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# **Local access to skill-related high-income jobs facilitates career advancement for low-wage workers**

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**Abstract:** A considerable proportion of jobs across labour markets of the Western world are low-wage jobs, while the number of “bad” jobs with deteriorating working conditions and task content is growing. This puts pressure on both successful and lagging regions as low-wage workers struggle to avoid getting priced out of urban areas, while diminishing economic opportunities in more lagging regions fuel social and political discontent. The aim of this paper is to provide empirical evidence on the role of local labour market structure and evolution in enabling or constraining workers in escaping low-wage jobs. Drawing on the network-based approach of evolutionary economic geography in measuring local labour market structure we employ a uniquely detailed individual-level panel dataset provided by Statistics Sweden to construct skill-relatedness networks for 72 functional labour market regions in Sweden. Our fixed-effect panel regressions indicate that the density of skill-related high-income jobs within a region is conducive of low-wage workers moving to better-paid jobs. While metropolitan regions offer a premium for this relationship, it also holds for smaller regions, as well as across various worker characteristics.

**Keywords:** skill-relatedness network; local labour market; low-wage workers; structural change; relatedness density

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## 1. Introduction

There is ample evidence that the share of low-wage jobs with deteriorating working conditions and task content is growing across labour markets of the Western world (*Kalleberg, 2011; Osternman & Shulman 2011; VanHeuvelen & Copas 2019*). Apart from the typical concern that these jobs offer limited career opportunities and might constitute a dead-end for the workers involved (*Autor & Dorn, 2013; Goos et al., 2009; Clark & Kanelloupolous, 2013*), this also has a clear regional dimension by putting pressure on both growing and lagging-behind regions. This is because in growing urban areas low-wage service workers struggle to avoid getting priced out, as seen in both the US and the EU (*Florida, 2017; Danley, 2021*), while diminishing economic opportunities in lagging-behind regions fuel social and political discontent (*Rodríguez-Pose, 2018*). Recent evidence from Sweden, for example, indicates that labour market polarization observed at the national level is predominantly driven by structural change in the labour market of metropolitan agglomerations and more peripheral regions with a core of traditional manufacturing activities (*Henning & Eriksson, 2021*). *Green et al., (2020)* even argue that some regions are becoming increasingly stuck in a low-wage trap with limited resources to upgrade their position in the global division of labour.

Despite these distinctive regional patterns, the local labour market and the evolution of labour demand are seldom considered in analyses on low-wage workers. Instead, the literature on low-wage jobs (and the possibilities to find better employment) puts emphasis on the role of individual worker characteristics, such as skills, endowments, motivation and personality (*Cappellari, 2002; Capellari & Jenkins, 2004; Cappellari, 2007; Cai, 2014; Cai, 2015; Schnitzlein & Stephani, 2016; Cai et al., 2018*), or lifts up the focus to the country level and considers national institutional settings (e.g., *Storer & Reich, 2021; Clark & Kanelloupolous, 2013*), often disregarding the local or regional context. Regional differences, if at all considered, have been examined with simple measures, for example by making distinctions

between urban and rural labour markets (e.g., *Phimister et al., 2006; Culliney, 2017; Grimes et al., 2019; Velthuis et al., 2019*). However a rural-urban divide merely captures size, and not the local opportunity structures available for workers in low-wage jobs. Such jobs are typically concentrated in some specific industries or occupations, which in turn structures the likelihood to “travel” to better paid destinations in the regional industry-firm-occupation space (c.f. *Hane-Weijman et al., 2018* for a similar take in relation to re-employment after redundancies). This calls for a more sophisticated treatment of the local labour market context, considering the regional economic structure and the spatial division of labour produced thereof.

Previous labour market research has indeed called for furthering our understanding of opportunities that workers have by combining firm, occupation and industry data (*Farkas & England, 1998*). While this approach is well-supported conceptually, little has been done to operationalize this in empirical research (for one of the few exceptions see *Avent-Holt et al. 2020*). The measure of relatedness density proposed in this paper is an important improvement in this regard by going beyond the size of the local job market to instead capture the presence of viable local job opportunities by putting a worker-perspective on the process of regional branching. It is well established by now how the current economic structure of regions opens some diversification options, while foreclosing others (e.g., *Neffke et al., 2011; Boschma et al., 2013; Kogler et al., 2017*). Yet, studies on how workers navigate an evolving local labour market structure are scarce. Inspired by recent approaches in evolutionary economic geography (*Neffke et al., 2017; Hane-Weijman et al., 2021*), we create a measure of opportunity links between all jobs to assess which other local jobs could be an alternative for low-wage workers in general, and local options for better-paid jobs in particular.

Hence, the aim of this paper is to provide empirical evidence on the role of local labour market structure in enabling or constraining workers in escaping low-wage jobs by drawing on the network-based approach of evolutionary economic geography in measuring local labour market structure. Specifically, the paper reveals the role of locally available opportunities for accessing better-paid jobs, as captured by our measure of relatedness density to high-income jobs. Relying on a uniquely detailed individual-level panel dataset provided by Statistics Sweden, we construct skill-relatedness networks for 72 functional labour market regions in Sweden, based on above-expected labour flows between jobs

(combinations of industries and occupations) for 2002-2005. We then deploy fixed-effect panel logistic regression to control for unobserved heterogeneity when estimating the likelihood of job changes of workers throughout 2005-2012.

In so doing, we contribute to economic geography in general, but the evolutionary literature in particular, by directly assessing how structural change may open or foreclose the opportunity space for the workforce with a focus on the most vulnerable low-wage workers. This is an essential departure from extant literature since how the labour market responds to change is a direct proxy for socio-economic development and rarely incorporated in the literature on regional branching (*c.f. MacKinnon, 2017; Hane-Weijman et al., 2021*). We also contribute to the low-wage literature by departing from individual-focused explanations and instead empirically address the calls to combine firm, occupation and industry data to reveal the opportunities for workers in different local labour markets (*Farkas & England, 1998; Avent-Holt et al., 2020*).

Our results indicate that the density of skill-related high-income jobs within a region is conducive of low-wage workers moving up to better-paid jobs. While metropolitan regions offer a premium for this relationship, it also holds for smaller regions, as well as across various worker characteristics. Thus, in regions where opportunities are good, even low-wage workers have a chance to find a secure level of income, while in other regions structural change entails a stronger low-wage persistence.

After this introduction, the next section provides the conceptual motivation for the study, section three presents the data and methods followed by the results in section four. Section five concludes.

## **2. Literature review**

### *2.1. Opportunity structures in local labour markets*

It is widely recognized that regional economies specialize in different functions in the production of goods and services and hence employ different groups of workers and have different prospects to break negative development paths (*Massey, 1995*). This spatial division of labour tends to be reinforced over time due to the path-dependent character of investments,

which implies that regions tend to become more tied to certain economic activities and certain functions in the value-chain. As exemplified by *Wixe & Andersson, (2017)* this functional specialization nowadays entails that the occupation-mix of regions provide a clearer picture of the specific resources for change present in different regions. This is because different sectors employ different types of occupations in different regions (*e.g.*, HQ compared to production units), and at the same time the regional occupation-mix tends to show much stronger inertia than the regional industry-mix (*Hane-Weijman et al., 2021*). Thus, regional labour markets are marked with great heterogeneity in terms of structure and possibilities for positive change and thus may be confined in a low-wage trap with limited space for upgrading (*Green et al., 2020*).

Studies have extensively weighed the relative merits of specialised and diversified local economies in creating opportunities for employment growth (*Glaeser et al., 1992; Grillitsch et al., 2021*), while nowadays it also well established that the related variety of local economic activities (*i.e.* activities that share some, but not all locally available capabilities for production and learning) is conducive of employment growth through the creation of new products and markets (*Frenken et al., 2007; for overview see Content & Frenken, 2016*). The relatedness between the elements of a local economy can be depicted as a network (*Boschma 2015*), reflecting potential solutions to particular coordination problems (*Shutters et al., 2018*), and the spatial division of labour (and knowledge). The structure of these relatedness networks predicts the emergence of new industries (*Neffke et al., 2011*), technologies (*Kogler et al., 2017*), and occupations in regions (*Muneeperakul et al., 2013; Alabdulkareem et al., 2018*), and influences the resilience of regions against economic shocks (*Tóth et al., 2020; Moro et al., 2021*). This is critical from a long-term perspective of providing employment opportunities in regions, as successful resistance to, and recovery from, one crisis influences the capacity to do so again in the future (*Simmie & Martin 2010*).

Crucially, the particular structure and diversity of local labour markets tends to follow size, which on its own creates different opportunities and constraints across space for workers. Wealthier metropolitan areas in both the US and Sweden tend to specialise in more unique occupations, while larger regions tend to have a more diverse set of occupations (*Muneeperakul et al., 2013; Hane-Weijman et al., 2021*). The volume of interdependencies between occupations shows increasing returns in regions of multiple developed economies to labour market size, proxied by the number of distinct occupations (*Shutters et al., 2018*).

Larger labour markets are usually more effective in matching workers and workplaces (*Puga, 2010*), and workers in the US were found to change occupations and industries less often in thick labour markets of more densely populated areas, which is consistent with increasing returns to scale in matching in these labour markets (*Bleakley & Lin, 2012*). Finally, larger cities tend to offer better chances to find co-workers with complementary skills (*Neffke, 2019*), reflected in an urban wage premium.

On the flip side, urban areas face challenges from the polarization of worker wages by adding new employment in low- and high-wage occupations while hollowing out the middle (*Scott, 2014*). Evidence from Sweden indeed indicates that the income polarisation observed at the national level is driven by polarisation and spatial sorting in Stockholm, Sweden's largest metropolitan area, and by manufacturing regions with low-skilled workforce, while other regions still follow the traditional labour market upgrading model (*Henning & Eriksson, 2021*). This polarization in and of itself creates a bottleneck for upward wage mobility as low-wage workers hardly ever jump directly from the bottom to the top of the earnings distribution. Additionally, *Alabdulkareem et al., (2018)* showed for the US that worker skills are clearly polarized into communities of socio-cognitive and sensory-physical skills, which contributes to the polarization of wages, as returns to socio-cognitive skills tend to be higher, and larger labour market regions tend to rely more on socio-cognitive skills in their workforce. As sensory-physical skills are likely overrepresented among low-wage workers, this casts doubt on whether escaping low-wage jobs is a simple matter of region size.

## *2.2. Workers, skills and jobs*

The critical question then is what mechanisms and which local labour market structures may enable the transition of individual workers from low- to better-paid jobs. While ample evidence indicates how the current economic structure of regions opens some diversification options, while foreclosing others (*e.g., Neffke et al., 2011; Boschma et al., 2013; Kogler et al., 2017*), studies on how workers navigate an evolving local labour market structure are scarce. This is despite an inevitable consequence of branching at the regional scale entailing redundancies of more peripheral jobs and activities with diminishing options for groups of workers in such regional activities (*Eriksson et al., 2018*). Consequently, by calling for labour to be more fully integrated into studies of evolutionary economic geography, *MacKinnon (2017)* for instance puts forward the concept of *labour branching*, defined as the movement

of workers between previous and new jobs and economic activities. While this may involve a shift from paid-work to different arrangements such as multiple part time jobs or retirement, to keep focus we direct our attention on shifts from one main employment to the next.

Critically, such transitions involve the redeployment of existing worker skills in new jobs, which is more feasible between some jobs than between others. In particular, pairs of economic activities are more skill-related, if they require more similar worker skills and competences (*Neffke et al., 2017*). Relatedness impacts worker options for both voluntary and involuntary job change. Previous research has shown that the time to re-employment after displacement in relation to plant closures is significantly shorter in regions with more skill-related jobs (*Hane-Weijman et al., 2018*), and that displaced workers are more inclined to find new employment in sectors that are similar or related to their previous sector of work (*Eriksson et al., 2018*). This is basically because skill-related activities provide greater prospects for inter-industry pooling at the regional level that enhances matching and growth (*Boschma et al., 2014*). Additionally, individual workers tend to diversify into skills related to their existing set of skills, which, together with the polarization of socio-cognitive and sensory-physical skills, was found to create a bottleneck for workers in reaching occupations with higher share of socio-cognitive skills, and particularly in leaving occupations with an equal share of the two (*Alabdulkareem et al., 2018*).

However, our understanding of how the structure and evolution of local labour markets create opportunities and constraints on escaping low-wage jobs needs to consider a more complete geography and division of labour, one that goes beyond metro areas or an urban-rural dichotomy. Skills of the labour force often reflect established patterns of regional industrial specialisation (*Storper & Walker, 1989*), and so, notwithstanding the role of scaling, even the same number of specialisations can lead to different opportunities for workers for upward wage-mobility, depending on the local presence of skill-related job options, as well as how accessible better-paid jobs are. For instance, a small region with prominent function in public administration offers different options for reaching better paid-jobs, compared with a similar size region with a resource-driven economy, where becoming an entrepreneur may be one of few options for reaching skill-related high-wage jobs. Additionally, gradual structural change in local labour markets through the decline of existing and the emergence of new jobs continuously changes the set of available opportunities for workers to transition to better-paid jobs. As related diversification on the job market seems to be the rule, and unrelated the



exception, the capacity of some regions to continually create options for upward wage mobility is therefore likely to exceed that of others (*Hane-Weijman et al., 2021*).

In the remainder of the paper we study this in the context of Swedish labour market regions and set out to show how the skill-relatedness network structure of these regions creates opportunities and constraints over time for upward wage mobility of low-wage workers.

### 3. Data and methods

#### 3.1. Data description

For the analysis we rely on individual-level panel data from Statistics Sweden covering 2002-2012. These data include the annual wages, and other characteristics of individuals active on the Swedish labour market, as well as their occupations and industry affiliations. We choose the period 2002-2012 for one main reason: information on occupation is only available in the register data from 2001 and onwards. There is also a break in the time-series between 2012 and 2013 due to a revision of occupation codes, which makes comparisons prior to and after 2012 virtually impossible.

To define a job we follow the methodology of *Henning & Eriksson, (2021)* by combining the occupation code with the industry code. This is because the task content of a specific occupation may be different across industries (see *Goos & Manning, 2007*). To define an occupation, we use the 3-digit level of the Swedish SSYK96 occupation nomenclature (consistent with the international ISCO-88); to define an industry, we use the 2-digit level of the SNI2007 industry classification system (consistent with NACE Rev. 2.).

We then exclude individuals who are not registered as “employed”, who have changed workplace (and/or occupation) during the previous two years, and all above defined jobs (industry  $\times$  occupation) with fewer than 100 employees. Based on the remaining sample, we then calculate wage deciles and remove the first and tenth deciles. All of this is done to reduce the impact of job changers on the income levels (people who change jobs tend to receive higher incomes) and to exclude potential outliers. As reported by *Henning & Eriksson (2021)*, excluding only the top and bottom 5%, or using the entire sample does not influence the general pattern of job classifications.

Finally, the median wage of workers within each one of the total 1791 jobs is calculated for 2005, then jobs are assigned to one of five quintiles based on the distribution of this median wage across the jobs. This classification is based on the strategy proposed by *Goos et al., (2009)* and replicates the classification strategies established by *Fernández-Macías, (2012)* and *Henning & Eriksson, (2021)*. Hence, moving forward we rely on a job-based definition of low-wage jobs where jobs belonging to one of the three lowest quintiles of the median wage distribution are considered low-wage. Note that since this is a job-based classification, it implies that workers will not be evenly distributed across the job quintiles. After having defined the position of each job in the national income-distribution, we attribute this value to all workers aged 18-64 registered as having their main income from employment and then select only those workers that belong to the lowest three job categories.

Since income tax registers do not provide information about the hours of work and instead sum up earnings on the annual basis as reported to the tax office, we use annual earnings, including all cash compensation paid by employers. Annual earnings may be a biased measure of wages for individuals working part-time (which in the Swedish working population often occurs when paid work is combined with parental leave) or due to career breaks. Therefore our analysis excludes observations that are registered having study loans or stipends from education registers, income from parental leave or unemployment. This step aims to avoid capturing transitions from low to higher income which are related to, for instance, getting back from parental leave. Since our focus is on employment switches, we exclude the observations on self-employed. After excluding observations with missing data, or longer spells of inactivity (*i.e.*, not having the main income from work), low-wage workers constitute about 30% of the total sample of workers (*Table 1*).

As shown in *Table 1*, the low-wage sample is fairly evenly distributed across the regional categories in relation to workforce as a whole and mainly concentrated in the three metropolitan regions (50%). It is however somewhat more likely that a metropolitan low-wage worker moves to a higher wage category (54%), which confirms the classic ideas on that large urban regions may serve as escalators (*Fielding, 1992*). The main contribution of our study is however to gain further knowledge on the channels through which such mobility can take place. These workers earn on average about 62 thousand SEK (*cca.* 6.2 thousand Euros) less than the total workforce on annual basis. Although there are no large differences

in terms of educational levels or age (workers in low-wage jobs are slightly younger), there is an over-representation of women and individuals born in the Global South in the low-wage group as well as workers having occupations like service and sales and clerical support as well as general elementary occupations.

*Table 1.* Pooled descriptives of all workers and the low-wage sample 2005-2012.

	All workers	Workers in low-wage jobs		
		All	Upward	Remaining
Upward Related density to high-income jobs	0.148	5% 0.081	0.118	0.079
Population density	88	87	93	86
Metro	50%	50%	54%	48%
Larger center	37%	37%	34%	37%
Smaller center	11%	11%	9%	12%
Other smaller region	3%	3%	3%	4%
Regional job size	3118	3276	2382	3318
Age	42	40	40	40
Income (1000)	333	272	324	270
Female	49%	54%	49%	54%
Higher education	32%	31%	32%	31%
Nordic	91%	89%	93%	89%
EU & Global west	2%	2%	2%	2%
Global south	7%	9%	5%	9%
Same employer	78%	75%	80%	75%
Stayer	90%	92%	95%	92%
<i>ISCO (1-digit)</i>				
Managers	6%	0%	0%	0%
Professionals	19%	0%	1%	0%
Technicians and associate professionals	20%	14%	17%	14%
Clerical support workers	9%	18%	28%	18%
Service and sales workers	19%	44%	25%	45%
Skilled agricultural, forestry and fishery workers	1%	2%	1%	3%
Craft and related trades workers	9%	5%	8%	5%
Plant and machine operators, and assemblers	11%	6%	11%	6%
Elementary occupations	5%	10%	8%	10%
<i>NACE (main division)</i>				
Human health and social work activities	16%	27%	11%	28%
Wholesale and retail trade; repair of motor vehicles and motorcycles	14%	18%	22%	18%
Education	12%	15%	10%	15%
Manufacturing	16%	9%	14%	9%
Accommodation and food service activities	3%	6%	3%	6%
Remaining sectors	37%	22%	38%	21%
<i>N</i>	22883110	6623051	288054	6109267

At the bottom of the table, the five most common sectors based on the 21 different main divisions of low-wage workers are health and social work activities, wholesale and retail and education that alone stand for about 60% of all low-wage jobs (compare with 42% of the total

workforce). This signals that many of the low-wage jobs are strongly gendered in the sense that low-wage jobs tend to be traditionally female dominated jobs connected to health and social work, primary schooling and retail which thus drives much of the processes discussed in the income-based definitions in the polarization literature (see *Oesch & Piccitto, 2019*).

### 3.2. Network construction and variable of interest

We capture the structure of jobs in a local labour market by means of a skill-relatedness network. This network rests on the idea, that, on average, workers tend to switch between roles where they can carry over their accumulated skills (*Neffke et al., 2017*). In this analysis, two jobs (industry  $\times$  occupation) are considered skill-related, if the observed labour flow between them ( $F_{ij}$ ) exceeds what we would expect based on the propensity of these industries to experience labour flows ( $(F_i F_j) / F_{..}$ ):

$$SR_{ij} = \frac{F_{ij}}{(F_i F_j) / F_{..}} \quad (1)$$

Here,  $F_i$  is the total outflow of workers from job  $i$ ,  $F_j$  is the total inflow to job  $j$ , and  $F_{..}$  is the total flow of workers in the Swedish economy. To arrive at the final measure of skill-relatedness between jobs, we consider the average of  $SR_{ij}$  and  $SR_{ji}$  to receive a symmetric measure, we normalize<sup>1</sup> the measure to have its range between -1 and +1, and keep only those links that have a normalized skill-relatedness above 0, corresponding to above expected labour flows. The network is based on labour mobility between 2002-2005, and so does not overlap with the period over which the job-mobility of low-wage workers is assessed.

While the overall skill-relatedness network informs us about the skill-overlap between jobs across the Swedish economy, not all of these jobs and connections are available locally, due to the spatial division of labour. Hence, we consider a job to be present in a local labour market if that region shows relative specialisation (revealed comparative advantage; location quotient) in that job, which is a common way of considering local economic structure in the literature on relatedness (for an overview see *Hidalgo, 2021*). In particular, the location

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<sup>1</sup> This is done because the distribution of the skill-relatedness values is strongly right-skewed (*Neffke et al., 2017; Neffke et al., 2018*). The normalization maps these values between -1 and 1:  $\bar{SR}_{ij} = \frac{SR_{ij}-1}{SR_{ij}+1}$ .

quotient of employment tells us how over- or underrepresented is the employment of a job  $i$  in a region  $r$  in year  $t$ , compared with the job's employment share in the national economy of Sweden:

$$LQ_{i,r,t} = \frac{emp_{i,r,t}/emp_{r,t}}{emp_{i,t}/emp_t} \quad (2)$$

A job is considered to be present in a region if its location quotient is above 1. We can then proceed to consider only those nodes (jobs) of the overall skill-relatedness network that a particular region demonstrates relative specialisation in. However, this way we not only get a representation of the local labour market in the form of a collection of specialisations, but also gain insight on those skill-relatedness connections that are not just feasible, evidenced by the overall network, but that are also available for workers of a particular region.

We describe these feasible, but also locally available transition paths for workers by means of the relatedness density measure. This is an established measure of how related an economic activity or a technology is to the regional portfolio, and it has been shown that relatedness density predicts the entry of new economic activities or technologies in regions (for an overview see *Hidalgo, 2021*). Specifically, we consider the relatedness density ( $RD_{i,r,t}$ ) of job  $i$  in region  $r$  in year  $t$  to be:

$$RD_{i,r,t} = \frac{\sum_i SR_{ij} I(LQ_{j,r,t})}{\sum_i SR_{ij}} \quad (3)$$

Here,  $I(LQ_{j,r,t})$  is an indicator variable, showing whether region  $r$  in year  $t$  has relative specialisation in job  $j \neq i$  (taking the value of 1), or not (taking the value of 0). In essence this measure reveals what percent of skill-relatedness to other jobs<sup>2</sup> is available locally for a worker working in a particular job. As a consequence, the temporal variation of this measure comes from the gradual change in the relative specialisation structure of a particular local labour market.

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<sup>2</sup> Note that the measure not just counts the number of connected jobs, but also considers the strength of these connections. Hence, it is the share of tie weights connecting a job to others present in the region.

Finally, the main variable of interest in the empirical analysis is a version of the relatedness density measure that also takes into account whether a particular job can be considered high-income or not. Specifically, high-income relatedness density ( $HI.RD_{i,r,t}$ ) of job  $i$  in region  $r$  in year  $t$  is:

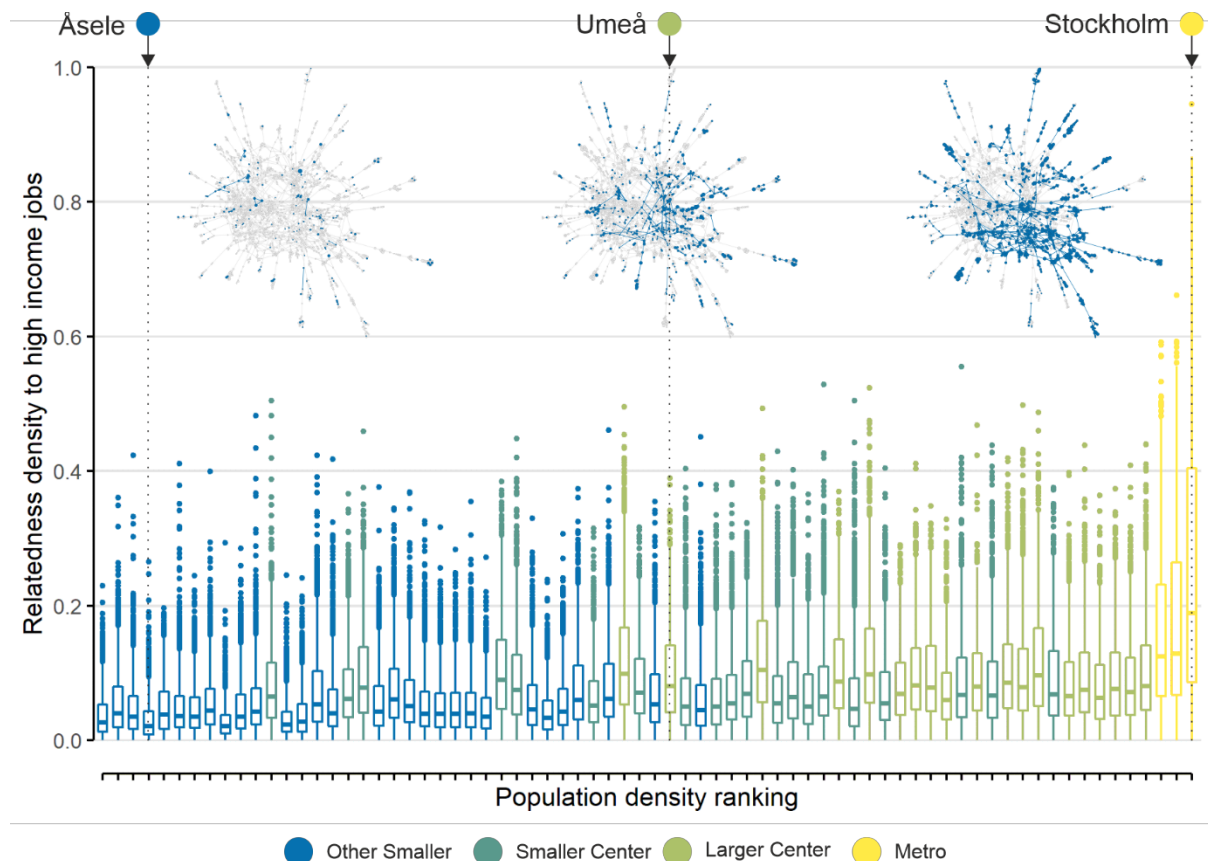
$$HI.RD_{i,r,t} = \frac{\sum_i SR_{ij} I(LQ_{j,r,t}) I(ICAT_j)}{\sum_i SR_{ij}} \quad (4)$$

Here, the new term  $I(ICAT_j)$  indicates whether a job has been classified in the top two quintile bins of the median income distribution detailed above. Hence, this version of relatedness density measures the percent of skill-relatedness connecting a job to locally available jobs that are also high-income.

*Figure 1* offers an impression on the network representation of local labour markets through three highly different example cases captured in 2006. We observe that high-income relatedness density has a right-skewed distribution, as many jobs have relatively strong, locally available connections to high-income jobs. In this skewness it follows relatedness density itself, which simply shows, that many of the feasible skill-related job options tend to be missing from a local labour market. We also check if higher-income jobs are more likely to be skill-related with other higher-income jobs. By means of Pearson-correlating the median-income of job pairs – nodewise correlation over the edgelist –, we find a statistically significant 0.39 correlation coefficient, which is indeed evidence of median-income assortativity among jobs. This seems reasonable in light of the interpretation of the skill-relatedness network: skills deployed in one higher income job are also valued more in related jobs to some extent.

Finally, it stands to reason that larger regions would have higher relatedness density on the account of likely having a more diverse set of economic activities, as evidenced for instance by the scaling literature (*e.g.*, *Shutters et al., 2018*). This is reflected in how richly connected jobs get in the local labour market, as we compare the three illustrative cases. Here, Stockholm represents a metropolitan labour market with a diverse portfolio of specialisations that tend to be an upward outlier in the spatial structure of Sweden (*Henning & Eriksson, 2021*). Umeå is a relatively large regional centre with a steadily growing population and a

variety of economic activities with forestry and manufacturing, but also knowledge-intensive activities and services centred around a university. Finally, Åsele can be considered a small, lagging region with a declining population and a shrinking economic base with a tradition in primary sectors activities (mining, forestry and the like). *Table A1* of the Appendix provides examples of jobs with high and low relatedness density in these different regional settings.



*Figure 1.* Relatedness density to high-income jobs by region type in 2006.

As an overall pattern we find that larger regions, as proxied by their position in the population density ranking, on average have higher high-income relatedness density, which becomes especially pronounced in the three metropolitan regions of Stockholm, Malmö and Gothenburg. This observation necessitates that we control for region size in the econometric analysis. However, and crucially to our investigation, there is a considerable variation of high-income relatedness density of jobs within each region. This represents the structure of the local labour market that we are after, that goes beyond simply having more specialisations.

### 3.3. Econometric model

To estimate the likelihood of transitioning from a low-wage job to a higher-waged job, we exploit the time-dimension in our data by comparing the job of a given individual in  $t - 1$  with  $t$ . If the worker has switched into a higher-paying job (*i.e.*, to any job in the two highest income categories from any category of the three lowest-paying categories) this is coded 1 (and otherwise 0). Due to this binary outcome and the panel data at hand, we use a fixed-effect logistic panel equation when estimating the likelihood of moving upwards. This allows us to account for the well-known fact that unobserved characteristics of workers may bias the results. Workers with better abilities, more motivation, or with better social connections may have greater possibilities to find new jobs. By stressing the within-variation instead of comparing different low-wage workers, our modelling approach estimate the conditional probability of experiencing an event (upward job mobility) as the density of the related jobs changes over time.

Our main models are estimated on the majority (92%) of all low-wage workers that remain in the same region across two consecutive years. This is because the decision of changing local labour market region is typically coupled with a change of residence, a decision that is influenced by many different considerations (*e.g.*, work situation of partner or social connections of children). Local career development is instead more tightly coupled to the individual. As shown in *Table 1*, there is also a slightly higher proportion of the upwardly mobile individuals that remain in the same region (95%) and/or workplace (80%) compared to those that stay in a low-wage job (92% and 75%, respectively). This resonates well with previous findings on job mobility in Sweden. General job mobility, but in particular inter-regional job mobility, is primarily performed by workers endowed with more capital (human and financial) and to a greater extent do not belong to a visible minority (*Eriksson & Rodríguez-Pose, 2017*), especially in more turbulent times (*Andersson et al., 2020*). To still acknowledge the variation across sub-groups, we also perform sensitivity analyses to distinguish the channels for upward mobility for different sub-groups, including interregional movers.

Although the fixed-effect model has some advantages for causal inference, it cannot on the other hand compute time-invariant variables (*e.g.* gender or country of birth) as individual changes are absent. Thus, all such observed and unobserved factors that are considered fixed



within individuals over time, but still may influence the outcome are omitted. We therefore have to restrict our control-variables to only include time-variant information of which two are individual controllers (age and income from work) and two are regional controls (population density and the size of the local labour market). First, younger segments of the workforce are more likely to switch jobs more often and also tend to be over-represented in low-wage jobs. Apart from that, age also proxies general accumulated experience which potentially increase the likelihood of escaping low-wage jobs. Moreover, we include income from work as an additional controller. This is important since the low-wage sample is job-based condition on the median incomes in each job while there might be large variations within a given job. Relative high-income earners in a low-wage job could signal a relatively better possibility of further career advancement (see *Andersson et al., 2020*).

At regional level we include two proxies for agglomeration. First, population density that on the one hand controls for the size of the local job market in general and that usually is strongly related with income development (*Duranton & Puga, 2004*), but also on the other hand often is included as a catch-all regional controller (*Boschma et al., 2014*). Then a more detailed controller of the local job market is added by summing the number of jobs in each region. This is because jobs with a large internal local market due to agglomeration forces usually imply a higher likelihood of finding new employment opportunities within the same labour market segment and also to build an internal job career as opposed to jobs that are not as frequently represented in the region (*Eriksson et al., 2018*). Yearly dummies are used to control for time-specific heterogeneity that may influence all workers in a similar way (e.g., changes in policy or the recession of 2008-10).

Due to the skewed distribution on income, density and size of regional jobs these variables are log-transformed. Moreover, to reduce the impact of simultaneity we use the lags of each right-hand side variable in the regressions. The regression sample is therefore restricted to the years 2006-2012. Since these models can only handle changes within individuals, the final sample is further restricted to workers that do change status over time. *Table 2* summarizes the main variables. There are no obvious signs of multicollinearity, the highest pair-wise correlation is between population density and job size (0.51).

Table 2. Variable description and correlation matrix on all low-wage workers remaining in region 2006-2012.

Variable	Description	Mean	Standard deviation
Into top 2	Dummy = 1 if transition from jobs in income groups 1-3 to jobs in income groups 4-5.	0.08	between: 0.17 within: 0.23
<i>HI.RD</i>	Relatedness density to high-income jobs ( $t - 1$ ).	0.08	between: 0.06 within: 0.02
<i>AGE</i>	Age of worker ( $t - 1$ ).	38.2	between: 11.6 within: 1.5
$\ln INCOME$	Ln yearly income received from work in 1000s SEK ( $t - 1$ ).	5.48	between: 0.46 within: 0.27
$\ln POPDENS$	Ln number of persons (total population) per square km in region ( $t - 1$ ).	4.14	between: 1.06 within: 0.14
$\ln JOBSIZE$	Ln number of jobs in region ( $t - 1$ ).	5.86	between: 2.13 within: 0.85

Correlation matrix						
	(1)	(2)	(3)	(4)	(5)	(6)
(1) Into top 2	1.00					
(2) <i>HI.RD</i>	0.10	1.00				
(3) <i>AGE</i>	-0.03	0.04	1.00			
(4) $\ln INCOME$	0.05	0.21	0.21	1.00		
(5) $\ln POPDENS$	0.02	0.28	-0.07	0.02	1.00	
(6) $\ln JOBSIZE$	-0.04	0.01	-0.10	-0.04	0.51	1.00

## 4. Results

### 4.1. Descriptive results

We first provide simple bivariate evidence on that the association between relatedness density and changing to better-paid jobs is economically significant. To do so, we bin the distribution of relatedness density to high income jobs (*HI.RD*) across time into four quartiles. Since one can expect that the local opportunity structure varies depending on the spatial division of labour, we perform this binning separately within four different categories representing the spatial hierarchy of labour market regions in Sweden. Finally, we calculate for each quartile bin the percent of workers with a job in the lowest three wage-categories who transition into the top two from one year to the next, pooled across the period of 2005-2012 (*Figure 2*).

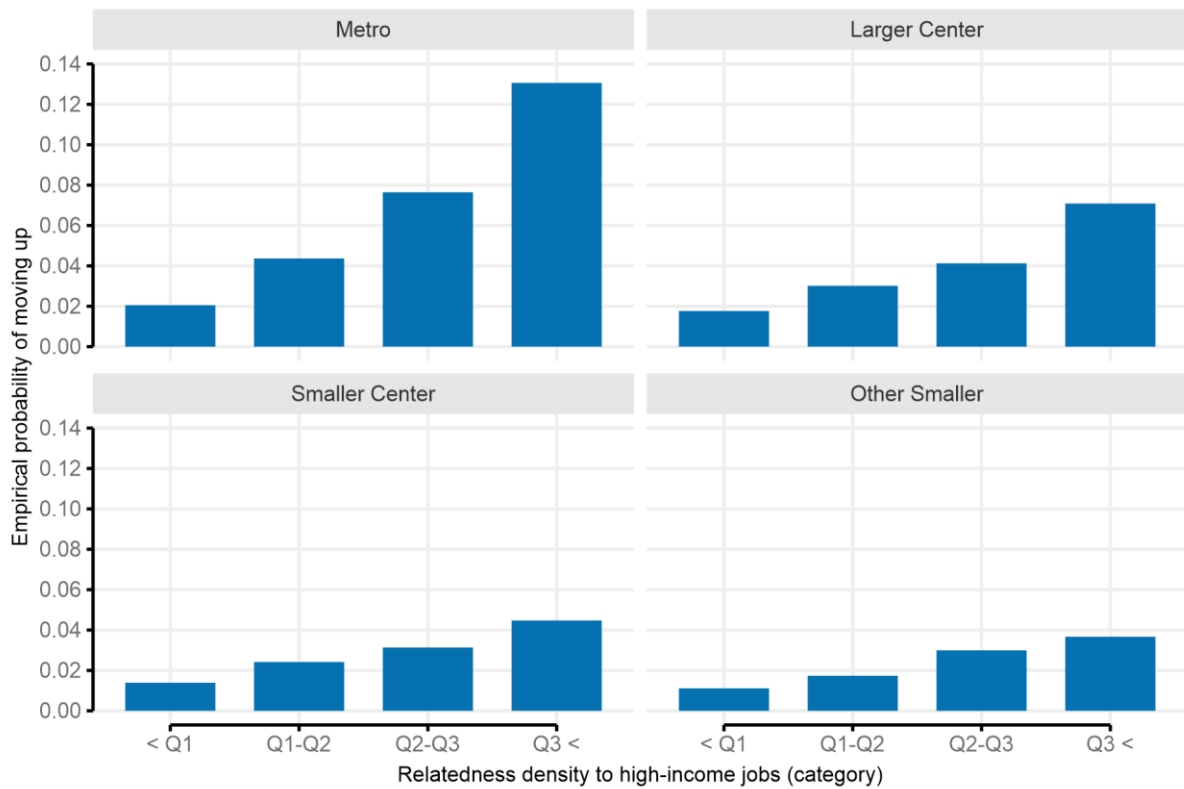


Figure 2. Empirical probability of switching to high income job by region type.

We find, first, that the observed pattern of higher propensity for upward wage mobility in higher bins of relatedness density to high-income jobs prevails across all region types. Second, we find that the boost from relatedness density to the propensity to move to better-paid jobs increases more sharply with moving up in the spatial hierarchy. That is, moving from the lowest to highest bin in relatedness density to high-income jobs, the probability of wage mobility increases from 1 to 4% in the smallest labour market regions, while it increases from 2% to 13% in metro regions. This indicates that there is an urban premium in the benefits of relatedness density to high-income jobs, partially due to the already higher network density in metro regions. However, as evidenced previously by *Figure 1*, the unique feature of metro regions is in having higher relatedness density at the upper end of the distribution, while also having jobs with low-levels of relatedness density. Hence, we find in *Figure 2* that all region types have similar probability for wage mobility in the lowest bin of relatedness density (1-2%). This also indicates a much larger heterogeneity in the probabilities of upward mobility in a metropolitan setting, and that the local opportunities for jobs with few other skill-related jobs present are indeed scarce in a thicker labour market as well.

While this set of evidence offers important initial insights to the significance of relatedness density to high-income jobs in an economic sense, it is limited to a bivariate association. Additionally, we aim to understand how gradual structural change in local labour markets creates opportunities and restrictions for workers to escape low-wage jobs. For these reasons we now turn to more sophisticated tools of analysis.

#### 4.2. Regression results

Table 3 presents the main regression results. We first test whether relatedness density to high-income jobs (*HI.RD*) influence job-mobility in general (*Model 1*), to discern whether higher density relates to potential mobility to better paid jobs through simply boosting job-mobility as such. Then in our main model (*Model 2*) we assess whether high-income relatedness density is positively related to upward mobility before running some robustness checks (*Models 3 to 5*). Odds-ratios are reported which implies that estimates exceeding 1 indicates a positive association with the likelihood of mobility, while an estimate below 1 is associated with a lower likelihood.

Table 3. Fixed effect logistic regression models on the within-regional career-mobility of low-wage workers 2006-2012.

LHS (sample)	(1) Job change (all LW)	(2) Into top 2 (all LW)	(3) Into top 2 (new workplace)	(4) Into top 3 (LW1-2)	(5) >60% median (<60% of median wage)
<i>HI.RD</i> <sub><i>t</i>-1</sub>	0.064*** (-91.27)	1.175*** (2.71)	6.123*** (17.14)	1.302*** (2.95)	8.084*** (32.03)
<i>AGE</i>	1.005*** (7.58)	1.120*** (77.08)	1.018*** (5.20)	1.168*** (86.06)	1.041*** (21.48)
ln <i>INCOME</i> <sub><i>t</i>-1</sub>	0.636*** (-141.85)	0.959*** (-6.76)	1.055*** (4.84)	1.061*** (8.54)	3.650*** (151.08)
ln <i>POPDENS</i> <sub><i>t</i>-1</sub>	1.427*** (59.26)	1.231*** (17.42)	0.982 (-0.63)	1.200*** (12.27)	1.067*** (4.53)
ln <i>JOBSIZE</i> <sub><i>t</i>-1</sub>	0.827*** (-216.23)	0.896*** (-54.49)	0.941*** (-18.79)	0.878*** (-54.44)	1.000 (0.03)
Year FE	YES	YES	YES	YES	YES
Person FE	YES	YES	YES	YES	YES
<i>N</i> (worker-year)	6623051	1987257	227290	1510055	882825
<i>N</i> (worker)	1357247	524938	94138	419385	308915
<i>LL</i>	-2284909	-550939	-70272	-407599	-268489

Notes: odds ratios; t-statistics in parentheses; \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

To start with, all control variables show expected signs. Higher age (*AGE*) is positively correlated with mobility, and upward mobility in particular, irrespective how upward mobility is defined. Relative high-income earners (*INCOME*) within the low-wage jobs are less likely to change job, but if they do so it tends to be by leaving a low-wage job for jobs in the higher income groups. Thus, when the internal career-options within a job diminishes, there is a bumping-up effect among the more highly paid (and presumably better achieving and perhaps ambitious) workers. In terms of the regional variables, population density (*POP DENS*) is strongly associated with mobility, both in general and upwards in the wage distribution. This is expected given the diversity of job opportunities that generally is associated with population density. On the other hand, the size of the particular job in the region (*JOBSIZE*) mitigate job mobility as expected given the greater likelihood of finding new employment opportunities within the same job in regions with a larger local job market.

Turning to the main variable of interest in this paper, our findings suggest that increasing relatedness density of high-income jobs mitigate the general job mobility of the low-wage workers (*Model 1*). However, an increasing density of higher-paid jobs increases the likelihood of moving upwards in the wage-distribution (*Model 2*). Altogether, this implies that although the opportunities of finding a related higher-paid job in the region increases, the viable opportunities for workers seem to be other low-wage jobs. Nevertheless, although reducing the likelihood of mobility *per se*, such mobility tends to increase the likelihood of escaping low-wage employment as it presumably offers fewer but better quality channels of mobility. Thus, the outcomes of *Models 1-2* by and large confirm that if the structural change in a region entails a branching process into more highly-paid related jobs, then the likelihood for workers in low-wage jobs to advance also increases. However, different mechanisms might influence this. To provide more detailed assessments on exactly how high-income relatedness density influences upward job mobility several further estimations has been performed as sensitivity analyses.

#### *4.3. Sensitivity analysis*

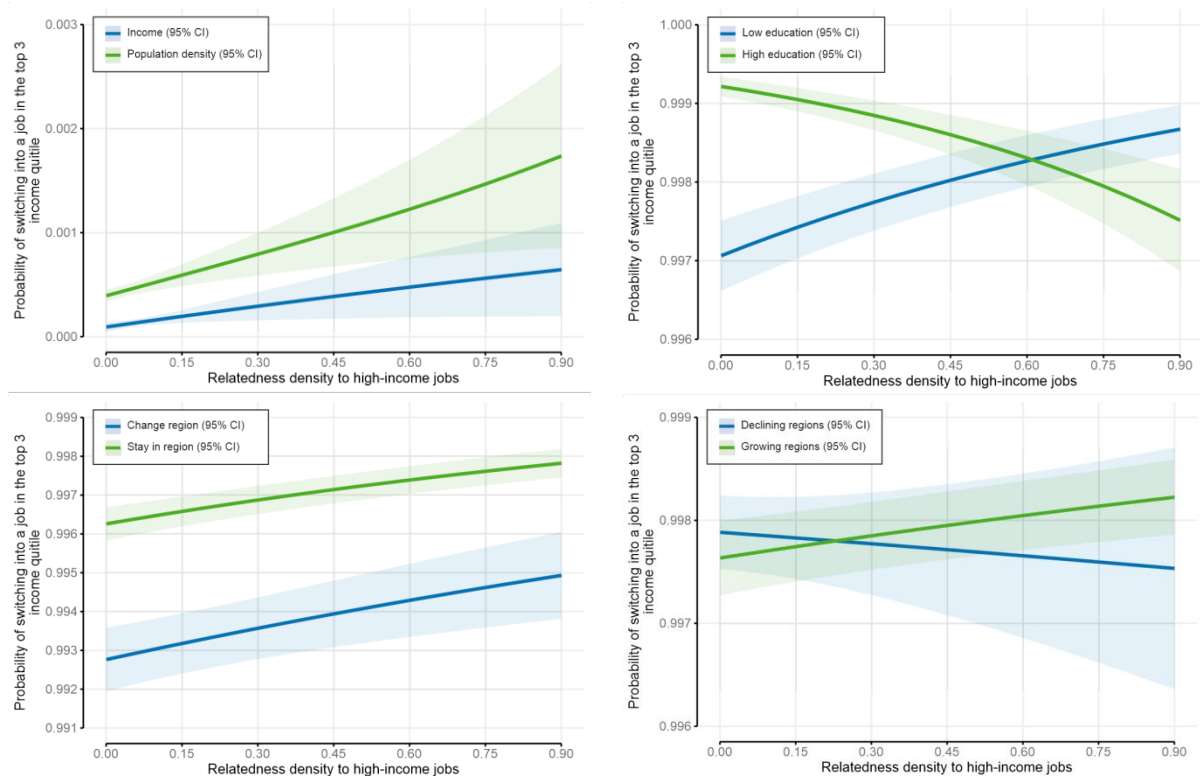
*Models 3 to 5* estimate different sub-samples based on different forms of mobility. According to *Model 3*, that only includes workers that also switch workplace, we see that the odds ratio

increases significantly for high-income relatedness density. Thus, rather than making an internal career, relatedness density increase the likelihood of upgrading by switching workplace. As compared to *Model 1* and *2*, this also indicates that relatedness density increase the quality of workplace mobility.

Moreover, these are general findings, based on the median income of each job even though low-wage jobs are usually defined as the income a worker receives in relation to the national median (*i.e.*, less than 60% of the median wage). To test whether these findings are driven by how we defined low-wage jobs, we tested changing the low-wage category to include only the bottom two quintiles and estimated the likelihood of changing jobs into the top three (*Model 4*). Although having a slightly lower estimate due to the definition of *HI.RD* based on relatedness in the two highest income categories, it is still positively correlated with the likelihood of escaping low-wage employment. This indicates that this channel of upward mobility also works for the workers in the lowest-paid jobs. Finally, since our categorization of low-wage workers is job-based, and therefore somewhat different to the recurring definition of low-wage workers (*e.g.*, *Vacas-Soriano 2018*), in *Model 5* we focus only on the workers earning less than 60% of the national median income from work any given year. When estimating the likelihood of moving from this traditional low-wage category to the group with incomes above 60% of the median, we also find a strong positive association of relatedness density on the likelihood of escaping low-wage work.

Furthermore, since we know that certain groups like immigrants, women and low-educated are more inclined to obtain low-wage jobs and also perhaps lack the necessary recourses to escape such employment, we have made a number of additional interaction models to assess whether the impact of relatedness density is significantly different across sub-groups of the workforce. While the interaction of relatedness density and women and immigrants, respectively, were not significant, *Figure 3* shows that relative high-income earners in low-wage jobs are more likely to escape such jobs, and more so when relatedness density increases. This is even more evident concerning population density as the general positive association between population density and escaping low-wage employment increases as more related high-income jobs are introduced in the region. Thus, a key-channel for career advancements of low-wage earners in larger and more densely populated regions is not density as such but that it can open career-paths to related jobs with higher income in the region. In this way we can detail the general mechanisms of metropolitan labour markets

discussed in previous studies (e.g. *Alabdulkareem et al., 2018; Moro et al., 2021*). Moreover, increasing relatedness density is mainly increasing the probability for low-educated workers to escape such employment, signalling that for workers with less generic human capital a skill-related career path might be a crucial resource. To also control for the fact that we reduced the sample to only include workers remaining in the region, we included all workers and interacted relatedness density with a dummy variable = 1 if the worker left for another region. Naturally, stayers benefit more from an increasing relatedness density compared with migrants that leave the region to find a job elsewhere.



*Figure 3.* Marginal effects on probability of positive outcome (moving into top 3) assuming that the fixed-effect is zero when interacting *HI.RD* with respective variable. Marginal effects and 95% confidence intervals.

Finally, structural job changes that increase relatedness density could be identified in both declining and growing labour markets, depending on the type of jobs that exit or enter the region (see *Hane-Weijman et al., 2021*). Therefore, we split the sample into two groups: one that had more jobs in 2012 compared to 2005 and one that had the same or fewer jobs. As noted from the figure, increasing relatedness density is particularly beneficial if also coupled with an increasing number of jobs compared to regions that decline but still become more

cohesive. Thus, growing labour markets that also branch into more highly-paid related jobs offer better career opportunities for low-wage workers.

## 5. Conclusions

The aim of this paper was to provide empirical evidence on the role of local labour market structure in enabling or constraining workers in escaping low-wage jobs. This was accomplished by drawing on a uniquely detailed individual-level panel dataset provided by Statistics Sweden, from which we could construct skill-relatedness networks for 72 functional labour market regions in Sweden, based on above-expected labour flows between jobs (combinations of industries and occupations) for 2002-2005. Fixed-effect panel regressions were then estimated on job changes of low-wage workers throughout 2005-2012.

Our main findings indicate that as regional economies evolve, structural change that entails more high-income jobs that are also related to existing jobs in the region increase the likelihood for low-wage workers to escape low-wage jobs. Our findings suggest that relatedness density forecloses general job changes, in particular if the local internal job market is large, but it opens up career-advancing trajectories if the high-income jobs require skills that overlap with those of low-wage jobs for the workers that can realize this potential. Thus, by this finding we both contribute to the low-wage literature by going beyond strict individual-specific explanations and instead quantifying the regional demand structure in terms of jobs and industries (*c.f. Avent-Holt et al., 2020*), as well as to the regional literature by showing that the direction of structural change (regional branching) has clear implications on the future labour market trajectories of low-wage workers, as conjectured by *MacKinnon (2017)*.

Moreover, given the role of the regional opportunity-structure, there is no spatially uniform way in which the career-advancement of low-wage workers can be facilitated. As shown by our descriptive evidence, there is an urban premium in the benefits of relatedness density, partially due to the already higher network density in metro regions. However, metro regions tend to have higher relatedness density at the upper end of the distribution, while also having jobs with low levels of relatedness density. This indicates a much larger heterogeneity in the probabilities of upward mobility in a metropolitan setting and that the local opportunities indeed are scarce also in thicker labour market. This advances previous accounts mainly



stressing that the thickness of urban labour markets in comparison to more rural labour markets promote career-advancement (*Puga, 2010; Culliney, 2017; Grimes et al., 2019*). On the contrary, we need to go beyond an urban-rural dichotomy and must understand the structure of the regional labour markets with respect to the type of jobs and connections between them. This is because the presence of skill-related jobs is a factor through which thick labour markets may increase the likelihood of escaping low-wage work. This is exemplified by the interaction between relatedness density and population density where the role of relatedness increases the denser the population is in a region.

Finally, our sensitivity analyses reveal some divergent patterns. While the role of relatedness does not seem to vary much between different groups of workers (men/women, Nordics/visible minorities), low-educated workers (not having a university degree) seem to benefit more from the presence of these career-advancing channels compared to more highly educated workers. Most importantly, increasing relatedness density seems to play a greater role in expanding labour markets as compared with contracting ones, thus not providing a counter-acting source of transformative potential in lagging-behind regions.

Taken together, these findings have clear policy implications. The current Smart Specialization agenda in the EU, for example, emphasises that regional economies should upgrade and diversify around core competencies. Our findings suggest that when such upgrading is firmly connected to also low-wage work in the region, this also increases the potential for upgrading within the existing pool of labour. This can be contrasted to any type of STEM-related upgrade which, if not aligned with existing capabilities, could imply greater adjustment costs for the region and for the workers in unrelated activities in particular. If there is a potential for low-wage workers to find higher-paid jobs in the process of structural change without re-skilling this will (1) make it easier to meet current labour market realignments, and (2) also be at par with Smart Specialization initiatives that seldom consider the labour market (*c.f. Hane-Weijman et al., 2021*), and (3) hopefully contribute to reducing inequalities. This opens some room for place-based policy even in lagging regions in which both job creation in general and skill-based links between jobs, occupations and industries should be the focus to assist more vulnerable groups of workers to manage labour market realignments.

The primary limitation of the present investigation lies with its use of labour flow to establish skill-relatedness between jobs. From a technical perspective this may create problems of endogeneity when exploring job transitions on the bases of it. In order to mitigate this issue, we separated the periods of network construction and analysis in the paper. Ideally, one would use some external bases to establish skill-relatedness, such as the \*ONET database in the US. However, such survey-based methods also come with drawbacks, as these tend to represent skill-requirements of employers. In contrast, skill-relatedness on the bases of labour flows tends to capture a broader set of job-related characteristics through the revealed behavior of workers, and is deployed frequently to assess diversification both at the regional and the firm level (*Neffke & Henning, 2013; Neffke et al., 2018*). Additionally, existing survey-based skill data, to our knowledge, is not available at the resolution of jobs that we investigate in this paper. Finally, we are studying the transition of workers between job categories based on wages. While the skill-relatedness network is somewhat assortative to wages, this is by no means dominating, while skill-relatedness networks in general tend to not be influenced by wage categories (*Neffke et al., 2017*).

In a broader sense, the present analysis, by design, is geared towards exploring skill-related options for regions to unlock better-paid jobs for workers, and as such it does not take up on the role of unrelated diversification in escaping low-wage jobs. We perceive this as a critical question that goes beyond the confines of this paper, and should be taken up in future research. Unrelated diversification, and the different types of agents that induce it, are high on the agenda of research in evolutionary economic geography (*Boschma 2017*). Recent studies indicate that new establishments by entrepreneurs (*Neffke et al., 2018*) and foreign-owned firms (*Elekes et al., 2019*) tend to create employment in more unrelated economic activities. It is unclear however whether and how these instances of unrelated diversification create career opportunities for workers in general, and escaping low-wage jobs in particular. The role of pioneer workers, making more unrelated jumps, represents an additional layer to this line of questioning as local labour markets likely hold heterogeneous capacities in enabling such transitions.

Notwithstanding these limitations and open questions, we argue that the findings put forward in this paper offer hitherto lacking, high-resolution insight to the evolution of local labour markets, and how it creates economic opportunities and constraints for workers.

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## Appendix

*Table A1.* Examples of high and low relatedness density to high income jobs.

Job (industry × occupation)	HI. RD
<b>Stockholm</b>	
65.242: Legal professionals in Insurance, reinsurance and pension funding, except compulsory social security	0.9451
92.213: Computing professionals in Gambling and betting activities	0.8675
92.123: Other specialist managers in Gambling and betting activities	0.8360
62.121: Directors and chief executives in Computer programming, consultancy and related activities	0.7969
64.121: Directors and chief executives in Financial service activities, except insurance and pension funding	0.7929
...	...
43.611: Market gardeners and crop growers in Specialised construction activities	0.0429
01.513: Personal care and related workers in Crop and animal production, hunting and related service activities	0.0423
96.932: Manufacturing labourers in Other personal service activities	0.0306
78.912: Helpers and cleaners in Employment activities	0.0281
85.513: Personal care and related workers in Education	0.0123
<b>Umeå</b>	
86.221: Life science professionals in Human health activities	0.3896
72.122: Production and operations managers in Scientific research and development	0.3414
86.211: Physicists, chemists and related professional in Human health activities	0.3272
85.231: College, university and higher education teaching professionals in Education	0.2939
72.221: Life science professionals in Scientific research and development	0.2926
...	...
01.513: Personal care and related workers in Crop and animal production, hunting and related service activities	0.0078
84.912: Helpers and cleaners in Public administration and defence; compulsory social security	0.0068
96.522: Shop and stall salespersons and demonstrators in Other personal service activities	0.0066
01.913: Helpers in restaurants in Crop and animal production, hunting and related service activities	0.0019
96.412: Numerical clerks in Other personal service activities	0.0012
<b>Åsele</b>	
35.131: Managers of small enterprises in Electricity, gas, steam and air conditioning supply	0.2467
31.131: Managers of small enterprises in Manufacture of furniture	0.1462
41.131: Managers of small enterprises in Construction of buildings	0.1368
84.248: Administrative professionals of special-interest organisations in Public administration and defence; compulsory social security	0.1352
49.131: Managers of small enterprises in Land transport and transport via pipelines	0.1335
...	...
47.513: Personal care and related workers in Other retail sale of new goods in specialised stores	0.0027
10.522: Shop and stall salespersons and demonstrators in Manufacture of food products	0.0027
47.912: Helpers and cleaners in Other retail sale of new goods in specialised stores	0.0023
82.422: Client information clerks in Office administrative, office support and other business support activities	0.0017
78.419: Other office clerks in Employment activities	0.0004

*Note:* the table indicates jobs for each example region, having the highest and lowest nonzero relatedness density to high income jobs in 2006. 3 out of 883 LQ > 1 jobs had 0 such relatedness density in Stockholm, 1 out of 473 in Umeå, and 9 out of 177 in Åsele.