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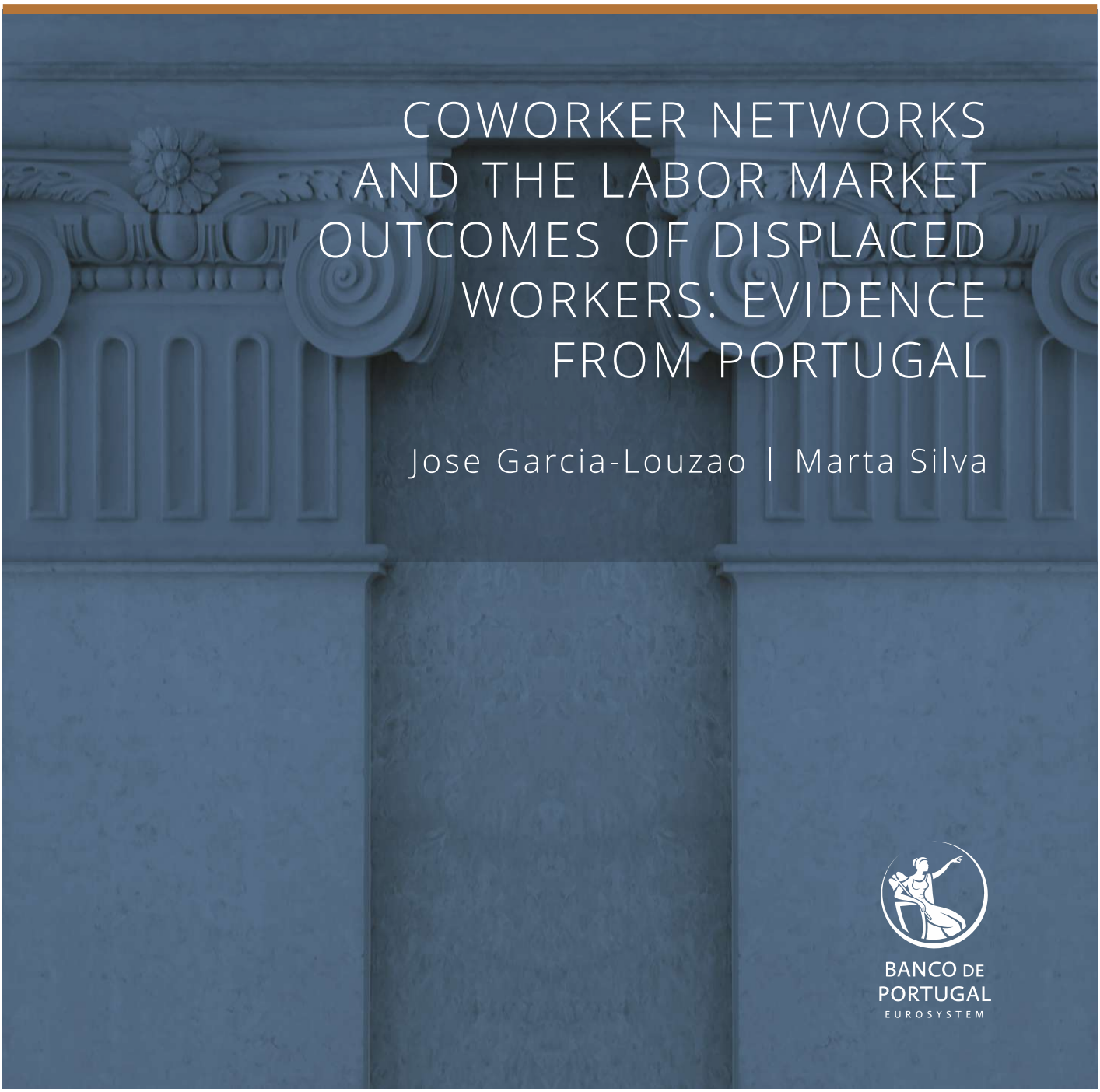

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Coworker Networks and the Labor Market Outcomes of Displaced Workers: Evidence from Portugal

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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 roughly 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.

JEL: J23, J63, L14

Keywords: Job Displacement, Coworker Networks, Re-Employment.

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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 evaluation of the impact of personal connections on hiring probabilities and 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 either 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 2013, 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 connected firms to identify the causal effect of former coworkers on the probability that a displaced worker is hired one year after firm closure (Kramarz and Skans 2014; Eliason *et al.* 2019; 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 around 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. 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.* (2019) and Saygin *et al.* (2021), who implement a similar identification strategy in 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. Therefore, our paper adds to the existing empirical literature by analyzing the relevance of social contacts in a completely different institutional setting where coworker networks tend to be smaller due to lower mobility and smaller firms. Moreover, our extensive heterogeneity analysis 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; Eliason *et al.* 2019).

This paper also contributes 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). Our focus on displaced workers and their labor market outcomes allows us to shed light on how former coworker networks can help these workers to recover from displacement, especially in a country where only one-fourth of displaced workers find a job after a year (OECD 2013a), and almost 40 percent of the wage losses associated with job displacement are accounted for by poorer worker-firm match quality upon re-employment (Raposo *et al.* 2021).

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, employers could rely on former coworkers as referrals (Galenianos 2013; Glitz and Vejlin 2021) to reduce the initial uncertainty about the quality of the match, instead of using fixed-term contracts to screen workers. Thus, our analysis on the type of contract that connected workers received upon re-employment adds 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, 2009; 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.* (2015) 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. 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.[1] This setting allows us to measure the differential effect of considering as coworkers only individuals that are likely to interact in the workplace because they perform the same task, similarly to Cardoso *et al.* (2018) and Raposo *et al.* (2021).

Portugal is also characterized by stringent employment protection legislation for permanent contracts and unemployment insurance that is generous by European

1. 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.

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).[2] Moreover, highly protected permanent contracts coexist with less protected fixed-term contracts.[3] 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).[4] 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. Thus, the highly right-skewed firm size distribution combined with the duality of the labor market and the high levels of long-term unemployment provide a unique setting in which to improve our understanding of the role of social contacts in the labor market.

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 2013 (excepting 1990 and 2001). QP is a unique database administered by the Ministry of Labor and Social Solidarity 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.[5] 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,

2. Long-term unemployment refers to individuals who remain unemployed for more than one year. According to OECD (2014), 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.

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

4. 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.

5. Appendix B provides a detailed description of the variables.

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).[6] 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.

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. 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.[7] Public firms and firms in the agriculture sector, as well as international organizations, are excluded from the analysis. The final sample includes 40,511,038 observations corresponding to 6,061,414 workers and 736,084 firms observed between 1986 and 2013. From this sample, we select the main agents in our analysis as described below. Tables A.1 to A.3 in Appendix A report basic descriptive statistics.

3.2. Firm and worker concepts

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 46,009 firms that went out of business between 1992 and 2012.[8]

Displaced workers. Individuals displaced due to firm shut-down who are employed in the last year in which we observe the firm in operation and have at least one year of tenure. 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 374,878 workers who were displaced between 1992 and 2012; among those, only 61,055 individuals found a job one year after firm closure.

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6. The information on the type of contract is only available from 2002 onwards.

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

8. We use 1992 as the first year for closing events to be able to use the 1986-1991 period to define former coworkers of workers displaced in this year.

Former coworkers. Individuals with whom displaced workers shared the same establishment in at least one of the five years prior to firm closure.[9] Co-displaced workers are excluded from the set of former coworkers, as these individuals are the counterfactual in our identification strategy. Additionally, we 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 533,873 former coworkers satisfying the criteria.

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 101,708 connected firms; among those, 21,826 hired at least one worker within a year after being displaced.

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 (plausible) 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.* (2019).[10]

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

$$Y_{i,k(i),c} = \gamma_{k(i),c} + \beta C_{i,k(i),c} + X_i\Omega + \varepsilon_{i,k(i),c} \tag{1}$$

9. Coworkers in firms with 300 or more workers are not considered.

10. 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.

where $Y_{i,k(i),c} = 1$ if worker i displaced from firm k is hired by connected firm c. $\gamma_{k(i),c}$ 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. $C_{i,k(i),c}$ 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. 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 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.[11] 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.

11. 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 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%.[12] However, this probability increases by 0.14 percentage points (pp) for displaced workers who are *directly* connected to that firm. Thus, displaced workers are roughly three times more likely to be hired by an employer where a former coworker is employed relative to other displaced workers from the same firm closure event who do not have such a tie 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 (see Table 1, Column 3). This suggests that the inclusion of closing-connected firm pairs fixed effects already captures worker-level factors that can influence individual mobility patterns beyond the personal 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 2021). In terms of education level, we find no differential impact across education attainment levels. We do find, instead, 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. 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).

12. 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 or not.

	Benchmark	Worker controls	Interactions
Former Coworker Link	0.1362***	0.1371***	0.1205***
	(0.0080)	(0.0080)	(0.0151)
× Female			-0.1036***
			(0.0119)
× High School			-0.0179
			(0.0151)
× University			-0.0310
			(0.0200)
× Age 20-35			0.1007***
			(0.0113)
× Blue Collar			0.0324**
			(0.0137)
Constant	0.0655***	0.0547***	0.0580***
	(0.0009)	(0.0023)	(0.0018)
No. fixed effects	398,764	398,764	398,764
Observations	14,806,215	14,806,215	14,806,215

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

Table 1. Former coworkers and hiring probabilities

The identified average effect of coworkers on hiring probabilities is in line with the results of Saygin *et al.* (2021) and Eliason *et al.* (2019) for Austria and Sweden, respectively.[13] The magnitude of the effect is nevertheless different. In particular, Eliason *et al.* (2019) 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.[14] Saygin *et al.* (2021) perform the same type of analysis in the Austrian economy, using only former coworkers as personal connections. Their relative effect is closer to ours: Austrian displaced workers with a link to a firm through a former coworker are 2.4 (3.1 in our case) times more likely to be hired by that firm compared to a co-displaced worker who

13. 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.

14. It is important to note that because they include more types of connections, their baseline hiring probability is unlikely to be comparable to ours.

lacks such link. However, the evidence for Austria points to no heterogeneity in the results between males and females, but indicates that more highly qualified and older workers benefit the most from work-related networks in the Austrian economy.

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-à-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 reflects the causal impact of personal connections. To validate this claim, we carry out two types of placebo exercises, described below.

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 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.[15] 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.[16] 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

15. 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.

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

	Benchmark	Ghost Connections	Random Connections
Former Coworker Link	0.1362***	0.0126***	-0.0006
	(0.0080)	(0.0040)	(0.0020)
Constant	0.0655***	0.0239***	0.0801***
	(0.0009)	(0.0001)	(0.0002)
No. fixed effects	398,764	558,476	398,764
Observations	14,806,215	27,136,989	14,806,215

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 2. Placebo tests

whether the displaced worker has at least one former coworker at the connected firm (Random Connections). If our 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 negative, albeit not statistically significant at a 10% significance level. 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.* 2019). However, it could be the case that stronger ties are less relevant if they convey redundant information (Granovetter 1973; Zenou 2015).

	Benchmark	Job Title	Homophily
Former Coworker Link	0.1362***	0.0852***	0.0745***
	(0.0080)	(0.0079)	(0.0080)
× Job-Task		0.2024***	
		(0.0185)	
× Demographics			0.1793***
			(0.0134)
Constant	0.0655***	0.0663***	0.0659***
	(0.0009)	(0.0009)	(0.0008)
No. fixed effects	398,764	398,764	398,764
Observations	14,806,215	14,806,215	14,806,215

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, 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 3. Probability of being hired by the intensity of the interaction

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 more than 2 times more likely to be hired compared to co-displaced workers who have a weaker connection and 4 to 5 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.

	Benchmark	Time Apart	Time Together
Former Coworker Link	0.1362***	0.1265***	0.1198***
	(0.0080)	(0.0079)	(0.0078)
× One year since separation		0.1678***	
		(0.0464)	
× Three or more years together			0.2192***
			(0.0302)
Constant	0.0655***	0.0631***	0.0634***
	(0.0009)	(0.0012)	(0.0010)
No. fixed effects	398,764	398,764	398,764
Observations	14,806,215	14,806,215	14,806,215

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 firm. 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

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 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 more than 6 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 connected 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 when acting as referral. 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.

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 or is a current manager in the prospective employer is a game-changer. Specifically, our analysis points to a probability 4 to 6 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

	Benchmark	Closing	Connected	Closing&Connected
Former Coworker Link	0.1362***	0.1199***	0.1172***	0.1227***
	(0.0080)	(0.0079)	(0.0079)	(0.0079)
× Manager Past		0.4547***		
		(0.0800)		
× Manager Present			0.3990***	
			(0.0703)	
× Manager Past&Present				0.6088***
				(0.1172)
Constant	0.0655***	0.0657***	0.0658***	0.0658***
	(0.0009)	(0.0008)	(0.0008)	(0.0008)
No. fixed effects	398,764	398,764	398,764	398,764
Observations	14,806,215	14,806,215	14,806,215	14,806,215

Notes: All specifications include closing-connected firm pairs fixed effects. Coefficients and standard errors are multiplied by 100. Closing, Connected, and Closing&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 closing 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 5. Probability of being hired by coworker's hierarchical position

whether the closing and connected firms operate in the same sector or are located in the same region.[17] 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 10 times that of between-industry mobility. This implies that relative importance of a direct connection is larger for between-industry movements, as directly connected workers are almost 6 times more likely to be hired by a firm in a different sector compared to workers without a direct link (2.3 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.[18]

17. 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.

18. 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.

	Sector relative to closing firm		Region relative to closing firm	
	Same	Different	Same	Different
Former Coworker Link	0.2047***	0.0794***	0.1479***	0.1049***
	(0.0149)	(0.0073)	(0.0096)	(0.0136)
Constant	0.1579***	0.0166***	0.0854***	0.0296***
	(0.0023)	(0.0006)	(0.0012)	(0.0009)
No. fixed effects	169,907	228,857	289,676	109,088
Observations	5,064,255	9,741,960	9,468,280	5,337,935

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 6. Probability of being hired by closing-connected firms similarity

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, 0.15 vs 0.10, 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 4.5 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 only 2.7 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.

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 in a connected firm 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.[19] 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 effect of former coworkers on re-employment outcomes. Therefore, we estimate models of the following form

$$Y_{i,k,h} = \beta^k C_{i,k,h} + X_{i,k,h}\Omega^k + Z_h\Gamma + \alpha_k + \varepsilon^k_{i,k,h} \tag{2}$$

$$Y_{i,k,h} = \beta^h C_{i,k,h} + X_{i,k,h}\Omega^h + W_k\Upsilon + \varphi_h + \varepsilon^h_{i,k,h} \tag{3}$$

$Y_{i,k,h}$ 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 indicate that workers with a connection have higher entry-level wages compared to non-connected workers. The starting wage premium

19. 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 2013. For the medium-term analysis, the period is 2003-2010 to be able to observe individuals 3 years after re-employment.

becomes slightly larger when including closing firm fixed effects instead of hiring firm fixed effects (3.27 vs 3.18 percent, respectively). Interestingly, our results highlight that connected workers are also more likely to start their job under a permanent contract. Again, the overall effect is modest (4.11 pp) and it increases to 4.78 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.

	Hourly wage	Perm. contract
Closing firm fixed effects	0.0327***	0.0411***
	(0.0091)	(0.0126)
Hiring firm fixed effects	0.0318**	0.0478***
	(0.0133)	(0.0140)
No. workers	45,813	45,813

Notes: Hourly wage is a linear regression specification for entry level (log) hourly wages. Perm. contract stands for a linear probability model for the likelihood of starting the job under a permanent contract compared to a temporary contract. Both models include controls for worker's age, indicators for education level (high-school and university, omitted category: elementary education.), females, and blue-collar occupation; whereas the wage regression also account for type of contract. 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.

Table 7. Re-employment outcomes at job start

Turning to medium-term outcomes (Table 8) and comparing workers displaced by the same closing event, we find that connected workers are more likely to remain employed (3.10 pp, Column 2 in Table 8), and this effect is particularly strong for the probability of remaining in the same firm (6.17 pp, Column 3 in Table 8). Interestingly, when comparing connected and non-connected displaced workers within the same 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 (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 latter result is consistent with the idea that, if former coworkers act as referrals, 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.

	Employed	Same firm	ΔHourly wage	Contract conversion
Closing firm fixed effects	0.0310**	0.0617***	-0.0126	0.0249
	(0.0128)	(0.0142)	(0.0106)	(0.0297)
Hiring firm fixed effects	0.0110	0.0241	-0.0191	-0.0553
	(0.0188)	(0.0196)	(0.0145)	(0.0409)
No. workers	32,847	32,847	18,664	10,247

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.

Table 8. Re-employment outcomes after three years

Taken together, our findings indicate that displaced workers benefit from having a connection in the hiring firm, as they have higher initial earnings and enjoy greater job security both by being more likely to receive a permanent contract at the hiring moment and being matched with firms that offer greater employment stability in the medium-term. This suggests that former coworkers may help to alleviate the costs of job displacement that arise from multiple job losses after re-employment (Stevens 1997; Eliason and Storrie 2006). Moreover, our findings provide support for the relevance of the referral channel. Namely, employers seem to rely on personal connections as a screening mechanism (referrals) to reduce uncertainty about match quality and initial differences disappear over time as

learning occurs (Simon and Warner 1992; Galenianos 2013; Dustmann *et al.* 2016; Saygin *et al.* 2021; Glitz and Vejlin 2021).

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, and a large prevalence of micro, small and medium enterprises compared to other European countries.

We show that former coworkers make displaced workers more likely to be hired within a year after displacement. Furthermore, workers benefit from having a personal connection in the hiring firm as they find better paid and more stable jobs. Our heterogeneity analysis suggests that strong ties as well as the hierarchical position of the former coworker are key. Moreover, we show that former coworkers are relatively more relevant to transitions that are less common, i.e., inter-industry and regional mobility. Finally, we uncover a new channel through which personal connections help displaced workers to improve their re-employment perspectives after displacement. Specifically, we show that connected workers are more likely to receive a permanent contract upon re-employment.

The relevance of our results extends beyond the quantification of the role of social contacts in the labor market on increasing hiring probabilities or improving the labor market outcomes of displaced workers. From a worker perspective, our findings indicate that personal connections help displaced workers to be better matched with their new employer and, hence, may mitigate an important source of earnings losses after displacement in Portugal, i.e., poor new worker-firm matches (Raposo *et al.* 2021). From an employer perspective, our results provide support to the relevance of the referral channel through which former coworkers help to alleviate information asymmetries in the labor market and ease the learning process about match quality (Galenianos 2013; Glitz and Vejlin 2021), restraining employers from using alternative screening devices like fixed-term contracts. Therefore, our findings are also relevant from a policy standpoint, as they contribute to the debate on whether fixed-term contracts are mainly used as screening devices or as an employment buffer. Specifically, our results suggest that employers may rely on temporary contracts as screening devices to hire new workers when they lack alternative mechanisms to reduce the initial uncertainty about match quality.

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Appendix A: Supplementary tables

	Mean	Std. Dev.
Panel A: All		
Female	0.46	
Age	37.42	9.31
Elementary education	0.75	
High-School	0.17	
University	0.08	
Blue-collar occ.	0.57	
Tenure at closing firm	7.92	7.95
Real hourly wage (euros) at closing firm	5.18	4.98
Hired in t+1	0.16	
Network		
Coworkers per displaced worker	26.04	61.29
Employed coworkers per displaced worker	7.31	16.67
All connected firms per displaced worker	39.50	112.07
Direct connected firms per displaced worker	4.22	6.71
No. workers		374,878
Panel B: Hired in t+1		
Female	0.39	
Age	34.94	8.66
Elementary education	0.74	
High-School	0.18	
University	0.08	
Blue-collar occ.	0.57	
Tenure at closing firm	5.70	6.02
Real hourly wage (euros) at closing firm	5.00	5.64
Network		
Coworker present in new firm	0.08	
Coworkers per displaced worker	29.93	67.70
Employed coworkers per displaced worker	9.32	20.47
All connected firms per displaced worker	49.34	158.22
Direct connected firms per displaced worker	4.79	7.56
No. workers		61,055

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.

Table A.1. Summary statistics: Displaced workers

	Mean	Std. Dev.
Panel A: All		
Female	0.41	
Age	34.24	9.65
Elementary	0.76	
High-school	0.16	
University	0.09	
Employed in t+1	0.31	
Network		
Displaced workers per coworker	7.61	17.03
No. workers		1,714,680
Panel B: Employed in t and t+1		
Female	0.42	
Age	32.71	8.10
Elementary	0.70	
High-school	0.19	
University	0.12	
Real hourly wage (euros)	5.50	5.36
Blue-collar	0.54	
Tenure	5.01	6.31
Network		
Displaced workers per coworker	5.15	12.12
Closing firms per coworker	2.14	1.74
No. workers		533,873

Notes: Panel A presents summary statistics for all former coworkers of displaced workers. 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 A.2. Summary statistics: Former coworkers

	Mean	Std. Dev.
Panel A: Closing Firms		
Age	13.49	13.39
Size (closing moment)	12.79	37.33
Sector		
Manufacturing	0.28	
Construction	0.21	
Services	0.50	
Region		
North	0.40	
Algarve	0.05	
Centre	0.20	
Lisbon	0.30	
Alentejo	0.05	
Network		
Coworkers per closing firm	72.99	179.37
Connected firms per closing firm	8.67	19.25
No. firms		46,009
Panel B: Connected Firms		
Age	13.26	17.48
Size	23.79	137.98
Sector		
Manufacturing	0.26	
Construction	0.17	
Services	0.58	
Region		
North	0.40	
Algarve	0.05	
Centre	0.21	
Lisbon	0.29	
Alentejo	0.05	
Network		
Displaced workers per connected firm	145.58	566.09
Coworkers per connected firm	7.24	24.92
Closing firms per connected firm	3.92	13.72
No. firms		101,708
Panel C: Hiring Firms		
Age	12.25	18.46
Size	50.35	254.73
Sector		
Manufacturing	0.26	
Construction	0.20	
Services	0.54	
Region		
North	0.39	
Algarve	0.05	
Centre	0.23	
Lisbon	0.27	
Alentejo	0.05	
Network		
Displaced workers per hiring firm	301.09	1086.97
Coworkers per hiring firm	15.23	45.25
Closing firms per hiring firm	7.81	28.24
No. firms		21,826

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 A.3. Summary statistics: Firms

Appendix 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).

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