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IZA DP No. 15488

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ABSTRACT

Training, Worker Mobility, and Employer Coordination*

This paper presents a new model of firms' decisions on training in a context of potential worker mobility. Such worker mobility can be influenced by employers coordination, namely through the operation of no-poach agreements and employers' associations (EAs). We then present supporting evidence from rich matched panel data, including firms' EA affiliation and workers' training levels. We find that workers' mobility between firms in the same EA is considerably lower than mobility between equivalent firms not in the same EA. We also find that training provision by EA firms is considerably higher.

JEL Classification: J53, J62, L40

Keywords: employers organisations, no-poach agreements, worker mobility

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1 Introduction

While investments in training can deliver large returns for firms and workers, these investments can also be particularly risky due to worker mobility. This situation can prompt many firms to increase their coordination towards lower levels of worker mobility. For instance, firms can engage in no-poach agreements to reduce their labour costs (from wages and turnover) and to increase their returns from training. These no-poach agreements (NPAs) have recently been documented in the US (Krueger & Ashenfelter (2018)),[1][2] and have motivated an executive order (White House (2021)) seeking to ban or limit non-compete agreements and to prevent employers from collaborating to suppress wages.[3]

Indeed, one reason for firms to collude in the labour market may be to mitigate "poaching (or quitting) externalities". This idea can be traced at least as far back as Pigou (1912) and arises when some of the returns from investment in training may accrue to an outside firm if a worker quits their original firm.[4]

In this paper, we investigate theoretically and empirically the effects of employers' coordination in the labour market - such as through NPAs - on training. Specifically we investigate this in a simple but novel model that is general enough to capture a range of market and bargaining structures. In the model, firms invest in general human capital, and trained workers may receive outside offers. At the same time, although workers in a participating firm benefit from additional training, they also face reduced opportunities to further their career outside of the training firm, and this may make working for a participating firm less attractive. Our main result shows that *even with firm commitment*, so in the absence of the hold-up problem, training is generally higher when there are fewer outside opportunities. Thus participation in an NPA would be expected to lead to more training. (It may have an ambiguous effect on profits, however.)

[1] As stated in the published version (Krueger & Ashenfelter (2022)), "as a direct result of an early draft of this paper many, if not all, franchise no-poaching agreements have been forcibly abandoned because of actions by the Washington State Attorney General and others."

[2] As reported in New York Times (2018), 'Seven major restaurant chains, including McDonald's, agreed to drop a hiring practice that critics say may be keeping tens of thousands of fast-food workers locked in low-wage jobs. The provisions prohibit workers at one franchise from going to another franchise of the same restaurant chain. No-poach clauses have drawn scrutiny over whether they hold down pay for restaurant employees'. See also U.S. Department of Justice (2021) for further evidence of wage collusion across employers.

[3] In the executive order, White House (2021), the U.S. President encourages the U.S. competition agency to ban or limit non-compete agreements. The executive order also seeks to strengthen antitrust guidance to prevent employers from collaborating to suppress wages by sharing wage information with one another.

[4] "Franchise owners say the clauses help protect their investments of time and money in training employees" (New York Times (2018)).

In an empirical application, we investigate the potential role of employers' associations (EAs) in promoting employers' coordination on an NPA. EAs are better known as the counterparts to trade unions in collective bargaining (OECD (2019)) in many countries. However, EAs typically provide many additional public goods, including representation, industry lobbying, dissemination of information across their members. EAs may also promote *collusion* amongst affiliated firms, both in the product market and in the labour market, with detrimental effects.

Specifically, we analyse the role of EAs in worker mobility between firms and training. We draw on matched employer-employee panel data from Portugal over three years (2009-2011), including information on EA affiliation of each firm and employee firm-provided training of each worker. We find results that are consistent with NPAs and consistent with the theory. In particular, we find that EA workers are less likely to move to another firm *of the same EA* and that EA workers tend to receive (much) more training than other similar workers.

Our paper contributes to a number of literatures. First, as indicated above, on the theoretical modelling of training investments. Empirically, our paper contributes to the recently growing literature on monopsony (Azar, Marinescu & Steinbaum (2020), Azar, Marinescu, Steinbaum & Taska (2020)). We believe this is the first paper that examines empirically the potential role of EAs in employers' labour market coordination, such as no-poaching agreements, and its implications on training.

1.1 Related Theoretical Literature

There is of course a vast literature on human capital investment. We mainly restrict the discussion below to closely related models of *general* human capital investment provided by firms and where *mobility* of trained workers varies.

Higher *exogenous* worker turnover – where workers randomly quit with a fixed probability – will lead to lower training in a number of models. Acemoglu & Pischke (1999) show this in a basic two-period hold-up model, in which, after training is sunk in period 1, the period 2 wage will be the outcome of a Nash bargain where the worker's outside option is what they would get from quitting (and the firm's is normalised to zero if the worker was to quit). In their "constrained case" where the wage in period 1 cannot be cut to make the worker effectively finance the training, it is shown that as turnover increases, training decreases. This follows

straightforwardly as the firm does not get any benefit from investment if the worker quits, so the marginal return to training falls as turnover increases.[5]

Models where separations are endogenous (and "poaching" occurs) typically exhibit inefficiently low investment in general human capital. This follows when trained wages are below productivity, leading to excessive turnover and sub-optimal training levels. Excessive turnover results because of the low wage leading to more quits than would be socially optimal, and hence some training returns accrue to outside firms. For example, Booth & Chatterji (1998) develop a model where separations are endogenous; in their case firms choose how many workers to train, but workers will quit whenever their outside productivity is greater than the trained wage. Outside productivity is always lower than inside productivity, and so paying a wage equal to inside productivity would prevent turnover and lead to efficient training numbers. However if the firm cannot commit to the second period wage, it will optimally choose a lower wage (trading-off some loss of trained workers with a lower wage bill), and this implies some returns to training leak. So training is too low unless there is a mechanism, such as a union, that can increase the trained wage. Likewise, Stevens (1996) shows that if, from the point of view of trained workers, jobs are not perfect substitutes, firms may pay a wage below marginal product to reduce the ex-post wage bill, at the cost of a loss of some trained workers. Thus the firm only benefits from a fraction of the gap between productivity and the wage because some workers quit, and the worker only benefits form the difference between the trained wage and the wage an untrained worker would get, so the combined return to the worker and firm is smaller than the productivity gain. Again this leads to inefficiently low training as too few workers are trained.

The above results arise as trained wages are determined ex post to maximise firm profits. Moen & Åsa Rosén (2004) show in a model with competitive search that if firms and workers can commit to contracts – more generally if there is "internal efficiency" – then both investment in general training and allocation of trained workers to firms is efficient. They show that, as in the papers such as Booth & Chatterji (1998) and Stevens (1996), if wages are set ex post to maximise profits, then wages in training firms are too low, turnover too high and

[5]Firms do not benefit from the extra wages a trained worker may get after separation. However they also consider a "full competition" regime where firms compete in period 1 to hire workers – a feature of our model – and the worker pays upfront, through a lower period 1 wage for any additional period 2 wages. Acemoglu (1997) shows that in even in the full competition case, training is too low from a societal point of view because the firm-worker problem doesn't take account of any surplus that accrues to outside firms in frictional labour markets. This effect is however smaller than in the constrained case discussed above, as there is still *some* benefit to a separated worker of more human capital.

general training too low relative to the social optimum.[6]

There are a few papers that, like us, consider *varying* the degree of mobility when there are endogenous separations. In Stevens (1994) investment may be in specific or general human capital, and the latter may be transferable to outside firms in differing degrees: specifically, some dimension of investment in human capital potentially benefits output in the training firm and a subset of outsider firms equally (but randomly). Varying the size of the subset of outsiders, which would be one way to model the possibility of increased outside opportunities, actually leads in her model to no effect on *general* human capital investment. The logic here is that although the leakage of surplus to outside firms is increasing in the subset size up to some point, and workers will be more likely to leave, leakage does not vary with the level of investment.

Another paper that explicitly analyzes the impacts of restrictions on mobility ("covenants not to compete") is Posner et al. (2004). While it excludes the pure general human capital case that we analyse, it considers in an incomplete contracting model the trade-offs between enhancing investment incentives by restricting mobility and achieving efficient ex post mobility. However the argument relies on the fact that full mobility is still possible if mutually agreed between employer and employee. A closely related model is Garmaise (2009) which looks at the effects of non-compete enforceability on training of managers. Again, this excludes the pure general human capital, and allows for ex-post mobility if all parties agree. It considers firm training, which is more likely to take place if a non-compete exists, and also self-funded training, which is correspondingly lower. Ghosh & Shankar (2017) contrast non-compete agreements with no-poach agreements. They model the former as putting a limit on the extent to which training is transferable to outside firms (and so effectively specific human capital formation), and characterise the optimal degree of transferability, whereas a no-poach agreement is an extreme version where there is no transfer (and hence no incentive to poach). These papers, as here, consider the trade-off between training and efficiency enhancing outside opportunities.

In our model, we allow firm commitment to wages and training levels, and vary the probability of contacts with outside firms that a trained worker has (and thereby the probability of an offer). If there is no lower bound on wages, general human capital investment is at the

[6]Interestingly though, they show that training is constrained efficient, taking as given the (endogenous) search behaviour of workers and entry of poaching firms, so that subsidies to general training would not be desirable.

efficient level, independent of the probability of an outside offer a trained worker receives, despite the possibility that outside firms receive some surplus from poaching workers.[7] We show, however, that if there is a minimum wage limiting the extent to which an untrained worker can contribute to investment, then training is declining in the number of outside offers. To our knowledge, the model is the first to consider varying the outside contact rate in a situation with firm commitment and potentially efficiency enhancing outside offers.

A paper without realised mobility in equilibrium which explicitly addresses whether a noncompete agreement can increase training is Meccheri (2009). In his reduced-form model a noncompete reduces the worker's outside option. He applies the outside option bargaining principle to the second period bargaining (see also Balmaceda (2005) for a similar model). By reducing the frequency of a binding outside option, the noncompete increases the return to training.

In addition to the above, there is a substantial literature on non-competes which deals with similar issues, but in a context where an employee who leaves may be in a position to compete with the initial employer, bringing in an additional effect. See Wickelgren (2018) for a discussion of this literature.

1.2 Related empirical literature

The only study of which we aware estimating the impact of mobility restrictions on training is Starr (2019). He exploits cross-state variations in noncompete enforceability in the U.S. and estimates a +14% effect on firm-sponsored training from increasing enforcement from zero to the mean state level (though he finds no noticeable effect on self-sponsored training and a reduction in hourly wages). Consistent with this, higher enforceability also is associated with increased mean tenure (and hence lower mobility). To do this, he constructs an index of enforceability using a factor analysis. Covenants not to compete, while agreed at the firm-worker level rather than between firms as in a NPA, may have a similar effect on competition in that they restrict the mobility of workers between certain firms, although as documented by Starr, how this works varies considerably across U.S. states.[8]

[7] This is related, but not equivalent, to the efficiency result in Moen & Åsa Rosén (2004), as firm commitment to the wage-training contract is not sufficient for internal efficiency (the firm-worker pair could increase surplus if the trained wage or the mobility of the worker was contingent on random outside productivity). However, because the firm can maximise surplus, subject to the incomplete contracting constraints, obtained from outside firms independently of training levels, it receives the full return on training.

[8] In most cases for a noncompete to be enforceable, it must be demonstrated that the firm has invested in the worker acquiring some valuable information which it seeks to protect. Once this hurdle is passed, however,

There is some indirect evidence. At a broad level, Acemoglu & Pischke (1999) argue that evidence that high turnover economies such as the U.S. have lower formal training than low turnover economies such as Germany, is consistent with the view that mobility adversely affects training. Garmaise (2009) studies executive mobility using a similar cross-sectional approach to Starr (as well as a time-series test using changes in the law over time in certain states). He finds that greater enforceability leads to reduced mobility, in line with theoretical predictions. While not testing the impact on training, he argues that the results on manager compensation suggest that there is more firm investment in training in jurisdictions where enforcement is greater. There is work in a number of countries finding that that firms provide less training in dense regional labor markets: Brunello & Gambarotto (2007) for the UK, and Brunello & De Paola (2008) for Italy. Using Swiss data and defining regional labor markets by travel time, Muehlemann & Wolter (2011) get similar results, strongest at the extensive margin of whether a firm trains at all. These papers support the theory that potential labour poaching, assumed to be greater in dense labour markets, adversely affects firm financed investment in general training. These papers also point out that there may be agglomeration effects that go in the other direction in dense markets, although these effects are not sufficient to offset the apparent negative poaching effect.[9]

Mohrenweiser et al. (2019) use a novel empirical strategy for German data to directly identify workers who are poached, and thereby also identify training firms which are "victims" of poaching. Given the German apprenticeship system is thought to provide a high level of transferable skills, it is interesting to see whether training firms are systematically losing many workers to poaching (which would be a puzzle from the point of view of theory given the level of training). They conclude that this is not the case; losing workers to poaching appears to be largely transitory, relating to firm downsizing events when a firm is not in a position or willing to, e.g., make counter-offers to retain staff. This suggests that modelling should take account of firm dynamics to better capture the impact of poaching.

Finally, we acknowledge briefly a number of related literatures. On no-poaching agreements, the study by Krueger & Ashenfelter (2018) is an important illustration, focusing on

Starr argues that further investment in training then becomes equally protected. In addition, some states will only enforce a noncompete if it can be demonstrated that some "consideration," such as additional pay or bonus, is provided in exchange for signing the noncompete.

[9] By locating where similar competitors are located, firm investment in general human capital may be subject to hold up as the worker can take her human capital elsewhere (Matouschek & Robert-Nicoud (2005), Almazan et al. (2007)) (see the discussion in Section 1.1). For worker provided training, Rotemberg & Saloner (2000) stress the positive effects of agglomeration.

the case of the US fast-food sector, and finding supporting evidence. A related literature is the recent research on labour market monopsony or market power, including Azar, Marinescu & Steinbaum (2020), Azar, Marinescu, Steinbaum & Taska (2020) and Bassanini et al. (2022). These papers find evidence of local labour markets characterised by high levels of employer concentration and that such concentration is associated with lower wages. Concentration is measured using the number of employers in a given local labour market (a combination of a region, such as a commuting zone, and an occupation). This approach disregards the potential coordination between these employers, leading to an effective number of prospective employers that may be lower that what is originally observed.

We also mention in conclusion the literature on inter-firm worker mobility. For instance, Buchinsky et al. (2010) consider workers' mobility decisions to study returns to tenure. Hijzen et al. (2013) draw on workers moving between firms to estimate wage premiums of foreign firms. In general, worker mobility has been used extensively to decompose firm and worker heterogeneity and study the wage returns or premiums of specific firm or worker attributes.

2 Model

The model[10] allows a worker's decision to separate from the firm to be endogenous; moreover it allows the firm, by choosing the wage contract appropriately, to retain a trained worker with a high probability.

Firms hire untrained workers, and invest in training. Trained workers are more valuable both within the firm that has trained them and in outside firms. We assume that the *increase* in value is the same within and outside the firm, so this is investment in general human capital.

Specific assumptions are: All training is paid for by firms. Firms offer wage-tenure-training contracts to untrained workers which specify wages while training, and a wage once the worker has been trained, as well as the level of training the worker will receive. We assume that untrained workers are in elastic supply at some given utility level so that firms must fashion their contracts to offer at least this level. We refer to this as the participation constraint. The assumption of elastic supply means that we are abstracting from questions of monopsony.

[10] See Appendix for details. For a more general model which extends to different contracting assumptions and specific human capital, see Martins & Thomas (2022).

Trained workers may receive an outside offer, and will leave if the offer is greater than the contracted wage.[11] The probability of a potential outside offer is the key variable in our analysis. If this is restricted, as with no-poach agreements, we are interested in knowing what are the likely effects on training.

We model the outside offer as follows: the worker's value to the outside firm is equal to the worker's inside productivity plus a random term to reflect additional match quality in the outside firm. If the term is positive then the worker has a higher productivity outside the training firm, and vice versa if negative. We assume that the worker and outside firm split the surplus available (the difference between the worth of the worker to the outside firm and the wage that is currently being received), so the worker will always leave if their outside value is higher than the wage. We allow this split to be arbitrary but fixed.

Discussion of model:

A key element of our approach is that a firm's wage policy (how the wage of a trained worker relates to their human capital) has to balance retention (lower wages or more training will lead to more workers taking outside offers *ceteris paribus*) with extraction of surplus from outside firms (a firm which values a worker sufficiently may be prepared to pay a high wage to poach a worker from a high wage firm). The training decision of the firm has to take into account both whether the worker will leave, and the extent to which its investment can be recouped from outside firms through lower wages.

This model is general enough to cover a wide range of scenarios. First, it allows for the fact that outside offers can be efficiency enhancing, even considering just the welfare of the initial match-pair, so that restricting mobility, as in a no-poach agreement, is not necessarily a dominant strategy. If a trained worker is more valuable outside the training firm, then they will receive a higher wage by taking an outside offer. We assume this is fully anticipated by the worker so they will be willing to work for lower wages at the training firm. Secondly, it is general enough to capture the canonical case considered by Becker (1962) where the worker receives the full value of general training in their trained wage: if the probability of an outside offer is one, if the worker receives all the surplus from an outside offer, and if the random additional match quality is always zero, then the worker always receives an outside offer equal to their value to the training firm. This is sometimes called the "competitive case"

[11] We ignore the possibility of counter-offers by the initial employer for simplicity.

(e.g. Acemoglu (1997)). It also allows for outside firms to receive some or even all of the surplus available when a worker is poached.

Result 1: If there are no restrictions on wages, then training levels are efficient and independent of the probability of a potential outside offer.

The idea here is that by paying a sufficiently low wage to an untrained worker, the firm can effectively get the worker to pay for the training. This means that even in the competitive case just discussed, where the worker receives the full value of training (and the firm will receive no benefit from investing in training), by transferring the cost of training to the worker the efficient[12] level of training is offered (Becker 1962). Our result shows that this efficiency result applies even when the outside offer probability is smaller than one, and when outside firms may receive some surplus from poaching a worker. As the outside offer probability varies, training stays at the efficient level.

Since the low wage to untrained workers in Result 1 may even be negative, a more realistic approach assuming that workers are likely to be credit constrained, is to suppose there is some minimum level below which wages cannot fall. This changes the result.

Result 2: If there is a minimum wage constraint, and if this constraint is binding, then training is decreasing in the probability of a potential outside offer.

We will give a rough intuition for this result. Start by considering the case where there are no outside offers. Choose wages so that the worker's participation constraint is just satisfied[13] with the untrained wage set at the minimum level. This can be done by cutting the trained wage if necessary. Consider a small increase in training. In this case, there is no change in the wage contract, and all the extra output accrues to the firm. Thus the return to training should be set equal to the marginal cost, and training will be at the efficient level.

Next suppose there is a chance of an outside offer. Again start from a wage contract such that the participation constraint just holds, with the untrained wage at the minimum level. Consider a state in which the worker has an offer from an outside firm for a fixed additional outside match quality. At the initial wage contract, if training is increased marginally, the worker is more productive so some of the extra output will accrue to the outside firm (assuming any surplus is split). This means that the return to the firm from training is lower than in the no-outside-offer case. (This is true for all outside offers such that the worker leaves.) The

[12] Where the difference between the productivity of the worker and the training cost is maximised. In our model this is also socially optimal.

[13] We can show that the firm doesn't offer a more generous contract than it needs to hire an untrained worker.

key point is that although the firm could stop extra surplus leaking to the outside firm by increasing the trained wage, it does not want to do this, as the firm would be paying the worker more than necessary.[14]

The same logic applies more generally as the likelihood of an outside offer increases, with the return on investment in training falling further.

We stress that although the return on training falls, it does not follow that either the firm or society is worse off. The additional outside opportunities are beneficial in that better matches can result, and anticipating this, the worker will accept a lower trained wage. The superior allocation of labour may more than offset losses from inefficient training levels.

3 Empirical results

Our empirical analysis focuses on the case of employers' associations (EAs) as a mechanism of employer coordination. Such employer coordination may reduce workers' outside options in a similar way to that described in our model. As discussed earlier, EAs can facilitate labour market collusion as they are composed by a number of firms operating not only in the same product market but also in similar labour markets. Different EA member firms will employ workers with the same or very similar skills, who may also live in the same commuting zones. The training provided by these firms may also be specific to the sector and thus general from the perspective of the firms that are affiliated with the same EA.

3.1 Data

Our empirical illustration is based on the population of all private-sector firms in Portugal and all their individual employees. Moreover, we also draw on the employers' association affiliation of each firm. These data are made available in Personnel Records ('Quadros de Pessoal', QP), a compulsory survey of all firms with at least one employee, conducted by the Ministry of Employment.

This census also includes a number of additional variables about firms and their workers, such as identifiers, geographical location, industry (five-digit code), sales, employee headcount, and individual wages of each employee. This data set, QP, has been used extensively in

[14] There is an additional effect as the worker will quit for a larger range of the additional outside match quality. Even though, as noted, it might increase profits, this further reduces the return on training.

industrial relations and labour economics research, including, more recently, Martins (2021*a*), Card & Cardoso (2022) and Bassanini et al. (2022).

We focus on employers' association data for 2009, the latest year available (Martinez-Matute & Martins (2022)), and wages and training data for 2010 and 2011 (training data is currently only available for those two years - see also Martins (2021*b*)). We also assume that each firm's EA affiliation is unchanged between 2009 and 2011. Appendix 4 presents an overview of labour market institutions in Portugal, with a particular focus on the cases of collective bargaining, employers' associations, and training.

3.2 Worker mobility data set

We exploit the comprehensive nature of the QP data set to construct a data set of all instances of inter-firm worker mobility. We believe our approach is novel but can be used in other coutries for which similar data sets are also available. As QP covers the full population of employees in Portugal and in each year (in the month of October) and also includes a time-invariant identifier for each employee and for each firm, we can establish all pairs of firms that were linked through mobility of their workers between one year and the next. Morever, we can also infer that all the remaining potential pairs of firms have not had worker mobility between them.

As the latest year for which we have EA affiliation information at the firm level is 2009 and as the training data that we exploit later is only available for 2010 and 2011, we focus on inter-firm mobility between these last two years. Moreover, we assume that the 2009 EA affiliation status of each firm remained unchanged in 2010 and 2011. We believe this is a reasonable assumption given the relatively limited amount of changes in firm EA affiliation over such short period of time.

We find a total of nearly 80,000 employees that move between different firms in the period above (out of a total of over three million employees in each year). These correspond to workers that are employed in one firm in (October of) 2010 and are then employed in a different firm in (October of) 2011.[15] These 80,000 employees are employed by about 37,000 firms in 2010 and by about 15,000 firms in 2011. The difference in the last two figures indicates greater

[15]To ensure that these are not spurious moves driven by changes in the firm identifier because of mergers or acquisitions, for instance, we also require that the tenure counter of the worker is reset at the new firm. Moreover, we ignore inter-firm mobility spells that involve more than 25 employees moving between a specific pair of firms, as that may denote a displacement from the first firm.

dispersion across separating firms compared to hiring firms.[16]

We use the data set above to estimate inter-firm mobility equations. These are based on both actual and *potential* mobility. Actual mobility is composed of all workers that change firms between 2010 and 2011, as described above. In contrast, potential mobility observations correspond to pairs of firms between which worker mobility is not observed in the data. However, these potential mobility consider only firms from which workers leave and firms to which workers are hired, as in the actual mobility case, even if the firms are not linked in terms of actual worker flows from one firm to the other. Given the large numbers of the latter pairs of firms, we consider a sample of up to 5% of such cases.

It is important to note that our data set construction and estimation approach relies strongly on the population nature of our data. As we cover all employees and all firms in the country, we can identify all cases of both actual and potential mobility. For estimation purposes, we draw only a sample of non-mobility spells, even if we skew it towards firms that exhibit some mobility.

Table 1 presents the resulting data set, in which the left-hand-side panel considers only firm pairs in which worker mobility was observed (79,082 observations). In contrast, the right-hand-side panel considers all firm pairs, including a sample of those in which worker mobility is not observed (3.1 million observations). We find that the number of worker movers per firm pair in which mobility is observed is low, with an average of 1.25. In other words, most of the 79,000 mobility spells found involve only one worker.

7.6% of such spells take place between firms in the same EA, a figure that increases to 20.8% in our full sample of firm pairs (including a sample of potential but not realised mobility spells). The percentage of realised mobility spells that involve both firms in the same collective bargaining agreement is 29.9%, 55.6% are located in the same region, and 24.3% work in the same industry. In the full sample, including both realised and non-realised mobility, the three percentages are lower, at 8.1%, 10.7% and 4.7%, respectively.

Moreover, 51% of the mobility pairs correspond to EA-affiliated firms (in either 2010 or 2011), while 28.7% correspond to case in which both firms are EA-affiliated (although not necessarily in the same EA). In the full sample, the equivalent percentages are 78% and

[16] Although we have information in QP regarding the month when the employment contract with each firm started, we do not know directly when an employment contract comes to an end. This implies that our data set includes both separations and quits and both workers that move directly from one firm to the next and those that experience a spell of unemployment in between.

68%. Finally, realised mobility firms are large, with a mean number of employees of about 830 workers both in the first and second year (2010 and 2011), while their full sample counterparts are much smaller, at about 65 workers.

These descriptive statistics may already point to restrictions in worker mobility between same-EA firms. On the one hand, we observe that EA firms are active in both separating and recruiting workers that move between firms. Moreover, firms operating in the same region, industry or collective agreement (which will all be the case of many same-EA firms) appears to be a strong predictor of inter-firm mobility, as expected given the importance of local labour markets and industry-specific skills. However, on the other hand, we find that same-EA mobility occurs only in a small percentage of realised mobility spells, despite the presumably large share of same-EA firms that operate in the same region, industry or collective agreement. Moreover, these statistics also indicate that EA firms correspond to a large share of firms with realised mobility.

3.3 Inter-firm worker mobility results

Our main analysis, presented in this subsection, concerns the question of whether EA-affiliation has a negative effect on worker inter-firm mobility. As discussed above, we hypothesise that EAs can serve as coordination devices to reduce worker mobility between affiliated firms, thus allowing the latter to benefit more from their investments in worker training.

Our empirical analysis is based on all instances of inter-firm worker mobility between (October of) 2010 and (October of) 2011 and a sample of potential but not realised spells of inter-firm mobility. The full sample used is described in Table 1 (right-hand-side panel). Each observation corresponds to a pair of firms, in which the 'separation firm' is a firm from which at least one employee left (to another firm) in 2010 and in which the 'hiring firm' is a firm from which at least one employee left (to another firm) in 2010.

We estimate two types of models: the first one is focused on the extensive margin (whether there is or not worker mobility from a given firm to another given firm), while the second also considers the intensive margin (how many workers move between the two firms, including zero - no mobility - but also one, two, or any other number of workers). We estimate the first case using a simple linear probability model and the second using a Poisson model (and the algorithm of Correia20).

We also pay particular attention to a number of potential determinants of inter-firm worker mobility which could confound the role of the EA-related variables. From the limited literature on this particular type of worker mobility (including BUCHINSKY10), we seek to control for the role of local labour markets, which will greatly facilitate worker mobility while also potentially be correlated with same-EA status. Similarly, we also control for the industry where both firms operate, as this can also facilitate mobility, given the role of industry-specific skills. The collective bargaining agreement of each firm can also be another form of similarity between the firms that can promote mobility while strongly correlated with EA affiliation and is controlled for in our equation.[17] We also control for the general EA status of each firm (affiliated or not in any EA), both individually and jointly (i.e. both separating and hiring firms being EA affiliated, although not necessarily in the same EA). These variables will control for systematic differences between EA-affiliated firms in terms of their separation and recruitment outcomes. Note that all previous variables above are also constructed in terms of whether they are matched between the (realised or not) separation and hiring firm.

More specifically, we estimate the following inter-firm mobility equation:

$$\begin{aligned} y_{i,j} =& \beta_1 SameEA_{i,j} + \beta_2 BothEA_{i,j} + \beta_3 SameRegion_{i,j} + \\ &+ \beta_4 SameCBA_{i,j} + \beta_5 SameIndustry_{i,j} + \alpha_i + \delta_j + u_{i,j}. \end{aligned} \tag{1}$$

The dependent variable, $y_{i,j}$, is a dichotomous variable equal to one if at least one worker from firm i in (October of) 2010 is employed by firm j in (October of) 2011 (linear probability model). Alternatively, $y_{i,j}$ is the count of workers that move from firm i in 2010 to firm j in 2011 (Poisson model). Each i, j observation is an actual or a potential (but not realised) match between two different firms: in all instances in each the match is not realised, $y_{i,j}$ is equal to zero.

The key explanatory variable is $SameEA_{i,j}$, a dummy variable equal to one if firms i and j are affiliated in the same EA and zero otherwise. Control variables include, depending on the specification: $BothEA_{i,j}$, a dummy variable equal to one if firms i and j are both EA affiliated (in the same or in a different EA); $SameIndustry(Region, CBA)_{i,j}$, a dummy variable equal to one if firms i and j are in same industry (region, CBA); and firm controls (total employment of each firm, in each year).

[17] Note that, as discussed in Section **??**, because of the extensions mechanism, firms can apply a given collective agreement although they are not affiliated with the EA that bargained such agreement.

Finally, the specification may also include α_i and δ_j, which are separating and hiring firm fixed effects, respectively. These will control for systematic differences across firms in their separation and hiring outcomes. Note that controls for firm characteristics (as opposed to match characteristics) will be subsumed by the firm fixed effects, as we observe each firm only once in each year, as either separating or hiring. Standard errors are clustered at the separating and hiring firm levels.

Table 2 presents our results from the perspective of the extensive margin (linear probability model). The first two columns control for EA affiliation (of each firm individually and jointly) and for firm size (column 1) or firms fixed effects (column 2) but do not control for match characteristics, except for the key variable of same-EA status. These results indicate that same-EA combinations are more likely to lead to worker mobility. However, as discussed above, firm pairs that are affiliated to the same EAs may also operate in the same region, industry and or collective agreement. All such common characteristics may also influence positively the mobility of workers between firms, leading to an estimate of the same-EA effect that is biased upwards.

Indeed, when we control for such common characteristics, we find (columns 3 and 4) that the same-EA coefficient switches sign and become larger in absolute terms. When controlling for firm characteristics (EA affiliation and size), the same-EA coefficient is -2.3% while, when controlling for firms fixed effects, it increases to -4.2%, in both cases statistically significant at the 0.1%. These results indicate that, consistently with our earlier discussion, firms that are in the same EA are less likely to have workers moving between them. In terms of their magnitude, the same-EA effects are approximately around half the size of the same-region or same-industry coefficients and two-thirds of the same-collective-agreement coefficient. Note that these same-EA effects are already stripped out of the direct EA effects, both in individual terms (through direct controls and firms fixed effects) and in match terms (through a both-EA-affiliated dummy variable).

We now turn a complementary analysis of the counts of workers moving between each pair of firms (zero, one, or more). Table 5 presents the results from our estimation of a Poisson model that captures both the extensive margin above but also the intensive margin in which several employees may be moving between a specific pair of firms. We find very similar results to those of the previous table in that the same-EA coefficients are positive when not

controlling for the common region, industry and collective agreement characteristics of both firms, but these coefficients become negative when considering such variables. In the latter two cases, we find that same-EA effects are of around -70% and statistically significant at the 0.1%. The signs of the control variables are also the same as in Table 2.

Overall, these two sets of results support the view that firms that are affiliated are less likely to exhibit inter-firm worker mobility. This result emerges once we control for firms' possible common characteristics along other dimensions that may also influence worker mobility, which would otherwise have their effects picked up by the same-EA variable. Our findings are consistent with the view that EAs can facilitate coordination across affiliated firms towards diminished worker mobility, thus increase such firms' ability to fully benefit from their investments in the training of their workforce. In the next subsection, we examine the extent to which workers are effectively receiving more training in EA firms.

3.4 Training results

Our analysis of training differentials between EA and non-EA firms is similar to the approach of the previous subsection in that we consider both the extensive and intensive margins (train or no train vs different hours of training), using either linear probability or Poisson models.

Table 6 describes our data set at the level of the employee in which we conduct our analysis of training. This data set pools data for 2010 and 2011, for which we have worker-level training information, corresponding to a total of 5.1 million observations. On average, employees have 9.3 years of schooling, they are 39.2 years old, and have been with their firms for eight years. 45.5% are women. 55.4% are employed by EA-affiliated firms, with average employment of 1,054 workers and annual sales of 185 million euros. 47.2% of the observations correspond to 2011. 32% of the employees receive training in the year of observation and the average amount of training weeks (across all employees, including those who do not receive training) is 0.33. Average log earnings is 6.6

In this case of our analysis of training differentials, we consider the following equation:

$$tr_{e,i,t} = \beta_1 EAaffiliated_i + \beta_2 X_{e,i,t} + \beta_t + a_i + v_{e,i,t} \tag{2}$$

The dependent variable, $tr_{e,i,t}$, is either a dummy variable equal to one if worker e receives firm-provided training in firm i in year t, or the actual count of hours received by the work.

As before, $EAaffiliated_i$ is a dummy variable equal to one if firm i is EA affiliated. $X_{e,i,t}$ is a set of worker and firm control variables (namely age, schooling, tenure, and female; and a 2011 dummy, number of workers and sales volume). These variables can explain differences in training across workers and also be correlated with the EA status of their firm. a_i denotes a worker fixed effect, exploiting the fact that our data includes instances of worker mobility between affiliated and non-affiliated firms. The key parameter is $beta_1$, which indicates the average difference between workers in affiliated and non-affiliated firms regarding the training they received.

In Table 3, we present our results concerning the extensive margin (whether a worker receives or not firm-provided training in a given year). We find positive and statistically significant EA affiliation coefficients on our training variable across all specifications. In other words, our evidence indicates that workers employed by firms affiliated in EAs tend to receive significantly higher levels of training than workers employed by firms not affiliated in EAs. These gaps range between 4% an 7%.

The only exception to the results above follows from column 4, which includes worker fixed effects and firm controls (firm size measured in both number of workers and total sales). The last result may follow from the limited within-worker variation in EA-firm status, given the short, two-year period covered in our data. Another important aspect concerns the legal requirement (although subject to several caveats) that most employees should receive at least 35 hours of training per year. This legal requirement could lead to limited variation across workers in the dependent variable in this equation, which disregards the intensive margin of training provision.

In this context, we now turn to Table 4, which presents the results of the same specification as before except that the dependent variable is given by the number of hours of training per worker. Given the large number of zeros, we estimate this equation using a Poisson model. Here we find statistically significant, positive effects of EA firms on training hours across all specifications, including in specifications with worker fixed effects.[18] The coefficients vary between 0.152 and 0.318 and are always significant at least at the 1% level. These results indicate that the amount of training provided at EA firms is substantially larger, by at least 15%, at EA firms, even after controlling for a large number of differences across the two types

[18] Note that the number of observations used in the latter case is substantially smaller than in models without worker fixed effects. This is because the estimation dropped 3.1 million observations that are either singletons or separated by a fixed effect Correia et al. (2020).

of firms.[19]

Overall, we regard these twin empirical findings of lower same-EA worker mobility and higher training levels in EA firms as consistent with our theoretical model and the role of EAs in promoting employer coordination and reducing outside opportunities for their employees.

4 Conclusions

Firm-provided training is an important avenue for investment in human capital. Such training can greatly increase worker productivity and firm performance. However, worker mobility - and particularly employee poaching - can influence firms' decisions regarding these investments. Employer coordination - namely through the operation of employers' associations - can affect these decisions.

In this paper, we studied these trade-offs from both theoretical and empirical perspectives. While our theory establishes some general results that imply that employer coordination on reducing mobility leads to increased training, our empirical analysis considers specifically the case of employers' associations as a specific labour market institution that can enhance such employer coordination. Specifically, we consider the possibility that employers' associations implement tacit no-poach agreements to reduce their labour costs (from wages and turnover) and to increase their returns from training.

Our empirical analysis draws on particularly rich matched employer-employee panel data from Portugal, including firm-level information on EA affiliation and employee-level information on inter-firm mobility and training. Our empirical findings are two-fold and in both cases consistent with our theory. The results are also consistent with no-poach agreements and employer coordination intermediated by employers' associations. First, we find that inter-firm worker mobility is significantly lower between EA-affiliated firms. In other words, workers in an EA firm are less likely to be poached by another firm affiliated with the same EA. Second, we find that firm-provided training is considerably higher in EA-affiliated firms.

These findings may also be useful in the new literature on labour market power, including Azar, Marinescu & Steinbaum (2020), Azar, Marinescu, Steinbaum & Taska (2020) and Bassanini et al. (2022). In this literature, concentration is typically measured using the number of employers in a given local labour market. Our results suggest that this approach will in

[19] The coefficients of the remaining control variables are also of general interest. They indicate that training tends to be lower for older and female workers, and higher for more educated and higher-tenure workers.

some cases disregard the potential coordination amongst these employers. Indeed, such coordination will reduce the effective number of prospective employers in a local labour market.

We believe our findings are also of policy relevance. First, these results suggest that the work of employers' associations should be monitored by competition agencies. EAs - as groups of typically competing firms that operate in the same product markets - may have a strong incentive to coordinate some of their activities, not only in product markets but also in labour markets. Second, such forms of employer coordination may have important benefits in terms of worker productivity if they lead to higher levels of training, as we document in our analysis. In this case, legislators that may want to reduce employers' coordination may need to take into account the potential detrimental effects of such measures in training levels.

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Table 1: **Descriptive statistics: inter-firm mobility**

	Mobility type:			
	Realised		Realised+Potential	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Positive N. of movers (DV)	1.000		0.025	
N. of movers	1.254	1.313	0.032	0.288
Same EA	0.076		0.208	
Same CBA	0.299		0.081	
Same region	0.556		0.107	
Same industry	0.243		0.047	
EA affiliated (2010)	0.514		0.78	
EA affiliated (2011)	0.512		0.782	
EA affiliated (2010 and 2011)	0.287		0.68	
Employees (2010)	838.5	2777.13	64.84	539.747
Employees (2011)	826.1	2675.25	68.17	531.926
N (firm pairs)	79,082		3,106,783	

Notes: The table characterises the pairs of firms between which there is worker mobility in the QP data set between 2010 and 2011. 'Positive N. of movers' is a dummy variable equal to one if there is at least one worker moving between the pair of firms. 'N. of movers' is the number of workers moving between the two firms, which can range from zero (no mobility) until 24 (cases of 25 and more workers moving between a pair of firms were excluded). 'Same EA (CBA, region, industry)' is a dummy variable equal to one if the two firms upon which mobility may have taken place are in the same employers' association (collective bargaining agreement, region, industry). 'EA affiliated (2010, 2011, and 2010 and 2011)' is a dummy variable indicating if the firm is affiliated in an employers' association in 2010, 2011 and 2010 and 2011. 'Employees (2010, 2011)' indicates the number of workers employed by the 2010 or 2011 firm.

Table 2: **Inter-firm mobility: extensive margin**

	(1)	(2)	(3)	(4)
Same EA	0.004***	0.011***	-0.023***	-0.042***
	(7.59)	(23.27)	(-33.66)	(-55.50)
EA affiliated	-0.038***	-0.036***	-0.035***	-0.032***
(2010 and 2011)	(-32.52)	(-36.10)	(-32.68)	(-34.74)
Employees (2010)	0.000***		0.000***	
	(7.36)		(7.66)	
Employees (2011)	0.000***		0.000***	
	(7.90)		(7.95)	
EA affiliated (2010)	-0.003**		-0.000	
	(-2.95)		(-0.45)	
EA affiliated (2011)	-0.005***		-0.002	
	(-3.80)		(-1.43)	
Same CBA			0.054***	0.065***
			(47.10)	(61.27)
Same region			0.098***	0.105***
			(80.14)	(101.35)
Same industry			0.089***	0.088***
			(51.67)	(58.81)
Constant	0.049***	0.047***	0.030***	0.035***
	(50.49)	(72.32)	(34.05)	(56.94)
Firm controls x2	X		X	
Firm FE x2		X		X
Observations	3106783	3106783	3106783	3106783

Notes: The table presents different models of worker inter-firm mobility estimated using a linear probability model. The dependent variable indicates the number of workers that moved between a particular firm in 2010 to another particular firm in 2011. The sample considers all spells of inter-firm mobility plus a sample of firm combinations which do not exhibit such mobility. In the former case, the dependent variable is equal to one. In the latter case, the dependent variable is equal to zero. 'Same EA (CBA, region, industry)' is a dummy variable equal to one if the two firms upon which mobility may have taken place are in the same employers' association (collective bargaining agreement, region, industry). 'EA affiliated (2010, 2011, and 2010 and 2011)' is a dummy variable indicating if the firm is affiliated in an employers' association in 2010, 2011 and 2010 and 2011. 'Employees (2010, 2011)' indicates the number of workers employed by the 2010 or 2011 firm. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3: **Training: extensive margin**

	(1)	(2)	(3)	(4)
EA firm	0.074***	0.044***	0.041*	0.019
	(5.21)	(6.68)	(2.45)	(1.20)
Age	-0.003***	-0.003***	-0.001*	-0.001*
	(-8.31)	(-21.91)	(-2.21)	(-2.18)
Schooling	0.021***	0.012***	0.005***	0.006***
	(18.89)	(32.26)	(4.86)	(5.75)
Tenure	0.006***	0.003***	0.003***	0.002***
	(13.20)	(11.96)	(4.02)	(3.49)
Female	-0.020**	-0.010***	0.027**	0.007
	(-2.72)	(-4.75)	(2.87)	(0.85)
Year 2011	0.032***	0.027***	0.010*	0.011*
	(7.21)	(6.31)	(2.17)	(2.30)
Workers		0.000*		0.000
		(2.03)		(1.26)
Sales		0.000		0.000
		(1.06)		(1.06)
Constant	0.143***	0.246***	0.280***	0.293***
	(7.08)	(28.54)	(9.77)	(10.60)
Firm controls		X		X
Worker FE			X	X
Observations	5105988	5105987	4149389	4149387

Notes: The table presents different models of worker training estimated using a linear probability model. The dependent variable is equal to one if the worker received at least one hour of training. The data set considers all individual workers in Portugal in 2010 and 2011 and the amount of training provided by their firms in each year. 'EA firm' is a dummy variable equal to one if the worker is employed by a firm affiliated with an employers' association. 'Firm controls' is a list of firm-level control variables (firm size in number of employees and total sales). 'Worker FE' denotes worker fixed effects. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4: **Training: intensive margin**

	(1)	(2)	(3)	(4)
EA firm	0.216***	0.152**	0.318***	0.295***
	(3.86)	(2.59)	(6.87)	(6.50)
Age	-0.0185***	-0.0158***	-0.00976	-0.00963
	(-15.50)	(-15.04)	(-1.76)	(-1.65)
Schooling	0.0949***	0.0713***	0.0290***	0.0279***
	(23.48)	(26.70)	(3.77)	(3.52)
Tenure	0.0224***	0.0104***	0.00953*	0.00588
	(10.49)	(5.70)	(2.56)	(1.46)
Female	-0.141***	-0.0708***	0.0177	-0.0232
	(-5.77)	(-4.92)	(0.36)	(-0.52)
Year 2011	0.0761*	0.0606	-0.0108	-0.0130
	(2.21)	(1.76)	(-0.33)	(-0.40)
Workers		0.0000314		0.0000155
		(1.39)		(1.48)
Sales		-6.13e-11		-1.66e-10***
		(-0.66)		(-3.84)
Constant	-1.642***	-1.272***	0.170	0.275
	(-19.40)	(-17.20)	(0.74)	(1.13)
Firm controls		X		X
Worker FE			X	X
Observations	5105988	5105567	1914511	1914509

Notes: The table presents different models of worker training estimated using a Poisson model and Correia20. The dependent variable indicates the number of training hours. The data set considers all individual workers in Portugal in 2010 and 2011 and the amount of training provided by their firms in each year. 'EA firm' is a dummy variable equal to one if the worker is employed by a firm affiliated with an employers' association. 'Firm controls' is a list of firm-level control variables (firm size in number of employees and total sales). 'Worker FE' denotes worker fixed effects. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Appendix: Model Details

We consider a two-period partial equilibrium model. Each can employ one worker in period 1. We assume that workers and firms are risk neutral and there is no discounting. If a firm succeeds in hiring a worker in period 1, period 1 output is $y_1 > 0$, and the firm invests $\tau \geq 0$ in training. In period 2 the worker produces $y_2(\tau) = y_1 + \tau^{1/2}$, if they remain with the firm. We can define efficient training τ^* as maximizing $y_2(\tau) - \tau$, i.e., satisfying $y_2'(\tau^*) = 1$ ($\tau^* = 0.25$). At the start of period 2, an employed worker makes a (single) contact with an outside firm with probability $\phi \leq 1$ and may quit. In period 1 there is a competitive labour market, and the firm must offer lifetime utility $\underline{U}$ in order to hire a worker. In terms of the main focus of the paper, ϕ is the critical variable. By adhering to a no poach agreement (joining the employers' association), the firm will reduce ϕ.

We describe wages and the decision whether to accept an outside offer next. The firm offers a wage-training contract (w_1, w_2, τ) at the beginning of period 1, to which it is committed. If the worker receives an outside contact in period 2, we assume that the worker's outside productivity is $y_2(\tau) + \theta$, where θ is distributed uniformly on $[-d, +d]$, $d \geq 0$. Thus τ reflects investment in general human capital, while θ reflects (additive) random match quality in the potential new match. If $\theta > 0$, the new match is more productive. θ is known at the point of contact by worker and outside firm. We assume that the incumbent employer does not make counter offers. This could be justified if the outside offer is non-verifiable. We also assume there are no costs, contractual or otherwise, to a worker who leaves. If $w_2 > y_2(\tau) + \theta$, there is no surplus in the new match and the worker will remain with the original firm. Otherwise the worker will leave, and we assume that she captures a fraction β, $0 \leq \beta \leq 1$, of the joint surplus $y_2(\tau) + \theta - w_2$ in the new match, receiving $w_2 + \beta(y_2(\tau) + \theta - w_2)$.

The firm solves the following problem:

$$\Pi(\phi) := \max_{w_1, w_2, \tau \geq 0} \{(y_1 - w_1 - \tau) + \mu(y_2(\tau) - w_2)\} \qquad \text{(Problem A)}$$

subject to:

$$U(w_1, w_2, \tau) := \tag{3}$$

$$w_1 + \mu w_2 + (1-\mu) E_\theta[w_2 + \beta(y_2(\tau) + \theta - w_2) \mid y_2(\tau) + \theta \geq w_2] \geq \underline{U} \tag{4}$$

where

$$\mu(w_2, \tau) := (1-\phi) + \phi \Pr[y_2(\tau) + \theta < w_2] \equiv (1-\phi) + \phi F(w_2 - y_2(\tau)) \tag{5}$$

is the probability that the worker stays with the incumbent firm, F is the (uniform) distribution function for θ and E_θ is expectation with respect to θ.

Then[20]

Proposition 1 (Unrestricted wages) *For any values of ϕ, β, in any solution to Problem A, training is at the efficient level τ^*, and hence independent of ϕ.*

Minimum wages

In what follows we will consider introducing a minimum wage. The firm can effectively still make the worker pay for training by cutting w_2. However this has implications the returns to training the firm receives through increased loss of surplus in period 2.

We impose a minimum wage $\underline{w}$, so that

$$w_t \geq \underline{w} \quad t = 1, 2. \tag{6}$$

We define **Problem B** to be the same as Problem A but with the addition of the constraint (6).

Proposition 2 *[Restricted wages] If the minimum wage constraint binds, then training is inefficiently low, and for any values of ϕ, β, training is strictly decreasing in ϕ.*

As discussed in the text, the training decision of the firm has to take into account both whether the worker will leave, and the extent to which its investment can be recouped from outside firms. Paying a higher period 2 wage will discourage the worker from taking her human capital elsewhere, which may *per se* be desirable (*is,* in the sense that a contract to prevent the worker moving for some outside offers would improve profits) but by doing so the firm is paying more than it needs to satisfy participation. Training at the efficient level would improve the worker's outside opportunities, and would require a high period 2 wage to prevent the worker from leaving from the point of view of joint surplus maximization. Since with a minimum wage, the firm cannot recoup the period 2 wage costs by paying a low period

[20] All proofs are in the online appendix.

1 wage, it prefers to restrict training. Alternatively it could set $\tau = \tau^*$ and cut w_2 to satisfy the participation constraint – effectively getting the worker to finance the training. But this is also sub-optimal because the worker will be more inclined to leave when she gets an offer – which is inefficient for low θ – and furthermore for $\beta < 1$ less surplus will be extracted from an outside firm in bargaining when she does leave.

As ϕ increases, these trade-offs worsen. Intuitively, the extra output from a marginal unit of investment either is retained by the firm-worker pair if the worker remains, otherwise it partly goes to the outside firm through bargaining. Moreover, as w_2 is not increased (and may fall), in all states where the worker leaves, the outside firm, which gets $(1-\beta)(y_2(\tau) + \theta - w_2)$, gets an *additional* $(1-\beta)y_2'(\tau)$ surplus at least. Thus the firm-worker pair loses more surplus. At a higher ϕ this occurs more often so more of the extra output is "lost" to outsiders; hence τ is decreasing in ϕ. [21]

[21] If $\beta = 1$, τ is still decreasing in ϕ as there is an additional effect whenever $\beta > 0$. The additional outside opportunities at a higher ϕ mean that to satisfy the participation constraint w_2 is reduced, which leads to additional separations when the worker is more valuable inside the firm than outside. This means there is a loss of surplus so a similar logic leads to τ falling.

Appendix: Portugal - institutional background

The labour market of Portugal and its institutions share many similarities to those of other continental European countries, in particular in Southern Europe. One important dimension concerns the relevance of sectoral collective bargaining, which covers 86% of private-sector employees as of 2010, when the empirical analysis in this paper is conducted. (On top of collective bargaining minimum wages, there is also a national, statutory minimum wage. This minimum wage is relatively large in relative terms over the period considered in the study, with a Kaitz index of approximately 60%.) Sectoral collective bargaining is conducted by over 300 EAs and an even larger number of trade unions. Martins (2020) provides a detailed description of EA activities and their potential effects, with a particular focus on the case of Portugal.

EA affiliation is estimated at 43%, a figure in line with the OECD mean, but much below the coverage rate of sectoral agreements. This gap is explained by the pervasive nature of administrative extension schemes, which widen the coverage of collective agreements to all firms and employees in each sector Martins (2020).

Regarding no-poach agreements (NPAs), the labour code of Portugal states that 'agreements between employers that forbid the hiring of a current or former employee or that require the payment of compensation for such hires are null'. This indicates that NPAs in the country are illegal in the sense that they are not enforceable in a court of law. However, if two or more employers agree tacitly to pursue such arrangements and benefit from them, such NPAs will be sustainable from a practical point of view.

An additional institutional dimension relevant in our study concerns legal requirements around firm-provided training. The labour code of Portugal mandates firms mandated to provide a minimum of 35 hours of training to each employee per full year of employment (40 hours since 2019). However, a number of exceptions apply, namely the possibility of backloading or frontloading of training over three-year periods and of payment of work hours in compensation for training not provided by firms.

The country's public employment services (IEFP) have an important role in training provision, although its focus is on unemployed jobseekers. Some of IEFP's activities are conducted under partnerships with EAs, in order to focus on the training for particular occupations in the industries of the EAs. However, again, the main targets of these training

activities are unemployed jobseekers.

From a macroeconomic perspective, we add that 2009 and 2011 were years of recession, with GDP falling by 3.1% and 1.7%. However, 2010 was an year of growth, with GDP increasing by 1.7%.

Appendix: Additional empirical results

Table 5: **Inter-firm mobility: intensive margin**

	(1)	(2)	(3)	(4)
Same EA	0.201***	0.750***	-0.707***	-0.657***
	(3.67)	(15.02)	(-17.10)	(-13.49)
EA affiliated	-1.206***	-1.111***	-1.037***	-0.958***
(2010 and 2011)	(-14.54)	(-17.50)	(-12.70)	(-13.70)
Employees (2010)	0.000***		0.000***	
	(16.56)		(12.64)	
Employees (2011)	0.000***		0.000***	
	(15.87)		(14.20)	
EA affiliated (2010)	-0.204***		-0.106*	
	(-4.98)		(-2.57)	
EA affiliated (2011)	-0.220***		-0.115**	
	(-5.63)		(-2.86)	
Same CBA			1.175***	1.165***
			(36.73)	(26.26)
Same region			1.800***	2.116***
			(32.54)	(31.78)
Same industry			1.061***	1.154***
			(18.74)	(20.07)
Constant	-2.237***	-1.423***	-3.318***	-2.698***
	(-107.51)	(-88.52)	(-64.13)	(-57.65)
Firm controls x2	X		X	
Firm FE x2		X		X
Observations	3106783	3106783	3106783	3106783

Notes: The table presents different models of worker inter-firm mobility estimated using a Poisson model and Correia20. The dependent variable indicates the number of workers that moved between a particular firm in 2010 to another particular firm in 2011. The sample considers all spells of inter-firm mobility plus a sample of firm combinations which do not exhibit such mobility. In the latter case, the dependent variable is equal to zero. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6: **Descriptive statistics: workers (2010 and 2011)**

Variable	Mean	Std. Dev.	N
Schooling	9.348	4.02	5113319
Age	39.293	11.092	5120851
Tenure	8.045	8.412	5126812
Female	0.455	0.498	5127627
EA firm	0.554	0.497	5127627
Firm employees	1054.631	3134.778	5127627
Firm sales	185.016	784.794	5127627
Year 2011	0.472	0.499	5127627
Training (0/1)	0.32	0.466	5127627
Training weeks	0.332	1.149	5127627
Log earnings	6.646	0.685	4840909

Notes: The table describes the worker level data used in the training equations. The data concerns all employees in the QP data set observed in 2010 and or 2011. Schooling indicates the years of schooling of each worker (based on the highest degree obtained). Tenure denotes the number of years of the woker in the firm. EA firm is a dummy variable equal to one for workers in firms affiliated with employers' associations. Firm employees is the number of workers of the firm. Firm sales is the total sales of the firm (in millions of nominal euros). Year 2011 is a dummy variable equal to one for observations of 2011. Training (0/1) is a dummy variable equal to one when the worker received firm-provided training (at least one hour) by his/her employer in that year. Training weeks is the number of hours of firm-provided training (divided by 35) received by the worker over the year. Log earnings is the logarithm of the October total monthly salary of the worker.

Online Appendix: Proofs

Proof of Proposition 1:

Proof. Suppose otherwise, so that $\hat{\tau} \neq \tau^*$, where $(\hat{w}_1, \hat{w}_2, \hat{\tau})$ is a solution to problem A. Then consider changing the contract so that $\tau = \tau^*$, $w_2 = \hat{w}_2 + y_2(\tau^*) - y_2(\hat{\tau})$, and $w_1 = \hat{w}_1 - (y_2(\tau^*) - y_2(\hat{\tau}))$. From (5) μ is unchanged and the LHS of (3) is unchanged, so it continues to hold. Moreover the second term in the maximand remains constant, while

$$\begin{aligned} y_1 - w_1 - \tau^* &= y_1 - \hat{w}_1 + (y_2(\tau^*) - y_2(\hat{\tau})) - \tau^* \\ &> y_1 - \hat{w}_1 - \hat{\tau}, \end{aligned}$$

by $y_2(\tau^*) - \tau^* > y_2(\hat{\tau}) - \hat{\tau}$. Hence profits are increased, a contradiction. ■

Proof of Proposition 2:

Proof. We assume w.l.o.g. that $w_1 = \underline{w}$ and $w_2 > \underline{w}$ (other cases can be shown to be

trivial). Assuming that $(w_2 - y_2(\tau))$ is in the interior of the distribution for θ,

$$\begin{aligned}\frac{\partial U(w_1, w_2, \tau)}{\partial w_2} &= 1 - \frac{\partial \mu}{\partial w_2} Z + \\ &\quad (1-\mu)\frac{\beta(-1 + F(w_2 - y_2(\tau)) + Z f(w_2 - y_2(\tau)))}{1 - F(w_2 - y_2(\tau))} \\ &= 1 - \phi\beta(1 - F(w_2 - y_2(\tau))),\end{aligned}$$

where we write Z for $E_\theta[\beta(y_2(\tau) + \theta - w_2) \mid y_2(\tau) + \theta \geq w_2]$, f for theuniform density, and are using $\partial\mu/\partial w_2 = \phi f(w_2 - y_2(\tau))$ and $(1-\mu) = \phi(1 - F(w_2 - y_2(\tau)))$. Likewise

$$\frac{\partial U(w_1, w_2, \tau)}{\partial \tau} = \phi\beta y_2'(\tau)(1 - F(w_2 - y_2(\tau))).$$

Consequently FOCs are:

$$-1 + \partial\mu/\partial\tau(y_2(\tau) - w_2) + \mu y_2'(\tau) + \lambda\phi\beta y_2'(\tau)(1 - F(w_2 - y_2(\tau))) = 0 \tag{7}$$

$$\phi f(w_2 - y_2(\tau)) - \mu + \lambda(1 - \phi\beta(1 - F(w_2 - y_2(\tau)))) = 0, \tag{8}$$

and

$$-1 + \lambda + \xi = 0, \tag{9}$$

where λ is the Lagrange multiplier on (5) and ξ that on (6) at $t = 1$. From (7) and (8) $\lambda = 1/y_2'(\tau)$. Hence from (9), $\xi = 0$ implies $y_2'(\tau) = 1$, so $\tau = \tau^*$, and we can establish that (3) is always binding, so we would have $\Pi = \Pi^*$, contrary to hypothesis. So $\xi > 0$ and we get $y_2'(\tau) > 1$, hence $\tau < \tau^*$ by $y_2'' < 0$.

Next, substituting $\lambda = 1/y_2'(\tau)$ in (8) and using $\partial\mu/\partial\tau = -\phi y_2'(\tau) f(w_2 - y_2(\tau))$ and (5), we get after rearrangement

$$1 - y_2'(\tau) + \phi\left((1 - F(w_2 - y_2(\tau)))(y_2'(\tau) - \beta) + y_2'(\tau) f(w_2 - y_2(\tau))(y_2(\tau) - w_2)\right) = 0.$$

This becomes

$$1 - \frac{1}{2\sqrt{\tau}} + \frac{1}{2d}\phi\left(\frac{1}{2\sqrt{\tau}} - \beta\right)(d + \sqrt{\tau} - w_2) + \frac{1}{4d\sqrt{\tau}}\phi(\sqrt{\tau} - w_2) = 0. \tag{10}$$

Taking total differentials of (10), and of (3) at $w_1 = \underline{w}$,

$$2\tau(-2\beta\tau + 2\sqrt{\tau}(\beta(-d) + \beta w_2 + 1) + d + 2\phi\left(\beta\sqrt{\tau} - 1\right)\frac{dw_2}{d\phi} - 2w_2) + \\ \frac{d\tau}{d\phi}(2d - \phi(2\beta\tau + d - 2w_2)) = 0$$

and

$$\beta\left(d + \sqrt{\tau} - w_2\right)\left(\sqrt{\tau}(d - w_2) + \phi\frac{d\tau}{d\phi} + \tau\right) - 2\sqrt{\tau}\frac{dw_2}{d\phi}\left(\beta\phi\left(d + \sqrt{\tau} - w_2\right) - 2d\right) = 0,$$

respectively. Solving:

$$\frac{d\tau}{d\phi} = \frac{4d\tau\left(2\beta\tau + 2\sqrt{\tau}(\beta d - \beta w_2 - 1) - d + 2w_2\right) - 2\beta\tau\phi\left(d + \sqrt{\tau} - w_2\right)\left(\beta\tau + \sqrt{\tau}(\beta d - \beta w_2 - 1) + w_2\right)}{4d^2 + \beta\phi^2\left(d + \sqrt{\tau} - w_2\right)\left(d + 2\sqrt{\tau} - 2w_2\right) - 2d\phi\left(2\beta\tau + \beta\sqrt{\tau} + (\beta+1)d - (\beta+2)w_2\right)},$$

and using (10) to substitute out w_2, we can simplify this to

$$\frac{d\tau}{d\phi} = \frac{d\sqrt{\tau}(\beta\sqrt{\tau} - 1)\left(\beta\phi^2 + 4(2\sqrt{\tau} - 1)(\beta + 2\beta\sqrt{\tau} - 4)\right)}{\phi\left(d(\beta(\phi+2) - 4)^2 - 8\phi(\beta\sqrt{\tau} - 1)^3\right)} < 0.$$

The numerator is negative as $\tau < \tau^* = 1/4$, so $(\beta\sqrt{\tau} - 1) < 0$ and $(2\sqrt{\tau} - 1) < 0$, and $(\beta + 2\beta\sqrt{\tau} - 4) < 0$ given $\beta \leq 1$, while the denominator is clearly positive. ■