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Escaping from low-wage employment: The role of co-worker networks

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ABSTRACT

Low-wage jobs are often regarded as dead ends in the labour market careers of young people. Previous research focused on disentangling to what degree the association between a low-wage job at the start of working life and limited chances of transitioning to better-paid employment is causal or spurious. Less attention has been paid to the factors that may facilitate the upward wage mobility of low-wage workers. We focus on such mechanisms, and we scrutinize the impact of social ties to higher-educated co-workers. Due to knowledge spillovers, job referrals, as well as firm-level productivity gains, having higher-educated co-workers may improve an individual's chances of transitioning to a better-paid job. We use linked employer-employee data from longitudinal Swedish registers and panel data models that incorporate measures of low-wage workers' social ties to higher-educated co-workers. Our results confirm that having social ties to higher-educated co-workers increases individual chances of transitioning to better-paid employment.

1. Background

Low-wage employment has become common on the European labour markets (Lucifora et al., 2005), raising concerns about job quality and long-term career opportunities of younger generations (Kalleberg, 2020). The literature takes different perspectives on the long-term consequences of low-wage employment. Some studies stress that as compared to prolonged unemployment, low-wage employment provides disadvantaged workers with an opportunity to avoid human capital depreciation, and thus creates chances for moving to a better-paid employment in the future (Fok et al., 2015; Pavlopoulos & Fouarge, 2010). In addition, compared with unemployment, "bad jobs" may still have less negative signalling value to future employers and thus may facilitate job search (Gebel, 2013). In the labour market segmentation literature, low-wage employment is however often regarded as a dead-end due to its persistence across working lives (Bills et al., 2017; Piore & Doeringer, 1971).

Previous research, especially in economics, has made a lot of effort to disentangling to what degree the persistence of low-wage employment is causal or spurious and driven by the unobserved characteristics of workers (Cai et al., 2018; Clark & Kanellopoulos, 2013; Fok et al., 2015). However, the role that low-wage jobs play for individual careers

depends not only on characteristics of workers, but also on the socio-economic context, in which these jobs are embedded (Campbell, 2012; Schultz, 2019). The aim of this paper is to develop the discussion on how upward wage-mobility can be facilitated by explicitly identifying the workplace-specific social environments that fosters transitions from low-wage to better-paid employment. The first goal in this paper is to estimate the total effect of social ties with higher educated co-workers on the upward pay mobility for workers who start their career in low-earnings jobs. The second goal is to explore potential mediating factors, namely (1) knowledge spillovers, (2) increasing firm productivity, (3) peer pressure and (4) support in finding higher-paid jobs. Thus, in this paper we ask the following research questions: What are the effects of social ties with highly educated co-workers on upward pay mobility? Which potential mechanisms may drive these effects?

Our study makes several contributions to address the possibilities for upward wage mobility. We outline the theoretical underpinnings and provide empirical evidence on the role of social ties to higher-educated co-workers for upward wage mobility. Using longitudinal matched employer-employee data from Swedish registers, we identify a group of individuals who started their labour market careers in low-wage employment, and we follow them over the course of their careers. Our choice to focus on workers starting a career in low-wage jobs is

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consistent with our theoretical considerations. Based on segmentation literature, we are concerned about further opportunities of workers who start their careers with "bad jobs" (Kalleberg, 2020). Following "entry port" hypothesis (Boschman et al., 2021; Knabe & Plum, 2013; Latner & Saks, 2022; Scherer, 2004), our paper challenges the idea that low-wage employment always means a "bad start". We then assess whether having ties to higher-educated co-workers increases the likelihood that these workers would transition to better-paid employment. Taking advantage of linked employee-employer data, we also explore the potential mechanisms that drive these effects. Recent studies on economic inequalities has stressed the need to scrutinize how firms shape labour market inequalities, emphasizing that the share of earnings inequality that is generated between workplaces is growing in high-income countries (Barth et al., 2016; Tomaskovic-Devey et al., 2020). However, to the best of our knowledge, this is the first study, which incorporates the insights from this literature to study the mechanisms shaping the upward wage mobility of low-wage workers.

Moreover, we take advantage of methodological innovations to capture the social ties developed at firms. Previous studies focused on co-worker networks tended to assume that all co-workers within firms know each other (Hensvik & Skans, 2016). However, employees tend to bond with co-workers who resemble them and social proximity within firm-specific social networks has important implications for the processes of sharing knowledge and learning within organizations (Aven & Zhang, 2016; Fernandez et al., 2000; Kmec & Trimble, 2009). Employees who are very different from their co-workers may find it more difficult to participate in team learning or to build mentoring relations with other employees. Hence, social proximity between low-wage workers and their peers in other workforce segments should be considered when assessing the role that social ties play for chances of upward wage mobility. This study focuses on the role of having better-educated workplace peers by reconstructing co-worker networks within workplaces using recently developed methods for longitudinal matched employer-employee data (Lengyel & Eriksson, 2017), which improves upon existing attempts to infer co-worker social connections from administrative data. In particular, the method relies on probabilistic tie weight assignment, whereby the formation of a social tie between two co-workers depends on their social proximity, hence considering the importance of homophily in the processes of social network formation. With this method, our study provides hitherto scarce systematic evidence with a longitudinal and nationwide coverage of establishments on how workplace social ties may create or foreclose opportunities for low-wage workers.

2. Theoretical insights

Research on the long-term consequences of "bad jobs" for labour market careers builds on two main theoretical perspectives. Segmentation theory points to the mechanisms that make such employment a "trap" (Bills et al., 2017; Piore & Doeringer, 1971). According to this literature, precarious employment brings not only immediate implications for individual incomes and working conditions; it is also related to poor prospects for workers' future. Jobs in the secondary labour market segment offer limited job autonomy, training opportunities and chances for a promotion, and high levels of insecurity. As accumulating tenure and work experience in the secondary segment does not augment workers' skills, their ability to move from the secondary to the primary labour market segment remains restricted, leading to entrapment effects. This raises concerns about opportunities of workers who start their careers with "bad jobs" (Kalleberg, 2020).

Another perspective, often referred to in the literature as "entry port" or "stepping-stone" hypothesis or "integration scenario" (Boschman et al., 2021; Knabe & Plum, 2013; Latner & Saks, 2022; Scherer, 2004), emphasizes that "bad jobs", while bringing some economic disadvantage in the short run, may constitute a route out of unemployment in the long term. While joblessness leads to human capital deterioration (Pissarides,

1992), involvement in paid work – even if low-paid – may nevertheless function as an entry port into stable and better-paid employment, since it provides labour market entrants with opportunities to gain work experience. Furthermore, access to paid work gives opportunities to enter social networks that may improve their chances of finding a better-paid job in future.

Instead of viewing these two theoretical perspectives as competing or contradictory, we propose to see them as alternative explanations that may be relevant depending on the context, and specifically, conditional on the firm-specific social environment. Thus, instead of asking *whether* low-wage jobs are traps or stepping-stones, we examine theoretically and empirically *when* transitions form low-wage to better-paid jobs are more likely. Specifically, this study contributes to the ongoing debates on how firms shape economic inequalities (Avent-Holt et al., 2019), by looking at the role of co-worker networks. This study also relates to the recent reviews of the literature pointing to the need of considering heterogeneous effects of "bad jobs" (Latner & Saks, 2022).

Sociological research has long recognized that social networks are crucial for labour market success (Granovetter, 1995; Lin, 1999), as they are important structural factors that provide access to social resources that are critical to careers (Vacchiano et al., 2022). Social relations between co-workers play an important role for the transfer of knowledge within organizations (Aven & Zhang, 2016). As co-workers tend to share their knowledge and experiences, due to knowledge spillovers low-wage workers are more likely to acquire new skills, thereby improving their opportunities for upward wage mobility. Knowledge spillovers can be understood as the effects of social interactions between co-workers that may occur both within and across the boundaries of occupations or job levels. Note that knowledge spillovers refer to all types of knowledge that co-workers can learn from each other, building up skills or competences, they are not restricted to formal knowledge or on-the-job experience. Higher educated workers tend to have more skills and broader knowledge that to a greater extent tend to be codified and therefore transferable. Moreover, since they had spent more time in the education system than workers with lower education attainment, they also had more exposure to pedagogic approaches and hence might be on average better at explaining and training others. From this perspective, having tertiary educated co-workers may be seen as the key organizational resource, which fosters upward wage mobility of low-wage workers. We thus formulate *Hypothesis 1: social ties to higher-educated co-workers increase chances of making transition to better paid jobs among low-wage workers.* This hypothesis can be only tested indirectly, by eliminating other potential explanations (elaborated on below).

The access to tertiary educated co-workers may improve opportunities for upward wage mobility also via channels other than knowledge spillovers. First, as the content of skills matters for the performance of the whole organization (Edmondson, 2002; Neffke, 2019), the enhanced economic performance of firms should be reflected in a faster wage growth, which benefits the whole workforce, including the low-wage workers. Following this idea, we propose *Hypothesis 2: the wage benefits from social ties to higher-educated co-workers among low-wage workers occur due to the mediating effects of the firm-level wage growth.*

Upward wage mobility may be also facilitated by the peer pressure. Having high educated co-workers may act as an incentive for workers to increase their efforts, which could, in turn, lead to decreases in productivity differentials and wage inequalities, raising the earnings of low-wage workers in the long run (Cornelissen et al., 2017). Against this background, we formulate *Hypothesis 3: the wage benefits from social ties to higher-educated co-workers among low-wage workers occur due to reductions in firm-level wage inequality.*

Finally, low-wage workers who are employed at firms with better-educated peers may be more advantaged because co-workers help each other find jobs within and outside of their workplaces (Granovetter, 1995; Ioannides & Datcher Loury, 2004), and having higher-status personal contacts improves chances of obtaining higher-quality jobs (Lin, 1999). We thus formulate *Hypothesis 4: the wage*

benefits from social ties to higher-educated co-workers among low-wage workers are explained by improved opportunities of moving to a better-paid job in another firm.

3. Previous empirical research

Previous research on how firm-specific social environment affects upward mobility of low-wage workers has been scarce. Mosthaf et al. (2010) examined the role of the composition of the firm's workforce. Their results indicated that a company with a high share of low-wage earners constitutes an environment in which it is more difficult to make the transition to a better-paid job. These findings suggest that the composition of an individual's co-workers may play a role in upward wage mobility. Studies that are somewhat less closely related to ours present evidence on how firm-specific social networks shape a broad range of labour market outcomes among disadvantaged social groups. For example, Hensvik and Skans (2013) examined how social ties to co-workers affected the job searches of young workers. They showed that youth who had participated in a summer job at a particular firm later had a higher probability than their school peers of securing a stable job at that firm. Eliason et al. (2019) found that social connections played a large role in hiring for smaller, younger, and less productive firms. De Grip and Sauermann (2012) provided evidence on knowledge transfers resulting from interactions between trained and untrained workers. Mellander et al. (2017) showed that for workers in low-skilled occupations, employment in a workplace with a substantial share of highly-skilled workers is strongly positively associated with income. It appears, however, that the wage benefits of having highly-skilled peers are restricted to low-skilled occupational groups. Yu (2013) found that having many co-workers with non-standard employment contracts is negatively related to wages, as well as to perceived chances of promotion. Overall, these studies suggest that the composition of peers in the workplace and of co-worker networks may have important consequences for workers' chances of finding a job, and for their level of income. Nevertheless, more research is needed to gain a better understanding of how social ties in a workplace can foster the careers of low-wage workers (Bolvig, 2005; Schultz, 2019).

4. Research design

We use longitudinal matched employer-employee data from Swedish registers. These data combine education registers, income tax registers, and social security registers, and use personal identity numbers and firm identity numbers to link individuals with their employers within and across registers. Our data provide annual information on incomes from employment, as well as study loans and scholarships, self-employment, parental leave benefits, and cash benefits for the unemployed and the poor. This data is comprehensive because according to legal regulations, filling a tax declaration is obligatory for all adult residents living in Sweden, whose annual income exceeds 20 thous. SEK (about 2000 EUR). Because this threshold is higher than the equivalent of a monthly salary in the lowest-paid occupations in Sweden, we believe our data capture all low-wage workers who are officially employed. Income tax registers may miss information about earnings of informal workers, but the prevalence of informal work is low in Sweden, as less than 1 % of all dependent employees has no written employment contract with his or her employer (Hazans, 2011).

We select cohorts born in 1970–75, who can be followed from the onset of the labour market career until ages 40–45; i.e., at the life course stage in which annual income levels tend to stabilize, and can be seen as proxies for lifetime income (Lucifora et al., 2005).[1] The first step in the process of defining our sample is to identify for each individual the first episode of dependent employment. This step is important because most entries into low wage employment in Sweden happens at the very beginning of labour market career (Brydsten & Baranowska-Rataj, 2022).

We identify the first employment spell by using data on labour market status and the identification number of a firm where dependent employment is located. To distinguish first significant jobs from the so-called "summer jobs" or "student jobs", we adopt the following approach. Whenever a first job coincides with income from participation in education in a given calendar year, we select the subsequent year. If in this subsequent year the individual continues to be employed and no longer receives income from education, we define this as the onset of the career. If instead the individual continues to combine work with education, we select the subsequent year. We repeat these steps five times, as the duration of most study programs lasts up to 5 years.

The next step is to define low-wage jobs, defined as jobs in which the earnings are below 60 % of the median earnings in Sweden in a given calendar year. Since income tax registers do not provide information about the hours of work, and instead sum up a worker's earnings on an annual basis as reported to the tax office, we use annual earnings, including all cash compensation paid by employers. However, annual earnings do not reflect the levels of wages for individuals who work part-time, as well as for those who combine paid work with parental leave, or experience unemployment within the same calendar year. At the same time, excluding all observations whenever individuals report income from parental leave or unemployment in the same calendar year as when they report low earnings is too restrictive. Thus, we exclude observations with low earnings when income from such non-labour sources exceeds the equivalent of two median wages (17 % annual median wage) in a given year. Finally, we only use observations where the dependent variable, as defined below, can be observed, hence the data used for the analysis includes n = 240,781 observations.

The dependent variable is defined as a transition from low-wage job into a better paid job, i.e. dependent employment with earnings of 60 % of the median earnings or higher. Each individual whom we observe to start working career with a low wage job, is followed in the subsequent year(s) and the dependent variable indicates whether or not his or her earnings in the next year(s) pass the threshold of 60 % of the median earnings. The sample is restricted to observations when these workers either remain in low-wage employment or become better-paid. We have also carried out additional analyses using multinomial models that instead of a binary outcome include additional outcomes of transitions out of employment as separate categories (Table A4 in Annex 1).

Our key explanatory variable measures social ties to co-workers with university education who are employed at the same workplace (i.e., are working for the same employer and at the same establishment or plant) as any given individual in our sample. While in our data, co-workers are defined as employees at the same workplace, i.e. working for the same firm *and* at the same establishment or plant, the terms "a workplace" and "a firm" are used interchangeably. Because the employer-employee links are available for the 1990–2015 period on a yearly basis, we are able to observe all of the co-workers for our cohorts over the course of their labour market careers. The workers are listed repeatedly with different workplace codes in the same year if they change workplaces over the year.

The reconstruction of social ties among co-workers tends to follow

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[1] Earlier cohorts could not be included in our analysis because the employer-employee links are available in Swedish registers starting from 1990. Most recent cohorts, born after 1975, had to be excluded because the observation window in our data ends in 2015, meaning that we do not observe incomes at age 40–45 for youngest cohorts.

two broad traditions. These connections can be mapped by means of surveys that provide an accurate, high-fidelity representation of the structure of social ties within (Podolny & Baron, 1997), and between organizations (Lőrincz et al., 2020). However, these networks tend to have a limited spatial and organizational scope, and without repeated surveys the changes in co-worker connections cannot be tracked over time. Alternatively, social ties can be derived by means of digital traces of connection and communication patterns (Eagle et al., 2010), online social networks (Chetty et al., 2022), as well as inferred from register-type administrative data (Glitz, 2017). These strategies partially remedy the above shortcomings at the cost of potentially decreased fidelity to actual social connections. In this paper we follow the latter approach and work with administrative data that allows us to infer social ties between co-workers across workplaces of the entire Swedish economy and to include potential changes in these inferred ties over time.

Recently Lengyel and Eriksson (2017) introduced an improvement for inferring social ties between co-workers from administrative data. They proposed a homophily-biased tie prediction approach based on observable individual characteristics and taking into account the size of the workplace. It is well-established that social ties tend to be created between similar individuals (McPherson et al., 2001), while group structure can reinforce this as larger subgroups of similar individuals offer more opportunities for connecting with similar individuals (Currarini et al., 2009). Subsequently they showed that the density of inferred co-worker ties between workplaces explain productivity gains through spillovers at the level of regions, as well as industry-regions in specialized local industry clusters. Hence, in the next step, we reconstruct co-worker networks within workplaces on a yearly basis using the method developed by (Lengyel & Eriksson, 2017). We assign tie weight between co-workers of the same workplace, so that the formation of a social tie between two co-workers depends on the co-workers' similarities in terms of age group, gender, and country of birth.[2] The strength of predicted ties is inversely proportional to the size of the group and the workplace which penalizes predicted tie strength in large workplaces (see Annex A2 for a formal description of the approach).

In the next step we filter for the most likely social ties in workplaces. While there is no straightforward way of doing so our aim was to keep the strongest ties while allowing for isolates (workers with no predicted ties), and allowing for an individual worker working in a larger workplace to have more ties (reflecting more opportunities to socialize). Accordingly we opted to select the strongest 25 % of (i.e., the most likely) social ties that could be created within each workplace. We acknowledge that alternative approaches for ties selection have merits, and so we constructed an alternative network. We consider the 25 strongest ties for each individual to be formed. This does not mean that everyone would get exactly 25 ties, as a strong tie in one individuals

ranking may be a weak one in the others. This approach does not produce isolates, while the number of connections increases with firm size. In addition, we carried out analyses controlling for more detailed categories of firm size and interactions with numbers of social ties. Sensitivity analyses yielded similar results to our main specification and do not suggest that the numbers of social ties pick up the effects of firm size (see Table A6 in Annex).

Finally, we group low-wage workers into categories according to the weighted sum of their predicted social ties to educated co-workers, distinguishing between categories of less than five, 5–9, 10–20, and over 20. We add a category of workers without any social ties to higher educated co-workers, which mostly captures employees at firms in which the whole workforce is low-educated.

Since the first goal in this paper is to examine the total effect of social ties to higher educated co-workers, in the initial step of the analysis we control for factors that may affect both the chances of establishing such ties and the outcome of interest; i.e., the probability of moving to a better-paid job. At this stage of the analysis, we aimed at including confounders in the analysis, but we do not include any variables that can be considered as mediators in order to avoid the overcontrol bias (Cinelli et al., 2021). Specifically, we control for age, sex, and educational attainment. Educational attainment has the following categories: less than primary, primary, lower secondary, upper secondary, university program of up to three years, university program of more than three years, as well as a separate category for missing information. To control for the experience of being a recent graduate from a school or university, we include a dummy variable which takes value one if the level of education attainment in the given calendar year is higher than the level of education attainment in the previous year, and zero otherwise. We distinguish between people born in Sweden, another Nordic country (or as a second-generation immigrant to Sweden), a non-Scandinavian country within Europe, or a country outside of Europe. We control for job tenure, which includes the following categories: one year, two years, three years, and four years or more. Our measure of firm size distinguishes between smaller companies with up to 300 employees and larger firms with 300 or more employees. We control for firm age, distinguishing between start-ups; firms that have been active 1–5 years, 5–10 years, or more than 10 years; and companies that were established before 1986 (the earliest year of observation of firm ageing in Swedish registers). We control for industry using the following categories: manufacturing of foods and beverages; manufacturing of chemicals and machinery; manufacturing related to water, gas, and waste; construction and trade; advanced services; personal services; education and health care; and personal services, leisure, and culture. Finally, dummies for the periods analysed in our data (1990–1995, 1996–2000, and 2001–2005), as well as for the region type (distinguishing between rural and urban functional labour markets), are included in our models to control for differences in economic conditions across time and space. All of these control variables are lagged by one year in the panel setting so that they correspond to the observation of low-wage employment (instead of relating to the year of transition to a better-paid job).

The second goal is to explore potential mediating factors, namely: increasing firm productivity, peer pressure and support in finding higher-paid jobs. Therefore, in the next step, we use variables that capture these potential mediating influences. In order to test the mediating role of increasing productivity, in an additional specification, we include a measure of the average annual firm-level wage growth. To test the role of peer pressure, we include a measure of firm-level wage skewness, as proxied by the ratio of the firm-level median wage to the mean wage. Finally, in order to assess whether upward wage mobility results from improved chances of moving to a better-paid job in another firm (Granovetter, 1995; Ioannides & Datcher Loury, 2004), we include a variable indicating between-firm job changes. By including these variables in the analysis, we can examine whether these factors "explain away" the impact of social ties to higher educated co-workers. Indirect effects are assumed to capture among others the role of knowledge

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[2] We opted not to include education level as a grouping feature as this would introduce a circular reasoning by predicting social ties based on education and then measuring connectedness to co-workers with a specific education level. Since we do not have information on occupations until after the year 2001, we cannot use this information without losing a majority of the years of observation. However, as Lengyel and Eriksson (2017) demonstrated, including further categories in the tie creation, like positions in the different income strata of the workplace, does not affect the likelihood of tie formation. In an alternative specification we added a grouping feature based on tenure at the workplace. An extensive literature on the impact of organizational tenure on newcomer socialization dynamics generally defines being a newcomer as someone with 2–3 years of experience at the organization (Rollag 2004). Based on this, we differentiated between two groups, one with up to three years of tenure at the workplace (newcomers), and one with more than three (non-newcomers). Our data does not provide information on the work history of the co-workers of our target cohort before 1990, and so with this alternative approach we can account for tenure groups starting with 1994. With using this alternative approach for sensitivity analysis, our main findings remain in place.

spillovers. While this is by no means a formal mediation analysis, exploring these potential explanations can be seen as the first step towards a better understanding of the mechanisms through which social ties to higher educated co-workers influence upward wage mobility.

For descriptive purposes, we first estimate linear random effects models that analyse transitions from low-wage to better-paid employment. Linear specification is preferred in this paper because of problems in nonlinear models related to interpreting coefficients and comparing them across model specifications (Breen et al., 2018). In the second step, we consider the possibility that the unobserved characteristics of workers may bias the results. Workers with better abilities and stronger motivation may have more opportunities to develop social ties to higher-educated co-workers. At the same time, these individual characteristics may affect upward wage mobility. Therefore, we run linear fixed effects models that control for such unobservable factors. While we cannot rule out all possible sources of confounding, our aim is to use methods that provide better insights on the causal effects, to the degree that it is possible in observational studies (Hernán, 2018). Fixed effects panel data models allow us to compare how changes in the degree of connectedness to higher-educated co-workers relate to transitions to better-paid employment by exploiting variation in social ties to higher-educated workers over time within individual careers. This variation comes from two main potential sources. First, the distribution of workers in the firm changes across the three dimensions: age, gender, and region of origin. This distribution is, in turn, driven by employee turnover (increasing or decreasing employment in the workplace and the mobility of the focal worker and co-workers). Second, an individual with a predicted tie within a workplace may obtain a higher level of education. While the nature of the network in the former case changes depending on who leaves or enters the workplace, the latter will increase the number of potential ties. By stressing the within-variation instead of comparing different low-wage workers, our fixed effects models consider these different transitions when analysing how changes in the number of social ties over time change chances of getting a better-paid job.

While standard fixed effects models control for individual-level unobserved heterogeneity, they still do not control for the non-random sorting of individuals into firms that provide better career opportunities. In the sensitivity analysis we explore how social ties to higher-educated co-workers affect upward wage mobility net of sorting. We estimate models that incorporate fixed effects for firm-worker matches (Abowd et al., 1999; Andrews et al., 2002), also known as spell fixed effects (hereafter: spell FE) models. This approach exploits the variation in individual employees' social ties to higher-educated workers, which stems only from changes in the number of ties within the same firm. In other words, we no longer use the variation in access to educated co-worker networks that stems from changing employers and from moving from one firm to another during an individual's career. Instead, this analysis is restricted to variation in access to educated co-worker networks that stems from changes in the number of higher-educated co-workers at a firm, based on the entries and exits of these co-workers from the firm. The basic version of such a modelling approach assumes that the exits and entries of higher-educated co--workers have opposing signs (Allison, 2019). The entries of new co-workers are expected to increase the upward wage mobility of their peers, and the exits are expected to decrease it. We instead use a more flexible version of this approach that separately assesses these two sources of variation in the number of ties.

Note that in random effects models we include the time constant variables: gender and the country of origin directly. In fixed effects models, the time invariant characteristics are indirectly controlled for, as estimations of these models removes the impact of all the time constant factors on the dependent variable.

Fixed effects models have a number of advantages, but they also have well-known limitations. First, the estimates can be only given causal interpretation if there is no unmeasured confounding due to time-varying characteristics that affect both the probability of being a low-wage worker and the chances of transition into better paid jobs. Second, while fixed effects models handle unmeasured confounding due to time constant factors, they are still prone to reverse causality. Third, fixed effects models have lower statistical power and can be more sensitive to measurement error than random effects models because they use fewer cases to estimate coefficients and the coefficients only represent within-individual changes over time. Fixed effects models also have limitations in terms of external validity, i.e., the generalizability of the estimation results, because they solely identify effects based on within-individual changes, whereas random effects models consider between-individual variation.

5. Empirical findings

We start by presenting the descriptive evidence on upward wage mobility of low-wage workers according to numbers of ties to higher-educated co-workers. As shown on Fig. 1, the likelihood of moving to a better-paid job within a year is higher among the low-wage workers with higher numbers of such ties. For instance, while among low-wage workers with only 1–4 ties to higher educated co-workers this proportion amounts to 41 %, in the group with more than 20 ties the proportion of moving to better-paid employment is almost 60 % Fig. 1.

Moving on to multivariate analyses, in the first step, we use random effects models to examine whether ties to higher-educated co-workers are associated with higher chances of transitions to better-paid employment (Model 1 in Table 1). The results confirm that low-wage workers are more likely to transition to a better-paid job when they operate in a workplace with higher-educated peers. Specifically, we observe that compared to the reference category of low-wage workers with 1–4 ties, workers with no ties have a four percentage point lower probability of transitioning to a higher-paying job. Compared to the reference category, low-wage workers with 5–9 ties have a five percentage point higher probability of upward wage mobility. For low-wage workers with 10–20 ties and for those with more than 20 ties, the chances of getting a better-paid job are 8 % points and 16 % points higher, respectively.

Next, we present estimates from fixed effects models that control for unobserved characteristics of workers (Model 2 in Table 1). According to our results, a part of the association between social ties to higher-educated co-workers and upward wage mobility observed earlier can be attributed to unobserved heterogeneity, as the key coefficients of interest become smaller in magnitude, especially when it comes to the top category. However, we still observe a positive relationship between social ties to higher-educated workers and upward wage mobility. Workers with no ties have a two percentage point lower probability of
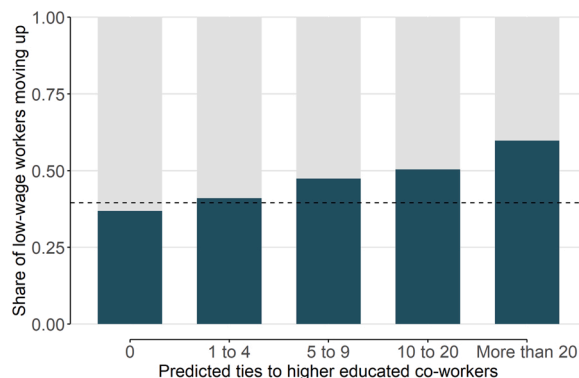

Fig. 1. Proportion of workers who transition from low-wage to better-paid employment according to the within-firm category of predicted ties to higher educated co-workers. *Source:* Swedish register data. *Notes:* the black dashed line indicates the share of low-wage workers moving to better-paid jobs in the overall sample, without differentiating between categories of co-worker ties.

Table 1

The effect of having higher-educated co-workers on the upward wage mobility of low-wage employees – results from panel data models.

	Model 1 RE	Model 2 FE	Model 3 FE + mediators
Age	0.00***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)
Sex: Women	-0.10***		
	(0.00)		
Country of birth (ref. Sweden)	0.00		
Nordic	-0.02***		
	(0.00)		
European	-0.04***		
	(0.00)		
Non-European	-0.08***		
	(0.00)		
Education attainment: Higher	0.09***	0.11***	0.11***
	(0.00)	(0.00)	(0.00)
Recent graduate	-0.09***	-0.10***	-0.10***
	(0.00)	(0.00)	(0.00)
Duration of low-wage employment (ref.1 year)			
2 years	-0.01***	0.17***	0.17***
	(0.00)	(0.00)	(0.00)
3 years	-0.02***	0.29***	0.28***
	(0.00)	(0.00)	(0.00)
4 years or more	-0.06***	0.45***	0.44***
	(0.00)	(0.00)	(0.00)
Firm size: large firm> 300 emp.	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)
Firm age: (ref. start-up)			
1–5 years	0.03***	0.01	0.01
	(0.01)	(0.01)	(0.01)
5–9 years	0.05***	0.02***	0.02***
	(0.01)	(0.01)	(0.01)
Over 10 years	0.05***	0.02**	0.02**
	(0.01)	(0.01)	(0.01)
Established before 1986	-0.17***	-0.10***	-0.08***
	(0.01)	(0.02)	(0.02)
Industry (ref. Manufacturing of beverages)			
Manufacturing of chemicals and machinery	0.12***	0.09***	0.09***
	(0.00)	(0.01)	(0.01)
Manufacturing - water, gas, waste	0.06***	0.03**	0.03***
	(0.01)	(0.01)	(0.01)
Construction	0.00	0.01	0.01*
	(0.00)	(0.00)	(0.00)
Trade	-0.11***	-0.05***	-0.05***
	(0.00)	(0.01)	(0.01)
Advanced services	0.05***	0.04***	0.04***
	(0.00)	(0.01)	(0.01)
Personal services	0.02***	0.03***	0.04***
	(0.00)	(0.01)	(0.01)
Education and health care	-0.05***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Personal services/leisure/culture	-0.10***	-0.04***	-0.04***
	(0.00)	(0.01)	(0.01)
Number of ties to higher-educated co-workers (ref. 1–4)			
Zero ties	-0.04***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)
5–9 ties	0.05***	0.03***	0.03***
	(0.00)	(0.00)	(0.00)
10–20 ties	0.08***	0.05***	0.05***
	(0.01)	(0.01)	(0.01)
More than 20 ties	0.16***	0.07***	0.08***
	(0.01)	(0.01)	(0.01)
Mobility between firms (ref. no mobility)			
Into a low-wage firm			-0.16***
			(0.00)
Into a high-wage firm			-0.03***
			(0.00)
Firm-level wage inequality			-0.01***
			(0.00)
Firm-level wage growth			0.00***

Table 1 (*continued*)

	Model 1 RE	Model 2 FE	Model 3 FE + mediators
			(0.00)
Constant	0.70***	0.63***	0.67***
	(0.02)	(0.02)	(0.02)
Number of persons	240,781	240,781	240,781
Number of person-observations	603,706	603,706	603,706

Notes: standard errors in parentheses. Fixed effects for periods and region types included, results not displayed. The number of ties to higher-educated co-workers is weighted, as explained in Section 3.
Source: Swedish register data.

upward wage mobility than workers with 1–4 ties. Low-wage workers with 10–20 ties and for those with more than 20 ties have a five and seven percentage point, respectively, higher probability of moving to a higher-paying job. This evidence confirms Hypothesis 1 that ties to higher educated co-workers increases chances of making a transition to better paid jobs.

In the next step, we look at the potential mechanisms that drive the effects of having higher-educated peers. In Model 4, in addition to covariates included in the previous models, we include the potential mediators: firm-level wage growth, firm-level wage inequality, and measures of mobility between the firms. We expected that firms with higher-educated workforce may become more productive and have a higher pace of overall wage growth, which should help low-wage workers move to better-paid employment. Our results show that, indeed, firm-level wage growth increases the chances of upward wage mobility, but that the effect is rather small, and does not "explain away" the relationship between social ties to higher-educated co-workers and the chances of transitioning to a better-paid job. Thus, we reject Hypothesis 2 stating that the wage benefits from access to tertiary educated co-workers among low-wage workers occur due to the mediating effects of the firm-level wage growth. Our findings further indicate that firm-level wage inequality has a negative but rather weak effect on upward wage mobility. We therefore reject Hypothesis 3 that the wage benefits from access to tertiary educated co-workers among low-wage workers occur due to the mediating effects of the firm-level inequality. We also scrutinize another potential channel related to between-firm transitions. Low-wage workers who move to a different firm, and specifically to a firm with a lower overall level of wages, are less likely to transition to a better-paid job. Contrary to what we expected, we do not find a positive effect of moving to a firm which overall pays higher wages. Overall, this factor does not "explain away" the relationship that we observe, as the estimates for regression coefficients in Models 3 and 4 are quite similar. We thus reject Hypothesis 4 that the wage benefits from access to tertiary educated co-workers among low-wage workers are explained by improved opportunities of moving to a better-paid job in another firm.

In subsequent sensitivity analyses, we examine to what degree the effects of social ties to educated workers that we observed in Models 3 and 4 may be still biased due to workers' sorting into firms with differential chances of upward wage mobility. One solution for this problem is to estimate spell fixed effects models (Abowd et al., 1999; Andrews et al., 2002). Using this approach, we examine whether changing the numbers of higher-educated co-workers that the same person has ties to while working for the same firm is related to upward wage mobility (Table A3 in Annex 1). Our findings suggest that both increases and decreases in social ties have the same sign and a similar magnitude. Our interpretation of these results is that when the number of higher-educated co-workers increases, low-wage workers' chances of benefitting from knowledge spillovers also increase, and their chances of upward wage mobility are raised. Higher-educated co-workers are most likely to exit their current firm by moving to a higher-paying firm, which may improve low-wage workers' chances for making a similar move (Eliason et al., 2019), or for receiving a promotion. Hence, both the

arrival and the departure of higher-educated co-workers can enhance low-wage workers' opportunities for upward wage mobility.

Our sensitivity analyses also consider that a move to a higher-paid job is one of the multiple potential labour market outcomes for low-wage workers. In principle, following the arguments outlined in (Cornelissen et al., 2017), one could argue that while having higher-educated co-workers may increase the pressure on productivity, and improve the chances of higher pay, this pressure may also increase the risk of job loss for those who cannot adjust to this increased competitiveness. As a result, firms with a skilled workforce may create a competitive environment in which "the only way is up," and workers who do not progress to a better-paid job are likely to be laid off. To address this concern, we estimated a multinomial logistic regression with Mundlak device (see Table A4 in Annex 1). This analysis is comparable to our main analysis in the sense that all time invariant confounders are controlled for, but the reported results are odds ratio instead of coefficients from linear models. These results indicate that having social ties to higher-educated co-workers is not associated with higher chances of transitioning back to education or to parental leave, and it does not increase the relative risk of transitioning out of the labour market. Hence, these results do not suggest that the benefits of having higher-educated co-workers for upward wage mobility comes at the cost of higher risk of losing a job. We also carried out sensitivity analyses regarding alternative specification of the predicted number of social ties to higher educated workers and additional specifications of the models testing for interactions with firm size as described in Section 4 (Tables A5 and A6). Sensitivity analyses confirm that our results are robust to changes in the way that predicted ties are calculated and that predicted social ties to higher educated workers do not capture solely the benefits of working in a larger firm.

6. Conclusions

Increasing incidence of precarious jobs, such as low-wage jobs, raises concerns about career opportunities of young workers (Kalleberg, 2020). This study contributes to the ongoing debate about the long-term consequences of such jobs. Whether they constitute "stepping stones" or "traps" may crucially depend on the specific labour market group (Boschman et al., 2021; Knabe & Plum, 2013; Scherer, 2004) or country context (Clark & Kanellopoulos, 2013; Lucifora et al., 2005). This article adds to this debate by highlighting the social ties to higher educated co-workers, which has been indicated as an important factor contributing to the overall rise in earnings inequality (Clark & Kanellopoulos, 2013; Gebel, 2010; Lucifora et al., 2005; Scherer, 2004).

Labour market research has long recognized that social ties play an important role for economic outcomes (Granovetter, 1995; Lin, 1999), and this study builds on these insights to further the knowledge on the opportunities for upward wage mobility of low-wage workers. Specifically, we examined whether having social ties to higher-educated co--workers influences the chances of upward wage mobility. Our empirical results confirm that a workplace with more opportunities for forming social ties to higher-educated co-workers raises the likelihood of upward wage mobility. These effects do not vanish even after we controlled for unobserved differences between workers. Hence, the degree to which a low-wage job becomes a "stepping-stone" or a "dead-end" for a young worker, depends on the skill composition at the firm where this job is located, and the opportunities to establish social ties with higher educated co-workers. The effects sizes are relatively modest. For instance, having 5–9 social ties to higher educated workers increases the probability for upward wage mobility by 3 % points, and having more than 20 ties is related to an increase in this probability by 8 % points. To compare, higher education attainment is related to a 11 % point increase in the probability for upward wage mobility (although it has to be noted that making such comparisons is problematic for reasons explained by (Keele et al., 2020) as we did not design our analysis to get estimates of causal effects of educational attainment). Nevertheless, these results

suggest that more attention should be paid to firm-specific factors that determine wage mobility among vulnerable labour market groups.

This study also explored the potential mechanisms linking firms that employ better-educated workforce with higher upward wage mobility. The skills of employees may be positively related to a faster wage growth of the whole organization (Edmondson, 2002; Neffke, 2019), thus contributing to upward wage mobility of all the workers, including the ones with lowest wages. Our analysis reveals that while the average firm-level wage growth is positively related to upward wage mobility, this is not the main reason for benefits from having better-educated co-workers. Previous studies suggested also the mechanism of peer pressure (Cornelissen et al., 2017), which should lead to decreases in productivity differentials, and, in turn, to decreases in wage inequality. Again, we do not find strong evidence suggesting that peer pressure mediates the positive impact of higher-educated co-workers on chances of upward wage mobility. In addition, we assess whether upward wage mobility results from improved chances of moving to a better-paid job in another firm. While our results confirm that moving to a high-wage firm is related to escaping low-wage employment, this mechanism also does not appear to "explain away" the benefits from having better-educated co-workers. Thus, the relationship observed in our results may be related to knowledge spillovers. Firms with a high proportion of well-qualified employees may constitute environments in which low-wage workers are more likely to acquire new skills, thereby improving their opportunities for upward wage mobility.

This study has some limitations. Relying on data from administrative registers has both advantages and drawbacks when researching labour market inequalities. On the one hand, using data from tax registers enables us to research individuals at the extreme ends of the income distribution, whereas these groups are typically underrepresented in survey data (Hümbelin & Farys, 2016). By merging income register data with data from other registers, we are able to gain insight into the mechanisms that drive earnings differentials and upward wage mobility over time (Antelius & Björklund, 2000). On the other hand, register data are not free from measurement error (Pavlopoulos et al., 2012), and do not cover some important details of individuals' working lives. Specifically, a limitation in this study is that we only include indirect measurements of co-worker networks without explicit information on the qualitative content of social ties between co-workers. Moreover, we have information on annual incomes, which restricts our ability to make inferences about the differences in the hourly wages of low-wage workers. In the context of our study, some of the upward mobility of low-wage workers may reflect transitions from part-time to full-time employment. In addition, our data contain limited information about individual-level life course events such as health shocks, which may limit both opportunities for forming ties to higher educated co-workers and the chances of upward wage mobility (Lundborg et al., 2015), hence this unmeasured confounder may bias our estimates upwards.

Despite these limitations, our findings offer several insights that are relevant both for labour market research and policy-making. This study highlights that education attainment should not be seen a private investment which brings benefits only to those who receive it. Instead, given that the knowledge spillovers at workplaces seem to benefit also the least advantaged groups of workers, education attainment should be regarded as a collective resource, and an important dimension of social policy. Finally, our results indicate that when investing in active labour market policies related to job placements and internships, policy-makers should focus on workplaces in which young workers have the opportunity to learn from others and to benefit from the presence of co-workers with human capital and social connections that could lead to better jobs. This insight is particularly important given the evidence on the limited effectiveness of active labour market policies for labour market entrants (Rosholm & Svarer, 2014). Given the insights from this study, since the connections to high-educated co-workers seems pivotal for low-wage workers´ career mobility, when designing labour market policies, respective stakeholder should prioritize allocating participants to firms

that could provide such career enhancing networks. This implies that such firms either should be able to offer access to such role-models internally, or make sure that participants of such policies in other ways can access mentors from whom they can learn.

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Data availability

Register data used for the purposes of this study are available at ASTRID Lab at Umeå University, according to the regulations these data have to be stored under special security rules and cannot be shared on any open data platform. However, the data are maintained and can be made available free of charge to researchers interested in replication of the results of this study upon request to the Department of Geography at Umeå University, where ASTRID Lab is located. The code for the replication is available at Open Science Platform under link https://osf.io/bdehr/.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.rssm.2022.100747.

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