Transmission of vocational skills at the end of career: horizon effect and technological or organisational change

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1 Introduction

Recent papers call for more policies that aim at combining entry of young workers in the labour market and retention of older workers (Eichhorst et al. 2013). As there is no clear-cut evidence that raising the labour force participation of older workers reduces job opportunities for young workers[1], both generations of workers have to be considered when setting new labour market reforms. In France, the *generation contract* reform enacted by law in March 2013 is an attempt to promote employment simultaneously for younger and older workers. This reform encourages employers to negotiate a collective agreement setting conditions on both the employment of young workers and the retention of older employees[2]. The innovative idea is to induce employers to rely on complementarities that may be set up between generations of workers, particularly through knowledge transmission. Hiring new entrants may be more productive if some experienced workers can train them and transmit their vocational skills and knowledge.

Nevertheless, recent studies that have examined the question of skills' transmission between younger and older workers in companies, mainly in terms of mentoring, highlight a striking fact: the under-representation of older workers among the mentors (Masingue, 2009; Molinié and Volkoff, 2013). If mentors are not especially older, the existence of complementarities between senior workers and young people is not so obvious. In this paper, we therefore focus on factors that may explain this reduced probability of transmitting vocational skills among workers aged 50 years and over.

The interactions that may exist between workers of different ages or experience levels have been well studied in the management literature, particularly in terms of mentor-protégé relationships[3], or in ergonomics in terms of quality of knowledge transmission (Gaudart et al., 2008; Thébault,

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[1]See Gruber and Wise (2009) for a comparative worldwide study.

[2]More precisely, firms with fewer than 50 employees are offered financial support for a three-year period to commit to the continued employment of older workers and the recruitment of young people between 16 and 26 years. Firms with 50 to 299 workers benefit from this grant provided that they sign a collective agreement and enter into an action plan to promote simultaneous employment of young and older workers. In addition, the law set a financial penalty equivalent to 1% of the overall company payroll for all firms with 50 employees or more that did not sign any generation contract agreement and that are not already covered by such an agreement at the industry-level.

[3]Cf Ragins et Kram (2007) for a recent literature review on mentoring at work.

2012). However, in economics too little attention has been paid to these interactions. Thus most papers examining wage-productivity profiles by age assumed a perfect substitutability between cohorts of workers[4]. While Card and Lemieux (2001) highlighted that workers with different ages and experiences may be imperfectly substitutable, their theoretical framework has been mainly used to study the impact of migration on natives' labour market outcomes. As noted by Guest (2007), too few papers account for interactions between cohorts of workers when studying the production function of firms[5].

In addition, the role of mentoring and more generally of informal transmission of skills on the accumulation of human capital (Becker, 1962) has not been widely studied[6]. Although new workers may acquire skills through experience or learning by doing, facilitating knowledge transmission may help them to learn complex tasks (learning by watching). Since we are interested in the phenomenon of informal transmission of knowledge, it is crucial to understand how employers select their internal trainers[7]. Garicano (2000) and Garicano and Hubbard (2005) have already studied the drivers of social learning within organisations. They showed that a knowledge-based hierarchy is an optimal way of organizing the acquisition of knowledge. In their model, workers are assigned to productive tasks and may ask managers to help them when they encounter a problem they cannot solve. Managers' role is to provide with solutions and to learn how to solve harder problems. However, their framework does not account for differences in age or experience

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[4]Cf seminal paper of Hellerstein et al. (1999) on US data and then cross-country studies in France (Aubert and Crépon, 2006), Finland (Daveri and Maliranta, 2007), Germany (Lallemand and Rycx, 2009; Bertschek and Meyer, 2010; Gbel and Zwick, 2012) , Belgium (Vandenberghe and Waltenberg, 2010), Portugal (Cardoso et al. , 2011) and Netherlands (Van Ours and Stoeldraijer, 2011)

[5]Grund and Westergard-Nielsen (2008) and Guest and Stewart (2011) show that age diversity may affect positively the productivity of firms. However, they do not seriously address the endogeneity of their age structure. Roger and Wasmer (2011) use an alternative approach to estimate productivity by age in the French case. They found that the elasticity of substitution between workers of different ages is far from infinity and they stress the importance of differentiating workers by age group, skill level and also by sector to measure precisely productivity profiles over the career.

[6]The main issues in this literature deal with the optimal amount of investment in human capital or the distinction between specific and general human capital (Acemoglu and Pischke, 1998 ; Leuven, 2005) but the issue of the trainers' characteristics is not really addressed.

[7]In this paper we use the term "internal trainer" rather than "mentor" given that in the management literature, a mentor may also provide to her protégé a psychosocial assistance (Chao, 1998), while we are interested only in transmission of vocational skills.

between the workers. Rufini (2008) filled this gap, considering young workers that may either learn on their own or benefit from knowledge transmission. In her model, experienced workers are entrusted with transmitting vocational skills to new workers. Here, experience is a process that builds over time and implies that workers with longer tenure are more likely to transmit their skills. But her model does not explain why older workers are actually under-represented among the trainers.

Beyond health aspects[8], we could explain the reduced probability for older workers to transmit their skills by a horizon effect, due to their closeness to the retirement age. Hairault et al. (2010) have already highlighted the negative effect of a short horizon on labour supply and also on the hiring rate of older workers. Regarding the probability of being an internal trainer we expect a more ambiguous effect of the career horizon. One the one hand, if an older worker accumulated skills over time her departure implies a loss in human capital for the organisation which affects productivity negatively[9]. Employers should be willing to encourage workers close to their retirement age to devote some time to skills transmission and thus we would observe a positive effect of a short horizon on the probability of being an internal trainer. On the other hand, if older workers' skills have been depreciated by technological or organisational changes within the work environment[10] knowledge transmission requires an update of their skills through on-the-job training. In that case, the effect of a short distance to retirement on the probability of being an internal trainer is expected to be negative. Indeed, Montizaan et al. (2010) and Langot and Khaskhoussi (2008) found a negative effect of a too short horizon on training incidence, putting forward that a shorter career horizon implies a shorter period during which both employees and

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[8]We could guess that the decline in health over time may explain the reduced probability of being an internal trainer for workers aged 50 and over. However, as shown by Welford (1958) or more recently by Marquié (1995) and Gaudart (1996), older workers develop strategies for the preservation of health, enabling them to save energy while maintaining a productivity level equal to that of younger workers.

[9]From data on the health care sector, Lefebvre et al. (2003) or Bartel et al. (2013) show how massive exits due to retirement led to a fall in productivity of some teams or services.

[10]Numerous studies highlighted the adverse effects of such changes on older workers' employment (Bartel et Sicherman, 1993; Aubert et al., 2006). The computerisation of the production process and the introduction of Information and Communication Technologies (ICT hereafter) in the 1990's accelerated the obsolescence of specific skills acquired by senior workers. Nevertheless, Greenan et al. (2012) put forward that nowadays computer use by older workers does not raise the same issues as in the early 1990's. Indeed, workers aged 50 or over in the mid-2000's were aged 30 when ICT started being more widely diffused, so their computer literacy rate is higher on average than that of workers aged 50 or over in 1990.

employers can reap the benefits of their investment.

The main contribution of this paper is to study empirically how the horizon effect and the technological or organisational changes interact to explain the probability of being an internal trainer at the end of career. We use data from a French matched employer-employee survey on Organisational Changes and Computerisation (COI) conducted in 2006. It contains information both on employees' knowledge transmission practices and employers' technological or organisational changes. We find that the shorter the horizon of a worker aged 50 and over, the higher is her probability of being an internal trainer, but only in firms that did not experience any changes. In changing firms, we find the same effect provided that the older worker benefited from a training session to update her skills.

The remainder of the paper is structured as follows. In Section 2, we present the data used and we provide some descriptive statistics on the relationship between age and the probability of transmitting skills, looking at gender and occupational effects. In Section 3, we study how the career horizon and the technological and organisational changes contribute to the explanation of the reduced probability of being an internal trainer for some categories of older workers. Section 4 concludes by suggesting a public policy recommendation regarding the implementation of the *generation contract* reform in France.

2   Data and descriptive statistics

2.1   The "Organisational Changes and Computerisation" survey

To perform our empirical study, we use a matched employer-employee survey on Organisational Changes and Computerisation (COI hereafter) conducted in 2006 where 14301 workers employed in 6385 firms with more than 20 workers in the commercial sector have been interviewed. This data set provides detailed information on demographic and economic characteristics of respondents, on their working conditions and also on their firm. As we are interested in knowledge transmission within the firm, we exploit information about the interactions that respondents may have with their colleagues to build our dependent variable, i.e. the probability of being an internal trainer. More precisely, workers are asked "how often they show some work practices to their colleagues", "how often they help some colleagues when they encounter some relational

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problem with other team members or customers" and "how often they help some colleagues who encounter technical problems"[11]. From this set of questions, we define an internal trainer in the following way: a worker who carries out each of these activities at least 2-3 times a year and at least one activity 2-3 times a month. To test whether all the results that we will present are not just driven by our definition of an internal trainer, we perform some robustness checks in Section 3.2 with alternative definitions.

To measure the career horizon, we follow a similar approach as in Hairault et al. (2010) and we build for each worker the distance to exit which is the distance to the age required to draw a pension at the highest replacement rate. This full retirement age is computed adding the required number of contributive years to be entitled to a full pension[12] to the age at which the individual left the education system. In addition, if the individual reaches 65 before she achieves the condition to draw a full pension, she can be entitled to the highest replacement rate. As stressed by Hairault et al., while unemployment episodes are included in the number of contributive periods, our proxy does not account for breaks in careers due to maternity or parental leave. But the latter are undoubtedly mostly taken by women in France and could lead to miscalculating their distance to retirement. Therefore, women are excluded from the analysis.

To control for technological or organisational changes, we use the employer section of the COI survey, where firm representatives are asked about the introduction of some modern management tools and ICT equipment in their organisation, at the time of the survey and three years before from retrospective questions. As shown in Table 1, 15 ICTs and 13 management tools are considered. We rely on indicators built by Bigi et al. (2013) synthesising the intensity in use of each type of tool in 2003 and 2006 by Multiple Correspondence Analysis. The indicator of intensity of change for each firm is simply computed by the difference in indicators between these two dates[13]. By studying the distribution of our indicator of technological (organisational) change, we see that a large proportion of firms remained inert between 2003 and 2006: 50% for technological change captured through the use of ICT tools, 60% for organisational change measured through modern management tools. Consequently, in the remainder of the study a firm that has undergone a change either in the ICT tools or in the management tools used

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[11]Note that these situations correspond to different strategies of knowledge transmission (Lefebvre et al., 2003).

[12]40 years in the 2006 French Social Security System

[13]For more details about the methodology, see Greenan and Mairesse (2006) and Bigi et al. (2013).

between 2003 and 2006 will be referred to as a changing firm.

Insert Table 1 about here

To select the other covariates that we include in our model to predict the probability of being an internal trainer at the end of career, we rely on the previous studies in management about the determinants of mentor-protégé relationships. In our regressions, we include the age, marital status, educational level, skill level, seniority and wage of the individual. To control for a potential effect of health, we introduce a dummy to indicate the presence of health limitations. Regarding work environment, we control for full time or part time jobs[14]. In addition, the management literature puts forward that spatial proximity (Festinger et al., 1950) or job rotations facilitate the initiation of mentor-protégé relationships. So we include a dummy indicating whether employee changed workplace frequently and another dummy for individuals who report having changed colleagues over the last 12 months. We also control for some constraints that may impair the quality of transmission, especially time constraints (Thébault et al., 2012), measured by the fact that workers report that their pace of work is imposed by an external demand. Regarding the employer, we know the sector, the size and also the age structure of each firm. Last but not least, the COI survey provides information about the different training spells that respondents experienced between 2003 and 2006. We consider training session on the use of new ICT or new management tools.

2.2 Descriptive statistics

Figure 1 displays the share of internal trainers by age and skill level in the whole sample for men and women. We note that first, the share of internal trainers is increasing with the age with a peak at 40-49 years and then it falls after 50, which is in line with the results found on another data source by Molinié and Volkoff (2013). Second, the proportion of internal trainers is increasing with the skill level for each age group but the decrease in the proportion of internal trainers after age 50 is only observed for skilled male workers[15]. In addition, the age pattern for low-skilled women is quite different and is steadily decreasing after 30, while other curves

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[14]We do not control the type of contract (temporary or not) given that the COI survey has been conducted on a sample of stable workers with more than one year of seniority.

[15]This negative effect of being aged 50 and over observed among male skilled workers is significant once controlling for all covariates mentioned in Section 2.1.

are hump-shaped. These stylised facts are consistent with previous studies carried out using the COI survey in 1997 and 2006 that showed that low-skilled women have a lower probability to occupy jobs that imply numerous interactions with their colleagues (Greenan et Walkowiak, 2005 ; Ratto, 2013)[16]. As the reduced probability of being an internal trainer among workers aged 50 and over is significant only for male skilled workers, we restrict our analysis to this sub-sample. We end up with 903 observations.

Insert Figure 1 about here

Table 2 gives descriptive statistics for this sub-sample, decomposing it between workers employed in a non-changing firm and those employed in a changing firm. We also present in this table the significance level of the differences in mean for each covariate. We see that employees are very much alike in terms of socio-demographic characteristics in the two types of firms. They mainly differ according to their average seniority and the industry of their employer.

Insert Table 2 about here

In addition, given the way we build the measure of the workers' career horizon we could wonder whether it is possible to disentangle the effects due to a short horizon from simple age or education effects. In Table 3, we see that for older males employed in skilled jobs the age structure or the distribution of educational level is somewhat well balanced among workers at 6 years or less from their full retirement age. However, around 95% of workers who are at 7 years or more from their full retirement age are aged 55 years or under. It makes more difficult to identify the proper effect of short horizon. We will discuss this issue in Section 3.2.

Insert Table 3 about here

3   Econometric results

3.1   Career horizon and knowledge transmission: the role of technological and organisational change and of training incidence

The aim of this section is to investigate how a short horizon affects the probability for a male skilled worker aged 50 and over to have a role of internal trainer. We pay a particular attention

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[16]It is worth precising that the sample of the COI survey does not include some sectors in which women have a well identified role of internal trainers, e.g. health sector or education.

to the role of technological and organisational changes that may have hit his work environment as well as the potentially offsetting effect of training. We define a short career horizon as a distance of 6 years or less[17] to the full retirement age. As our dependent variable is binary, we estimate Probit regressions on two sub-samples: skilled male workers employed in changing firms and those employed in non changing firms. This empirical approach may have some pitfalls, given that workers employed in changing firms may differ from workers employed in non-changing firms in terms of observables and also of unobservables. Regarding the first issue, Table 2 shows that workers on both sub-samples are very much alike, except for seniority and industry which will be controlled in our regressions. To address the second issue and hence to control for unobserved heterogeneity, we estimate a wage fixed effect from a Mincerian regression using social security records of the employees' work history (the DADS administrative panel) since 1976. This estimation has been carried out over the time period before the entry of the respondent in the firm that answers the COI survey. It allows us to disentangle the characteristics of the worker from those of his current firm and then to remove, at least partially, the omitted variable bias[18].

We present our results in Table 3. Columns 1 and 3 present the effect of a short horizon on the probability of being an internal trainer, once controlling for a wide set of workers', jobs' and firms' characteristics. Columns 2 and 4 show how training incidence may interact with the effect of the career horizon. It could be surprising that an employer invest in the human capital of a worker close to his exit age. Nevertheless, among our sub sample, 47% of workers report having participated into a training session. This proportion does not vary significantly with the career horizon, 49% for individuals at more than 6 years from full retirement age and 46% for those at 6 years or less from it. So we could check whether skill updating could allow an older worker to be an internal trainer even though he is employed in a changing firm. This implies studying the interaction term between the short time horizon dummy and the training participation dummy[19].

First, we discuss briefly the coefficients associated to the covariates, leaving aside the results on

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[17]We could choose a narrower window to define short horizon (5 or 4 years before the full retirement age), but we face the problem of the small size of our sub-samples. Nevertheless, using smaller durations to define short horizon, we obtain qualitatively similar results but they are less significant.

[18]For a similar specification, see also Behaghel and Greenan (2010).

[19]We use the Ai and Norton's (2003) methodology to compute the interaction effect in a non linear model.

short horizon and training participation. The estimates show a positive correlation between the educational level or the seniority and the probability of being an internal trainer. In addition, we see a negative effect of the wage on the probability of transmitting the skills, which would imply that those who transmit their skills are not employed in the more rewarding jobs. As knowledge transmission is time consuming and attention is limited, especially in rewarding jobs with more complex tasks, workers in such positions would be less likely to devote time to the informal transmission of their skills. Indeed the associated opportunity cost would be too high. We also see that some correlations are significant in non-changing firms but not in changing ones. Thus, in non-changing firms only, a high share of workers aged 45 and over or a large firm's size reduce the incidence of knowledge transmission. Knowledge transmission would be less necessary between experienced workers when firms keep on using the same technology in the same organisational setting and bigger sized firms would rely more on formal training for new entrants than on informal transmission. Industry-specific effects are non-significant in non-changing firms while in changing ones, knowledge transmission seems to be favoured in financial or real estate activities and in construction characterised by frequent change in legal and technical norms and less frequent in the retail trade.

The main result in columns 1 and 3 of Table 3 is that a short horizon (6 years or less from the full retirement age) increases the probability of being an internal trainer by 15 percentage points for older workers employed in non-changing firms, while this effect is only of 4.1 points (and is non-significant) in changing firms. Note that these coefficients are not affected significantly when we add age dummies in the regressions[20]. These empirical findings would support the claim that an older skilled worker close to his exit age has higher chances to transmit his skills, but only if his knowledge has not been depreciated by technological and organisational change. However, we have to discuss whether our effect results from a low distance to exit and not from a high distance to entry (Benallah et al., 2008).

Insert Table 4 about here

A high distance from labour market entry is mainly associated with low educational level, because of early entry or with a high seniority in the firm. The former, as mentioned previously,

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[20]We have tested different specifications with age dummies or interacting these dummies with the indicator of the short horizon. This does not change our results in a significant way.

exerts a negative effect on the probability of being an internal trainer. Thus, a distance-to-entry effect that would result from a low educational level cannot be confounded with the distance-to-exit effect we show, given that they have the opposite sign. In addition, seniority has not any significant effect on the probability of being an internal trainer, given that too few older workers have stayed less than 10 years in the same firm[21]. Consequently, the effect that we highlight comes from a short career horizon.

Then we analyse in Columns 2 and 4 of Table 4 the role of training incidence. We see that on the one hand for changing firms once we control for training participation and its interaction with short horizon, the latter has a negative and significant effect of 12 points at a 10% level. On the other hand, in the sub-sample of workers employed in non-changing firms, accounting for training participation does not affect the influence of the career horizon. In addition, we see that in changing firms the interaction term is positive and significant at a 5% level so we could say that when they are trained, older workers in dynamic environments are no more excluded from transmission.

It could be argued that this effect may be due to a simple selection bias. If those who benefit from training are the more productive workers, we could expect that they would have transmitted their skills at the end of their career, anyway. However, we have seen previously that given the high opportunity cost of devoting some time to knowledge transmission, this activity is not necessarily associated with high performance. In this respect, note that the participation to a training session reduces the probability of being internal trainers for workers at 7 years or more from their full retirement age. When trained workers are as still far from their exit age, employers prefer to assign them to their usual tasks rather than to knowledge transmission. Indeed, their opportunity cost of transmitting increases after their skills' update. In addition, if the positive and significant coefficient associated with the interaction term was only due to some selection bias, we would observe the same effect in non-changing firms. There is no reason to think that the selection of trained workers would work in a different way in inert and in changing firms[22].

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[21]In Table 4, Column 1, we see that having more than 10 years of experience in a firm seems to be discriminant for being an internal trainer. Among workers with higher seniority, additional years of experience do not influence significantly the probability of transmitting skills.

[22]The training rates in inert and changing firms are very similar, respectively 43.55% and 46.93% (the difference is not significant even at the 10% level).

As the interaction effect is almost nil in non-changing firms, the significant effect in changing firms may show to some extent that trained workers in changing firms are no more excluded from transmission. At last, note that the wage fixed-effect is strongly significant in changing firms. This indicates a selection bias, i.e. the high-ability workers sort into more dynamic work environments. So, introducing the fixed-effect in the regression, we remove partially this bias and we can be more confident in our results.

3.2   Robustness checks

First, we have to test the robustness of our findings to alternative definitions of our dependent variable. We suggest four different definitions. According to the first, the three types of transmission (showing work practices and solving technological or relational problems) have to be carried out at least 2-3 times a month. This corresponds to a more restrictive definition. For the other three definitions, we characterize internal trainers by the more frequent transmission situation they report[23].

Furthermore, our dependent variable could reflect only the probability of having supervisory responsibilities. With our data, we know whether respondents have direct subordinates. Using this information, we see that one third of the workers having supervisory responsibilities are not internal trainers (whatever the definition used). So we can disentangle pure transmission aspects from other management situations. Regressing this variable on short horizon dummy and the other covariates, we can test whether the horizon effect is still significant.

In Table 5 we report only the marginal effect of the short horizon for workers employed in changing firms and those employed in non-changing ones. All other covariates introduced in the regressions are the same as in Table 4[24]. For each of the definitions used, a short career horizon increases the probability of being an internal trainer but only in non-changing firms. This confirms our previous results. In addition, when considering the dummy for supervisory responsibilities as dependent variable the effect of short horizon in non-changing firms is 1.5 lower than the one found in Table 4 and is no more significant. So we could say that the effect we show has to do with knowledge transmission.

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[23]Regarding definitions 2, 3 and 4, the more frequent transmission situation corresponds respectively to "showing some work practices", "solving technical problems" and "solving relational problems".

[24]The full table with the coefficient of the other covariates for each dependent variable is available upon request.

It is interesting to compare the coefficients obtained with the definition 3 with those obtained with the definition 4 of an internal trainer. Indeed, we would expect that the transmission of knowledge-based tasks would be more subject to skill obsolescence than the transmission of experience-based tasks[25]. On the one hand for the definition 3, in non-changing firms short horizon raises the probability of being an internal trainer by 19.8 points while this effect is only of 3.3 points in changing environments. This difference indicates that in dynamic environments, older workers are excluded from transmission of knowledge-based skills. On the other hand if we use the definition 4, short horizon increases the probability of transmitting skills by 14.6 points in inert firms while this effect is still of 9.5 points in changing ones. Even though this effect is not significant, it is almost three times higher than the one found using definition 3. This may show that older workers close to the exit age keep on transmitting experience-based skills even though they faced a technological or organisational change.

In addition, our findings are subject to a potential selection bias that may lead us to overestimate the effect of short horizon on the probability of knowledge transmission. Indeed, it could be that employers retain the more productive seniors and encourage less productive ones to leave, exploiting the different early exit pathways still available in France between 55 and 59 years[26]. Hairault et al. (2010) show that the distance to the full retirement age has a significant effect on the employment probability but only after 56 years old. So, we could test whether our results hold for workers aged 50-54 years less subject to selection bias. This regression may also help us to better disentangle horizon effect from simple age effects. Indeed, we have seen in Table 3 that the age distribution is well balanced among workers aged 55 and under. Note that among workers aged 50-54 years 50% are at 6 years or less from their full retirement age. So we can perform the same regressions as in Table 4 for this age group. However, we face the problem of the small size of our sub-samples if we distinguish changing firms and non-changing ones. So we estimate for the whole sample of skilled workers aged 50-54 years the effect of the interac-

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[25]Backes-Gellner and Janssen (2009) distinguish two kinds of activities: those based on a technical knowledge (e.g. programming softwares) and those based on experience (selling or negotiating contracts). With German data they show that workers performing knowledge-based tasks face greater skill obsolescence than those performing experience-based ones.

[26]In France in 2006, while the share of employed workers aged 50-54 is around 80%, it drops to 65% for individuals aged 55 years and to 40% for those aged 59 (Source : "Transitions from Work to Retirement", an ad hoc module of the annual French Labour Survey).

tion term between the short horizon dummy and an indicator variable for changing environments.

In Column 1 of Table 6, we present the marginal effect of having a short distance to full retirement age on the probability of being an internal trainer (using the baseline definition), including the same covariates as in Table 4. Then in Column 2 of Table 6, we add the changing environment dummy and the interaction term with the short horizon one[27]. In Column 1, short horizon exerts a positive effect but not significant while in the second column, it becomes strongly significant. In addition the interaction term is negative and almost significant at a 5% level. This shows that a worker close to his exit age may be more likely to be an internal trainer provided that his work environment has not been affected by any change.

Insert Table 6 about here

Our findings suggest that in inert firms, skilled older workers have a comparative advantage in terms of experience. Consequently, just before they leave into retirement, they transmit their knowledge and therefore contribute to the production process of firms. However, in dynamic environments older workers could be excluded from knowledge transmission if their skills have not been updated. In this setting, forcing firms to retain them may be counterproductive if they do not benefit from training sessions on new work practices. This result has public policy implications regarding the implementation of the *generation contract* in France. This reform should combine the financial penalty, already set for all firms with 50 employees or more that did not sign any agreement, with training subsidies targeted to older workers. Firms would be encouraged to update their older workers' skills and would allow them to contribute to the production process through skills' transmission.

4   Conclusion

In this paper, we analyze the factors that affect the probability for older workers of transmitting their knowledge within the firm. Given that recent French reforms aim at promoting employment among younger and older workers, a better understanding of their interactions within the workplace is a crucial issue. We focus our study on the sub-sample of male skilled workers, for whom the probability of transmitting skills is significantly reduced after age 50.

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[27]We use the Ai and Norton's (2003) methodology to compute the interaction effect in a non linear model.

The main contribution of this paper is to show that short horizon increases the probability of being an internal trainer, provided that the firm has not adopted recently new ICT or new management tools. This suggests that technological or organisational changes play a key role in explaining the under-representation of older workers among internal trainers. In inert work environments employers have interest to encourage workers to devote some time to knowledge transmission just before they leave. In these firms, workers participate to the transmission of vocational skills even at the end of career. However, in changing firms older workers can lose their comparative advantage in terms of experience if their skills have not been updated after the change. In that case, short horizon may exclude workers from knowledge transmission.

As it stands our work presents some limits. First, with our data we cannot identify workers who benefit from the knowledge transmission. It would be interesting to investigate how they get this knowledge and to better grasp the learning-by-watching process especially for new entrants in the firm. In addition, we study the probability of being an internal trainer but we did not measure either the quality of the transmission or its effects on the firms' performance. Regarding the management of an ageing workforce these are key issues that deserve further investigation.

In terms of public policy, considering informal skills' transmission may contribute to the optimal design of training subsidies over the life cycle. Indeed, if transmission raises the productivity of new entrants, assigning older workers to this activity may be a good way of combing entry of young workers and retention of old ones. We suggest that training subsidies targeted to older workers could be a useful tool to achieve this goal. It would encourage employers to update their older workers' skills after a change despite their short career horizon. In doing so, they would restore the older workers' comparative advantage in terms of experience and may generate positive externalities through transmission of vocational skills. So the introduction of knowledge transmission in models examining the optimal design of training subsidies appears to be a promising avenue for future research.

References

Acemoglu, D., and Pischke, J. S. (1998). Why do firms train? Theory and evidence. The Quarterly Journal of Economics, 113(1), 79-119.

Ai, C., and Norton, E. C. (2003). Interaction terms in logit and probit models. Economics letters, 80(1), 123-129.

Aubert, P. and B. Crépon (2006). Age, wage and productivity: firm-level evidence. Discussion Paper INSEE, Paris.

Aubert, P., Caroli, E., and Roger, M. (2006). New technologies, organisation and age: firm-level evidence. The Economic Journal, 116(509) : 73-93.

Bartel, A. P., and Sicherman, N. (1993). Technological change and retirement decisions of older workers. Journal of Labor Economics, 11(1), 162-183.

Bartel, A., Phibbs, C., Beaulieu, N., and Stone, P. (2011). Human Capital and Organizational Performance: Evidence from the Healthcare Sector. NBER Working Paper, no. 17474.

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. The journal of political economy, 70(5), 9-49.

Behaghel, L. and Greenan, N. (2010). Training and age-biased technical change. Annals of Economics and Statistics, pp. 317-342.

Benallah, S., Duc, C., and Legendre, F. (2008). Peut-on expliquer le faible taux d'emploi des seniors en France. Revue de l'OFCE, (2), 19-54.

Bertschek, I. and J. Meyer (2008). Do older workers lower IT-enabled productivity? Firm-level evidence from Germany. Firm-Level Evidence from Germany. Jahrbücher für Nationalökonomie und Statistik, 229(2/3), 327-342.

Bigi, M., Greenan, N., Hamon-Cholet, S., and Lanfranchi, J. (2013). Organisational Changes and the Evolution of Working Life Quality: A Comparison between the Private Sector and the State Civil Service. In Kirov V. (ed.) Adressing quality of work in Europe, Ciela, Sofia.

Card, D., and Lemieux T. (2001). Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis. The Quarterly Journal of Economics 116(2): 705-746.

Cardoso, A. R., Guimares, P., et Varejo, J. (2011). Are older workers worthy of their pay? An empirical investigation of age-productivity and age-wage nexuses. De Economist 159(2): 95-111.

Chao, G. T. (1998). Invited reaction: Challenging research in mentoring. Human Resource Development Quarterly, 9(4) : 333-338.

Daveri, F. and M. Maliranta (2007). Age, seniority and labour costs: lessons from the Finnish IT revolution. Economic Policy 22(49): 117-175.

Eichhorst, W., Boeri, T., de Coen, A., Galasso, V., Kendzia, M. J., and Steiber, N. (2013). How to Combine the Entry of Young People in the Labour Market with the Retention of Older Workers. No. 7829. IZA Discussion Paper.

Festinger, L., Back, K. W., and Schachter, S. (1950). Social pressures in informal groups: A study of human factors in housing (No. 3). Stanford University Press.

Garicano, L. (2000). Hierarchies and the Organization of Knowledge in Production. Journal of Political Economy, 108(5): 874-904.

Garicano, L., and Hubbard, T. N. (2005). Hierarchical sorting and learning costs: Theory and evidence from the law. Journal of economic behavior and organization, 58(2) : 349-369.

Gaudart, C. (1996). Transformations de l'activité avec l'âge dans des tâches de montage automobile sur chaîne. Thèse d'ergonomie. LEPC-EPHE, Paris.

Gaudart, C., Delgoulet, C., and Chassaing, K. (2008). La fidélisation de nouveaux dans une entreprise du BTP: Approche ergonomique des enjeux et des dterminants. Activités, 5 (2), 2-24.

Göbel, C. and T. Zwick (2012). Age and productivity: sector differences. De Economist 160(1): 35-57.

Greenan, N., and Mairesse, J. (2006). Les changements organisationnels, l'informatisation des entreprises et le travail des salariés. Revue économique, 57(6): 1137-1175.

Greenan, N., Narcy, M., and Robin, S. (2012). Changements au sein des entreprises et accès des seniors la formation continue dans les années 1990 et 2000. Revue française d'économie, 27(1) : 129-162.

Gruber, J. and Wise, D.A. (2010). Social Security programs and retirement around the world: the relationship to youth employment. University of Chicago Press.

Grund, C., and Westergard-Nielsen, N. (2008). Age structure of the workforce and firm performance. International Journal of Manpower 29(5): 410-422.

Guest, R. (2007). Innovations in the macroeconomic modelling of population ageing. Economic Modelling, 24(1): 101-119.

Guest, R., and Stewart H. (2011). The age dispersion of workers and firm productivity: a survey approach. Australian Journal of Labour Economics 14(1): 59-75.

Hairault, J. O., Sopraseuth, T., and Langot, F. (2010). Distance to Retirement and Older Workers' Employment: The Case for Delaying the Retirement Age. Journal of the European Economic association, 8(5): 1034-1076.

Hellerstein, J. K., Neumark, D., and Troske, K.R. (1999). Wages, Productivity, and Worker Characteristics: Evidence from Plant-Level Production Functions and Wage Equations. Journal of Labor Economics 17(3): 409-446.

Janssen, S., and Backes-Gellner, U. (2009). Skill obsolescence, vintage effects and changing tasks. Applied economics quarterly, 55(1) : 83.

Lallemand, T. and F. Rycx (2009). Are older workers harmful for firm productivity. De Economist 157(3): 273-292.

Lefebvre, S., Cloutier, E., Ledoux, E., and Chatigny, C. (2003). Transmission et vieillissement au travail. Vie et vieillissement, 2(1-2) : 67-76.

Leuven, E. (2005). The economics of private sector training: A survey of the literature. Journal of economic surveys, 19(1): 91-111.

Marquié, J. CL.(1995). Changements cognitifs, contraintes de travail, et expérience: les marges de manoeuvres du travailleur vieillissant. In J. Cl. Marquié, D. Paumès and S. Volkoff (Eds.). Le travail au fil de l'âge : pp. 211-244.

Masingue, B. (2009). Seniors tuteurs: comment faire mieux. Rapport au Secrétaire d'Etat chargé de l'emploi.

Molinié, A.F., and Volkoff, S. (2013). Avoir un rôle de tuteur : qui et dans quel travail. Connaissance de l'emploi. 101.

Ragins, B. R., and Kram, K. E. (Eds.). (2007). The handbook of mentoring at work: Theory, research, and practice. Sage.

Ratto, M. (2013). Work practices as implicit incentives to cooperate, CEE working papers, 167, november.

Roger, M., and Wasmer, M. (2011). Heterogeneity Matters: Labour Productivity Differentiated by Age and Skills. INSEE working paper, G2011/04.

Rufini, A. (2008). The organization of social learning in firms: Should it be formal or informal?, Mimo GREDEG, april.

Thébault, J., Gaudart, C., Cloutier, E., and Volkoff, S. (2012). Transmission of vocational skills between experienced and new hospital workers. Work: a journal of prevention, assessment and rehabilitation, 41(2), 195-204.

Van Ours, J. C. and L. Stoeldraijer (2011). Age, wage and productivity in Dutch manufacturing. De Economist 159(2): 113-137.

Vandenberghe, V. and F. Waltenberg (2010). Ageing workforce, productivity and labour costs of Belgian firms. IRES WP(2010-3).

Welford, A.T. (1958). Ageing and Human Skills. London: Oxford University Press.

Table 1: Presence of ICT and new management tools in firms over the period 2003-2006

	% of productive units with ICT tools	
	2003	2006
Website	61.2	73.3
Local Area Network (LAN)	61.3	66.7
Intranet	47.9	57.8
Extranet	25.0	30.2
Electronic data interchange system	36.2	45.8
Using an Enterprise Resource Planning (ERP)	26.6	29.6
Database for research	26.1	28.8
Database on the management of Human Resources	34.5	38.5
Use of software or firmware for research	47.4	49.8
Use of software or firmware for the management of Human Resources	63.4	65.3
Tools for data analysis	39.5	47.1
Tools for interfacing databases	21.1	28.6
Tools for automated data archiving or research	21.4	27.4
Collaborative tools (groupware)	15.1	21.0
Tools for process modelling	8.8	12.7
	% of productive units with new management tools	
	2003	2006
Contractual commitment top provide a product or service or customer service within a limited time	66.1	68.5
Long-term relationships with suppliers	51.7	54.7
Requirements for suppliers to meet tight deadlines	51.5	53.5
Quality certifications	36.3	41.4
Satisfaction surveys for customers	32.9	38.7
Teams or autonomous work groups	30.7	33.8
Tools for tracing products or services	28.3	32.9
Tools for labelling goods and services	28.3	30.8
Call centres	25.5	28.0
Management of production in good time	22.9	24.3
Methods of problem solving	17.3	20.9
IT management integrated to the customer relationship	9.7	14.3
Environmental or ethical certification	9.7	12.9

Source : COI (2006)/ INSEE-DARES-CEE

Note: The sample includes firms with 20 employees or more in the commercial sector.

Table 2: Descriptive statistics in changing and non-changing firms for skilled male workers aged 50 years and over

	Non-changing firms	Changing firms
Worker's characteristics		
Socio-demographic variables		
Career horizon	4.9	4.2
Single	0.868	0.914
Educational level		
Primary	0.100	0.110
Vocational	0.245	0.252
High School	0.137	0.187
Undergraduate	0.251	0.193
Graduate post-graduate	0.267	0.257
Health limitations	0.066	0.066
Job's characteristics		
Seniority		
0-10 years	0.160	0.211
11-20 years	0.227	0.134*
21-30 years	0.334	0.251
More than 30 years	0.279	0.405**
Log of the daily wage	4.63	4.652
Part-time	0.016	0.014
Working conditions		
Change workplace frequently	0.170	0.124
No time constraint	0.585	0.565
No change in colleagues over the last 12 months	0.513	0.535
Firm's characteristics		
Age structure		
High share of young workers (¡30 years)	0.353	0.312
High share of workers aged 30-45 years	0.256	0.285
High share of older workers (¿45 years)	0.196	0.201
Firm's size		
20-49 workers	0.103	0.099
50-299 workers	0.246	0.256
300 workers or more	0.651	0.644
Industry		
Manufacturing	0.404	0.537**
Construction	0.066	0.055
Retail trade	0.150	0.158
Transports	0.031	0.071*
Financial and real estate activities	0.209	0.093*
Media and services to firms	0.139	0.086*
Observations	349	554

Source: COI survey 2006/ INSEE-DARES-CEE
Note: The sample includes skilled male workers aged 50 and over with at least one year of experience and employed in firms with 20 workers or more.
Significance levels for differences in means: ***p$<$0.01,**p$<$0.05,*p$<$0.1

Table 3: Distribution of age and educational level for different career horizons among skilled male workers aged 50 and over

| Age group | Distance to full retirement age | | |
	2 years or less	3-6 years	7 years or more
50-51	9	83	127
	(3.09%)	(23.99%)	(47.74%)
52-53	30	108	76
	(10.31%)	(31.21%)	(28.57%)
54-55	93	75	49
	(31.96%)	(21.68%)	(18.42%)
56-57	85	60	14
	(29.21%)	(17.34%)	(5.26%)
58-59	74	20	0
	(25.43%)	(5.78%)	0
Educational level			
Primary	74	27	2
	(25.43%)	(7.80%)	(0.75%)
Vocational	112	110	27
	(38.49%)	(31.79%)	(10.15%)
High-School	61	84	33
	(20.96%)	(24.28%)	(12.41%)
Undergraduate	32	77	76
	(11.00%)	(22.25%)	(28.57%)
Graduate, post-graduate	12	48	128
	(4.12%)	(13.87%)	(48.12%)
Observations	291	346	266
	(100%)	(100%)	(100%)

Source: COI survey 2006/ INSEE-DARES-CEE
Note: The sample includes skilled male workers aged 50 and over with at least one year of experience and employed in firms with 20 workers or more.

Table 4: The determinants of the probability of being an internal trainer for skilled male workers aged 50 and over in changing and non-changing firms

	Non-changing firms		Changing firms	
Variables of interest				
Short horizon (6 years or less from full retirement age)	0.150**	0.167**	0.0410	-0.120*
	(0.0639)	(0.0839)	(0.0567)	(0.0730)
Participation to a training session		-0.0231		-0.245***
		(0.0888)		(0.0836)
Interaction low horizon*participation to training		-0.0295		0.375***
		(0.108)		(0.103)
Mincerian wage fixed effects from DADS	-0.0437	-0.0421	0.322***	0.294***
	(0.0808)	(0.0794)	(0.0928)	(0.0836)
Socio-demographic variables				
Single	-0.0964	-0.0979	-0.208***	-0.200**
	(0.0776)	(0.0760)	(0.0782)	(0.0786)
Educational level (ref.: graduate and post-graduate)				
Primary	-0.301***	-0.316***	0.00413	-0.0243
	(0.0907)	(0.0938)	(0.117)	(0.112)
Vocational	-0.234***	-0.235***	-0.0768	-0.0875
	(0.0737)	(0.0738)	(0.0904)	(0.0872)
High School	-0.165**	-0.169**	-0.0249	-0.0246
	(0.0800)	(0.0800)	(0.0852)	(0.0826)
Undergraduate	-0.109	-0.115	0.0370	0.0254
	(0.0748)	(0.0734)	(0.0920)	(0.0896)
Health limitations	0.0102	0.0132	0.0727	0.0991
	(0.0907)	(0.0899)	(0.0842)	(0.0826)
Job's characteristics				
Seniority (ref.: more than 30 years)				
0-10 years	-0.118*	-0.109	-0.0149	-0.0163
	(0.0707)	(0.0704)	(0.0800)	(0.0769)
11-20 years	-0.0582	-0.0531	0.0967	0.104
	(0.0744)	(0.0735)	(0.0628)	(0.0632)
21-30 years	-0.0650	-0.0630	-0.0447	-0.0307
	(0.0629)	(0.0624)	(0.0567)	(0.0568)
Log of the daily wage	-0.147**	-0.146**	-0.139**	-0.119*
	(0.0628)	(0.0626)	(0.0662)	(0.0630)
Part-time	-0.188	-0.194	-0.306	-0.315
	(0.166)	(0.163)	(0.242)	(0.230)
Working conditions				
Change workplace frequently	0.0311	0.0335	-0.0438	-0.0291
	(0.0621)	(0.0628)	(0.0750)	(0.0726)
No time constraints	-0.116**	-0.109**	-0.167***	-0.184***
	(0.0477)	(0.0469)	(0.0537)	(0.0520)
No change in colleagues over the last 12 months	0.0484	0.0471	-0.0336	-0.0295
	(0.0527)	(0.0521)	(0.0452)	(0.0441)
Firm's characteristics				
Age structure (ref.: high share of mid-age workers)				
High share of young workers	-0.0977	-0.0949	-0.0540	-0.0526
	(0.0597)	(0.0581)	(0.0499)	(0.0498)
High share of older workers	-0.150**	-0.154**	0.0403	0.0562
	(0.0742)	(0.0738)	(0.0689)	(0.0646)
Firm's size (ref.: 300 workers or more)				
20-49 workers	0.141*	0.132*	0.0307	0.0530
	(0.0763)	(0.0759)	(0.0801)	(0.0795)
50-299 workers	-0.0532	-0.0620	-0.0465	-0.0159
	(0.0564)	(0.0558)	(0.0572)	(0.0553)
Industry (ref.: manufacturing)				
Construction	0.118	0.119	0.133	0.147*
	(0.0948)	(0.0932)	(0.0867)	(0.0874)
Retail trade	-0.0108	-0.00859	-0.118*	-0.101
	(0.0685)	(0.0689)	(0.0707)	(0.0693)
Transports	-0.0661	-0.0786	0.123	0.143
	(0.0880)	(0.0895)	(0.100)	(0.0950)
Financial and real estate activities	-0.0872	-0.0821	0.184**	0.202**
	(0.0766)	(0.0753)	(0.0778)	(0.0796)
Media and services to firms	0.0868	0.0850	0.0213	0.0214
	(0.0847)	(0.0833)	(0.0756)	(0.0761)
Observations	349	349	554	554

Source: COI survey 2006/ INSEE-DARES-CEE
Note: The sample includes skilled male workers aged 50 and over with at least one year of experience and employed in firms with 20 workers or more. Marginal effects are estimated with Probit models for each sub-sample. Standard errors (in parentheses) are computed with delta method.
The marginal effect of the interaction term has been computed following Ai and Norton's (2003) approach.
Significance levels: ***$p<0.01$,**$p<0.05$,*$p<0.1$

Table 5: Marginal effects of short horizon on the probability of being an internal trainer for different definitions of the dependent variable

			Marginal effects (in percentage points)	
Dependent variables	Frequency (minimal)		Non-changing firms	Changing firms
Show some work practices	2-3 times a month	}		
Solve technical problems	2-3 times a month	} Definition 1	0.229**	-0.044
Solve relational problems	2-3 times a month	}	(0.079)	(0.060)
Show some work practices	2-3 times a month	}		
Solve technical problems	2-3 times a year	} Definition 2	0.235**	-0.068
Solve relational problems	2-3 times a year	}	(0.071)	(0.064)
Show some work practices	2-3 times a year	}		
Solve technical problems	2-3 times a month	} Definition 3	0.198**	0.033
Solve relational problems	2-3 times a year	}	(0.077)	(0.086)
Show some work practices	2-3 times a year	}		
Solve technical problems	2-3 times a year	} Definition 4	0.146*	0.095
Solve relational problems	2-3 times a month	}	(0.095)	(0.085)
Has supervisory responsibilities			0.103	0.031
			(0.086)	(0.055)
Observations			349	554

Source: COI survey 2006/ INSEE-DARES-CEE
Note: The sample includes skilled male workers aged 50 and over with at least one year of experience and employed in firms with 20 workers or more. Marginal effects are estimated with Probit models for each sub-sample. Standard errors (in parentheses) are computed with delta method. In each regression we have included the same covariates as in Table 4.
Significance levels: ***p<0.01,**p<0.05,*p<0.1

Table 6: The effect of horizon and technological or organizational change on the probability of being an internal trainer for skilled male workers aged 50-54 years

	Marginal effects	
Short horizon (6 years or less from the full retirement age)	0.103	0.218**
	(0.064)	(0.088)
Employed in a changing firm		0.140
		(0.078)
Interaction term		-0.203*
		(0.106)
Observations	464	464

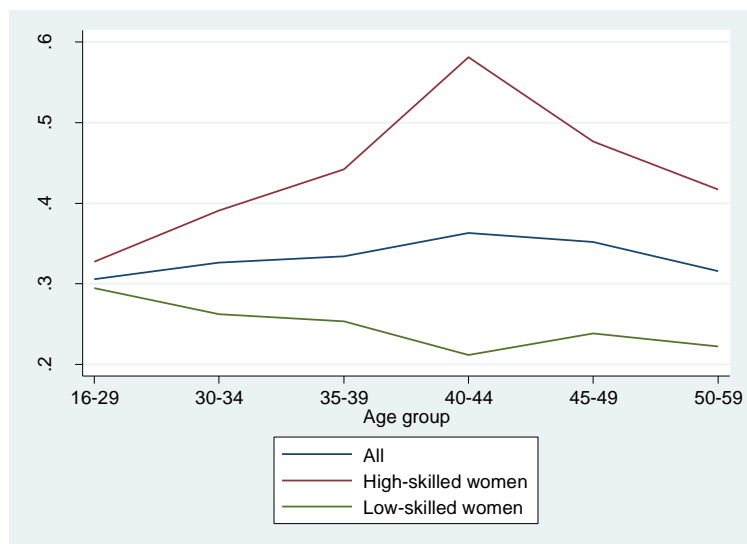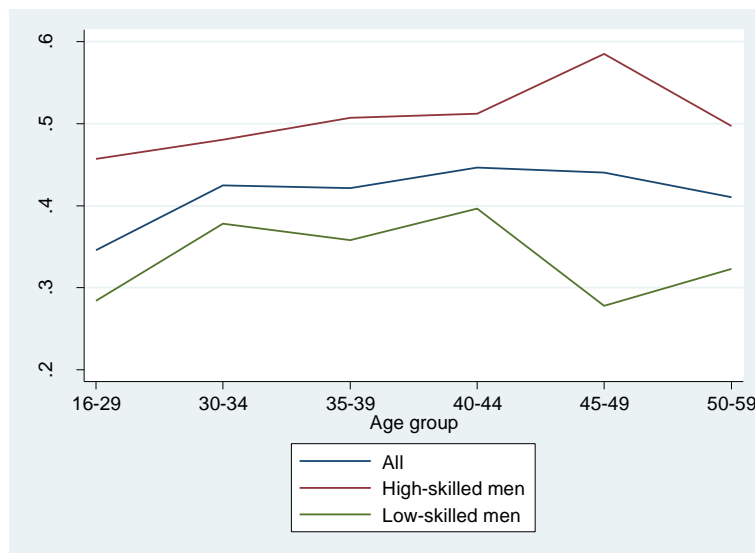Source: COI survey 2006/ INSEE-DARES-CEE
Note: The sample includes skilled male workers aged 50-54 with at least one year of experience and employed in firms with 20 workers or more. Marginal effects are estimated with Probit models for each sub-sample. Standard errors (in parentheses) are computed with delta method. In each regression we have included the same covariates as in Table 4. The marginal effect of the interaction term has been computed following Ai and Norton's (2003) approach.
Significance levels: ***p<0.01,**p<0.05,*p<0.1

Figure 1: The proportion of internal trainers by age, gender and skill level

Source: COI survey 2006/ INSEE-DARES-CEE
Note: The sample includes workers aged 16 and over with at least
one year of experience and employed in firms with 20 workers or more.

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