepted jobs. Expected annual labor income may increase through lower unemployment, but the effect is theoretically ambiguous if newly induced matches differ in hours or compensation. Expected commuting distances fall when improved access shifts accepted jobs toward shorter commutes.

In particular, the model supports the following four hypotheses, which we will examine empirically:

- H1 Better job access reduces the individual unemployment risk.
- H2 Commuting distances have a smaller impact on the individual risk of unemployment for skilled workers than for unskilled workers.
- H3 Conditional on the match, commuting distance does not affect hourly wages or compensation, whereas a better skill fit raises total compensation, but has an ambiguous effect on hourly wages.
- H4 Better access to jobs—due to a greater number of effectively available jobs nearby and a better skill match—shortens commute times and reduces the skills gap in individuals' actual employment.

3 Data and Empirical Strategy

3.1 Institutional Background

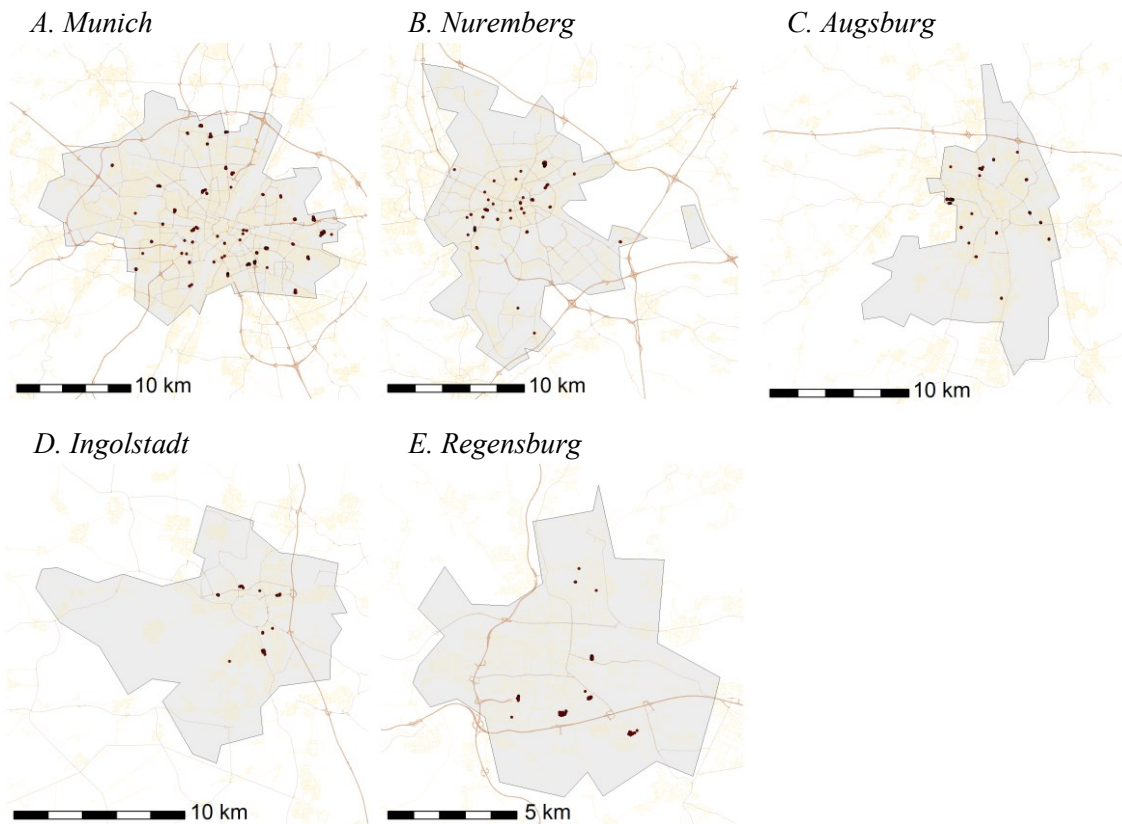
This paper uses data on 465 subsidized affordable rental housing projects completed between 1997 and 2007 in the five largest Bavarian cities. All five cities experienced strong rent increases and under-supply of affordable housing during the housing boom 2009-2020.

Figure 1 shows the locations of the affordable housing projects in each city. Unlike in the U.S., where affordable housing is often spatially concentrated in disadvantaged areas (Quigley 2011), the Bavarian institutional setting promotes spatial dispersion. In our sample, affordable units are distributed across various parts of the cities, ranging from central high-amenity areas to peripheral districts. This allows the identification of the effects of geographical job accessibility as it provides sufficient variation between locations.

The provision of affordable housing in Germany works through subsidies to developers. In exchange for the subsidy, the developers must rent out the units at a reduced rate during a pre-determined period, typically 25 years. The maximum rents permitted do not vary within cities, which we confirm empirically in Table B1. Most developers are housing cooperatives or municipal housing companies, but the subsidy is also open to profit-oriented private investors. Restricting rent stabilization to 25 years implies that the affordable housing stock consists of relatively modern buildings, as older buildings eventually fall out of the affordable housing stock.

The funding regime is federal-state-specific. In subsidized housing projects in Bavaria granted before 2002 under the so-called “first funding route” [1. Förderweg], all rental units had to be rented to tenants that met an income threshold in terms of household-level income, subject to a

Figure 1
Distribution of affordable housing objects in sample within and across municipalities



Notes: The maps show the extent of the municipalities of Munich, Nuremberg, Augsburg, Ingolstadt, and Regensburg as grey-shaded areas, the street network based on Open Street Map data as light orange lines, and the approximate locations of the affordable housing objects in the data as red dots.

Sources: Open Street Map 2023, GeoBasis-DE/BKG 2023, own representation.

number of blanket deductions, and were allocated through the local housing offices. We describe in detail the calculation of the eligibility thresholds and how these thresholds compare to the yearly gross labor income observed in our data in the year prior to admission in Online Appendix B.

Eligible applicants are admitted by the local housing offices based on a neediness score and waiting time. There is a long queue for these dwellings: In Munich, affordable housing comprises a stock of 48,500 units, out of which about 3,000 are reallocated each year. In contrast, there are around 38,000 applications annually.⁶ In practice, when a unit becomes available, the housing office presents two to four applicants from top of the waiting list to the landlord. The landlord may then select one of these applicants.

One important aspect of this design is that the applicants cannot deliberately choose the location of residence, nor can they determine the timing of this process. This suggests that the allocation of workers across affordable housing buildings can be used as a source of exogenous variation in residential locations.

3.2 Data

We make use of the universe of Integrated Labor Market Biographies (IEB, version 15.00.00-201912) provided by the Institute for Employment Research (IAB). This dataset covers the entire employment biographies of all employees in Germany in jobs subject to social security contributions, unemployed individuals, and individuals receiving other labor-related welfare benefits, covering the years 1992 to 2019.⁷ We complement this data by the exact geocodes of the residential addresses of these individuals and the addresses of establishments, which are available from 2000 to 2017 for the present data set. Online Appendix B provides details.

The IEB are then linked to data on affordable housing units provided by the municipalities of Munich, Nuremberg, Augsburg, Ingolstadt, and Regensburg, the five largest cities in Bavaria, based on the residential address information. There are 465 distinct affordable housing addresses in our sample. These affordable housing projects represent all newly built affordable housing in the five cities completed between 1997 and 2007 under the first funding route. We link the two data sets at the building address level.

We consider only the first move into an affordable housing address. Moreover, we restrict the sample to prime working age (18-60 years) at the time of admission as this group is most likely to participate in the labor market. Workers in vocational training or in university⁸ at the time of admission are also excluded from the sample. There are 7,896 persons in the sample.

For each worker, we calculate the worker-specific job accessibility measure at the affordable housing location in the year of admission, defined below, as well as an alternative, unspecific measure based on all jobs and irrespective of the worker's skill profile. For the computation of the job access measures, we rely on a 2% random sample of the IEB to meet data privacy

⁶ <https://stadt.muenchen.de/service/info/fachbereich-wohnen/1073964/>

⁷ We do not observe self-employed individuals, tenured civil servants, and retired individuals who are not subject to social security insurance contributions. While tenured civil servants are typically not eligible for affordable housing due to their higher salary, we caveat that this does not necessarily hold for self-employed individuals.

⁸ We do not observe student status directly, but exclude workers who appear in our data as unskilled at the time of admission and who hold a university degree in the first three years after admission.

requirements. In addition, for each affordable housing location, we compute the distance to the city centers of the five cities⁹, rounded to the nearest 500m, as well as the distance to the nearest rail-based public transport stop, rounded to the nearest 250m. These are railway, tramway, and subway stations, as well as high-frequency commuter train stations, the so-called “S-Bahn”.

Neighborhood characteristics are based on all individuals living inside a circle with a radius of 500m around the affordable housing address in the year of admission, again using the 100% sample of the IEB.¹⁰ In particular, these are the median daily wage, the share of unemployed persons, and the share of non-German individuals.

Table B2 displays summary statistics for the variables used in the analysis. Panel A shows descriptive statistics for the whole sample. Panel B refers to the period prior to admission to the affordable housing unit.

3.3 Access to Jobs

Following Andersson et al. (2018), we define job access as the normalized difference between the distance-weighted number of job opportunities, O_i , and potential competitors for jobs, C_i :

$$A_{i,t_i^*} = \frac{O_{i,t_i^*} - C_{i,t_i^*}}{\frac{1}{2}(O_{i,t_i^*} + C_{i,t_i^*})}. \quad (1)$$

A_{i,t_i^*} can take on values between -2 (no job opportunities) and $+2$ (no competitors). For each worker, it is measured in the period the person was first observed in affordable housing, denoted by t_i^* . The two components O_{i,t_i^*} and C_{i,t_i^*} are worker- and location-specific, incorporating geographic proximity as in Andersson et al. (2018) and proximity in skill space as in Macaluso (2025):

$$O_{i,t_i^*} = \sum_{k \in W_{i,t_i^*}} \exp(-\theta \max(1, d_{ik})) \exp(-q_{ik}), \quad (2)$$

$$C_{i,t_i^*} = \sum_{j \in R_{i,t_i^*}} \exp(-\theta \max(1, \tilde{d}_{ij})) \exp(-\tilde{q}_{ij}). \quad (3)$$

Here, W_{i,t_i^*} is the set of workplaces and R_{i,t_i^*} is the set of residences in a 15 km radius around the affordable housing i was assigned to.¹¹ d_{ik} is the distance between residence i and job $k \in W_{i,t_i^*}$ in kilometers, all measured in the year of admission, t_i^* . We assume that there is no further distance discount for locations in close proximity, i.e., less than one kilometer away.¹² $\theta > 0$ is a distance decay factor.

Following Macaluso (2025), the second component is the skill distance between worker i 's skill profile and job k 's skill requirement, $q_{ik} \in [0,1]$. The greater the distance, the smaller the weight assigned to job opportunity k . To obtain these weights, we first characterize each job as a vector of intensities of 13 tasks performed on the job, where jobs are defined by the three-

⁹ As city centers, we use central places in each city: Marienplatz in Munich, Hauptmarkt in Nürnberg, Rathausplatz in Augsburg, Franziskanerplatz in Ingolstadt, and Neupfarrplatz in Regensburg. These places are close to the geographical and historical centers of these cities.

¹⁰ Data protection rules require us to have at least 25 individuals inside the 500m circle. In case there are less than 25 individuals inside the circle, we increase the radius step-wise by 100m, up to a maximum of 1,500m.

¹¹ We use a cutoff at 15 km to speed up the computation, as locations beyond 15 km receive a very small distance weight anyways (provided the distance decay factor is not too close to zero).

¹² Andersson et al. (2018) use a similar minimum threshold, based on estimated travel time.

digit German Classification of Occupations 1988. The task intensities range continuously from zero to one and are derived from the 1999 Qualification and Career Survey of the IAB and the German Federal Institute for Vocational Training (see Spitz-Oener 2006 for one of the first applications of these data). We define the task requirement distance between job opportunity k and job h as the average absolute difference between k 's and h 's task intensities. The skill distance is then computed as the weighted average over task requirement distances of all jobs held by worker i in the ten years before t_i^* .¹³

Potential competitors for jobs near i 's residence are captured by the weighted sum over the number of similar workers living in residences $j \in R_{i,t_i^*}$, again weighted by the geographic distance between i 's and j 's residences, $\tilde{d}_{ij}$, and by the distance between their skill profiles, $\tilde{q}_{ij}$. In doing so, we assume that workers living close to each other apply to similar jobs.¹⁴ This has three main advantages. First, we treat the two components of A_i symmetrically, which is compatible with the assumption that each worker can take up only one job. It also implies that the two components of A_i are of similar magnitude. Second, it keeps the computations feasible, as we only have to compute distances between the affordable housing locations and other residences and workplaces in the city (rather than the distances between all pairs of workplaces and residences). Third, it keeps the functional form simple and transparent and therefore yields a simple interpretation of our access measure: If a location hosts more workplaces than workers at residence, job access is positive (and vice versa).

Figure 2 plots job opportunities and potential competition from other workers at the affordable housing locations in Munich against the distance to the city center. Clearly, when moving closer to the center, the number of job opportunities increases. While the number of workers at residence is also higher in the center, it increases relatively less strongly, suggesting that workers who live closer to the center have access to many job opportunities but face relatively less competition from other workers.

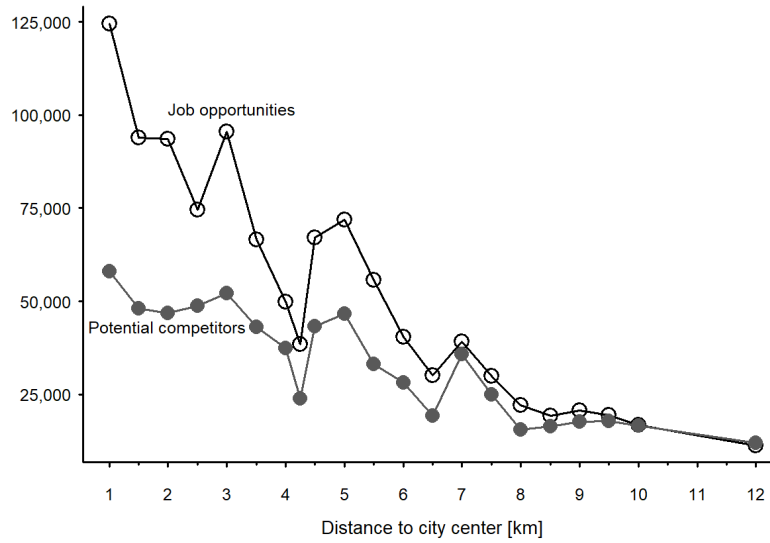
3.4 Empirical strategy

Endogeneity concerns. Our job access measure consists of two components capturing i) the geographic distance of the worker's residence to nearby jobs and ii) the distance in "skill space" between the worker's and nearby jobs' skill profiles. Both components may be correlated with unobserved factors that affect the worker's labor market outcomes.

¹³ The weights are proportional $1 - \tau/11$, with τ being the time elapsed since the worker held the respective job.

¹⁴ An alternative would be to compute the number of workers that can reach a given job k and take this as a measure of competition. It would be necessary to compute this for all workplaces in the city, similar to Andersson et al. (2018). One complication is potentially very severe over-counting of competing workers if many workplaces are located in a single neighborhood - the reason being that a single worker can only take up one (main) job but is counted as a competitor for multiple destination workplaces. Andersson et al. (2018) solve this by scaling down competitors from neighborhoods with many job opportunities. This approach is not feasible in our case as it requires computing the number of competing workers at each establishment address (rather than for only a relatively small set of neighborhoods, as in Andersson et al. (2018)). We instead change the perspective, assuming that workers who live in similar places apply to similar firms. The upside is that we do not double-count competitors and hence do not have to rely on re-weighting.

Figure 2
Job opportunities, potential competitors, and distance to the city center of Munich



Notes: The figure plots the number of job opportunities (i.e., jobs) and potential competitors (i.e., workers at residence) against the distance to the city center of Munich. Job opportunities (potential competitors) are defined as the distance-weighted number of jobs (workers at residence) at the affordable housing locations in Munich, taking into account distance in geographic and skill space. For each sample location, we consider all jobs (residences) in a 15 km radius around the respective location. Jobs (residences) at geographic distance of d km from the location and skill distance q receive a distance weight of $\exp(-0.5 \times (\max(1, d) - 1)) \exp(-q)$.

Firstly, even within cities, people choose their residential location based on an array of factors, some of which may be correlated with labor market outcomes. For example, more economically able workers may prefer to live closer to job opportunities than less able workers but are also less likely to be unemployed to begin with. Simply comparing the labor market outcomes of workers living at different locations may thus lead to erroneously attributing a lower unemployment probability to higher job access, despite the former being explained by differences in unobserved ability rather than job access.

Secondly, in a given local labor market, some types of jobs are likely more common than others, as local labor markets are oftentimes specialized. Therefore, some types of workers in the local market are going to have skill profiles that are closer to the typical job in the labor market than others. To the extent that higher-ability and highly motivated workers are more likely to sort into labor markets that suit their skill set, these workers could have better outcomes because they have access to a higher number of suitable jobs, but also because of their unobserved traits.

Assignment to affordable housing locations as a source of exogenous variation. We propose to overcome these two challenges using a two-pronged empirical strategy. To overcome the endogeneity of location choices, we exploit the quasi-random assignment process to affordable housing locations. Each year, the number of available units exceeds the number of applicants on the waiting list by a factor greater than ten. Vacancies are driven by households who move out, a process out of the control of the applicant or the housing office. From the perspective of the applicant, turning down an offer is very unlikely because the opportunity costs of doing so are high. This is because the subsidy is relatively large – with rents about 40-50 percent below market rates – and one must expect to wait a long time to get another offer due to the long waiting list and the unpredictable admission process. This assignment process implies that

individuals admitted to affordable housing have practically no influence on the concrete residential location of their future dwelling within the city.

As the first component of our empirical strategy, we therefore compare workers assigned to different affordable housing buildings within the same city and in the same year and track their labor market performance both before and after having moved into affordable housing.

However, in this assignment process, there is some limited scope for selection, both, from the perspective of the tenants and the landlords. Landlords are predominately housing cooperatives or municipal housing companies that are not profit-maximizing, but the subsidy is also open to profit-oriented private investors. These landlords may try particularly hard to discard applicants who they suspect to let the property fall into disrepair. Since they get to choose between two to four applicants from the top of the waiting list, there is some leeway for discrimination against applicants with particularly low status. For this to threaten our identification strategy, the discriminative behavior by landlords would have to be correlated with job accessibility. The latter appears rather implausible. If anything, landlord behavior may be related to the quality of the building, which we will control for in our main specification. Another source of selection might be the tenants. Even though the opportunity costs of turning down an offer are high, some workers may choose not to move into particularly unattractive objects—especially if they have good outside options. If this were the case, workers who are likely to have more favorable employment outcomes anywhere might be underrepresented in locations with inferior job accessibility.

To rule out any remaining suspicion of endogeneity due to non-random allocation, we propose an instrumental variable strategy using (log) distance from the affordable housing building to the city center as excluded instrument. Ever since Alonso (1964), theoretical models in urban (labor) economics have built on the idea that workers commute to the central business district, where the density of jobs is higher than residential density. Figure 2 shows that this holds empirically in our setting. Proximity to the center should therefore predict worker-specific job accessibility.

For the instrument to be valid, the building's distance to the center must not have an effect on labor market success through channels other than job access. Hence, it must not be correlated with unobserved characteristics that themselves determine labor market success. More central locations may be advantageous to the extent that they offer better local social networks, better commuting infrastructure, and a higher density of retail and service employment. Local social networks might plausibly be an alternative mechanism to job accessibility. In Section 4.3, we examine this mechanism and find that it is relevant but unrelated to the instrument. The commuting infrastructure in general may induce measurement error in our distance-based measure of job accessibility. If more central locations offer better access to city-center jobs, but also more remote jobs due to access via public transit, the IV strategy mitigates this measurement error problem. Finally, the concentration of higher density of retail and service employment is precisely the channel our measure for job accessibility is designed to capture. A violation of the independence assumption would occur, in particular, if landlords' selectivity varies with distance from the city center. To rule out this concern, we run balancing tests and find that none of the potentially relevant observable characteristics are either statistically or economically significantly related to distance to the center.

Balance of covariates and pre-treatment outcomes. Since it is theoretically conceivable that the affordable housing assignment depends on worker characteristics, we test whether job accessibility and distance to the center at time of admission are correlated with observable worker characteristics and labor market outcomes prior to admission.

Table 1 displays results from fixed-effects regressions with the job access measure and the distance to the city center (both measured at the affordable housing location) as outcomes. The explanatory variables are worker characteristics and labor market outcomes in the pre-treatment baseline period.

In column 1, the outcome is the worker-specific job access measure, and each coefficient is obtained from a separate bivariate fixed-effects regression, conditional only on year- and city-fixed effects. Some results are indeed in line with the conjecture that individuals with better outside options prefer locations with better accessibility. Women and foreign nationals move into affordable housing buildings with lower access to suitable job opportunities, whereas the reverse holds for workers with a vocational degree or with a higher income or wage prior to admission. This suggests that a simple regression of worker-specific job access on employment probabilities would likely lead us to overstate the effect of access.

The correlations between job access and worker characteristics are attenuated substantially when replacing the worker-specific job access measure with the unspecific job access measure in column 2. This measure simply counts the distance-weighted job opportunities and potential competitors, irrespective of their proximity in skill space. Nonetheless, some covariates are still statistically significant, including the annual labor income in the baseline period. However, the estimated coefficient is very small with 0.0005, suggesting that a one-standard deviation higher annual income (16.0) is associated with only a tiny increase in non-specific job access of 0.008 (SD: 0.207).

In contrast to being close to many jobs, proximity to the center on its own may not be important to a worker or landlord, suggesting that pre-admission worker characteristics cannot predict the distance to the center. We test this conjecture directly in columns 3 and 4, where the outcome variable is the log distance to the center. Column 3 shows bivariate regressions. None of the worker characteristics or pre-treatment outcomes is significant. The only statistically significant variable is the log distance between the previous residential address and the city center. However, the elasticity is small, with 0.0119, suggesting that a one-percent decrease in the distance of the previous address to the center is associated with being allocated to an affordable housing building 0.012 percent closer to the city center. When all covariates are included jointly in column 4, the results are qualitatively unchanged, with again only the distance being statistically significant. In the subsequent regression analyses, we therefore always control for the distance of the previous address to the center.

Table 1
Balance of Covariates and Pre-Admission Outcome Variables

<i>Dependent variable:</i>	(1)			(2)			(3)			(4)		
	Regressions with one covariate at a time									Multivariate regression		
	Worker-specific job access			Unspecific job access (geographic proximity)			Log distance, affordable housing to center			Log distance, affordable housing to center		
	Coef.	Std. err.	N	Coef.	Std. err.	N	Coef.	Std. err.	N	Coef.	Std. err.	N
Age	0.0004	0.0003	7,896	0.0005**	0.0002	7,896	-0.0006	0.0006	7,896	-0.0006	0.0008	5,508
Female	-0.0196***	0.0039	7,896	0.0015	0.0032	7,896	-0.0050	0.0079	7,896	-0.0035	0.0188	5,508
Female age 20-40	-0.0168***	0.0044	7,896	-0.0034	0.0039	7,896	0.0064	0.0098	7,896	-0.0020	0.0213	5,508
Foreign	-0.0175***	0.0064	7,896	-0.0095	0.0061	7,896	-0.0064	0.0138	7,896	0.0010	0.0160	5,508
Skilled	0.0255***	0.0050	7,896	-0.0004	0.0047	7,896	0.0048	0.0103	7,896	0.0118	0.0125	5,508
Health / birth event	-0.0018	0.0089	7,896	-0.0052	0.0083	7,896	-0.0013	0.0197	7,896	-0.0644	0.0534	5,508
Health / birth event × female	-0.0151	0.0113	7,896	-0.0130	0.0103	7,896	0.0221	0.0231	7,896	0.0517	0.0598	5,508
Health / birth event any pre-period	0.0022	0.0051	7,896	-0.0017	0.0049	7,896	-0.0000	0.0117	7,896	-0.0014	0.0186	5,508
Health / birth event any pre-period × female	-0.0147**	0.0063	7,896	-0.0083	0.0059	7,896	0.0077	0.0140	7,896	0.0223	0.0269	5,508
Vocational training	0.0102	0.0078	7,896	-0.0141*	0.0075	7,896	0.0125	0.0159	7,896	0.0043	0.0193	5,508
Unemployed	-0.0059	0.0061	7,896	-0.0069	0.0056	7,896	-0.0002	0.0137	7,896	-0.0063	0.0242	5,508
Δ Unemployed	0.0024	0.0059	7,020	0.0016	0.0054	7,020	0.0009	0.0139	7,020	-0.0233	0.0213	5,508
Labor income	0.0014***	0.0002	7,896	0.0005**	0.0002	7,896	-0.0004	0.0004	7,896	-0.0001	0.0007	5,508
Δ Labor income	-0.0001	0.0003	7,020	-0.0001	0.0003	7,020	-0.0001	0.0006	7,020	-0.0000	0.0009	5,508
Log wage	0.0224***	0.0032	6,874	0.0060**	0.0028	6,874	-0.0068	0.0068	6,874	-0.0107	0.0101	5,508
Δ Log wage	0.0010	0.0038	5,844	0.0005	0.0036	5,844	0.0005	0.0093	5,844	0.0051	0.0114	5,508
Log distance, previous address to center	-0.0051**	0.0021	7,229	-0.0007	0.0020	7,229	0.0119**	0.0052	7,229	0.0207***	0.0071	5,508
Year FE	Yes			Yes			Yes			Yes		
City FE	Yes			Yes			Yes			Yes		

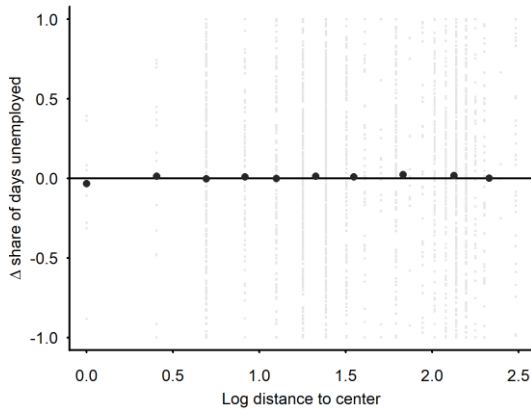
Notes: Standard errors clustered by affordable housing address; ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. The sample consists of individuals two years before they are observed in affordable housing for the first time. Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. Columns 1-3 show coefficients for bivariate regressions (conditional on year and city fixed effects). Column 4 shows coefficients from a multivariate regression including all variables listed.

Although Table 1 shows that covariates are well-balanced with respect to log distance of the affordable housing to the center at the mean, there could still be imbalances in the tails of the distribution. For example, buildings very close to the center could attract individuals on positive earnings trends despite the insignificant relationship between trends in pre-treatment earnings and distance in the center of the distribution. In Figure 3, we therefore plot the changes in pre-treatment outcomes – the share of days unemployed, annual labor income, days in employment, and log daily wage – in the baseline period against the log distance of the affordable housing to the center. Black dots represent binned values and the small light-grey dots show the individual data points. In all four graphs, the black dots lie on or very close to the horizontal axis, without any systematic deviation. These patterns corroborate the hypothesis that the allocation to affordable housing buildings with respect to distance to the center is as good as random.

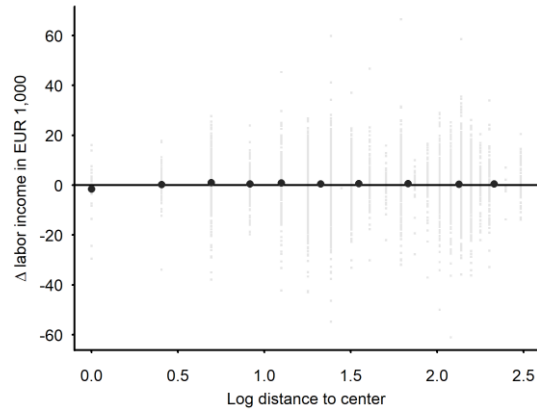
Figure 3

Pre-trends in outcome variables and distance of affordable housing to city center

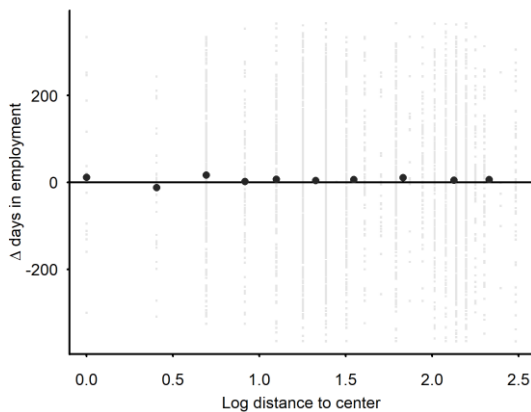
A. Share of days unemployed



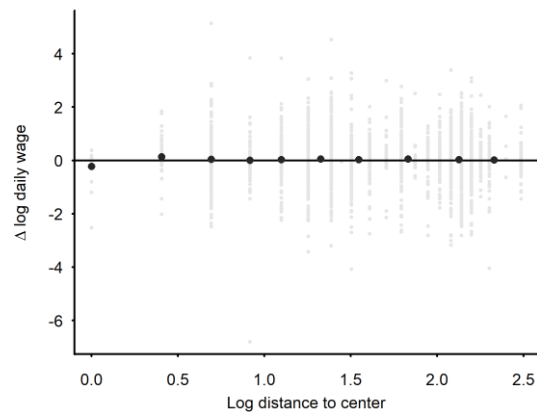
B. Labor income in EUR 1,000



C. Days in employment



D. Log wages



Notes: The bold black dots represent average (binned) values. The light grey dots represent actual values. Outcomes are changes from one period before the baseline period to the baseline period (pre-treatment).

Outcomes and estimating equation. In the analysis, we consider several outcomes y_{it} for worker i in year t . Our main outcome is the share of days a worker is registered as unemployed (relative to the number of days the worker is observed in our data). Additional outcomes include the days in employment, the log daily wage, log yearly labor income, commuting distance, as well as several other job-related variables.

The estimating equation is

$$y_{it} = \alpha A_{i,t_i^*} \times post_{it} + \beta d_{i,t_i^*-1} \times post_{it} + \phi_i + \psi_t + FE_{t \geq t_i^*}^{city_i} + \eta_{it}. \quad (4)$$

A_{i,t_i^*} is job access measured in period t_i^* as defined in equation (1), where t_i^* is the period i was first observed at the affordable housing location. $post_{it}$ equals one if $t \geq t_i^*$ and zero otherwise. Parameter α captures the effect of job access on the outcome. We control for the log distance between the last address prior to the move and the city center d_{i,t_i^*-1} . This way, we account for potential bias arising from the slight pre-treatment imbalance in this dimension. In addition to year- and person-fixed effects, the regression controls for city-specific post-period fixed effects, $FE_{t \geq t_i^*}^{city_i}$. This captures any differential trends in the five cities under study. In extended specifications we also control for the age and vintage of the affordable housing buildings to capture design and quality differences across buildings that could be related to potential non-random selection into buildings.

4 Results

4.1 Effect of worker-specific job access on unemployment hazard

As the main outcome variable, we consider the share of days a worker is registered as unemployed, capturing the worker's unemployment hazard.

Event study estimates. We start with a dynamic version of equation (4), where the post-dummy is replaced by a full set of event-time indicators. In these regressions, we control for person- and year-fixed effects as well as for an interaction of the event period with the distance between the city center and the last residence before moving into affordable housing. The event window starts five years before the person is first observed at an affordable housing address and ends six years after this date. Estimates for the first and last periods in the event window are pooled, thereby capturing earlier and later event times, respectively.

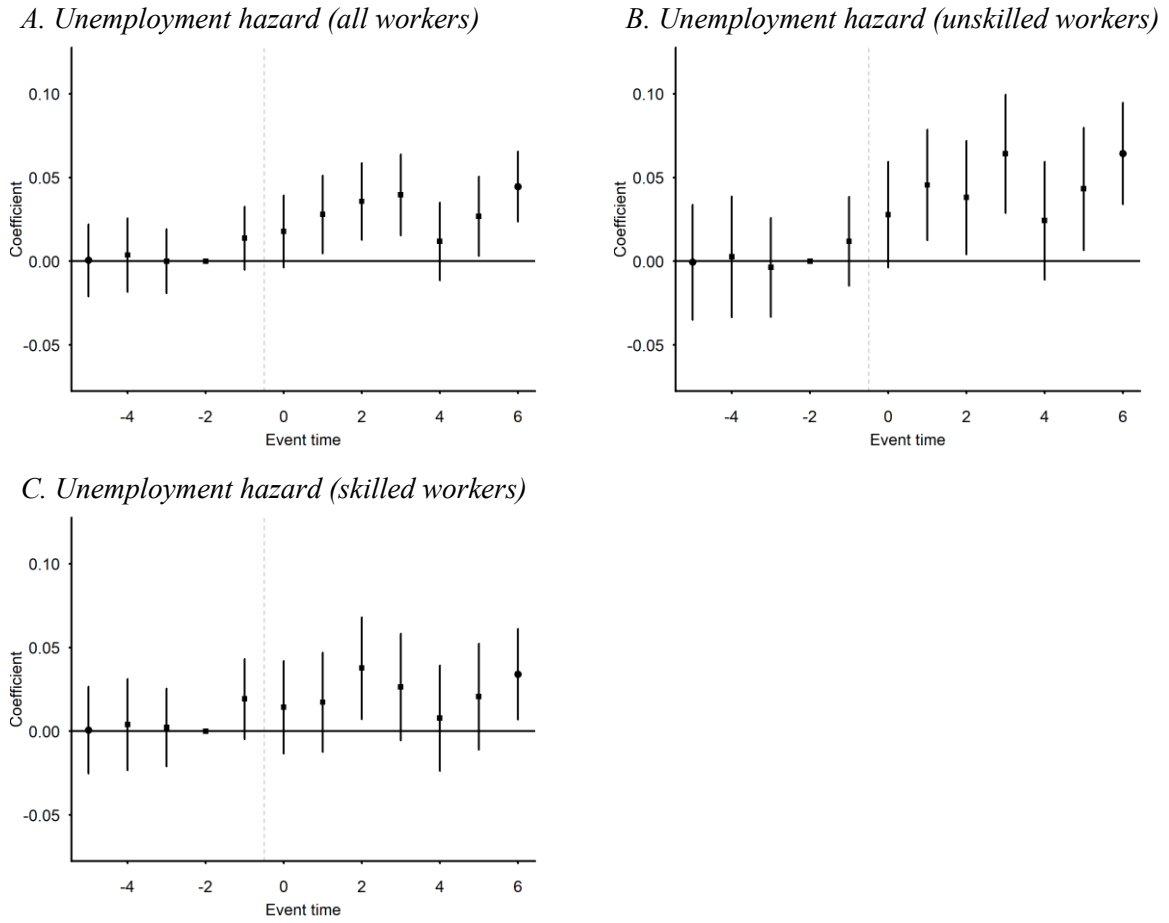
Figure 4 shows the reduced-form relationship, using the log distance of the affordable housing to the center as the explanatory variable. Panel A shows results for all workers in the sample. All pre-treatment estimates are close to zero and do not exhibit a trend. The coefficients turn significantly positive one year after the person was first observed in affordable housing.

In most of the analysis, we distinguish between unskilled workers who do not hold a vocational qualification at the time they are granted access to affordable housing, and skilled workers who hold a vocational qualification or a university degree at that time. We do so because some jobs are restricted to workers holding the respective degree, and because such jobs pay substantially higher wages, making this distinction a natural choice in the German institutional setting.

Panel B displays results for unskilled workers. Here, the coefficients post-admission are considerably larger, suggesting that proximity to the center matters much more for the labor market success of this group than for the group of skilled workers. This is confirmed in panel C, which shows results for workers who held a vocational degree at the time of admission. Here, the post-admission coefficients are smaller and mostly not statistically significant.

Figure 4

Reduced-form relationship between distance to center and unemployment hazard

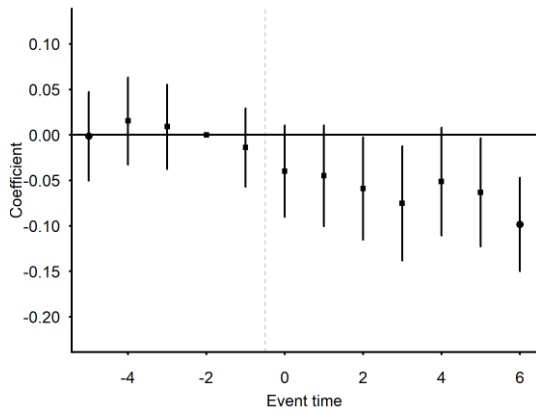


Notes: The graphs show coefficient estimates for the interaction of event time dummies with the log distance of the affordable housing address to the city center. The first (last) estimate is pooled over all earlier (later) periods. The outcome variable is the share of days a person was registered unemployed (over all days the person was observed in the administrative data). A person is unemployed if working less than 15 hours per week. All regressions control for person and year fixed effects, as well as an interaction of the event time dummies with the log distance from the city center to the last address before moving into affordable housing. In period 0, individuals were observed at an affordable housing address for the first time. Persons in vocational training or in university or college at the time of admission to affordable housing excluded. The vertical bars depict 95% confidence intervals (cluster-robust at affordable housing address level).

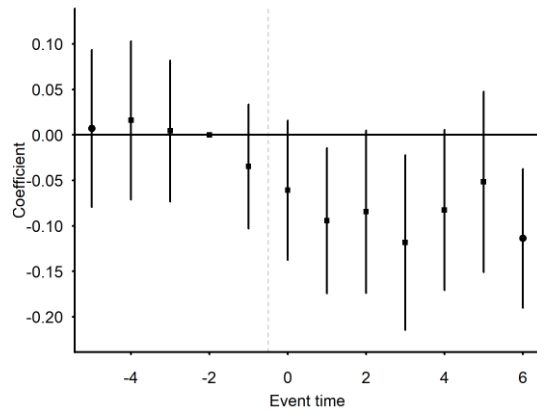
In Figure 5, we report an analogous set of results but using the worker-specific job access measure instead of the log distance to the center. The patterns are comparable overall, and there are no signs of differential pre-trends – despite the slight imbalance with respect to the worker-specific job access measure documented in column 1 of Table 1: Unskilled workers assigned to locations with better job access are statistically significantly less likely to be unemployed, whereby the coefficients are stable after about two years. For skilled workers, the effects are not significant and much smaller in the first five years after admission, with only the long-run coefficient being statistically significantly negative.

Figure 5
Worker-specific job access and unemployment hazard

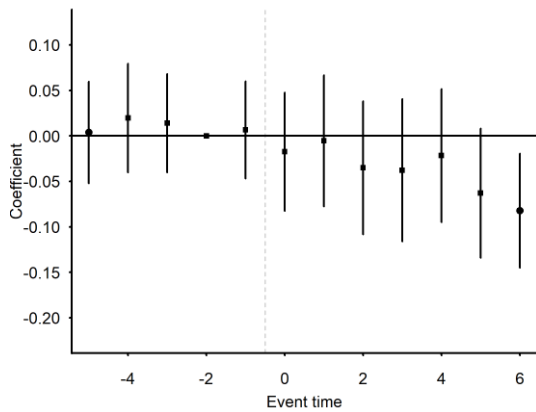
A. Unemployment hazard (all workers)



B. Unemployment hazard (unskilled workers)



C. Unemployment hazard (skilled workers)



Notes: The graphs show coefficients for the interaction of event time dummies with the worker-specific job access at the affordable housing address, estimated by ordinary least squares. The first (last) estimate is pooled over all earlier (later) periods. The outcome variable is the share of days a person was registered unemployed (over all days the person was observed in the administrative data). A person is unemployed if working less than 15 hours per week. All regressions control for person and year fixed effects, as well as an interaction of the event time dummies with the log distance from the city center to the last address before moving into affordable housing. In period 0, individuals were observed at an affordable housing address for the first time. Persons in vocational training or in university or college at the time of admission to affordable housing excluded. The vertical bars depict 95% confidence intervals (cluster-robust at affordable housing address level).

Baseline estimates. Table 2 shows results for our baseline specification, equation (4). In columns 1-4, the sample is again restricted to workers who do not hold a vocational or university degree in the year of admission. The model in column 1 is estimated by OLS. Higher worker-specific job access is associated with a lower number of days in unemployment. We again control for the distance from the last address to the city center, interacted with the post-period dummy. The respective coefficient is not significant. The regression also includes year- and person-fixed effects, and city-specific post-period dummies.

Table 2
Impact of worker-specific job access on unemployment hazard by skill group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Dependent variable:</i>	Share of days unemployed ^a							
<i>Sample:</i>	Unskilled workers ^{b, c}				Skilled workers ^{b, c}			
	OLS	IV ^d	IV ^d	IV ^d	OLS	IV ^d	IV ^d	IV ^d
Post × Worker-specific job access	-0.072** (0.028)	-0.097* (0.059)	-0.154** (0.066)	-0.155** (0.066)	-0.026 (0.022)	0.043 (0.044)	0.021 (0.047)	0.021 (0.047)
Post × Log distance, previous address to center	0.004 (0.004)	0.001 (0.004)	-0.000 (0.004)	-0.000 (0.004)	-0.000 (0.003)	-0.000 (0.003)	-0.002 (0.003)	-0.002 (0.003)
Post × Dummy: new building (at time of move)			-0.028 (0.017)	-0.027 (0.017)			-0.004 (0.012)	-0.004 (0.012)
Post × Building vintage (at time of move)			0.004** (0.002)	0.004** (0.002)			0.006*** (0.001)	0.006*** (0.001)
Post × Female				0.015 (0.010)				0.006 (0.008)
Post × Foreign				0.007 (0.012)				-0.013 (0.008)
Post × Age in years				-0.001 (0.001)				-0.001 (0.001)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of construction × Post period FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	50,091	50,091	50,091	50,091	87,353	87,353	87,353	87,353
Adj. R squared	0.308				0.290			
Kleibergen-Paap F statistic		150.8	118.6	118.8		151.4	128.6	128.6
Mean outcome variable (pre-period)	0.187	0.187	0.187	0.187	0.167	0.167	0.167	0.167
Standard deviation worker-specific job access	0.218	0.218	0.218	0.218	0.209	0.209	0.209	0.209

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^d: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center; first-stage results reported in Table 3. The decay factor for the job access measure is $\theta = 0.5$. The Kleibergen-Paap F statistic refers to Kleibergen and Paap (2006).

In column 2, we estimate the same regression using the distance of the affordable housing unit to the city center interacted with the post dummy as instrument. The coefficient is again negative and statistically significant, albeit only at the ten-percent level. The Kleibergen-Paap F statistic is far above the critical value of 10, indicating a very strong relationship between the distance to the center and the job access measure.

In column 3, we additionally control for the age of the affordable housing building and an indicator for new buildings. Moreover, we add fixed effects for the year of construction in the post-period. Building design may affect labor market outcomes and may be related to residual selectivity of landlords but may have changed over time. All of these controls are interacted with the post-period dummy to capture differential effects of admission by building type. The coefficient of main interest becomes somewhat larger, with -0.154, and is significant at the five-percent level. This does not change much when adding person characteristics, i.e., indicator variables for gender, age, and nationality, interacted with the post-period dummy as additional controls in column 4. These findings lend support to hypothesis H1.

In column 5-8, we repeat the analysis for skilled workers, i.e., workers holding a vocational degree at the time of admission. Here, the coefficient of main interest is insignificant and much closer to zero in both the OLS and the IV regressions.¹⁵ This difference in coefficients cannot be explained by the lower unemployment rate in this group, which is only 2.0 percentage points lower than in the group of unskilled workers. Rather, it suggests that skilled workers do not rely as much on job opportunities in the close proximity of their residence, thereby confirming hypothesis H2.

Magnitudes. Taking the coefficient from the baseline specification reported in column 4, an increase in worker-specific job access by one standard deviation (0.218) reduces an unskilled worker's unemployment hazard by 3.4 percentage points or 18 percent relative to the sample mean.

The estimates from Weinberg et al. (2004) and Andersson et al. (2018) allow a rough comparison to our estimates. Weinberg et al. (2004) find that an increase in job accessibility by one standard deviation leads to an increase in annual hours of 3.6 percent, which corresponds to around 68 additional hours. For individuals with fewer years of schooling, they find an effect that is marginally but not significantly larger. Our estimate of 3.4 percentage points corresponds to around 12 days or 99 hours, which is slightly more but of a similar magnitude. The difference likely stems from the fact that their worker fixed effects specification only partially addresses the downward bias arising from selection of low-attachment workers into central neighborhoods in the US. Andersson et al. (2018) estimate that an increase in job accessibility by the interquartile range reduces the joblessness duration of low-earnings workers by 4.4 percent. Rescaled by the ratio of the standard deviation to the interquartile range of our job accessibility measure ($0.218/0.245$), their estimate translates to a reduction of 3.9 percent per standard deviation. Inferring from their Table 1 that the average duration of unemployment in the first year after layoff is 2.1 quarters or 190 days, this implies a reduction of the unemployment duration by around 7.5 days. This is smaller than our estimate of 12 days, but their estimate becomes 50 percent larger for Blacks and even twice as large for Hispanics.

¹⁵ A pooled regression reported in Table C1 confirms that the difference in the coefficients of unskilled and skilled workers is statistically significant.

Moreover, as we explain below, we also obtain a much smaller estimate when we only use geographic proximity to jobs, but not the skill distance, to construct our measure of job accessibility.

IV relevance. In Table 3, we report the first-stage regressions corresponding to the IV regressions from Table 2. The log distance from the affordable housing to the center is strongly negatively related to the worker-specific job access, with a very stable coefficient in all regressions between -0.23 and -0.20. The coefficients are precisely estimated, with cluster-robust (at the level of affordable housing buildings) standard errors around 0.02.

4.2 Robustness and sensitivity of baseline estimates

We test the robustness of our baseline estimates to several potential threats to identification.

Potentially endogenous location choices. Our empirical strategy rests on the assumption that workers do not move into a particular affordable housing unit for reasons that are related to their labor market success. We explore this potential threat to identification in two ways. First, in Table C2, we estimate the change in log commuting distance when workers move house, using observations from pre-treatment periods up to the move into affordable housing. The main variable of interest is a dummy for the move into affordable housing, which captures the differential change in commuting distances associated with this particular type of move. It is significantly positive across all specifications, in a plain bivariate regression (column 1), controlling for year-, age-, and city-fixed effects (columns 2 and 3), and when restricting the sample to workers who did not simultaneously switch employer (column 4). This strongly suggests that workers in our sample did not move into affordable housing to get closer to their current job.

Second, we exclude local moves from our baseline regression where the change in the distance to the center was below 2 km in Table C3. Moves where distances change only little may be selective to the extent that these persons try to stay in their original neighborhood. When excluding these moves, the results are qualitatively unchanged, with a slightly stronger effect for unskilled workers.

Household composition. The balancing tests have revealed a small but statistically significantly positive correlation between the distances of the affordable housing unit to the center, and of the previous address to the center. One reason for this imbalance could be a correlation between unit sizes and centrality in affordable housing. To the extent that larger units in both affordable and market-rate rental housing are on average closer to the periphery, households with many children are more likely to live further out both before and after admission. This represents a threat to identification as (lone) parents may have a harder time finding a job than singles or couples without children.

Table 3
First-stage results for Table 2: Impact of worker-specific job access on unemployment hazard by skill group

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Dependent variable:</i>	Post × Worker-specific job access					
<i>Sample:</i>	Unskilled workers ^{a, b}			Skilled workers ^{a, b}		
	OLS	OLS	OLS	OLS	OLS	OLS
Post × Log distance, affordable housing to center	-0.229*** (0.019)	-0.209*** (0.019)	-0.209*** (0.019)	-0.238*** (0.019)	-0.228*** (0.020)	-0.227*** (0.020)
Post × Log distance, previous address to center	-0.007*** (0.002)	-0.007*** (0.002)	-0.007*** (0.002)	0.004 (0.002)	0.004* (0.002)	0.003 (0.002)
Post × Dummy: new building (at time of move)		-0.010 (0.012)	-0.010 (0.012)		-0.016* (0.009)	-0.016* (0.009)
Post × Building vintage (at time of move)		-0.004*** (0.001)	-0.004*** (0.001)		-0.004*** (0.001)	-0.004*** (0.001)
Post × Female			-0.029*** (0.006)			-0.015*** (0.005)
Post × Foreign			-0.018*** (0.007)			-0.015** (0.006)
Post × Age in years			0.000 (0.000)			0.000 (0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of construction FE × Post period FE	No	Yes	Yes	No	Yes	Yes
Observations	50,091	50,091	50,091	87,353	87,353	87,353
Adj. R squared	0.905	0.914	0.915	0.891	0.900	0.900

Notes: Standard errors clustered by affordable housing address. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^b: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university.

Household composition is not observed in our data, except for persons on welfare benefits. These benefits were introduced in 2005. In Table C4, we therefore reproduce our baseline results for workers on welfare benefits who were admitted to affordable housing between 2005 and 2017, for which we can observe household composition. When considering unskilled workers and without controls for household composition in column 1, the coefficient of main interest is similar in size to the baseline specification using the full sample, but standard errors are too large for the estimate to be statistically significant. Controlling for household size interacted with the post-period dummy in column 2, the coefficient gets slightly larger but remains statistically insignificant. In column 3, we distinguish between different types of household members, but this does not affect the coefficient on the job access measure much.

Columns 4-6 display the same set of regressions for the group of skilled workers on welfare benefits. Here, the coefficients are negative and larger in magnitude than in the baseline regression for skilled workers, but again not statistically significant. Hence, the job access coefficients are more similar across skill groups among workers on welfare benefits, which could be due to lower productivity of skilled workers on welfare benefits as compared to skilled workers who do not receive welfare benefits.

We therefore pool the two groups together in columns 7 (with controls for household size only) and 8 (with controls for household members by type). In both cases, the coefficients are statistically significant at the ten-percent level and very close to the baseline coefficient. Overall, this suggests that the potential imbalance in household sizes with respect to the affordable housing allocation is much too small to affect our estimates meaningfully.

Alternative distance decay factors. For the job access measure in the baseline specification, we assume a distance decay factor of 0.5. In Table C5, we test the sensitivity of the results to choosing a lower (0.25) or higher (0.75) discount factor. Columns 1 and 2 show results for unskilled workers only, where the coefficient of main interest is again statistically significantly negative. The quantitative impacts are slightly larger as compared to the baseline specification: According to column 1, a one standard deviation increase in job access reduces the unemployment hazard by about 3.7 percentage points, whereas column 2 suggests a reduction by 4.3 percentage points. The coefficient estimates for skilled workers displayed in columns 3 and 4 are again close to zero and statistically insignificant.

4.3 Mechanisms

In this section, we shed light on some of the mechanisms that drive our results.

Worker-specific vs. unspecific job access. The job access measure in Table 2 combines closeness to jobs in skill space with geographic proximity to jobs. In Table 4, we test whether geographic proximity or combination of both dimensions drives our results. Since we have only one instrumental variable that mainly captures geographic proximity to jobs, we run OLS regressions using an augmented baseline specification corresponding to columns 4 and 8 of Table 2. In addition to the worker-specific job access measure, we include an unspecific access measure that ignores the skill profile of workers and jobs (i.e., setting all skill distances to zero). Column 1 shows results for unskilled workers. The worker-specific job access measure is again negative and significant (albeit only at the ten-percent level), with -0.099, whereas the unspecific job access measure is small and insignificant. Hence, the combination of skill

distance and geographic proximity matters for this group, rather than the mere number of jobs nearby.

Results for skilled workers are displayed in column 2. The worker-specific job access measure is insignificant, but the coefficient is now much closer to the respective coefficient for unskilled workers, with -0.086. However, the coefficient on the unspecific job access measure is also relatively large and positive, with 0.075. In conjunction, this suggests that increasing geographic proximity does not have a large overall effect (as it increases both measures in a similar way). However, the pattern is consistent with the findings from Macaluso (2025) that a lower skill distance to typical jobs in the broader local market reduces unemployment hazards for this group.

Table 4
Role of geographic and skill distance for job access

<i>Dependent variable:</i> <i>Sample:</i>	(1)	(2)
	Share of days unemployed ^a	
	Unskilled workers ^{b, c}	Skilled workers ^{b, c}
	OLS	OLS
Post × Worker-specific job access	-0.099* (0.059)	-0.086 (0.053)
Post × Unspecific job access (geographic proximity)	0.019 (0.063)	0.075 (0.057)
Baseline controls	Yes	Yes
Year FE	Yes	Yes
Person FE	Yes	Yes
City × Post period FE	Yes	Yes
Year of construction FE × Post period FE	Yes	Yes
Observations	50,091	87,353
Adj. R squared	0.310	0.293

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university.

Means of transportation. Our main results indicate that better job accessibility reduces unemployment hazard only for unskilled individuals. This is in line with the behavioral model sketched in Section 2, where unskilled workers incur higher commuting costs per unit of distance than skilled workers, and that these costs rise more sharply as the distance increases. The main explanation for the difference in variable commuting costs is that unskilled workers are less likely to own a car (Gautier and Zenou 2010). They are hence more reliant on the immediate spatial proximity of jobs and access to public transport. In contrast, employed skilled workers usually earn a wage that allows them to buy or lease a car, which allows them to cover larger distances more easily, thereby reducing the need to primarily search for jobs in close proximity to their residence.

Table 5 provides evidence for this explanation, drawing on the Mobilität in Deutschland [Mobility in Germany] survey 2017, a large household survey on mode choices. According to panel A, respondents who do not hold a vocational or higher degree are less likely to have a driver's license or go by car (including trips where the respondent is not driving), as compared to respondents with vocational or higher degrees. Panel B shows that this pattern is more

pronounced in larger cities. Panel C further restricts the sample to respondents in cities with low economic status, as captured by household income. Arguably, this group is most comparable to the affordable housing residents studied in this paper. In this group, 39.6% of respondents without a vocational degree do not have a driver's license, whereas only 17.7% (10.8%) with a vocational (higher) degree do so. These patterns are similar when considering car usage rather than presence of a driver's license. Overall, this evidence supports the conjecture that unskilled workers are much less likely to rely on car transportation as compared to skilled workers, especially in cities.

Table 5
Holders of a driver's license and car usage by skill group

<i>A. All respondents</i>						
	Has a driver's licence			Drives/goes by car at least occasionally		
	No	Yes	Total	No	Yes	Total
No vocational degree	1,602 11.7%	12,068 88.3%	13,670	1,244 9.1%	12,399 90.9%	13,643
Vocational degree	2,932 4.7%	59,903 95.3%	62,835	3,562 5.7%	59,229 94.3%	62,791
Higher degree	1,002 2.2%	45,152 97.8%	46,154	2,852 6.2%	43,276 93.8%	46,128
<i>B. City dwellers</i>						
	Has a driver's licence			Drives/goes by car at least occasionally		
	No	Yes	Total	No	Yes	Total
No vocational degree	677 24.4%	2,101 75.6%	2,778	578 20.9%	2,189 79.1%	2,767
Vocational degree	1,690 9.1%	16,928 90.9%	18,618	2,306 12.4%	16,290 87.6%	18,596
Higher degree	765 3.4%	21,972 96.6%	22,737	2,410 10.6%	20,310 89.4%	22,720
<i>C. City dwellers with low economic-status</i>						
	Has a driver's licence			Drives/goes by car at least occasionally		
	No	Yes	Total	No	Yes	Total
No vocational degree	245 39.6%	374 60.4%	619	228 36.8%	391 63.2%	619
Vocational degree	513 17.7%	2,384 82.3%	2,897	635 22.0%	2,257 78.0%	2,892
Higher degree	169 10.8%	1,403 89.2%	1,572	373 23.8%	1,196 76.2%	1,569

Notes: Data source is the Mobilität in Deutschland 2017 survey (regional person-level data). Car usage includes trips by private car where someone else was the driver. The “No” category captures respondents who stated they never use a car for daily trips. Low economic status is based on household income and includes persons in the bottom-two categories (out of five) reported in the survey.

An alternative way to cover long commuting distances by car is to rely on public transit. Trains and subways allow also the least wealthy workers to cover long distances—if they live reasonably close to a transit stop. We therefore expect that job access effects are less pronounced for unskilled workers who are well connected to the public transit system. To test this, we augment the baseline specification by interactions of the job access measure with an indicator variable capturing proximity to a rail-based public transit stop (less than 750m) in Table 6. For workers living more than 750m from the nearest stop, the coefficient is larger than

in the baseline specification and highly significant. The interaction term is positive, as expected, but not significantly different from zero. This suggests that the job access measure does not capture as well the actual job opportunities available to unskilled workers who can easily access train or subway connections. In column 2, we restrict the sample to the two largest cities, Munich and Nuremberg, where subway and light-rail networks are available. Column 3 shows results for Munich only. In both cases, the results are qualitatively similar, with coefficients being somewhat larger in magnitude. Columns 4-6 display the corresponding results for skilled workers. Here, controlling for public transit access pushes the main coefficient into the negative domain and yields a positive interaction effect, but both coefficients are not statistically significant in any of the three regressions, again suggesting that skilled workers do not rely as much on jobs in close proximity to their residence.

Table 6
Impact of worker-specific job access and proximity to public transport on unemployment hazard

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Dependent variable:</i>	Share of days unemployed ^a					
<i>Sample:</i>	Unskilled workers ^{b, c}			Skilled workers ^{b, c}		
	IV ^d	IV ^d	IV ^d	IV ^d	IV ^d	IV ^d
Post × Public transport ^c	-0.008 (0.023)	-0.011 (0.026)	-0.019 (0.030)	0.039 (0.053)	0.030 (0.061)	0.090 (0.068)
Post × Worker-specific job access	-0.189*** (0.073)	-0.204** (0.088)	-0.222* (0.117)	-0.047 (0.060)	-0.032 (0.075)	-0.102 (0.079)
Post × Public transport × Worker-specific job access	0.100 (0.074)	0.123 (0.102)	0.169 (0.124)	0.012 (0.024)	0.010 (0.025)	0.027 (0.026)
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes
Year of construction × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes
Cities in sample	All cities	Munich, Nuremberg	Munich	All cities	Munich, Nuremberg	Munich
Observations	50,091	38,920	35,766	87,353	71,049	67,745
SW-F, main term	153.1	59.3	38.3	140.8	67.4	53.0
SW-F, interaction term	327.3	176.3	74.8	285.6	205.6	192.9

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^d: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center; Post × Public transport × Worker-specific job access instrumented by Post × Public transport × Log distance, affordable housing to center. ^e: Public transport is a dummy that equals one if the affordable housing is closer than 750m to a rail-based public transport stop. SW-F is the Sanderson-Windmeijer conditional F statistic (Sanderson and Windmeijer 2016).

Neighborhood effects as alternative mechanism. So far, the results are consistent with job access effects. However, even if the assignment of applicants to affordable housing units is as good as random with respect to location characteristics, proximity to jobs could be correlated with overall neighborhood quality, which may affect labor market outcomes through other channels than pure job accessibility. To test this, Table C6 reports regression results controlling

for neighborhood quality in three dimensions: Average wages, the unemployment rate, and the share of foreign local residents in a 500m circle around the affordable housing location. For both unskilled and skilled workers, the coefficient on the worker-specific job access variable is almost identical to the respective coefficient from the baseline regression in column 4 of Table 2. Hence, neighborhood characteristics do not seem to explain the job access effects.

4.4 Effects on days in employment, wages, and commuting and skill distances

Apart from the unemployment hazard, job accessibility may affect a number of other job-related variables. In Table 7, we test to what extent higher job accessibility affects long-term unemployment, employment, labor income, wages, and realized commuting and skill distances. The top (bottom) panel shows results for unskilled (skilled) workers.

Long-term unemployment and labor force participation. In columns 1 and 8, the outcome is a dummy variable capturing long unemployment spells that span the entire year. Consistent with the results for the unemployment hazard (i.e., the share of days registered as unemployed), unskilled workers with higher job access are less likely to be unemployed over an entire year, whereas the coefficient is not significant for skilled workers.

Workers are considered unemployed if involuntarily working less than 15 hours a week. The unemployment hazard may thus not capture smaller job opportunities. In columns 2 and 9, we therefore test whether workers with better job access are more likely to be employed in any type of job at least half of the year. This is the case for unskilled workers, but not for skilled workers. In columns 3 and 10, we consider an alternative dummy measure capturing positive labor income in the given year, with similar results.

Labor income and wages. Better job accessibility may enable workers to find better-matching or higher-quality jobs and increase their bargaining power when negotiating wages. In columns 4 and 11, we restrict the sample to workers with positive labor income and use the log yearly labor income as outcome. For both unskilled and skilled workers, we get a positive, yet statistically insignificant coefficient. The same holds true when considering the log average daily wage instead in columns 5 and 12. Although this result is inconclusive, it is consistent with hypothesis H3.

Commuting and skill distances. Hypothesis H4 suggests that having more suitable job opportunities nearby may allow workers to choose jobs closer to their residence and skill profile. In columns 6 and 13, the outcome is the log commuting distance. Both skilled and unskilled workers take advantage of the opportunity to shorten their commute when job accessibility at the location is higher. The effect of higher job accessibility is statistically significant in both cases, with a somewhat larger impact on skilled workers. Hence, when job accessibility is high, choosing a shorter commute may be an alternative to bargaining for higher wages at a more distant location. Moreover, it suggests that skilled workers benefit from job accessibility as well, but through other channels than unskilled workers.

Table 7
Impact of worker-specific job access on further employment-related outcomes

<i>A. Unskilled workers</i> ^{a, b}							
<i>Dependent variable:</i>	(1) Unemployed for at least 365 days IV ^c	(2) Employed at least half of the year IV ^c	(3) Positive labor income in current year IV ^c	(4) Log yearly labor income (conditional) IV ^c	(5) Log daily wage (conditional) IV ^c	(6) Log distance to workplace (conditional) IV ^c	(7) Skill distance (conditional) IV ^c
Post × Worker-specific job access	-0.072** (0.034)	0.135* (0.072)	0.115* (0.061)	0.104 (0.225)	0.153 (0.158)	-1.023** (0.445)	-0.041** (0.018)
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year + Person FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of construction × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50,091	50,091	50,091	41,734	41,724	33,565	35,922
Kleibergen-Paap F	118.8	118.8	118.8	113.7	113.7	110.2	107.5
<i>B. Skilled workers</i> ^{a, b}							
<i>Dependent variable:</i>	(8) Unemployed for at least 365 days IV ^c	(9) Employed at least half of the year IV ^c	(10) Positive labor income in current year IV ^c	(11) Log yearly labor income (conditional) IV ^c	(12) Log daily wage (conditional) IV ^c	(13) Log distance to workplace (conditional) IV ^c	(14) Skill distance (conditional) IV ^c
Post × Worker-specific job access	-0.008 (0.022)	0.032 (0.048)	0.041 (0.046)	0.070 (0.154)	0.108 (0.113)	-1.252*** (0.283)	0.016 (0.014)
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year + Person FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of construction × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	87,353	87,353	87,353	77,603	77,58	57,544	65,861
Kleibergen-Paap F	128.6	128.6	128.6	129.7	129.6	129.5	129.4

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^b: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^c: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center.

Improved job access may also translate into a smaller distance in skill space. To explore this, we again restrict attention to workers in employment and consider the skill distance of the current job to all jobs the worker held in the previous ten years, weighted by employment duration and time distance. For unskilled workers, an increase in job access causes the skill distance to decrease, see column 7 in panel A. This suggests that these workers take advantage of job opportunities nearby not only by reducing their commute, but also by choosing jobs that fit their skill profile. Column 14 shows that skilled workers' skill distances are not affected by job access. This may be due to the fact that workers with a vocational degree are already specialized in one occupation and are therefore less likely to switch to jobs that require a different set of skills. The findings that better job accessibility lowers commuting distances and, in the case of unskilled workers, also causes better matches in terms of skill distance, are in line with hypothesis H4.

The theoretical framework suggests a link between skill distance and compensation of a worker, capturing the idea that workers with a tighter skill fit to their current job are relatively more productive in that job. Table C7 explores this relationship in our sample by regressing log income (column 1) and the log wage (column 2) on the skill distance and on dummy variables for skill level (vocational degree), gender, and foreign nationality, conditional on age-, year-, occupation- and city-fixed effects. The sample is restricted to job switchers in the pre-treatment period, so that the skill distance captures the distance between jobs held previously and the new job. The regressions also include an interaction of the vocational degree dummy the skill distance to allow for the possibility that skill fit is more important for workers with a vocational degree.

These regressions reveal a tight, negative relationship between our skill distance measure and compensation and a significantly negative interaction term of the skill distance measure with the vocational degree dummy in the wage regression. For unskilled workers, a reduction of the skill distance by 0.1 is associated with a 0.0885 log points higher daily wage.

Taking the estimated effect of access on skill distance in this group of -0.041, an increase in the access measure by one unit decreases skill distance by 0.041. Table C7 suggests that this reduction in skill distance increases log wages by $(-0.041) \times (-0.885) \approx 0.036$, or around one quarter of the estimated, albeit insignificant impact of access on wages of 0.151, reported in column 5 of Table 7.

4.5 Gender-specific effects of living closer to the city center

A key factor that can influence how place of residence affects labor market outcomes is gender. Le Barbanchon et al. (2021) show that women value commute distance more than men and have shorter maximum acceptable commutes. This suggests that job accessibility is not a gender-neutral constraint: The labor market returns to a given residential location may systematically differ between women and men. In our context, this implies that assignment to affordable housing units with poor job accessibility could impose particularly large costs on women, to the extent that their effective search radius is more constrained. We explore this possibility by separating between women and men in Table 8.

Table 8
Effects by Gender

<i>A. Unskilled workers</i> ^a				
<i>Dependent variable</i>	(1)	(2)	(3)	(4)
	Share of days unemployed ^b	Full-time ^d	Log distance to workplace ^d	Distance to workplace at most 3 km ^d
	OLS	OLS	OLS	OLS
Post × Log distance, affordable housing to center	0.028 (0.018)	-0.011 (0.020)	0.166* (0.098)	-0.019 (0.027)
Post × Log distance, affordable housing to center × female	0.010 (0.021)	0.078*** (0.029)	0.122 (0.110)	-0.066** (0.031)
Baseline controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
City × post period FE	Yes	Yes	Yes	Yes
Year of construction × post period FE	Yes	Yes	Yes	Yes
Observations	50,091	39,305	33,565	33,565
Adj. R squared	0.314	0.468	0.279	0.335
<i>B. Skilled workers</i> ^a				
<i>Dependent variable</i>	(5)	(6)	(7)	(8)
	Share of days unemployed ^b	Full-time ^d	Log distance to workplace ^d	Distance to workplace at most 3 km ^d
	OLS	OLS	OLS	OLS
Post × Log distance, affordable housing to center	-0.003 (0.012)	-0.027* (0.014)	0.306*** (0.068)	-0.063*** (0.018)
Post × Log distance, affordable housing to center × female	-0.004 (0.015)	0.017 (0.025)	-0.047 (0.091)	-0.014 (0.026)
Baseline controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes
Year of construction x Post period FE	Yes	Yes	Yes	Yes
Observations	87,353	73,994	57,544	57,544
Adj. R squared	0.295	0.400	0.265	0.295

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^b: Unskilled workers do not have a vocational, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^c: Share of days in unemployment over total days observed. ^d: Conditional on being employed.

The worker-specific job access measure already takes into account potentially gender-specific skill profiles and preferences for working part-time. For that reason, we run a reduced-form regression with the log distance to the city center interacted with the post dummy as the main explanatory variable. Moreover, we add a triple interaction of that variable with the female dummy. Apart from these differences, the regressions include the same controls as the baseline regression.

Panel A displays results for unskilled workers. The outcome in column 1 is the share of days registered as unemployed. There is no statistically differential effect for women. Column 2 shows that living closer to the city center decreases the probability that unskilled women take up full-time rather than part-time jobs, conditional on taking up any job, relative to the null-effect on unskilled men. This suggests that proximity to the city center does not differentially affect the extensive margin of labor supply in this group, but it reduces intensive-margin labor supply of women relative to men.

Columns 3 and 4 consider differential effects on commuting distances, conditional on working. The triple-interaction effect is not statistically significant. However, living closer to the city center increases the likelihood to have a workplace in walking distance (less than 3 km) among unskilled women relative to unskilled men.

These results are consistent with a commuting cost mechanism. Women who seek part-time employment and are assigned to housing farther from the city center may find working financially unattractive, as the associated earnings are insufficient to cover commuting costs, effectively pricing them out of part-time employment. Conversely, similar women residing closer to employment centers face lower commuting costs, making part-time work a viable option.

Results for skilled workers are shown in panel B. We do not find gender-specific effects for this group. However, conditional on working, commuting distances decrease as workers move closer to the city center, and workplaces are within walking distance with a higher probability for both genders.

5 Quantitative importance of job accessibility for city-wide unemployment rates

The evidence presented so far suggests that job accessibility is important, especially for unskilled workers. The effects apply at the individual level. Aggregation is complicated by general equilibrium effects, as each worker contributes to the competition for jobs as perceived by other workers. Therefore, changing the patterns of segregation in a local labor market or city will indirectly affect job access of all workers who live in that location. Thus, to be able to infer the importance of job accessibility at the aggregate level – i.e., with respect to the spatial mismatch hypothesis –, we need to take into account these equilibrium effects.

In this section, we therefore present simulation results for two scenarios that are at the extremes of spatial segregation by skill. We run the scenarios for the City of Munich, the largest city in our sample, taking into account workplaces and workers in a 15 km radius around Munich's city limits. In both scenarios, we fix the set of workplace and residence locations (geocodes) to the ones observed in the data. Moreover, we hold constant all job locations both in and around Munich, and workers' residential locations around Munich.

The simulations are based on the 2% sample for 2017. The unemployment rate is shown in column 1 of Table 9. It is identical to the unemployment rate reported in official statistics for

June 2017, with 5.5%. We then randomly draw 2,000 workers in Munich and compute the job access measure for these 2,000 individuals, which serves as the baseline for the simulations.¹⁶

Panel A of Figure D1 shows the distribution of workers by skill group with respect to the distance to the city center of Munich. Both skill groups exhibit a similar tendency to live downtown. Whereas unskilled workers are somewhat more prevalent close to the city limits, i.e., between 5 and 10 kilometers from the center, a relatively higher share of skilled workers lives even further out, i.e., more than 15 kilometers from the center.

In the first scenario, all unskilled workers living in Munich are randomly allocated to the residential addresses closest to the city center, whereas all skilled workers are randomly assigned to the remaining residential addresses. Panel B of Figure D1 show the resulting distance distributions. We then re-compute job access for the 2,000 randomly drawn individuals from the baseline scenario.

The impact on the aggregate unemployment rate is given by applying the coefficients from the baseline regressions (columns 4 and 8 of Table 2) to the difference in the job access measure between scenario 1 and the baseline scenario and then averaging over the 2,000 workers. As reported in column 2 of Table 9, Munich’s unemployment rate is 1.3 percentage points lower in this case – a considerable reduction showing that the improved proximity to city-center jobs dominates the fiercer competition stemming from the higher overall number of unskilled workers in the center.

Scenario 2 reverses the allocation of workers by skill group, as can be seen in panel C of Figure D1. Here, all skilled workers are assigned to residential addresses closest to the center, and unskilled workers are allocated to the remaining locations further out. Column 3 of Table 9 reports the resulting impact on the unemployment rate, which now is 1.7 percentage points higher than in the baseline scenario.

Table 9
Aggregate impact of segregation by skill on city-wide unemployment

	(1)	(2)	(3)
	Baseline: Munich, 2017 (data)	Scenario 1: Unskilled workers near the city center	Scenario 2: Skilled workers near the city center
Unemployment rate	5.5%	4.2%	7.2%

Notes: Values for columns 2 and 3 are obtained by computing the difference in job access for 2,000 randomly-drawn workers in Munich between the baseline (as observed in the data in 2017) and the respective scenario, applying the baseline coefficients from Table 2, columns 4 and 8, and adding the resulting difference to the baseline unemployment rate. In scenario 1, all unskilled workers living in Munich are randomly allocated to residential addresses closest to the center, until all such workers are allocated. Skilled workers who previously lived at those addresses were randomly allocated to residential locations further out. In scenario 2, skilled workers were allocated to city-center addresses, using the same approach as in scenario 1 for unskilled workers.

In conjunction, the simulations suggest that city-wide unemployment rates depend strongly on segregation by skill level and the accessibility of jobs for unskilled workers. In fact, according to our results, the unemployment rate may decrease by as much as 3.0 percentage points in a

¹⁶ Since we apply IV estimates, which provide LATEs, to the whole population, we compare the characteristics of the “compliers” in our IV analysis using Angrist and Imbens (1995) weights in Table D1. This analysis shows that the compliers exhibit characteristics very similar to the population means.

city characterized by strong spatial segregation if going from a configuration with unskilled workers living far from suitable workplaces to the reverse configuration. Overall, this lends support to the hypothesis that spatial mismatch can explain high unemployment rates among unskilled workers who lack access to car transportation or good public transit links and who live far away from suitable job opportunities.

6 Conclusions

In this paper, we study the effects of job accessibility within cities on employment outcomes. For identification, we exploit the arguably random allocation to affordable housing locations in Germany. We develop a measure for job accessibility that combines the advantages of established measures used in previous studies, allowing job accessibility to depend both on the geographical distance to job opportunities and on the fit between the worker's skill profile and the job's skill requirement.

The results indicate that, among unskilled workers, proximity to suitable jobs causally reduces unemployment. Our preferred estimate implies that, all else equal, improving job accessibility by one standard deviation reduces unemployment hazard by 18 percent, relative to the sample mean. Better access allows these workers to take up jobs with superior skill fit. To the contrary, skilled workers' unemployment hazard is not affected, most likely because car ownership makes them less dependent on spatial proximity to jobs. However, both unskilled and skilled workers take advantage of better job access by reducing their commuting distance.

In simulations, we show that the job access effects can be quantitatively important on aggregate, i.e., at city level. Using Munich as a case study, the observed unemployment rate of 5.5% would decline by 1.3 percentage points if all unskilled workers were allocated to central neighborhoods and all skilled workers to the outskirts. In the reverse case, unemployment would increase by 1.7 percentage points. Overall, the simulations imply that there is a strong relationship between the skill-specific spatial pattern of residences and workplaces and unemployment, the main mechanism behind the spatial mismatch hypothesis.

The quantitative magnitude of our estimates should be interpreted in light of differences across urban systems. For example, cities in the U.S. are typically more racially and ethnically segregated than European cities and have worse public-transit coverage, suggesting that spatial mismatch may be quantitatively even more important than in the German case.

For policymakers who seek to reduce unemployment among unskilled individuals, our results suggest that policies affecting the residential location of low-income households – such as the density of residential development in central areas, the site selection of affordable housing, or investments in public transit infrastructure – have real labor market consequences, plausibly because these workers, unlike skilled workers, find it harder to cover long commuting distances. This divide is aggravated in recent years by the possibility to work from home, which may render residential location less consequential but is highly skill-biased, with unskilled workers typically having to be physically present at their workplace (Barrero et al. 2023).

Therefore, to reduce unemployment, it would be advisable to avoid measures that encourage households with unskilled members to settle in areas that are relatively far from suitable jobs.

Similarly, restrictions on building density in central areas that offer good access to jobs are misguided from a labor market perspective. An alternative way to alleviate the consequences of spatial mismatch is to provide an effective public transit system that connects individuals in remote locations to the jobs in the city center.

A fruitful avenue for future research is to study more deeply how access to urban labor markets shapes the labor market success of unskilled workers. While our study focuses on tenants of affordable housing, holding constant housing costs across locations, further research could study the triad of job accessibility, labor market outcomes, and housing costs. Finally, the possibility to work remotely likely amplifies the skill divide in job access effects.

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Online Appendix – Not for Publication

A: Theoretical model

This appendix develops a spatial model with skill-specific commuting costs, directed search and wage bargaining.

Environment

The city consists of a finite set of residential locations $r \in \mathcal{R}$ and workplace locations $\ell \in \mathcal{W}$. Let $z_i \geq 0$ denote the distance from location $i \in \mathcal{R} \cup \mathcal{W}$ to the city center and let $d(r, \ell)$ denote the distance between residence r and workplace ℓ . There is a finite set of worker types $s \in S = \{L, H\}$, where L denotes unskilled and H skilled workers. Unskilled workers face higher effective variable commuting costs, $\tau_L > \tau_H > 0$. The main reason for this is that, due to high fixed costs, they have less access to cars and are reliant on public transportation.

Jobs are exogenously distributed across workplace locations and job classes $q \in \mathcal{Q}$. Let $J_{\ell q}$ denote the mass of job opportunities of class q at location ℓ . Jobs are centrally concentrated: For each job class $q \in \mathcal{Q}$, $J_{\ell q} = \bar{J}_q e^{-\rho_q z_\ell}$, $\rho_q > 0$. Each job class q requires a skill profile. Let $\phi_{sq} \in (0, 1]$ denote the fit of worker type s to job class q , with larger values indicating better fit. The reduced-form representation is $\phi_{sq} = e^{-\gamma \Delta_{sq}}$, $\gamma > 0$, where Δ_{sq} is skill distance.

Wages, hours, and feasible matches

Let total compensation be denoted by $x_{sq\ell} = w_{sq\ell} h_{sq\ell}$. A filled job of class q at workplace ℓ produces $y_{sq\ell}(h) = A_{\ell q} \phi_{sq} h$, where $A_{\ell q} > 0$ is workplace productivity. Let $c_q(h)$ denote the firm's strictly convex hours cost and $v_s(h)$ the worker's strictly convex disutility of hours. Let b_s be the worker's outside option.

For a technologically feasible match (s, q, ℓ) , efficient hours maximize joint surplus net of hours costs:

$$A_{\ell q} \phi_{sq} = c_q'(h_{sq\ell}^*) + v_s'(h_{sq\ell}^*). \quad (\text{A1})$$

Hence, ceteris paribus, $h_{sq\ell}^*$ increases if ϕ_{sq} increases. Define the technological surplus of match (s, q, ℓ) by

$$\Sigma_{sq\ell}^0 = A_{\ell q} \phi_{sq} h_{sq\ell}^* - c_q(h_{sq\ell}^*) - v_s(h_{sq\ell}^*) - b_s. \quad (\text{A2})$$

Only matches with $\Sigma_{sq\ell}^0 \geq 0$ are technologically feasible.

Assume commuting costs are borne privately by workers after wage bargaining and are not contractible. Then bargaining over total compensation does not depend directly on residence. Given a technologically feasible match, total compensation is determined by Nash bargaining:

$$x_{sq\ell}^* \in \arg \max_x [x - v_s(h_{sq\ell}^*) - b_s]^\beta [A_{\ell q} \phi_{sq} h_{sq\ell}^* - c_q(h_{sq\ell}^*) - x]^{1-\beta}. \quad (\text{A3})$$

The solution is

$$x_{sq\ell}^* = \beta (A_{\ell q} \phi_{sq} h_{sq\ell}^* - c_q(h_{sq\ell}^*)) + (1 - \beta)(v_s(h_{sq\ell}^*) + b_s), \quad (\text{A4})$$

so that

$$x_{sq\ell}^* - v_s(h_{sq\ell}^*) - b_s = \beta \Sigma_{sq\ell}^0, \quad (\text{A5})$$

$$A_{\ell q} \phi_{sq} h_{sq\ell}^* - c_q(h_{sq\ell}^*) - x_{sq\ell}^* = (1 - \beta) \Sigma_{sq\ell}^0.$$

The implied hourly wage is

$$w_{sq\ell}^* = \frac{x_{sq\ell}^*}{h_{sq\ell}^*}. \quad (\text{A6})$$

A worker of type s living at r accepts job (ℓ, q) only if worker participation holds:

$$x_{sq\ell}^* - v_s(h_{sq\ell}^*) - b_s - \tau_s d(r, \ell) \geq 0. \quad (\text{A7})$$

Using (A5), this can be written as

$$\beta \Sigma_{sq\ell}^0 \geq \tau_s d(r, \ell). \quad (\text{A8})$$

Hence residence affects the set of acceptable jobs through commuting costs, but not hours worked and the wage paid by a given match (prediction 1, see below). Since the marginal commuting costs for skilled workers are assumed to be lower than for unskilled workers, shorter commuting distances have a smaller impact on their willingness to take a job (prediction 3).

Define the acceptance indicator

$$a_{sq\ell}(r) = \mathbf{1}\{\Sigma_{sq\ell}^0 \geq 0 \text{ and } \beta \Sigma_{sq\ell}^0 \geq \tau_s d(r, \ell)\}. \quad (\text{A9})$$

The quality of the skill match affects not only the set of acceptable jobs, but also hours worked, wages and total compensation (prediction 1). Using (A1) and (A4),

$$\frac{dx_{sq\ell}^*}{d\phi_{sq}} = \beta A_{\ell q} h_{sq\ell}^* + v_s'(h_{sq\ell}^*) \frac{dh_{sq\ell}^*}{d\phi_{sq}} > 0. \quad (\text{A10})$$

Even though a better skill fit within a given match has a positive effect on total compensation, this does not necessarily have a positive impact on the hourly wage:

$$\frac{dw_{sq\ell}^*}{d\phi_{sq}} = \beta A_{\ell q} + \frac{v_s'(h_{sq\ell}^*) - w_{sq\ell}^*}{h_{sq\ell}^*} \frac{dh_{sq\ell}^*}{d\phi_{sq}}. \quad (\text{A11})$$

Search equilibrium and outcome

A type- s worker living at r faces the effective mass of acceptable job opportunities

$$\Omega_s(r) = \sum_{\ell \in \mathcal{W}} \sum_{q \in \mathcal{Q}} J_{\ell q} a_{sq\ell}(r). \quad (\text{A12})$$

Let $N_s(r)$ denote the total mass of type- s workers living at r . Competition is defined as the mass of potential competitors weighted by the share of their acceptable job opportunities that also belong to the focal worker's acceptable job set:

$$\Psi_s(r) = \sum_{r' \in \mathcal{R}} \sum_{s' \in \mathcal{S}} N_{s'}(r') \frac{\sum_{\ell \in \mathcal{W}} \sum_{q \in \mathcal{Q}} J_{\ell q} a_{sq\ell}(r) a_{s'q\ell}(r')}{\sum_{\ell \in \mathcal{W}} \sum_{q \in \mathcal{Q}} J_{\ell q} a_{s'q\ell}(r')}. \quad (\text{A13})$$

Define worker-specific effective tightness as

$$\Gamma_s(r) = \frac{\Omega_s(r)}{\Psi_s(r)}. \quad (\text{A14})$$

The higher the proportion of nearby, effectively available jobs with a high match in qualification requirements, the more likely it is that the commute time for the actual job will be short and the skill fit will be high (prediction 4).

Since acceptance indicators are not observable, the empirical job-access measure counts distance- and skill-weighted job opportunities and compares them with distance- and skill-weighted potential competitors which fits well with the idea of the theoretical model to avoid double-counting workers across many jobs and to distinguish weak overlap from strong overlap. Competitors are approximated by workers living nearby and having similar skill profiles, because workers with similar skills and nearby residences are assumed to compete for similar sets of jobs. If we disregard the skill dimension and assume a monocentric city, we can draw conclusions—for sufficiently small search intervals—about the relationship between the ratio of the theoretical measure to the empirical approximation and the geographic distance from the center. The sign of the change of this ratio with distance is determined by how the curvature of worker density, relative to its level, changes with distance. Specifically, the ratio decreases with distance if the level-normalized curvature n''/n of the worker density function n decreases with distance. However, in general, it is not possible to make a statement about the relationship between the two measures. Finally, we also replace the ratio with the normalized difference $2[\Omega_s(r) - \Psi_s(r)]/[\Omega_s(r) + \Psi_s(r)]$, which is a positive monotone transformation of the effective tightness measure $\Gamma_s(r)$ defined in the theoretical model.

More central residential locations are assumed to have weakly shorter commuting distances to the relevant distribution of jobs, and competition for those jobs does not rise proportionally. Under this assumption, effective job access is higher in more central locations. Directed search implies that the job-finding hazard for type- s workers at r is

$$\lambda_s(r) = m_s(\Gamma_s(r)), \quad m_s'(\cdot) > 0, \quad m_s''(\cdot) \leq 0. \quad (\text{A15})$$

Assuming an exogenous separation rate $\delta_s \in (0,1)$, the flow-equilibrium unemployment risk of type- s workers at residence r ,

$$u_s(r) = \frac{\delta_s}{\delta_s + m_s(\Gamma_s(r))}, \quad (\text{A16})$$

is decreasing in effective job access (prediction 2).

Summary of implications

Hence, the model supports the following four predictions:

- (1) Conditional on the match, commuting distance does not affect hourly wages or compensation, whereas a better skill fit raises total compensation, but has an ambiguous effect on hourly wages.
- (2) Better job access reduces the individual unemployment risk.
- (3) Commuting distances have a smaller impact on the individual risk of unemployment for skilled workers than for unskilled workers.

- (4) Better access to jobs—due to a greater number of effectively available jobs nearby and a better skill match—shortens commute times and reduces the skills gap in individuals' actual employment.

B: Detailed Data Description

This online appendix provides details on the various sources and computation of variables used in our empirical analysis.

Table B1 investigates the relationship between rents in the affordable housing buildings (at time of completion) and the distance to the city center, conditional on year- and city-fixed effects. According to the results in column 1, the rent per square meter does not decrease with distance. Column 2 adds controls for neighborhood characteristics. This does not change much the coefficient on the distance variable, and the neighborhood characteristics themselves also cannot explain rent levels in the data. This is consistent with the fact that rents in the funding regime are not supposed to be higher for buildings closer to the center or in better neighborhoods.

Table B1
Rent gradient in affordable housing

	(1)	(2)
<i>Dependent variable:</i>	Log affordable rent per square meter	
	OLS	OLS
Log distance to center	-0.010 (0.009)	-0.009 (0.009)
Log median daily wage in neighborhood		0.025 (0.025)
Unemployment rate in neighborhood		-0.076 (0.051)
Share foreign nationals in neighborhood		0.010 (0.044)
Year of construction FE	Yes	Yes
City FE	Yes	Yes
Observations (buildings)	413	408
Adj. R squared	0.707	0.706

Notes: Robust standard errors in parentheses, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. Affordable rents refer to the year of construction. No data available on affordable rent for 51 buildings. Neighborhood variables measured in 2010 and are missing in 5 cases due to data privacy protection rules.

Table B2 displays summary statistics of the variables used in the analysis.

Table B2
Summary Statistics

<i>A. Person- and job-related variables (estimation sample)</i>						
	Mean	Median	SD	Min	Max	N
Unemployed	0.19	0	0.36	0	1	137,444
Days in employment	258	365	140	0	366	137,444
Unemployed for at least 365 days	0.03	0	0.15	0	1	137,444
Daily wage ^a	60.3	56.8	39.2	0.01	971	119,304
Annual labor income ^a	17.9	14.9	16.0	0	134	137,444
Distance to workplace in km	25.7	6.7	78.1	0	781	91,109
Age	35.8	35.0	10.8	13	74	137,444
Year of observation	2007	2008	7.14	1992	2019	137,444
<i>B. Time-invariant variables (in year of admission, estimation sample)</i>						
	Mean	Median	SD	Min	Max	N
Skilled (pre-admission) ^b	0.58	1	0.49	0	1	7,212
Age	34.9	34	9.71	18	60	7,212
Female	0.44	0	0.50	0	1	7,212
Non-German nationality	0.60	1	0.49	0	1	7,212
Year of admission	2008	2007	4.42	2002	2017	7,212
Worker-specific job access	0.301	0.28	0.212	-0.385	0.99	7,212
Unspecific job access	0.294	0.272	0.207	-0.37	0.838	7,212
Distance [km], affordable housing to center ^c	5.64	4.50	2.58	1	12	7,212
Distance [km], previous address to center ^c	33.1	5.50	87.7	0.50	601	7,212
Building is new	0.20	0	0.40	0	1	7,212
Vintage of building in years	6.76	6	4.95	0	20	7,212
Year of construction	2001	2001	1.90	1997	2005	7,212
Median daily wage in neighborhood ^{d)}	81.2	79.2	14.3	23.4	133	7,201
Unemployment rate in neighborhood ^{d)}	0.09	0.08	0.051	0	1	7,192
Share foreign in neighborhood ^{d)}	0.25	0.25	0.10	0	0.59	7,192

Notes: The table refers to the final sample, excluding university and college students and persons in vocational training at the time of admission to affordable housing. ^{a)}: Real EUR values, deflated by CPI with base year 2015. In individual cases, income spells can be one-day spells that may be due to one-time payments or corrections. These spells can lead to very high values for the daily wage and income variables. In total, there are six (three) person-year observations with a daily wage above 250 EUR (500 EUR). ^{b)}: Person holds a vocational training or higher degree. ^{c)}: Distance rounded up to the nearest 500m to fulfill data privacy protection requirements. ^{d)}: In 500m radius; radius increases up to 1,500m if less than 25 other cases within radius to fulfill data privacy protection requirements.

Matching with affordable housing addresses. The affordable housing data were provided by the local housing offices of Munich, Nuremberg, Augsburg, Ingolstadt, and Regensburg and cover all subsidized housing constructed in the period 1997 to 2007 in these cities. We match the addresses of the buildings with the address-level geocodes in the 100% sample of the linked employer-employee data of IAB Nuremberg, treating the first instance when a person was observed at an affordable housing address as the move-in date.

Address histories. Importantly, residential addresses may be updated in the data only with a lag, depending on the employment status (i.e., on the actual source of the address information in the administrative data). For employed persons, starting in 2007, address information is updated when the person registers the new address at the local residents' registration office. Usually, new residents may take up to six months to register after a move, but enforcement is weak. Before 2007, address information was provided to the social security system directly through

the worker's employer(s). In general, address changes do not require employers to submit a record to the social security system but are observed only when compulsory records are submitted. Workers receiving unemployment insurance payments provide their current address to the employment agency and are supposed to update the address when moving. Finally, persons on welfare benefits need to provide their address to the employment agency in order to get housing benefits. All in all, there may be a lag of several months between the actual move and the updating of the address information in the data. As a consequence, we cannot rule out that persons observed at an affordable housing address in a given year had already moved in one year earlier.

We take these features of the data into account by setting the baseline period to two years before the date a worker appears at the affordable housing address for the first time. Moreover, we require that the individual was not observed at another affordable housing address. Since the address information coming from different underlying sources are updated at different frequencies, different sources may at times report conflicting address information, especially around the time a person moves house. For example, consider a person holding a main job and a secondary job with a fixed-term contract ending on January 31, 2001. Suppose the person moved house in March 2000 and reported the new address to their main employer immediately. The new address would then be reported to the social security system in the end-of-year statement on December 31, 2000. Suppose she forgot to inform the secondary employer about the address change. The job termination statement from the secondary employer would then still hold their previous address on January 31, 2001. Similar cases are possible for persons holding a job and receiving unemployment or welfare benefits.

Before 2000, we do not observe addresses. For the same reason as explained above, a person moving into affordable housing in 1999 may appear in our data as living at a non-affordable housing address throughout the year 2000. In such a case, we would erroneously assign the move-in date to 2001. We therefore restrict our analysis to moves into affordable housing observed between 2002 and 2017.

Job access variable. For the computation of the job access variable, we rely on a 2% sample of workers (residences and workplaces) in the five cities and in locations up to 15 km around these cities.

Income and daily wage. The IEB contains the yearly labor income as reported to the social security insurance. Income is top-coded at the income threshold up to which contributions are mandatory for employees. In rare cases, reported income may be higher due to one-time payments or a change of employer during the year, since firms cannot necessarily top-code earnings at the correct threshold in these cases. The daily wage is computed as the total yearly income divided by the number of days in employment.

Income eligibility thresholds. The income we observe in the data is the total gross labor income. Around 20% of gross income are transferred directly to the social security insurance system and do not appear on the wage bill sent to the employees, with the statutory pension system and the statutory health insurance being the largest components. We observe the remaining 80% of gross income, which we refer to as “employee gross income” below.

Income eligibility is determined in terms of the employee gross income. Employed applicants have to submit a form filled out and signed by the employer stating their current and expected income. The signature on the form must not be older than three months. Moreover, they have to provide the notice of the income tax assessment from the previous year. In case of recent or expected changes in pay, the local housing office uses 12x the monthly pay instead.

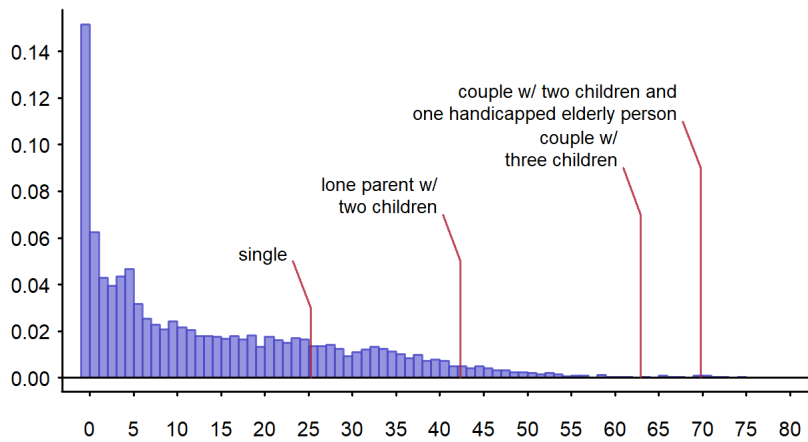
Employees pay taxes and an additional 20% of contributions to the social security system out of their employee gross income. The income eligibility rules allow for a blanket deduction of 1,000 EUR for work-related expenses, and blanket deductions of 20% for the social security contributions and 10% for income taxes. To this value, other income sources are added, such as received alimony payments. Persons having to pay alimony payments may subtract these payments up to thresholds of 4,000 EUR per child and 6,000 EUR per former spouse, respectively. At this point, incomes of all household members are summed up. Moreover, there are deductions of 4,000 EUR for each person in the household with a disability, and of 5,000 EUR for young married couples, which are subtracted in the final stage of the computation. The resulting value is then compared to the threshold value.

In 2015, the nominal income thresholds were 14,000 EUR for singles, 22,000 EUR for couples, and 4,000 EUR for each additional person in the household. In addition, the threshold increased by 1,000 EUR for each child in the household. In real terms, the income thresholds were more or less constant over time, with adjustments reflecting consumer price inflation in Germany.

Affordable housing admission. We infer admission to affordable housing from worker residential addresses and the street addresses of affordable housing buildings. All affordable housing residents in these buildings are required to fulfill the income eligibility criterion.

We do not observe household-level income and the income eligibility check by the housing offices. To test whether the worker-level incomes observed in our sample in the year prior to admission to affordable housing are consistent with the eligibility rules, we compute income eligibility thresholds for 2015 in terms of the total gross income for example households, assuming that there is a single earner in the household, and plot these thresholds in a histogram of observed real incomes in the year prior to admission to affordable housing in Figure B1.

Figure B1
Income Distribution One Year Before Admission and Examples for Income Eligibility Thresholds



Notes: The histogram shows the total yearly gross labor income in EUR 1,000 (employer-gross income including social security and pension contributions) in the year before admission on the horizontal axis. The red lines indicate the eligibility thresholds for different example households, assuming that only one person in the household earns income. The histogram is cut off at EUR 80,000, which excludes one observation with a reported income of EUR 134,000. This outlier is likely due to a one-time payment.

The figure shows that around three quarters of the workers in our sample earn less than the eligibility threshold for singles. There are some workers with relatively high incomes, with the right tail going up to 75,000 EUR. However, these workers may still have met the income eligibility threshold in case they lived in larger households, had to pay alimony, or lived with a disabled person in the household. For example, a couple household with two children and a handicapped (elderly) person faces an income threshold of around 70,000 EUR (employer-gross income including social security and pension contributions) if there was a single earner in the household – as may often be the case when the second adult cares for the handicapped person and the children.

The admission process requires workers to register with the housing office. Workers are then placed on a wait list. There are several criteria that can make a timely admission more likely, whereby the strongest criterion fulfilled by the household counts. These criteria include exposure to domestic violence, homelessness or likely loss of accommodation, severe overcrowding, and health incidences. A (lone-mother) pregnancy can also increase the chances of admission. Conditional on availability of suitable units, the waiting time is used to break ties among equally-needy households.

Distance variables. We use crow-fly distances throughout. Distances to rail-based public transport stops are computed using Open Street Map data from 2021. The commuting distance is the distance between the establishment and the worker's residential address.

Neighborhood variables. The computation of neighborhood variables is based on the 100% sample of the IEB. For each residential location in our sample, we draw a 500m ring around the location and compute neighborhood statistics based on all observations in this ring, leaving out workers registered at the residential location itself. In cases where less than 25 observations are present, we increment the radius by 100m until the number of valid cases is 25 or higher, up to

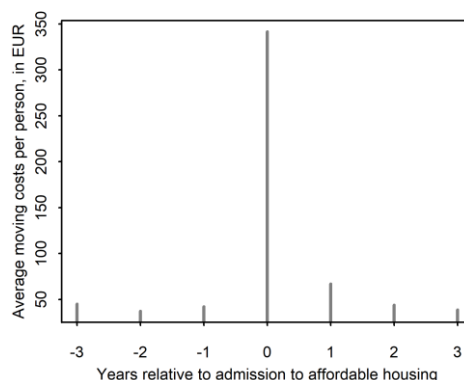
a maximum of 1,500m. The neighborhood variables are set to missing if less than 25 cases are present in a radius of 1,500m.

For the computation of median daily wages in the neighborhood, we require at least three employed persons. Otherwise, this variable is also set to missing. If exactly one person in the neighborhood is observed to be unemployed or non-German, we change the value to two persons. The same applies reversely if all but one worker are unemployed or if only one worker is German. These changes are necessary to fulfil data protection requirements.

SGB II welfare benefits data. We use the “Leistungshistorik Grundsicherung“ (LHG, V10.00.00-201904), which contains information on household composition, and the “Leistungsstatistik SGB II” (LST-S, V10.00.00-201904), which provides payment information extracted directly from the payment system of the Federal Employment Agency. We use these data to investigate the fiscal costs of affordable housing, and to measure housing costs of welfare benefit recipients before and after admission to affordable housing.

The payment information system is completely distinct from the information system used to construct the labor market biographies and hence provides an alternative way of assessing the quality of the data. More precisely, welfare recipients can claim support payments for residential moves. Hence, the payment data allow us to test whether the admission to affordable housing – a central piece of information in our empirical approach – was associated with moving costs in the payment data. The admission to affordable housing is based on address information provided to the Federal Employment Agency. Unemployed persons and welfare benefit recipients report their address to the local branches of the Federal Employment Agency. To date, there is little systematic evidence about the quality of these address data. Figure B2 shows the average moving costs in the years shortly before and after admission. The average moving costs are mostly below 50 EUR per person and year both before and after the date of admission, but over 400 EUR per person in the year of admission. This pattern strongly suggests that we assigned correctly the date at which welfare benefit recipients entered affordable housing.

Figure B2
Moving costs of welfare benefit recipients around time of admission



Notes: The sample consists of all welfare benefit recipients observed in the respective periods. The figure shows average total yearly moving costs by number of years relative to admission to affordable housing. The most important moving cost item is payments for deposits, which makes up around 80% of moving costs.

C: Additional Results

Table C1

Baseline results: Testing the difference in effects between skilled and unskilled workers

<i>Dependent variable:</i>	(1)	(2)	(3)
	Share of days unemployed ^a	Post × Worker-specific job access	Post × Worker-specific job access × unskilled
	IV (Second Stage)	First Stage	First Stage
Post × Worker-specific job access	-0.005 (0.046)		
Post × Worker-specific job access × unskilled	-0.104** (0.050)		
Post × Log distance to center		-0.221*** (0.020)	0.017 (0.025)
Post × Log distance to center × unskilled		-0.001 (0.008)	-0.253*** (0.062)
Post × skilled	-0.049*** (0.015)	0.020 (0.013)	-0.702*** (0.101)
Baseline controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Person FE	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes
Year of construction FE × Post period FE	Yes	Yes	Yes
Observations	137,444	137,444	137,444
Sanderson-Windmeijer-F, main term	198.8		
Sanderson-Windmeijer F, interaction term	302.6		
Adjusted R squared		0.905	0.922

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Days in unemployment over all days the person was observed. Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university.

Table C2
Residential Moves and Change of Distance to Workplace

<i>Dependent variable</i>	(1)	(2)	(3)	(4)	(5)
	Δ Log distance to work				
	OLS	OLS	OLS	OLS	OLS
Intercept	0.010 (0.008)				
Admission to affordable housing	0.068*** (0.024)	0.078*** (0.026)	0.079*** (0.026)	0.091*** (0.031)	0.058 (0.050)
Year FE	No	Yes	Yes	Yes	Yes
Age FE	No	Yes	Yes	Yes	Yes
City FE	No	No	Yes	Yes	Yes
Observations	21,336	21,336	21,336	12,786	8,550
Sample	Residential moves of all workers (before admission)	Residential moves of all workers (before admission)	Residential moves of all workers (before admission)	Residential moves, worker stays with same employer	Residential moves and change of employer
R squared	0.000	0.004	0.004	0.008	0.010
Adj. R squared	0.000	0.001	0.001	0.003	0.002

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. The sample is restricted to employed persons who moved residence, up to the move into affordable housing. Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. The difference in the log distance to work is computed from the year before the residential move to the year the person was observed at the new residential address.

Table C3
Robustness of baseline results: Excluding local moves

	(1)	(2)
<i>Dependent variable:</i>	Share of days unemployed ^a	
<i>Sample:</i>	Unskilled workers ^{b, c}	Skilled workers ^{b, c}
	IV	IV
Post × Worker-specific job access	-0.232*** (0.086)	-0.010 (0.065)
Baseline controls	Yes	Yes
Year FE	Yes	Yes
Person FE	Yes	Yes
City × Post period FE	Yes	Yes
Year of construction FE × Post period FE	Yes	Yes
Observations	26,237	46,015
Kleibergen-Paap F statistic	118.2	123.7

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. Observations excluded if distance to center changes by less than 2 km. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^d: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center.

Table C4
Robustness of baseline results: Controlling for household composition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Dependent variable:</i>	Share of days unemployed ^a							
<i>Sample:</i>	Unskilled workers ^{b, c}		Skilled workers ^{b, c}			All workers		
	IV ^d	IV ^d	IV ^d	IV ^d	IV ^d	IV ^d	IV ^d	IV ^d
Post × Worker-specific job access	-0.175 (0.129)	-0.196 (0.128)	-0.199 (0.126)	-0.084 (0.116)	-0.119 (0.117)	-0.115 (0.115)	-0.144* (0.084)	-0.145* (0.082)
Post × Household size		-0.017** (0.007)			-0.030*** (0.007)		-0.023*** (0.005)	
Post × No. of adults fit for work			-0.033* (0.019)			-0.073*** (0.018)		-0.058*** (0.013)
Post × No. of persons 15-17 fit for work			-0.019 (0.034)			-0.077* (0.040)		-0.041 (0.029)
Post × No. of adults, not in labor force			0.004 (0.070)			-0.041 (0.056)		-0.045 (0.040)
Post × No. of persons under 15			-0.022** (0.011)			-0.006 (0.010)		-0.013* (0.007)
Post × No. of other persons			0.029 (0.021)			-0.030 (0.037)		0.019 (0.016)
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of construction FE × Post period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,281	16,281	16,281	21,452	21,452	21,452	37,733	37,733
Kleibergen-Paap F statistic	75.6	74.9	75.5	92.2	92.5	93.1	97.0	97.4

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. The sample is restricted to workers who receive welfare benefits in the year of admission (SGB II, 2005-2017), as the welfare benefits data contain information on household composition. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^d: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center.

Table C5
Robustness of baseline results: Alternative decay factors for job access variable

	(1)	(2)	(3)	(4)
<i>Dependent variable:</i>	Share of days unemployed ^a			
<i>Sample:</i>	Unskilled workers ^{b, c}	Skilled workers ^{b, c}		
	IV ^d	IV ^d	IV ^d	IV ^d
Post × Worker-specific job access	-0.307** (0.128)	-0.136** (0.061)	0.041 (0.092)	0.019 (0.042)
Baseline controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Person FE	Yes	Yes	Yes	Yes
City × Post period FE	Yes	Yes	Yes	Yes
Year of construction FE × Post period FE	Yes	Yes	Yes	Yes
Distance decay factor	0.25	0.75	0.25	0.75
Observations	50,091	50,091	87,353	87,353
Kleibergen-Paap F statistic	146.1	49.2	145.3	57.3
Standard deviation orker-specific job access	0.121	0.316	0.116	0.304

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^d: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center.

Table C6
Alternative mechanism: Neighborhood effects

	(1)	(2)
<i>Dependent variable:</i>	Share of days unemployed ^a	
<i>Sample:</i>	Unskilled workers ^{b, c}	Skilled workers ^{b, c}
	IV	IV
Post × Worker-specific job access	-0.158** (0.066)	0.022 (0.047)
Post × Median log wage in neighborhood	0.008 (0.045)	-0.037 (0.035)
Post × Unemployment rate in neighborhood	-0.202*** (0.050)	-0.012 (0.039)
Post × Share foreign in neighborhood	-0.046 (0.080)	0.022 (0.062)
Baseline controls	Yes	Yes
Year FE	Yes	Yes
Person FE	Yes	Yes
City × Post period FE	Yes	Yes
Year of construction FE × Post period FE	Yes	Yes
Observations	49,944	87,102
Kleibergen-Paap F statistic	120.0	132.6

Notes: Standard errors clustered by affordable housing address, ***, $p < 0.01$, **, $p < 0.05$, *, $p < 0.1$. Neighborhood variables measured in a 500 m radius around the affordable housing building; if less than 25 cases present, the radius was incremented in steps of 100 m, to at most 1 500 m. ^a: Days in unemployment over all days the person was observed. ^b: Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. ^c: Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university. ^d: Post × Worker-specific job access instrumented by Post × Log distance, affordable housing to center.

Table C7
Skill distance to current job and compensation among job switchers

<i>Dependent variable</i>	(1)	(2)
	Log income	Log wage
	OLS	OLS
Skill distance	-2.486*** (0.158)	-0.885*** (0.098)
Skilled	0.161*** (0.031)	0.139*** (0.022)
Skill distance × skilled	-0.284 (0.195)	-0.369*** (0.121)
Female	-0.366*** (0.027)	-0.325*** (0.018)
Foreign national	0.157*** (0.026)	0.029* (0.015)
Age FE	Yes	Yes
3-digit occupation FE	Yes	Yes
Year FE	Yes	Yes
City FE	Yes	Yes
Observations	32,307	32,297
Adjust R squared	0.230	0.333

Notes: Standard errors clustered by affordable housing address, ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. Both regressions are conditional on being employed. The sample is restricted to periods when the worker switched jobs prior to admission to affordable housing. The skill distance is the distance between the worker's current occupation and her/his recent history of occupations held in the ten previous years. Persons in vocational training, in college, and in university at time of admission to affordable housing excluded. Unskilled workers do not hold a vocational training, college, or university degree at the time of admission to affordable housing. Skilled workers have completed vocational training, college, or university.

D: Simulations

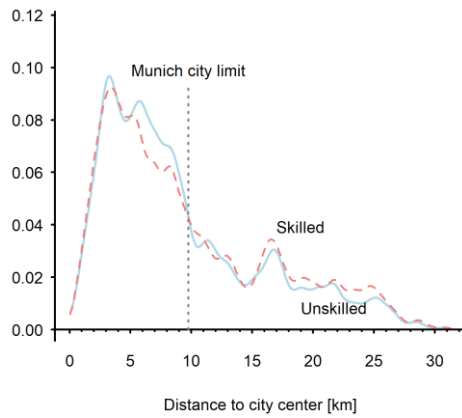
Table D1
*Complier and raw means using Angrist-Imbens weights for
 LATE compliers in baseline IV regression*

<i>A. Unskilled workers</i>			
	Weighted mean	Raw mean	Difference
Female	0.4616	0.4611	0.0004
Age	32.2144	32.2793	-0.0649
Foreign national	0.7096	0.7083	0.0012
Labor income in t-2	13.6822	13.6832	-0.0010
Log wage in t-2	3.5606	3.5615	-0.0009
Share of days unemployed in t-2	0.2125	0.2135	-0.0010
<i>B. Skilled workers</i>			
	Weighted mean	Raw mean	Difference
Female	0.4100	0.4076	0.0024
Age	32.8246	32.9525	-0.1279
Foreign national	0.4976	0.4939	0.0037
Labor income in t-2	19.7190	19.6493	0.0697
Log wage in t-2	3.9059	3.9040	0.0019
Share of days unemployed in t-2	0.2158	0.2181	-0.0023

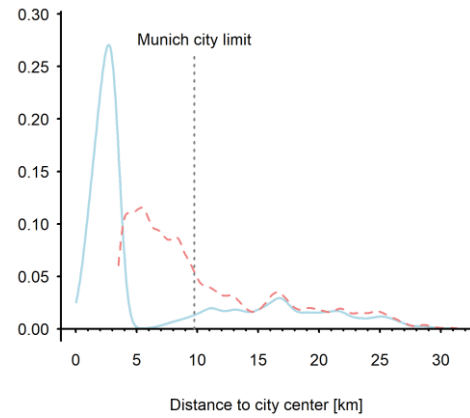
Notes: The table shows weighted means, employing weights proposed by Angrist and Imbens (1995) to characterize LATE compliers in the baseline IV regression (Table 4, columns 4 and 8) and raw means for the respective sample, as well as the difference between the weighted and the raw means.

Figure D1
Scenarios in the simulation exercise: Segregation by skill level

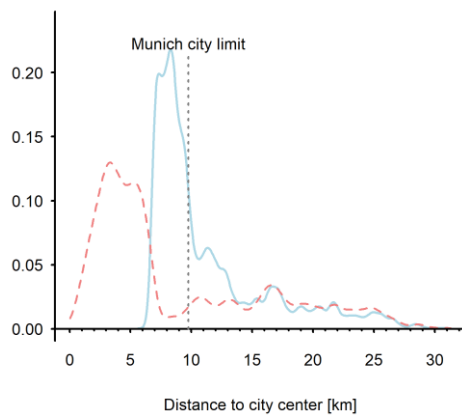
A. Baseline (data, 2017)



B. Scenario 1: Unskilled workers in the center



C. Scenario 2: Skilled workers in the center



Notes: The graphs show the distribution of skilled and unskilled workers in Munich with respect to the distance to the city center. The vertical dashed line indicates the median distance of Munich's city limit to the center. The underlying data are a 2% sample of workers living in Munich and up to 15 km from Munich's city limit in 2017.