Coworker Networks and the Labor Market Outcomes of Displaced Workers: Evidence from Portugal

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Abstract

The use of social contacts in the labor market is widespread. This paper investigates the impact of personal connections on hiring probabilities and re-employment outcomes of displaced workers in Portugal. We rely on rich matched employer-employee data to define personal connections that arise from interactions at the workplace. Our empirical strategy exploits firm closures to select workers who are exogenously forced to search for a new job and leverages variation across displaced workers with direct connections to prospective employers. The hiring analysis indicates that displaced workers with a direct link to a firm through a former coworker are three times more likely to be hired compared to workers displaced from the same closing event who lack such a tie. However, we find that the effect varies according to the type of connection as well as firms' similarity. Finally, we show that successful displaced workers with a connection in the hiring firm have higher entry-level wages and enjoy greater job security although these advantages disappear over time.

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1   Introduction

Social contacts play a key role in the labor market as information providers who facilitate the matching process between firms and workers (Beaman, 2016). Cross-country evidence indicates that up to 50 percent of all job matches are obtained through personal connections (Topa, 2011). Despite significant evidence on the widespread use of social contacts in the labor market, knowledge on the extent to which they actually facilitate the matching process is limited.

In this paper, we provide a comprehensive empirical investigation of the link between personal connections and hiring probabilities, as well as re-employment outcomes, of displaced workers in Portugal. Our analysis focuses on personal connections that arise from interactions at the workplace, as they are likely to be of primary relevance in the labor market because of their plausible better knowledge about work-related abilities when referring a worker or the availability of job opportunities (Antoninis, 2006).

Using matched employer-employee data from Portugal, covering virtually all employers and their employees between 1986 and 2018, we investigate the effect of former coworkers on hiring probabilities of displaced workers. Our empirical strategy hinges on two key ingredients. Firstly, we exploit firm closures to find workers who are exogenously displaced and, hence, forced to search for new jobs. Then, we use our social contacts definition to identify firms that are connected to each closing firm through former coworkers. In this framework, we leverage variation across displaced workers in direct connections to firms to assess the link between having (at least) a former coworker employed in a firm and the probability that a displaced worker is hired one year after firm closure in that firm (Kramarz and Skans, 2014; Eliason et al., 2023; Saygin et al., 2021).

In a second step, we focus on workers who successfully found a new job to shed light on whether having a connection in the new firm affects re-employment outcomes. Our goal is twofold. On the one

hand, we are interested in understanding whether having a former coworker improves the re-employment perspectives of displaced workers. On the other hand, we seek to shed light on whether these former coworkers might be transmitting information about match quality that otherwise would not be observable. We provide evidence on these issues by comparing entry-level wages and type of contract of connected and non-connected workers as well as their employment outcomes three years after.

Our hiring analysis yields the following results. Firstly, we find that displaced workers with a direct link to a connected firm are three times more likely to be hired by that firm compared to workers who were displaced from the same closing event but without that direct link to the connected firm: a relative effect approximately 40% higher than that of the only fully comparable analysis conducted in Austria by Saygin et al. (2021). However, males, younger workers, and blue-collar workers benefit the most from having a connection in the firm. Secondly, we show that the type of connection matters. In particular, our results point to a larger effect when considering individuals with whom displaced workers had more robust interactions, i.e., stronger ties matter. Interestingly, we reveal that the hierarchical position of former coworkers, both during the period when the relationship was built as well as in the prospective firm, also plays a key role. Thirdly, our results highlight that former coworkers' links play a prominent role improving hiring probabilities that are less common, i.e., those that involve inter-industry or regional mobility. Overall, the evidence suggests that former coworkers improve hiring probabilities of displaced workers by either sharing information about available job opportunities or directly acting as a referral in their current firm (or both).

With respect to re-employment outcomes, we find that connected workers earn higher starting wages and are more likely to start the new job under a permanent contract. Moreover, three years after re-employment, connected workers are more likely to remain employed in the same firm. However, when comparing workers hired by the same firm, we find no differences in job retention probabilities. Finally,

we provide suggestive evidence that initial wage differences dissipate over time, and that there is no heterogeneity in conversion rates between connected and non-connected individuals who started under a temporary contract. Taken together, the findings are consistent with the idea that initial uncertainty is larger when hiring in the external market but as learning occurs and bad matches are destroyed, differences between connected and non-connected workers fade with time (Galenianos, 2013; Glitz and Vejlin, 2021).

Our paper is closely related to Eliason et al. (2023) and Saygin et al. (2021), who implement a similar identification strategy for Sweden and Austria, respectively. However, while the Austrian and Swedish economies are characterized by high levels of flexibility and dynamism, Portugal reflects low levels of worker mobility and high levels of long-term unemployment (Blanchard and Portugal, 2001; OECD, 2013a). Moreover, small, and medium enterprises are more widespread in the Portuguese economy relative to Austria and, to a lesser extent, Sweden. Equally relevant is the fact that Portugal exhibits lower levels of search intensity and use of informal search methods (e.g., social connections) by the unemployed (Bachmann and Baumgarten, 2013). Therefore, our work adds to the existing literature by analyzing the relevance of social contacts in a completely different setting in which the productivity of coworker networks in enhancing the search and matching process might differ and, therefore, would contribute to improve our understanding of their role in the labor market.

Our extensive heterogeneity analysis also contributes to improving our understanding of the relative importance of weak versus strong ties, both of which, to date, have been shown as important in the literature (Granovetter, 1973; Zenou, 2015; Kramarz and Skans, 2014; Gyetvai and Zhu, 2022; Eliason et al., 2023). In this regard, Portugal's system of collective bargaining agreements, and the job titles defined by it, allow us to identify workers who performed the same task when they were employed in the same

company and, therefore, to measure in a novel and precise way the strong ties that arise from workplace interactions.

This paper also connects to the vast literature on the costs of job displacement, which has documented strong and persistent negative effects in terms of earnings and future employment stability (Jacobson et al., 1993; Stevens, 1997; Eliason and Storrie, 2006; Davis and von Wachter, 2011; Lachowska et al., 2020). Similar to recent work on the link between job displacement and coworker networks (e.g., Cingano and Rosalia, 2012; Glitz, 2017; Saygin et al., 2021), we shed light on how former coworkers can help displaced workers to recover from the negative employment shock. However, our analysis differs from the existing literature by focusing on a country where only a quarter of displaced workers find a job within one year (OECD, 2013a) and workers experienced the largest losses after displacement driven by the fact that they are re-employed in worse firms and that the new worker-firm matches tend to be of poorer quality (Raposo et al., 2021, Bertheau et al., 2022). In this regard, our focus on Portugal helps inform policymakers about the potential to promote the use of personal connections among displaced workers to mitigate the large costs of displacement in sluggish labor markets.

Importantly, displaced workers also face a high risk of re-entering employment under atypical forms of work, such as fixed-term or part-time contracts (OECD, 2013a). If the quality of a new worker-firm match is an "experience good" (Jovanovic, 1979), employers may use fixed-term contracts, which entail lower firing costs, to evaluate the quality of the match when hiring displaced workers. In this regard, if former coworkers convey useful information about the prospective employee, employers could rely on them to reduce the initial uncertainty about the quality of the match (Galenianos, 2013; Glitz and Vejlin, 2021), instead of using fixed-term contracts to screen workers. Thus, the widespread use of fixed-term contracts in Portugal allows us to investigate the type of contract that connected workers received upon re-employment and, hence, to add to the existing literature on whether former coworkers are a source of

information about the quality of new potential employees to their employers and, hence, reduce initial uncertainty. In the same vein, our article contributes to the debate on whether fixed-term contracts are used as screening devices or just as buffer stocks allowing firms to adjust employment (Faccini, 2014; Portugal and Varejao, 2005, 2022; Centeno and Novo, 2012).

The rest of the paper is structured as follows. Section 2 outlines key institutional features of the Portuguese labor market. Section 3 describes the data. Section 4 presents the empirical strategy for the hiring analysis, whereas Section 5 discusses the results. Section 6 analyzes re-employment outcomes and Section 7 concludes.

2   The Portuguese labor market

The Portuguese labor market is characterized by several features that make it an appealing setting in which to study the role of coworker networks in the labor market: collective wage agreements, stringent employment protection legislation, generous unemployment insurance, and the high prevalence of small firms.

Portuguese collective agreements are typically negotiated at the industry level and define the minimum conditions with respect, for example, to the monthly base wage and the working time for each job title (see Addison et al. (2022) for a detailed description of the Portuguese bargaining framework). The job title corresponds to an occupation category within a collective agreement, and it is attributed based on the task and the specific skills of the worker (Cardoso et al., 2018; Raposo et al., 2021). The collective agreements cover approximately 90% of the workers in the private sector despite the low share of

unionized workers, which is mainly due to the existence of extension mechanisms, making the agreements binding for all the employers in a sector.[3]

Portugal is also characterized by stringent employment protection legislation for permanent contracts and unemployment insurance that is generous by European standards (OECD, 2004, 2013b; Venn, 2012). These two institutions are the usual suspects when explaining why despite comparable job flows and unemployment rate to those in the United States, worker flows are low and long-term unemployment is high (Blanchard and Portugal, 2001; OECD, 2002, 2013a). [4] Moreover, highly protected permanent contracts coexist with less protected fixed-term contracts.[5] The coexistence of the two types of contracts translates into a labor market characterized by low labor market dynamism for highly protected workers and high mobility rates for workers under fixed-term contracts who rotate across temporary positions.

Another important feature of the Portuguese labor market is a firm size distribution that has been shifting to the left for more than 20 years (Braguinsky et al., 2011).[6] This process of shrinking firms is remarkable and explains the high prevalence of micro, small and medium firms in Portugal and the larger share of employment accounted for by these firms compared to other European countries.

Taken these features together, the Portuguese economy provides a unique setting to improve our understanding of the role of social contacts in the labor market for at least three reasons. Firstly, the sluggishness of the labor market compared to the more dynamic labor markets on which the literature has focused allows us to shed light on whether social contacts play (or not) a more prominent role in

[3] These extensions were limited after 2011 and could only apply if the companies signing the agreement represented over 50% of the employment level of the sector of activity. This reform was reverted by two legislation changes that occurred in 2014 and 2017 (Hijzen and Martins, 2020; Card and Cardoso, 2022).

[4] Long-term unemployment refers to individuals who remain unemployed for more than one year. According to OECD (2013a), the share of displaced workers who find a new job within one year in Portugal decreased from approximately 35% between 2000 and 2008 to 25% in the wake of the Great Recession. These figures are much lower than those for the US, Finland, and Sweden, where more than 70% of displaced workers get re-employed one year after.

[5] Fixed-term contracts represent approximately 20% of total employment and, since 2006, account for over 80% of all new hires (OECD, 2014).

[6] Recent evidence suggests that since 2013, the shrinking size distribution has reverted and there has been an increase in the share of large firms in the Portuguese economy.

affecting the search and matching process. Secondly, the collective bargaining system and the associated job title categories enables us to unequivocally identify workers who share tasks within the firm and thus directly address the role of strong ties in an environment where networks are already small and therefore likely informative. Thirdly, the dual nature of the labor market permits us to learn more about labor demand and how employers cope with ex-ante uncertainty about the quality of the match when hiring.

3   Data and definitions
3.1   Personnel Records

Our main data source is a longitudinal linked employer-employee database, *Quadros de Pessoal* (QP), for the period 1986 to 2018 (INE, 2021). QP is a unique database administered by the Ministry of Labor, Solidarity and Social Security covering all firms in mainland Portugal with at least one wage employee in the reference month, namely, March of each year until 1993, and October thereafter.

Each firm is required to provide detailed information on the firm and each one of its employees and establishments.[7] Specifically, the dataset includes information on the firm (location, industry, legal form, ownership, year of foundation, employment, and sales), the establishment (location, industry, and employment), and its workforce (gender, age, education, occupation, tenure, earnings [base wage, seniority-related earnings, other regular and irregular benefits, and overtime pay], normal and overtime hours, type of contract and collective bargaining agreement, and the respective job title).[8] Given that each unit (firm, establishment, and worker) has a unique identifier, the dataset allows us to track workers and their employers over time to create former coworker networks for each individual based on the set of individuals who shared the same workplace at some point in time.

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[7] Appendix B provides a detailed description of the variables.

[8] Worker-level data is not available for two specific years: 1990 and 2001. In Table A4 in the Online Appendix we present a robustness test to the exclusion of observations affected by this data restriction with no change in our results. The information on the type of contract is only available from 2002 onwards.

To select our estimation sample, we impose the following constraints on the original dataset. We have restricted the analysis to employees with valid identifiers aged 20 to 55 years old who worked at least one hour during the reference month and had complete information.[9] Additionally, for employees with two or more jobs, we consider the employee's main job as defined according to the longer hours worked or, in case of a tie, the job paying higher wages.[10] Public firms and firms in the agriculture sector, as well as international organizations, are excluded from the analysis. The final sample includes 49,237,115 observations corresponding to 6,711,854 workers and 858,617 firms observed between 1986 and 2018. From this sample, we select the main agents in our analysis as described below.

3.2 Firm and worker concepts

In this section, we follow previous literature (e.g., Eliason et al., 2023) to define the main labor market agents in our analysis: closing firms, displaced workers, former coworkers, and connected firms.

Closing firms. We define firm closures based on the last year that we observe the employer identifier in the data. We refer to this last year as the *closing year*. To mitigate the inclusion of firms involved in corporate actions such as mergers and acquisitions as closing firms, we analyze worker flows between firms and re-code as non-closing those firms with at least 5 employees for which we observe more than 50% of the workforce moving to the same firm in the year following the closing event. Given the empirical strategy that we develop below, we consider only firms that displace at least two workers. This definition yields 47,560 firms that went out of business between 1994 and 2016.[11] Table A3, Panel A, in the Online

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[9] We remove duplicate observations and discard repeated observations with inconsistencies regarding gender or year of birth.

[10] This implies that, when creating the network, in the case of multiple job holders, we only count coworkers from the main job. Therefore, we are most likely to select the strongest connections at the cost of underestimating the true size of the network of former coworkers.

[11] We use 1994 as the first year for closing events due to data quality issues and to be able to use the 1989-1993 period to define former coworkers of workers displaced in this year. We use 2016 as the last year for closing events to allow for at least two subsequent years in which we do not observe the firm identifier.

Appendix presents the descriptive statistics for these firms, which show that they have an average of 13 employees at the time of closure, that 50% of them belong to the service sector, and that 30% of them are located in Lisbon metropolitan area). Relevant for our purposes, these companies are connected, on average, to 9 companies through networks of coworkers.

Displaced workers. Individuals displaced due to firm shutdown who are employed in the last year in which we observe the firm in operation and have at least one year of tenure.[12] Moreover, in order to exclude spurious behavior of workers involved in several firm closure events, we focus on workers who experience a single displacement event. We end up with 364,613 workers who were displaced between 1994 and 2016; among those, only 64,921 individuals found a job one year after firm closure. Table A1 in the Online Appendix provides summary statistics for all displaced workers (Panel A) and those who were able to find a job (Panel B). Although several of the demographic and job characteristics are balanced, those who were successful in finding a new job within one year are younger and more likely to be male. Moreover, they have been with the firm that closed for less time, implying that a larger part of their network was created in firms other than the one that closed. Importantly, successful job seekers have slightly better networks in terms of size, employment rate, and number of companies they are connected with.

Former coworkers. Individuals with whom displaced workers shared the same establishment in at least one of the five years prior to firm closure.[13] Co-displaced workers are excluded from the set of former coworkers, as these individuals are the counterfactual in our identification strategy. Additionally, we

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[12] Although our definition of displaced workers is standard in the literature it is not without caveats. For example, unless the closure is a sudden event, workers may have expectations about the future event based on their inside knowledge and thus react in advance, which may lead to selection in labor turnover and ultimately in the pool of displaced workers. In Table A4 in Online Appendix, we test the sensitivity of our results to this issue using as displaced workers those who are employed both the last year in which we observed the firm in operation and the year before. Consistent with the evidence that suggests that early leavers are typically the best workers (Schwerdt, 2011; Baghai et al, 2021), the results of this exercise point to similar effect of former coworkers, but a higher baseline hiring probability driven by early movers.

[13] Coworkers in firms with 300 or more workers are not considered. Nevertheless, our benchmark finding is robust to a stricter firm size restriction (see Table A4 in the Online Appendix).

require that former coworkers are already employed by another firm at the time of the given worker's displacement and stay in that firm during the following year. The relevance of this condition is twofold. Firstly, it will allow us to define a set of firms that are potential new employers of displaced workers. Secondly, we ensure that the former coworker was already employed before the firm closure and, hence, she can act as an information provider to either the displaced worker about job opportunities or to her current employer about a potential new employee. We obtain 691,968 former coworkers satisfying the criteria. In Table A2 of the Online Appendix, we show the characteristics of these intermediary workers both for all of them and for those that are valid connections given our empirical strategy. Interestingly, they are not very different from each other, apart from the fact that valid coworkers are slightly younger and more educated. Moreover, each valid former coworker is linked to more than two companies that close.

Connected firms. Active firms that are linked to closing firms through former coworker networks. These are firms where at least one of the former coworkers of one, or some, of the displaced workers is employed at the displacement moment and the year after. Thus, all workers displaced from the same firm are connected (directly or indirectly) to the same set of firms, which can potentially hire them. This criterion produces a set of 107,283 connected firms; among those, 19,613 hired at least one worker within a year after being displaced. Panel B of Table A3 in the Online Appendix show the characteristics of connected firms, whereas Panel C focuses on the subset that hired displaced workers. This latter group of firms tends to refer to larger companies that are more likely to operate in the manufacturing sector (similarly to closing firms), and have more links to the closing firms, as more of the displaced workers' former coworkers are employed there.

4   Econometric model and identification

We are primarily interested in testing whether having at least one former coworker in a given firm impacts the probability that a worker will be hired by that firm, compared to a similar worker who does not have such a link to the same firm. Thus, our set-up needs to account for the counterfactual probability that a displaced worker would have been hired by a firm where her former coworker is, even if the former coworker was not employed there. We rely on firm closures to identify (plausibly) exogenously displaced workers in order to investigate their re-hiring probabilities and exploit *co-displaced workers* as a counterfactual, in line with Saygin et al. (2021) and Eliason et al. (2023).[14]

We specify the following regression model for the probability that connected firm *c* hires worker *i* who was displaced due to the closure of firm *k*

$$Y_{i,k(i),c} = \gamma_{k(i),c} + \beta C_{i,k(i),c} + X_i \Omega + \epsilon_{i,k(i),c}$$

where $Y_{i,k(i),c}$ = 1 if worker *i* displaced from firm *k* in year *t* is hired by connected firm *c* in year *t+1*. $\gamma_{k(i),c}$ are closing-connected firm fixed effects to account for potential unobserved factors that may lead workers from closing firm *k* to be more likely to move to firm *c* for reasons other than the presence of a former coworker.[15] $C_{i,k(i),c}$ is an indicator capturing whether at least one former coworker of displaced worker *i* is employed in firm *c* at both displacement moment and hiring moment.[16] Our main parameter of interest is β, which measures how much more (or less) likely a firm *c* is to hire a displaced worker who has a direct

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[14] Kramarz and Skans (2014) use a similar approach to analyze school-to-work transitions of young workers in Sweden. Their analysis focuses on whether having a parent in a given firm increases the probability that a young worker will get her first job in that firm, using former classmates as counterfactuals.

[15] To the extent that individuals sort across firms based on unobserved traits that are correlated with network composition over time, comparing workers displaced by the same firm within potential employers (connected firms) will control for these unobserved factors. In addition, firm-pair fixed effects will absorb any location-, industry-, or time-specific shocks that may affect re-employment.

[16] Variation in the number of connections between workers displaced by the same firm emerge due to differences in working histories. While long-tenured workers will have connections that arose mainly in the closing firm, the network of displaced workers with less tenure in the firm will be largely composed of former coworkers from the firms in which they were employed before joining the closing firm.

connection in the firm through a former coworker than someone else from the same closing firm who lacks a direct tie to firm *c*. X_i represent worker characteristics. In our main specification, we do not include characteristics of displaced workers to avoid capturing part of the effect of the actual connection. In other words, we do not account for characteristics that may not be easily observed by new employers. The information problem faced by firms when searching for new employees is one of the main theoretical arguments in the literature on why employers prefer to hire workers with a connection in the firm, as they reduce informational asymmetries (Montgomery, 1991; Galenianos, 2013; Dustmann et al., 2016; Glitz and Vejlin, 2021). However, we show that including workers' personal traits does not affect our results.

To implement our empirical strategy, we rely on the linked employer–employee dataset described above, and we organize observations in the form of pairs of displaced workers *i* from closing firm *k* and connected firm *c*. As explained before, connected employers are those firms where a displaced worker could potentially find a job either because she has a former coworker employed there or because a displaced worker from the same closing event has a former coworker employed there.[17] The inclusion of closing-connected firm fixed effects implies that the main parameter of interest β is identified by comparing two workers displaced from the same closing firm *k* where one of them has a connection through a former coworker employed in firm *c* whereas the other does not. Thus, only variation in direct connections ($C_{i,k(i),c}$) to firm *c* among individuals displaced from the same closing firm *k* contributes to identifying the effect of interest. In other words, closing-connect firm pairs in which all displaced workers have a former co-worker present in the new firm do not contribute to identifying the effect of interest.

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[17] Note that this definition excludes employers with no connection to closing firm *k*. However, given our identification strategy, these firms do not contribute to identifying the influence of former coworkers on the differential hiring probability between workers with and without a link to the hiring firm.

5 The impact of former coworkers on hiring

5.1 Are connected workers more likely to be hired?

Table 1 reports the results of the hiring analysis where coefficients and standard errors are multiplied by 100, so that they can be interpreted as percentages. We present the point estimates of our benchmark specification with and without worker controls, as well as the differential impact of former coworkers along individual observable characteristics.

Our results indicate that former coworkers seem to contribute to increase the likelihood that displaced workers will be hired in Portugal. In particular, we find that the baseline hiring probability (constant term) of a displaced worker being hired by a connected firm within a year after displacement is equal to 0.07%.[18] However, this probability increases by 0.16 percentage points (pp) for displaced workers who are *directly* connected to that firm. Thus, our results suggest that having (at least) one former coworker employed at a connected firm is associated with a 3.4 times higher probability of being hired by that firm relative to other displaced workers from the same firm closure event who do not have such a link to the firm. This finding suggests that the presence of a former coworker in a connected firm serves as a bridge between job seekers and prospective employers by either directly acting as a referral or simply sharing information about job opportunities. Importantly, the effect remains essentially unchanged when accounting for workers' characteristics such as age, gender, education, and previous-job occupation, and tenure (see

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[18] In our model, the constant term represents the average probability of hiring in the sample (connected set), so it can be interpreted as the probability of hiring regardless of having a connection. In Table A4 in the Online Appendix, we restrict our sample to those displaced workers who had at least one employed former coworker to assess the sensitivity of our results to the fact that some workers might not have networked at all. The results of this exercise suggest that the extensive margin (having connections or not having connections at all) plays a role in the probability of hiring, but is not the main source of the effect, as we still find a relative effect of having a former coworker of 2.6 versus 3.4 when we consider all displaced workers regardless of whether they have a connection or not.

Table 1, Column 3). This suggests that the inclusion of closing-connected firm pairs fixed effects already captures most of the factors that can influence individual mobility patterns beyond the connection.

The interaction of the observable characteristics with the indicator for the presence of former coworkers in the connected firm reveals interesting differences (see Table 1, Column 4). Our findings indicate that females are less likely to be hired by a connected firm compared to males, which can be explained by differences in their network characteristics (Lindenlaub and Prummer, 2020). In terms of education level, we find no differential impact between individuals with either elementary or high-school education, but a negative effect for college graduates. We do also find differences across age groups: younger workers (aged 20-35) being those who have higher returns to direct links to connected firms. This latter finding, however, may be a consequence of the network of older workers having a lower employment rate overall, despite being larger in our setting. Correspondingly, we observe that workers with less tenure are the ones who benefit the most, as they are younger and more mobile individuals. Finally, blue-collar workers seem to benefit more from having a direct link to the connected firm than white-collar workers. These differences are in line with the evidence on the use of informal search methods across demographic groups in Portugal discussed in Addison and Portugal (2008).

The identified average effect of coworkers on hiring probabilities aligns with the results of Saygin et al. (2021) and Eliason et al. (2023) for Austria and Sweden, respectively.[19] The magnitude of the effect is nevertheless different. In particular, Eliason et al. (2023) estimate hiring probabilities of displaced workers in Sweden, but they are able to differentiate according to type of connection, i.e., family, coworkers, classmates, and neighbors. Their estimates imply that former coworkers increase hiring probabilities of displaced workers by 10 times. Our relative effect represents only 30% of theirs, but it is important to note

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[19] Under an alternative identification strategy, our results for Portugal are qualitatively comparable to Cingano and Rosolia (2012) and Glitz (2017) who find that former coworkers increase job finding probabilities of displaced workers in the Region of Veneto (Italy) and Germany, respectively.

that since they include more types of connections, their baseline hiring probability is not nearly comparable to ours. The only study fully comparable to ours in terms of methodology and definitions is that of Saygin et al. (2021) who perform the same type of analysis in the Austrian economy. Their implied relative effect translates into the average Austrian displaced worker with a link to a firm through a former coworker being 2.4 times more likely to be hired by that firm compared to a co-displaced worker who lacks such link.[20] Our implied relative effect is 3.4, which corresponds to a 40% higher relevance of former coworkers in improving the likelihood of being hired after displacement in Portugal compared to Austria. This suggests that, despite Portuguese workers having smaller networks, they benefit more from them, which can be explained by the lower search intensity and used of social contacts of the average worker in Portugal relative to Austria (Bachmann and Baumgarten, 2013). In other words, it is likely that social contacts are more productive in helping displaced workers to find a job in countries where their use is less widespread. Importantly, this finding highlights that former coworkers can play a more decisive role in reducing the incidence of unemployment in sluggish labor markets.

5.2 Is the connection what actually matters?

The previous findings suggest that firms are more likely to hire displaced workers with a direct connection to that firm vis-a-vis workers who lost their jobs due to the same displacement event but lack such a tie. Our identification strategy hinges on the assumption that closing-connected firm pairs fixed effects capture all the relevant heterogeneity that may lead to some workers being more likely to be hired by a given firm besides having a personal connection in the firm. Thus, our claim is that this larger hiring probability mostly reflects the impact of personal connections. To validate this claim, we carry out two types of placebo exercises, described below.

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[20] The Austrian evidence points to no heterogeneity in the results between males and females but indicates that highly qualified individuals and older worker benefit the most from work-related networks.

If former coworkers convey valuable information that can improve the hiring probabilities of displaced workers, we should expect a null effect if we use as former coworkers those individuals who were employed in the same organization but never interacted, as they were not working during the same period. Our first test thus consists of using individuals who were employed in the same establishment as the displaced worker but not during the same period of time, so they did not share time together (Ghost Connections). We use these workers to define a placebo-type former coworker link, generate the set of closing-connected firms, and re-estimate our benchmark model.[21] Column 3 in Table 2 reports the point estimate attached to this placebo-type former coworker link. The results show that the identified effect using these so-called ghost connections is 10 times smaller than our main effect of interest and approximately half of the baseline hiring probability in this sample.[22] Given the large difference in the magnitude of the effect, we take this finding as direct evidence supporting our empirical strategy to identify the causal effect of connections on hiring probabilities.

Another concern about the causal interpretation of our findings is that firm closures may have affected the rest of the firms in the market. On the one hand, firm closures can reduce competition in the product market and create growth opportunities for other firms (Cestone et al., 2018). On the other hand, it could depress the local labor market thus affecting hiring probabilities through the competition for fewer jobs (Gathmann et al., 2020). These mechanisms should in practice affect all displaced workers from the same closing firms in a similar way and, hence, they should be accounted for by closing-connected firms fixed effects. In our second placebo exercise, we randomize the dummy variable, indicating whether the displaced worker has at least one former coworker at the connected firm (Random Connections). If our

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[21] Note that since these placebo-type connections are not the same as in our baseline estimation sample, the set of connected firms will also be different, which will affect the new estimation sample.

[22] The number of observations has almost doubled when using ghost connections to create the set of closing-connected firm pairs, which may affect the statistical power of our estimation.

identified effect exclusively captures the role of former coworkers on hiring probabilities, we should expect a null effect when estimating our model with the randomized connection variable. The estimates reported in Column (4) in Table 2 show that the effect of the random connection variable on the hiring probability is essentially zero. This result provides support to the causal interpretation of our estimates.

5.3 When and which connections matter the most?

Thus far, our results indicate a positive impact of former coworkers on hiring probabilities of displaced workers, especially among young male individuals displaced from blue-collar occupations. However, an important question that remains open is whether connections are always equally important. In this section, we look at three sources of heterogeneity with respect to the agents involved in the matching process. Firstly, we look at how the impact of former coworkers varies depending on the strength of the relationship between a displaced worker and her connections. Secondly, we investigate whether the hierarchical position of former coworkers during the network formation period and in the prospective firm differentially influence hiring probabilities. Finally, we evaluate the potential of former coworkers to improve the matching process by looking at the similarity between closing and connected firms.

5.3.1 Strength of the relationship between displaced workers and coworkers

Our analysis has assumed that all former coworkers are equally likely to be personally connected to the displaced workers and, therefore, to share relevant labor market related information. However, it is plausible that workers do not interact equally with all their coworkers. There is a large body of evidence that indicates the existence of strong degrees of homophily in social networks, i.e., individuals tend to associate with other individuals who are similar in terms of socio-economic characteristics (McPherson et al., 2001). Similarly, one may expect that individuals who perform the same job/task in a given organization are more likely to interact relative to any other worker (Cardoso et al., 2018). Thus, stronger ties may play a more prominent role in improving hiring probabilities of displaced workers (Kramarz and

Skans, 2014; Eliason et al., 2023). However, it could be the case that stronger ties are less relevant if they convey redundant information (Granovetter, 1973; Zenou, 2015).

To test this possibility, we narrow down our former coworker definition to consider only workers who are more likely to interact (strong ties) and, hence, act as information providers. To define former coworkers who shared the same job, we exploit a particular feature of our dataset that allows us to identify individuals who perform the same type of task in the firm based on the job title defined by the collective agreement in force. Alternatively, we consider as former coworkers only those individuals sharing key demographics (homophily). An individual is labeled as a coworker if she belongs to the same cell, defined by education level, gender, and age, at any point during the period when they worked together. Table 3 reports the point estimates of our benchmark model extended to include an additional indicator variable for either of our refined former coworker concepts. Our results indicate that when the link to the connected firm is through (at least) one strong tie, displaced workers are about 2 times more likely to be hired compared to co-displaced workers who have a weaker connection. However, strongly connected displaced workers are instead 5 to 6 times more likely to be hired relative to co-displaced workers who lack any type of connection to the firm.

Another dimension that can influence the strength of the relationship between displaced workers and their former coworkers is time. For instance, it seems conceivable that workers who spent more time working in the same organization built a stronger relationship. Similarly, the time since the last moment individuals worked together may also affect either the strength of the relationship or reduce the ability of former coworkers to convey reliable information when making a referral.

We investigate these issues in Table 4, where we show the results of our benchmark model extended to include dummy variables that identify former coworkers who either interacted until just before the displacement event (one year since separation) or who spent a significant amount of time working for the

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same organization (three or more years together). The findings from these specifications reinforce previous evidence on the importance of tie strength. In particular, we find that when the connection is through a former coworker with whom the displaced worker spent three or more years, the hiring probability is about 7 times higher relative to a co-displaced worker with no link to the connected firm, while it is roughly 2 times higher compared to a co-displaced worker with a weaker link. Stronger connections measured by how much time passed since individuals stopped working together lead to qualitatively similar conclusions, but the difference in hiring probabilities between weakly and strongly connected co-displaced workers is significantly smaller.

Taken together, our findings suggest that stronger ties have a larger impact in increasing hiring probabilities of displaced workers compared to (plausibly) weaker ties. This higher effect can arise from two complementary mechanisms. On the one hand, stronger personal connections have more and better information about displaced workers that can be provided to prospective employers. On the other hand, close social contacts are more likely to share information about job opportunities or act as a referral.

5.3.2 Coworker hierarchical position

The strength of the relationship between displaced workers and their former coworkers influences hiring probabilities in a non-negligible way, an effect that increases with the similarity of the agents. However, when acting as providers of labor market-related information, the hierarchical position of the personal connection may be of higher relevance. On the one hand, former coworkers who hold a managerial position during the period of network formation may provide more reliable information about the unobserved quality of displaced workers. On the other hand, holding a managerial position in the connected firm may impact the probability of being hired either because of better knowledge about available vacancies or due to greater influence on the hiring decision.

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Table 5 shows the estimates of extended versions of our model, adding narrower definitions of coworkers. In particular, we add to our benchmark model indicator variables that exclusively identify as former coworkers those who either held a managerial position when sharing a workplace in the past with the displaced worker (Column 3), hold a managerial position in the connected firm (Column 4), or both (Column 5). The analysis reveals that having at least one former coworker who was a manager during the period of network formation and/or is a current manager in the prospective employer is a gamechanger. Specifically, our analysis points to a probability 3 to 4 times larger relative to displaced workers who have a tie, but not one of high relevance, to the prospective employer. This finding, together with the results in the previous section, seems to indicate that while strong ties are key, having at least one tie with specific knowledge about job performance and/or more influence in the hiring decision may be of higher transcendence.

5.3.3 Similarity between closing and connected firms

We now seek to shed light on the ability of former coworkers to ease the matching process by reducing informational asymmetries. We rely on the similarity between closing and connected firms to proxy for the degree of uncertainty faced by firms and workers. In particular, we estimate separate models depending on whether the closing and connected firms operate in the same sector or are located in the same region.[23] These results are reported in Table 6.

The results show that the effect of a direct link to the firm on the probability of being hired is larger for within-industry movements. However, the baseline hiring probability for within-industry reallocation is roughly 7 times that of between-industry mobility. This implies that the relative importance of a direct connection is larger for between-industry movements, as directly connected workers are almost 6 times

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[23] We consider that closing and connected firms operate in the same sector if they share the same section of the Portuguese Classification of Economic Activities (revision 2.1). If the firms are located in the same NUTS II (Nomenclature of territorial units for statistics), we consider that they share the same region.

more likely to be hired by a firm in a different sector compared to workers without a direct link (2.6 for within-industry hiring). This finding is consistent with former coworkers acting as referrals and revealing information about match quality (Montgomery, 1991; Simon and Warner, 1992; Galenianos, 2013; Dustmann et al., 2016; Glitz and Vejlin, 2021). Thus, by revealing the unobserved potential ability that may help workers to adapt to industry-specific needs, former coworkers could facilitate labor market transitions that otherwise are less likely to occur.[24]

The analysis with respect to firm location yields similar results. We find that the impact of having a direct link to a connected firm in the same region as the closing firm is slightly larger relative to the case when the connected firm is in another region, 0.17 vs 0.13, respectively. However, baseline hiring probabilities are significantly different, with the between-region hiring probability being around one-third of the within-region. This translates into a larger relative impact of having a former coworker link when the hiring involves a regional change. A displaced worker with a direct link to a connected firm in a different region than her previous employer is almost 6 times more likely to be hired compared to a similar worker without that link. In the case of connected firms in the same region, directly connected displaced workers are roughly 3 times more likely to be hired relative to non-connected job seekers. This larger relative impact for inter-regional hiring can be explained by the exchange of information about job opportunities among social contracts (Topa, 2001; Calvo-Armengol and Jackson, 2004, 2007). Thus, former coworkers ease the matching process by acting as a source of information for connected displaced workers about available vacancies that non-connected displaced workers do not have.

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[24] Note that this result also serves as additional support for our identification strategy, as it represents direct evidence that reduced competition in the product market is not driving our results, otherwise we would find a nearly zero effect on the inter-industry mobility.

6   Re-employment outcomes of displaced workers

In this section we focus on successful displaced workers, i.e., workers who managed to find a job within a year after firm closure, to investigate the role of former coworkers in shaping re-employment outcomes. Our goal is twofold. On the one hand, we are interested in studying whether connected workers hired by a new firm are better off in terms of earnings and employment perspectives than non-connected displaced workers. On the other hand, we seek to shed light on the possibility that employers rely on their current employees when hiring in order to reduce information asymmetries with respect to the (unobserved) quality of the match, by exploiting the use of temporary vs permanent contracts.

6.1   Econometric model

To explore these issues, we look at entry-level wages and the starting type of contract, as well as the following labor market outcomes after three years: in terms of wage growth, employment perspectives, job stability, and conversion of fixed-term contracts.[25] In our hiring exercise, our identification strategy leveraged variation in direct connections to potential hiring firms between displaced workers from the same firm closure. To investigate the impact of former coworkers on re-employment outcomes, ideally, one would like to compare two workers displaced and hired by the same firm, one having a coworker already employed in the hiring firm while the other did not. Unfortunately, we cannot perform such an exercise as we lack variation on workers displaced by the same firm and being hired by the same organization one year after. Thus, we adopt a similar strategy to Kramarz and Skans (2014) and alternate the use of closing and hiring firm fixed effects that allows us to provide a lower and upper bound of the

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[25] Given that the type of contract is not available before 2002, re-employment outcomes of workers who found a job within a year after displacement refer to job starts that occurred between 2003 and 2017. For the medium-term analysis, the period is 2003-2015 to be able to observe individuals 3 years after re-employment.

effect of former coworkers on re-employment outcomes. Therefore, we estimate models of the following form

$$Y_{i,k,h} = \beta^k C_{i,k,h} + X_{i,k,h} \Omega^k + Z_h \Gamma + \alpha_k + \epsilon_{i,k,h}^k$$

$$Y_{i,k,h} = \beta^h C_{i,k,h} + X_{i,k,h} \Omega^h + W_k \Upsilon + \phi_h + \epsilon_{i,k,h}^h$$

$Y_{i,k,h}$ stands for our outcome variables of worker *i* displaced from firm *k* and hired by firm *h* one year after displacement. The main variable of interest is $C_{i,k,h}$, which indicates whether a worker *i* displaced from closing firm *k* is hired by a firm *h* where at least one former coworker was already present. Model 2 compares labor market outcomes of workers displaced by the same closing event with and without a direct link through a former coworker to the new employer. For this end, we include closing firm fixed effects α_k and control for worker characteristics as well as the new occupation of worker *i* and the observed characteristics of the hiring firm *h* (size, age, sector of activity, and location). In Model 3, we instead include hiring firm fixed effects φ_h and we control for worker characteristics and the occupation in the new firm *h* as well as the characteristics of the closing firm *k* (size, age, sector of activity, and location). In this specification, we compare outcomes of workers with and without connections who were hired by the same firm *h*.

6.2   The value of a former coworker in the new firm

Table 7 reports the results for the short-term analysis: the entry level re-employment outcomes. The estimates reveal that connected displaced workers are also more likely to start their job under a permanent contract. The overall effect is modest (2.8 pp), but it substantially increases to 5.6 pp when accounting for hiring firm fixed effects. The comparison between specifications using either closing or hiring firm fixed effects may suggest that displaced workers who presumably found their job through a former coworker may be potentially hired by organizations that are more likely to offer a temporary contract to displaced workers. This latter result is novel and brings to light new evidence on the use of

temporary contracts, as they suggest that the adverse selection problem faced by firms when hiring could be less of a concern when hiring connected workers. In other words, firms may find it less profitable to rely on temporary contracts as a screening device when other mechanisms to reduce the costs of learning about match quality are available.

Moreover, consistent with the literature, we find that workers with a connection in the hiring firm earn higher entry-level wages compared to non-connected workers. The starting wage premium becomes slightly larger when including closing firm fixed effects instead of hiring firm fixed effects (2.9 vs 2.4 percent, respectively). To better understand from where this effect comes from, in the last two columns of Table 7 we re-estimate the wage regression excluding hiring firm characteristics and then, run a similar specification in which we replace the wage for an estimate of hiring firm's pay policy based on firm fixed effects estimates from an AKM model (Abowd et al., 1999).[26] The results show that when comparing workers displaced by the same firm, connected workers end up in a firm that pays, on average, higher wages.[27] Taking the ratio of this effect (0.0177) to the effect of the coworker link on entry-level wages without accounting for hiring firm characteristics (0.0417), one can learn how much of the wage effect comes from workers moving to firms with higher wage premia (e.g., Lachowska et al., 2020, Bertheau et al., 2022). The result of this exercise suggests that 40% of wage gain that connected workers obtain come from moving to better paying firms, while the remaining is likely to be associated to the better screening by firms when hiring connected candidates. We investigate this hypothesis in more detail by looking at the dynamics of wages and employment three years after re-employment in Table 8.

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[26] In particular, using the whole dataset, we regress (log) wages on worker and firm fixed effects additionally controlling for age and year effects. We then retrieve the estimates of the firm fixed effects that represent a measure of firm-specific pay policies (Card et al., 2018).

[27] This result is consistent with the evidence provided by Eliason et al. (2023) in Sweden that connections help displaced workers to join better-paying firms. In this regard, we have also experimented with the interaction of the coworker effect with the ability of displaced workers, approximated by worker fixed effects, and find a stronger effect for high ability workers, which would suggest positive sorting. However, investigating the differential effect of connections across the distribution of firm and worker quality and how it affects inequality through sorting effects is beyond the scope of this paper and, therefore, we leave it for future research.

Turning to medium-term outcomes and comparing workers displaced by the same closing event, we find that connected workers are more likely to remain employed (2.7 pp, Column 2 in Table 8), and this effect is particularly strong for the probability of remaining in the same firm (6 pp, Column 3 in Table 8). Interestingly, when comparing connected and non-connected displaced workers within the same hiring firm, we find no differences in the probability of remaining employed after three years. This latter finding is rationalized by theoretical models where initial uncertainty about match quality is higher for firms when hiring in the external market (non-connected workers). However, initial differences fade with time, as learning occurs and bad job matches are destroyed (e.g., Galenianos, 2013; Glitz and Vejlin, 2021).

Finally, we compare wage growth and the probability of getting a permanent contract in the sample of displaced workers who stay in the hiring firm after three years. Column 4 in Table 8 shows that, although the point estimates are non-significant, differences in wage growth between connected and non-connected individuals seem to dissipate over time, in line with the learning hypothesis. Moreover, we find no differences in conversion rates of temporary contracts into permanent ones between connected and non-connected individuals (Column 5 in Table 8). This is consistent with the idea that, if former coworkers convey relevant information about the job applicant not observed by the employer, they should help to mitigate initial uncertainty about match quality. Then, conditional on entering into a temporary contract, we should not expect relevant differences between connected and non-connected displaced workers after the match is made, as both parties have the opportunity to learn about its quality.

7   Conclusion

This paper investigates the impact of personal connections on the labor market outcomes of displaced workers. We implement our analysis in the Portuguese economy, a two-tier labor market characterized by low worker mobility, high long-term unemployment, a less intense use of personal connections, and a larger prevalence of small firms compared to other European countries. In this context, we show that

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former coworkers help workers to be more likely to be hired after displacement. We also document that stronger and better ties are key to improving the likelihood of hiring, and also that connections are especially relevant for facilitating less common labor market transitions, i.e., inter-industry and regional mobility, because of the information they plausibly convey. Furthermore, workers benefit from having a personal connection in the hiring firm as they find better paid and more stable jobs. In this regard, we uncover a new channel through which personal connections help displaced workers to improve their re-employment perspectives after displacement: connected workers are more likely to receive a permanent contract upon re-employment.

Taken together, our results indicate that the role of social contacts in improving job search is relatively more prominent in less dynamic labor markets, as suggested by the comparison between Austria's results and ours. Moreover, given the larger relative effect, our findings suggest that coworker networks might be key to reducing the cost of job loss in those countries where such losses are larger. This is especially true because they not only reduce the incidence of (long-term) unemployment, but also because they help avoid a critical source of post-displacement income losses: moving to worse firms and poorer work-firm matches (Raposo et al., 2021, Bertheau et al., 2022). Thus, from a policy perspective, one promising way to address the incidence of unemployment and alleviate the cost of job displacement is to encourage well-connected workers to rely on their networks in the job search process, while devoting the bulk of employment office resources to helping the not-so-well-connected.

Our results are also related to labor demand and employers' hiring behavior. More specifically, our results support the importance of former coworkers acting as information providers, thus helping to alleviate knowledge asymmetries between firms and workers and, hence, facilitating the process of learning about match quality (e.g., Galenianos, 2013; Glitz and Vejlin, 2021). We uncover these advantages not only in wages and job stability, but also in the lower probability that connected workers are hired

under a temporary contract. Therefore, our analysis is also relevant from a policy perspective, as our results suggest that employers may resort to temporary contracts as screening devices to hire new workers when they lack alternative mechanisms to reduce initial uncertainty about the quality of the match, rather than using them just as an employment buffer.

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Tables

Table 1: Former coworkers and hiring probabilities

	Benchmark	Worker controls	Interactions
Coworker Link	0.1586***	0.1599***	0.0921***
	(0.0082)	(0.0082)	(0.0168)
x Female			-0.0888***
			(0.0114)
x High School			-0.0249
			(0.0155)
x University			-0.0437**
			(0.0202)
x Age 20-35			0.0875***
			(0.0110)
x Blue Collar			0.0389***
			(0.0139)
x Tenure <5			0.0799***
			(0.0141)
Constant	0.0664***	0.0490***	0.0581***
	(0.0009)	(0.0030)	(0.0027)
No. fixed effects	407,705	407,705	407,705
Observations	15,300,008	15,300,008	15,300,008

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Columns 3 and 4 add worker controls referring to indicators for gender, workers aged 20-35, high-school and university education, blue-collar occupation, and tenure less than 5 years. Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 2: Placebo tests

	Benchmark Connections	Ghost Connections	Random Connections
Coworker Link	0.1586***	0.0159***	0.0005
	(0.0082)	(0.0035)	(0.0021)
Constant	0.0664***	0.0221***	0.0833***
	(0.0009)	(0.0001)	(0.0002)
No. fixed effects	407,705	669,484	407,705
Observations	15,300,008	32,579,018	15,300,008

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Ghost connections specification considers as former coworkers those individuals who were employed in the same establishment as the displaced workers but during a different period of time. Random connections specification randomizes the dummy variable identifying a former coworker link. Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 3: Probability of being hired by the intensity of the interaction

	Benchmark	Job Title	Homophily
Coworker Link	0.1586***	0.1284***	0.0955***
	(0.0082)	(0.0084)	(0.0081)
x Job Task		0.1941***	
		(0.0207)	
x Demographics			0.1858***
			(0.0129)
Constant	0.0664***	0.0667***	0.0669***
	(0.0009)	(0.0009)	(0.0009)
No. fixed effects	407,705	407,705	407,705
Observations	15,300,008	15,300,008	15,300,008

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Job Title and Homophily specifications interact the former coworker link dummy with indicators for a more restrictive coworker definition based on the similarity of the job or worker's demographic, respectively, between a displaced worker and her former coworkers. Job-Task is a dummy variable that classifies as coworkers only those who shared the same job title. Demographics is an indicator that categorizes only as coworkers individuals of same gender, age class, and education level. Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 4: Probability of being hired by the length of the interaction

	Benchmark	Time Apart	Time together
Coworker Link	0.1586***	0.1460***	0.1367***
	(0.0082)	(0.0080)	(0.0081)
x One year since separation		0.2125***	
		(0.0481)	
x Three or more years together			0.2764***
			(0.0300)
Constant	0.0664***	0.0633***	0.0636***
	(0.0009)	(0.0013)	(0.0010)
No. fixed effects	407,705	407,705	407,705
Observations	15,300,008	15,300,008	15,300,008

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Time apart and Time together specifications interact the former coworker link dummy with indicators capturing the strength of the relationship. One year since separation is a dummy variable taking value one if the displaced worker has at least one coworker who was together the year before the plant closing. Three or more years together is an indicator for at least one coworker who spent at least three years working in the same establishment. Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 5: Probability of being hired by coworker's hierarchical position

	Benchmark	Networking	Connected	Networking &Connected
Coworker Link	0.1586***	0.1417***	0.1375***	0.1439***
	(0.0082)	(0.0081)	(0.0080)	(0.0080)
x Manager Past		0.4253***		
		(0.0735)		
x Manager Present			0.4264***	
			(0.0674)	
x Manager Past&Present				0.6630***
				(0.1194)
Constant	0.0664***	0.0667***	0.0668***	0.0668***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
No. fixed effects	407,705	407,705	407,705	407,705
Observations	15,300,008	15,300,008	15,300,008	15,300,008

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Networking, Connected, and Networking&Connected columns classify the firms where former coworkers hold the managerial position: past, present, and past&present, respectively. Manager is a dummy variable that categorizes as former coworkers only those who have a managerial position in either network formation or connected firms or in both. Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 6: Probability of being hired by closing-connected firms' similarity

	Sector relative to closing firm		Region relative to closing firm	
	Same	Different	Same	Different
Coworker Link	0.2343***	0.0952***	0.1692***	0.1311***
	(0.0150)	(0.0079)	(0.0099)	(0.0139)
Constant	0.1476***	0.0203***	0.0892***	0.0290***
	(0.0023)	(0.0006)	(0.0013)	(0.0009)
No. fixed effects	175,884	231,821	293,845	113,860
Observations	5,461,485	9,838,523	9,467,008	5,833,000

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 7: Re-employment outcomes at job start

	Perm. contract	Wage	Wage	Firm FE
Closing firm fixed effects	0.0278**	0.0293***	0.0417***	0.0177***
	(0.0113)	(0.0081)	(0.0081)	(0.0043)
Hiring firm fixed effects	0.0559***	0.0236**		
	(0.0128)	(0.0100)		
No. workers	52,563	52,563	52,563	52,563

Notes: Perm. contract stands for a linear probability model for the likelihood of starting the job under a permanent contract compared to a temporary contract. Wage is a linear regression specification for entry level (log) hourly wages. Firm FE is a linear regression where the dependent variable is the fixed effect of the hiring firm, estimated from an AKM model. All models include controls for worker's age, indicators for education level (high-school and university, omitted category: elementary education.), females, blue-collar occupation at the hiring firm and tenure at closing firm, whereas the wage regression also account for type of contract. The specifications in columns 2 and 3 control for firm characteristics of the firm for which fixed effects are not included. Firm characteristics consist of a quadratic polynomial of degree two in (log) size, firms' age, and indicators for broad industry (construction and services; omitted category manufacturing) and location of the firm (4 regions; omitted category northern region). Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Table 8: Re-employment outcomes after three years

	Employed	Same firm	Δ Hourly wage	Contract conversion
Closing firm fixed effects	0.0274**	0.0603***	-0.0047	-0.0129
	(0.0107)	(0.0118)	(0.0096)	(0.0315)
Hiring firm fixed effects	0.0012	0.0067	-0.0111	-0.0296
	(0.0158)	(0.0147)	(0.0142)	(0.0314)
No. workers	46,736	46,736	18,343	9,971

Notes: Employed and Same firm specifications are linear probability models for the likelihood a worker is still employed or employed in the same firm, respectively, three years after being hired. ΔHourly wage estimates the three-year change in (log) hourly wages for workers staying in the same firm. Contract conv. is a linear probability model for the likelihood workers who were under a temporary contract have a permanent contract three years after being hired in the same firm. All models include controls for worker's age, indicators for education level (high-school and university, omitted category: elementary education), females, and blue-collar occupation, and type of contract (except for the conversion model). All specifications control for firm characteristics of the firm for which fixed effects are not included. Firm characteristics consist of a quadratic polynomial of degree two in (log) size, firms' age, and indicators for broad industry (construction and services; omitted category manufacturing) and location of the firm (4 regions; omitted category northern region). Standard errors (in parentheses) are clustered at the closing firm. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

Online Appendix

A   Supplementary tables

Table A1: Summary statistics: Displaced workers

	Mean	Std.Dev.
Panel A: All		
Female	0.46	
Age	37.59	9.33
Elementary education	0.72	
High-school	0.18	
University	0.09	
Blue-collar occ.	0.55	
Tenure	7.87	7.94
Real hourly wage	5.26	4.72
Hired in t+1	0.18	
Network		
Coworkers per displaced worker	34.01	54.68
Employed coworkers per displaced worker	7.67	16.98
All connected firms per displaced worker	41.96	117.38
Direct connected firms per displaced worker	4.48	7.02
No. workers	364,613	
Panel B: Hired in t+1		
Female	0.39	
Age	35.23	8.79
Elementary education	0.72	
High-school	0.19	
University	0.09	
Blue-collar occ.	0.56	
Tenure	5.72	6.04
Real hourly wage	5.01	4.55
Network		
Coworker present in new firm	0.11	
Coworkers per disp. worker	36.33	60.07
Employed coworkers per displaced worker	9.73	20.79
All connected firms per displaced worker	46.47	125.53
Direct connected firms per displaced worker	5.05	7.87
No. workers	64,921	

Notes: Panel A reports summary statistics of displaced workers selected as described in Section 3.2. Panel B focuses on successful displaced workers, i.e., individuals who have found a job within one year after displacement. Job characteristics refers to the closing firm in both panels.

Table A2: Summary statistics: Former coworkers

	Mean	Std.Dev.
Panel A: All		
Female	0.41	
Age	35.55	9.85
Elementary education	0.73	
High-school	0.17	
University	0.10	
Employed in t+1	0.41	
Network		
Displaced workers per coworker	7.41	16.69
No. workers	1,701,173	
Panel B: Employed in t and t+1		
Female	0.42	
Age	34.14	8.35
Elementary education	0.69	
High-school	0.18	
University	0.12	
Network		
Displaced workers per coworker	7.49	16.34
Closing firms per coworker	2.51	1.99
No. workers	691,968	

Notes: Panel A presents summary statistics for all former coworkers of displaced workers with respect to the last networking year. Panel B focuses on suitable former coworkers, i.e., those who were employed in the year in which the displacement occurred and the following year, as described in Section 3.2.

Table A3: Summary statistics: Firms

	Mean	Std. Dev.
Panel A: Closing Firms		
Age	13.34	13.24
Size (closing moment)	12.65	44.18
Sector		
Manufacturing	0.27	
Construction	0.21	
Services	0.52	
Region		
North	0.40	
Algarve	0.05	
Centre	0.20	
Lisbon	0.30	
Alentejo	0.06	
Network		
Coworkers per closing firm	69.50	180.64
Connected firms per closing firm	8.57	19.68
No. firms	47,560	
Panel B: Connected Firms		
Age	14.38	18.06
Size	23.21	144.30
Sector		
Manufacturing	0.25	
Construction	0.16	
Services	0.59	
Region		
North	0.40	
Algarve	0.05	
Centre	0.21	
Lisbon	0.29	
Alentejo	0.05	
Network		
Displaced workers per connected firm	142.61	543.89
Coworkers per connected firm	7.05	24.70
Closing firms per connected firm	3.80	13.42
No. firms	107,283	

Table A3: Summary statistics: Firms (continued)

Panel C: Hiring Firms		
Age	16.02	21.31
Size	70.99	342.13
Sector		
Manufacturing	0.32	
Construction	0.18	
Services	0.50	
Region		
North	0.41	
Algarve	0.04	
Centre	0.21	
Lisbon	0.29	
Alentejo	0.04	
Network		
Displaced workers per hiring firm	399.52	1136.79
Coworkers per hiring firm	21.84	50.84
Closing firms per hiring firm	10.46	29.89
No. firms	19,613	

Notes: Panel A reports summary statistics of closing firms as described in Section 3.2. Panel B presents descriptive statistics of connected firms, i.e., firms where suitable former coworkers are employed in the closing year and the following year as discussed in Section 3.2. Panel C focuses on the set of connected firms who hired at least one displaced worker.

Table A4: Former coworkers and hiring probabilities – Robustness tests

	Without cohorts affected by data gap	Definition of displaced workers	Network firms <100 employees	Displaced workers with at least 1 connection
Coworker Link	0.1562***	0.1402***	0.2257***	0.1517***
	(0.0094)	(0.0082)	(0.0119)	(0.0084)
Constant	0.0641***	0.0866***	0.1068***	0.0943***
	(0.0010)	(0.0010)	(0.0014)	(0.0017)
No. fixed effects	310,426	527,829	259,007	407,705
Observations	11,799,183	15,349,336	7,437,886	7,988,293

Notes: All regressions include closing-connected firm fixed-effects. All coefficients and standard errors are multiplied by 100. Standard errors are clustered at the closing firm. Column 2 excludes the cohorts of displaced workers affected by the two worker level data gaps (1990 and 2001). Column 3 considers as displaced workers those who are employed both the last year in which we observed the firm in operation and the year before. Column 4 considers the estimation of the benchmark model in a sample where the networking firm has less than 100 employees. Column 4 excludes displaced workers without any connection. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively.

B   Variables definition

Worker age and gender. In case a time inconsistency on the workers' year of birth or gender is found, we replace them by the value reported for more than 50% of the observations for that worker, similarly to Cardoso (2006).

Education. Corresponds to the highest level of education completed by the worker. We aggregate this variable into three levels: i) elementary education (less than 12 years of education completed); ii) high school education; and iii) university education (including polytechnic degrees (*Bacharelatos*) and bachelor's, master's and PhD degrees).

Occupation. We rely on the Portuguese Classification of Occupations to create occupation categories. Blue-collar occupations include the following 1-digit codes: 6-Farmers and skilled agricultural, fishery and forestry workers; 7-Craftsman; 8-Plant and machine operators; and 9-Unskilled workers. White-collar occupations include: 1-Directors and executive managers; 2-Intellectual and scientific activities specialists; 3-Technicians and associate professionals; 4-Clerical support workers; 5-Salespersons.

Hourly wages. Wage is computed as the sum of base wages, seniority, regular and overtime payments divided by normal and overtime hours worked. Wages are deflated using the Consumer Price Index (base 2012).

Open-ended contract. Indicator variable that identifies employment contracts with no predetermined duration. The indicator takes value zero for workers on fixed-term contracts, temporary agency workers or in case the contract type is not applicable or ignored.

Sector of activity. Main sector of activity according to the Section of the Portuguese classification of economic activities (Revision 2.1). We further aggregate this classification into three levels: i) Manufacturing (extractive industries, manufacturing and electricity production and distribution and water

supply), ii) Construction, and iii) Services (wholesale and retail, lodging and restaurants, transport, financial activities, property, public administration, education, health and social work and collective, social and personal services).

Location. We divide the location of the firm into five categories —North, Algarve, Centre, Lisbon and Alentejo— according to the second level of the Nomenclature of Territorial Units for Statistics (version 2013).