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Explaining Cross-Country Differences in Job-Related Training: Macroeconomic Evidence from OECD Countries

Serge Coulombe (University of Ottawa)
Jean-François Tremblay (University of Ottawa)

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Abstract

This paper presents an empirical analysis on the determinants of aggregate levels of training across 14 OECD countries. Training data comes from the 1994 International Adult Literacy Survey (IALS), which provides highly comparable cross-country data on the percentage of employed individuals that received job-related training. We use a panel data structure to explain the levels of training across country and age groups from the average literacy skills of the corresponding population subset and other cross-country variables, including indicators of compression in the wage structure, the rate of unionization, the unemployment rate, the level of innovation activity and measures of industrial structure. We find that the average level of literacy skills in each age group has a positive and highly significant effect on the proportion of workers that receive training, which is consistent with microeconomic evidence on the effect of educational attainment on the probability that workers participate in training. More importantly, our analysis shows that compression at the bottom of the wage distribution increases training but compression at the top has the opposite effect. These effects are robust and highly significant across gender and for different age-group samples. Potential policy implications are discussed.

Résumé

Les auteurs présentent une analyse empirique des déterminants des niveaux globaux de formation dans 14 pays de l'OCDE. Les données sur la formation proviennent de l'Enquête internationale sur l'alphabétisation et les compétences des adultes (EIACA) de 1994, qui contient des données très facilement comparables d'un pays à l'autre sur le pourcentage de personnes employées qui ont reçu une formation liée à l'emploi. Ils ont utilisé des données de type de celles recueillies au moyen d'un panel pour expliquer les niveaux de formation selon les pays et les groupes d'âge par rapport aux capacités de lecture et d'écriture du sous-ensemble de la population correspondant et à d'autres variables des pays, notamment les indices de compression de la structure salariale, le taux de syndicalisation, le taux de chômage, le niveau d'activité novatrice et les mesures relatives à la structure industrielle. Ils ont constaté que le niveau moyen des capacités de lecture et d'écriture de chaque groupe d'âge a un effet positif et très important sur la proportion de travailleurs qui reçoivent de la formation, ce qui est conforme aux données micro-économiques concernant l'effet du niveau d'études sur la probabilité de participation des travailleurs à une formation. Plus important encore, leur analyse montre que la compression dans la tranche inférieure de la répartition des salaires a pour effet d'augmenter la formation, alors que la compression dans la tranche supérieure a l'effet contraire. Ces effets sont robustes et très significatifs pour les deux sexes et pour différents échantillons de groupes d'âge. Les auteurs examinent certaines conséquences possibles sur le plan des politiques.

1- Introduction

The level of employer-supported training is known to vary considerably across countries (e.g. OECD, 2003). However, the sources of these variations are not yet well understood. There is substantial microeconomic evidence on the determinants of training at the individual level. In particular, worker participation in employer-supported training is usually found to be significantly associated with educational attainment, age, gender, the industry of employment, occupation, technology adoption in the firm of employment, among other factors (e.g. OECD, 1999; Bassanini, Booth, Brunello, De Paola and Leuven, 2005).

For policy-making purposes, understanding the factors that determine the aggregate levels of training across economies is also of great importance. If differences across countries are largely explained by factors that determine the total social return from investment in skills, such as the age-distribution of the population, the industrial structure, or the economy's intensity of R&D activities, then the role of policy intervention may be quite limited. On the other hand, if differences in training levels across countries are largely driven by the labor market structure and institutions that affect how the total returns from skills are divided between firms and workers, then the role of public policies may be more important.

In this paper, we attempt to identify the main determinants of aggregate levels of training across fourteen OECD countries. Our training measures are taken from the 1994 International Adult Literacy Survey (IALS), which provides highly comparable cross-country data on the percentage of employed individuals that received job-related training. We use a panel data structure to explain the levels of training across country and age groups from the average literacy skills of the corresponding population subset and other cross-country variables, including indicators of compression in the wage structure, the rate of unionization, the unemployment rate, the level of innovation activity, and measures of industrial structure.

Of central importance to our analysis is the relation between the wage structure and training. It is well known that in perfectly competitive labor markets, firms cannot capture any of the return on general skills, and therefore have no incentive to support the cost of investment in general training (Becker, 1964). Since wages are equal to the marginal product of workers, the entire cost of general training is supported by workers, either directly or indirectly in the form of lower equilibrium wages. The cost of training will only be shared between firms and workers if the skills acquired from training are firm-specific.

However, if imperfections in the labor market lead to a compressed wage structure in the sense that as skills increase, productivity increases more rapidly than wages, firms may have incentives to pay some of the cost of general training. Indeed, there is empirical evidence suggesting that employers do support part of the cost of training even when it is general in nature (e.g. Barron, Black and Loewenstein, 1989; Lynch, 1992; Loewenstein and Spletzer, 1998; Barron, Berger and Black, 1999; Booth and Bryan, 2005). On the other hand, a compressed wage structure will lower the private benefits of training for workers and will therefore lower their incentives to invest in their own skills.

Recently, the literature has formalized a variety of specific mechanisms that tend to compress the wage structure and therefore provide incentives for firm investment in general training. For example, search and matching frictions make it costly for workers to find a new job, which tends to provide some monopsony power to the current employer (Acemoglu, 1997; Acemoglu and Pischke, 1999). Hence, such frictions allow firms to capture some of the return from general training and therefore induce them to invest in the skills of their workers. Employers may also have some monopsony power if skills are partly transferable across firms (Stevens, 1994). Asymmetric information between the current employer and potential future employers may also induce firm-sponsored training. If current employers have superior information about the ability or other unobservable characteristics of their workers, adverse selection may make it difficult for workers who leave their job to credibly signal these characteristics to the market. In turn, it will allow firms to capture some of the benefit from training investments (Acemoglu

and Pischke, 1998). Similarly, potential employers may simply be unable to perfectly observe the quantity and quality of general skills acquired through training. Therefore, the outside wage of trained workers will not fully reflect those skills and that will tend to compress the wage structure (Katz and Ziderman, 1990; Chang and Wang, 1996). Lazear (2003) argues that firms may be able to capture some return on general training if they use sets of general skills in different combinations. The wage structure may also be compressed by particular labor market institutions, such as unions and minimum wage legislation (Acemoglu and Pischke, 2003).

In a perfectly competitive labor market, if workers are not liquidity-constrained or if there are no credit market imperfections and other barriers that prevent them from investing in their own skills, the socially optimal level of investment in general skills will be achieved. Of course, there will be under-investment otherwise. However, in the presence of credit market imperfections or other barriers to workers' investment in skills, labor market imperfections and wage compression will tend to increase the level of training towards the efficient level by providing firms incentives to invest in the skills of their workers. However, the level of firms' investment will generally fall short of the social optimum given that the return on training will be shared with workers and possibly with future employers.

Hence, the empirical relationship between the degree of wage compression and training may be quite informative about whether governments should intervene to promote training, and if so, what policy instruments should be used. If wage compression tends to increase training, employers are likely supporting a substantial share of the cost of training at the equilibrium wages, but their investments are probably sub-optimal given that the returns may still be shared with workers to some extent. In this case, policy incentives for investment in training targeted at firms may be efficiency-enhancing. In contrast, if we observe that wage compression lowers training investments, workers are probably supporting most training costs. In this case, policy intervention can potentially increase the efficiency of training investments by mitigating the credit constraints and

other barriers faced by workers, and policies geared at firms' incentives may not be very useful.

There is some recent empirical literature on the relation between wage compression and training. Almeida-Santos and Mumford (2004) find evidence that the probability of British workers receiving training is positively affected by wage compression. However, Peraita (2001) shows that high wage compression in the highly regulated Spanish labor markets does not encourage training. Finally, Bassanini and Brunello (2003) report evidence from the European Community Household Panel (ECHP) according to which wage compression does increase the probability that workers receive training. Their approach partitions workers in terms of country, education, occupation and sector.

The results of the empirical analysis presented in this paper indicate that compression at the bottom of the wage distribution (below the median wage) increases the proportion of workers that receive training, but that compression at the top has the opposite effect. This novel result suggests that the allocation of training costs between workers and firms may differ over the wage distribution. As a result, the nature and the importance of inefficiencies in training decisions may also vary between high-wage and low-wage workers. Hence, different policies may be required in order to encourage training in different segments of workers.

An important feature of our analysis is the use of literacy indicators in explaining levels of training across countries. There is substantial empirical evidence on the positive effect of educational attainment on the likelihood of receiving training at the individual level (e.g. Turcotte, Léonard and Montmarquette, 2003). However, literacy test scores are likely to be more comparable measures of the productive human capital of the workforce across countries than educational attainment data, and should therefore be more closely related to returns from training investments. Recently, Green and Riddle (2001) showed that literacy scores from the IALS are closely linked to the productivity of workers in the Canadian labor market, while Coulombe, Tremblay and Marchand (2004) provide evidence that literacy scores are much better predictors of the relative long-run growth of

OECD countries than schooling attainment data. Moreover, indicators of literacy skills are likely to be more reliable measures of the general human capital that individuals have at the time of receiving training than educational attainment. In fact, because of lifelong learning and human capital depreciation, there may be a substantial gap between schooling attainment and current skills, especially for older workers. As expected, our analysis finds a strong and robust effect of literacy on the proportion of workers that receive job-related training across countries and age-groups.

The next section presents our empirical methodology. Section 3 describes the data. Results are presented and discussed in Section 4. Finally, conclusions are presented in the last section.

2- Empirical Methodology

The relationship between literacy, cross-country structural variables, and measures of training is analyzed using a panel data structure characterized by the country and the age group dimensions. As a starting point, we first consider the following linear model:

$$TR_{i,g} = LS_{i,g}\phi_1 + u_{i,g} \qquad (1)$$

for $i = 1,...,N; \quad g = 1,...,G$. Here, $N = 14$ is the number of countries, and $G = 5$ is the number of age groups. The $TR_{i,g}$ are measures of training for various sub-populations per country and age group, and the $LS_{i,g}$ are measures of literacy scores also per country and age group. Pooling observations according to both country and age groups will allow the explanatory variables, especially literacy, to have differential effects across age cohorts, and mitigates the small sample problem given the limited number of countries available. The key interest in this simple model is that the disturbances $u_{i,g}$ can be modeled in a two-way error component:

$$u_{i,g} = \mu_i + \lambda_g + \varepsilon_{i,g},$$

where the μ_i are the country-specific effects and the λ_g are the age-group-specific effects. The estimate of $\hat{\mu}_i$ will capture the unobserved country effects after controlling for the literacy and the demographic structure of the workforce (controlled by the

common country group-specific effects). These $\hat{\mu}_i$ are intended to measure the specific performance of a country in term of training under the *ceteris paribus* assumption. Given that we cannot estimate country fixed effects if we also include variables that do not have the age-group dimension, the information that we get from estimating these fixed effects is somewhat limited. They simply measure the cross-country (specific) differences in training that cannot be explained by differences in the age structures and in literacy.

In a second set of regressions, corresponding to model (2), we investigate the extent to which cross-country differences in a number of variables can account for these country specific differences in training. The country-fixed effects are dropped, and we use the following specification to estimate the effect of age group-invariant determinants of training:

$$TR_{i,g} = LS_{i,g}\phi_1 + Z_i\beta + \lambda_g + \varepsilon_{i,g} \qquad (2)$$

where Z_i is a vector of cross-country variables. In (2), the disturbances $u_{i,g}$ are modeled in a one way error component, since the effects of the vector Z_i cannot be estimated with country fixed effects.

A number of variables are included in the vector Z_i and are expected to be important determinants of differences in training across countries. These are wage compression indicators, the unionization rate, the unemployment rate, R&D expenditures as a share of GDP, and the shares of production in particular industries, which are intended to control for different industrial structures across countries.

Finally, most regressions are performed using generalized least squares with cross-section weights to account for cross-sectional heteroscedasticity. Heteroscedasticity consistent standard errors (HCCME) are computed to provide asymptotic valid inference in the presence of the remaining cohort heteroscedasticity. To illustrate robustness, results from pooled least squares estimations, for which we have also computed heteroscedasticity consistent standard errors (HCCME), are reported in the appendix.

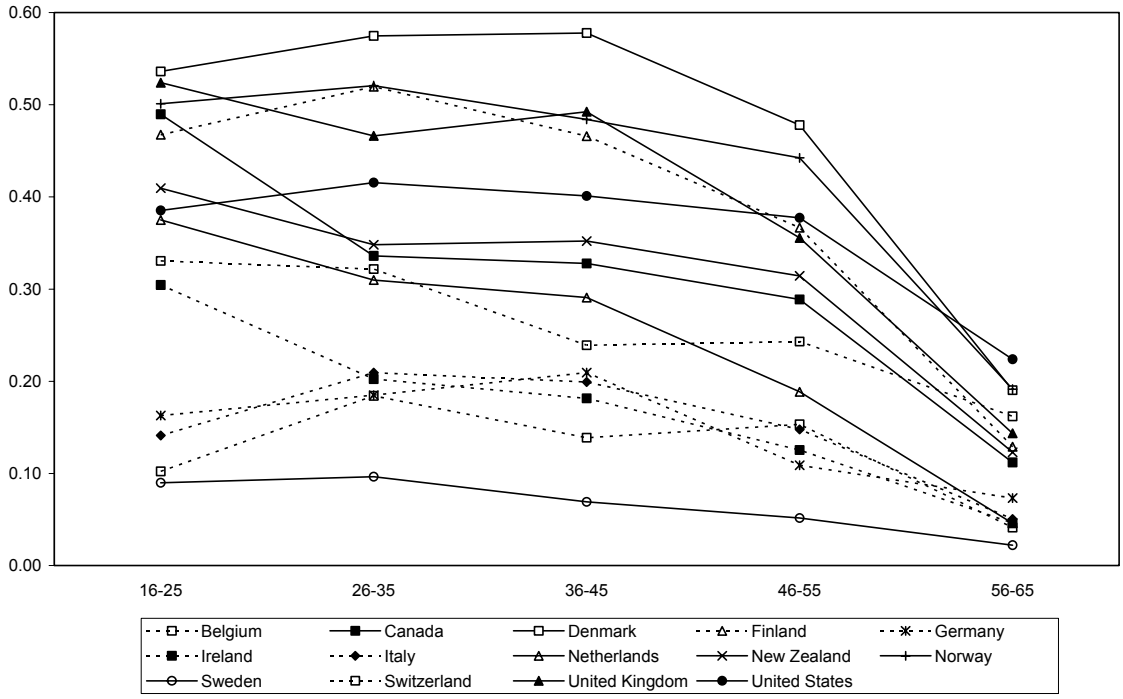
3- Data

Data on training and literacy are taken from the 1994 IALS. Our training indicators are the percentages of employed individuals that received job-related training in the twelve months preceding the interview. This data is available by gender, for individuals aged between 16 and 65 and for fourteen countries.[1] We divided the population into five age groups: 16-25, 26-35, 36-45, 46-55 and 56-65. Our training indicators for both sexes are depicted in Figure 1.

The Figure highlights a few important points. First, as expected, training appears to be significantly correlated with age. The proportion of workers trained decreases slowly across the first three age-groups, from a cross-country average of 34 percent in the group of 16 to 25 years old to 33 percent and 32 percent in the 26 to 35 and the 36 to 45 years old. The fall is much more pronounced in the two oldest groups, where the cross-country averages are 26 percent and 11 percent for the 46 to 55 and the 56 to 65 years old. Second, in all age-groups there is substantial variation across countries. The proportion of trained employees is generally highest across age-groups in Denmark, Norway, Finland, the UK and the US. Countries at the bottom of the distribution include Sweden, Belgium, Italy, Germany and Ireland.

[1] These countries are Belgium, Canada, Denmark, Finland, Germany, Ireland, Italy, Netherlands, Norway, New Zealand, Sweden, Switzerland, United Kingdom and the United States.

Figure 1: Proportion of Workers that Received Job-Related Training by Age-Groups



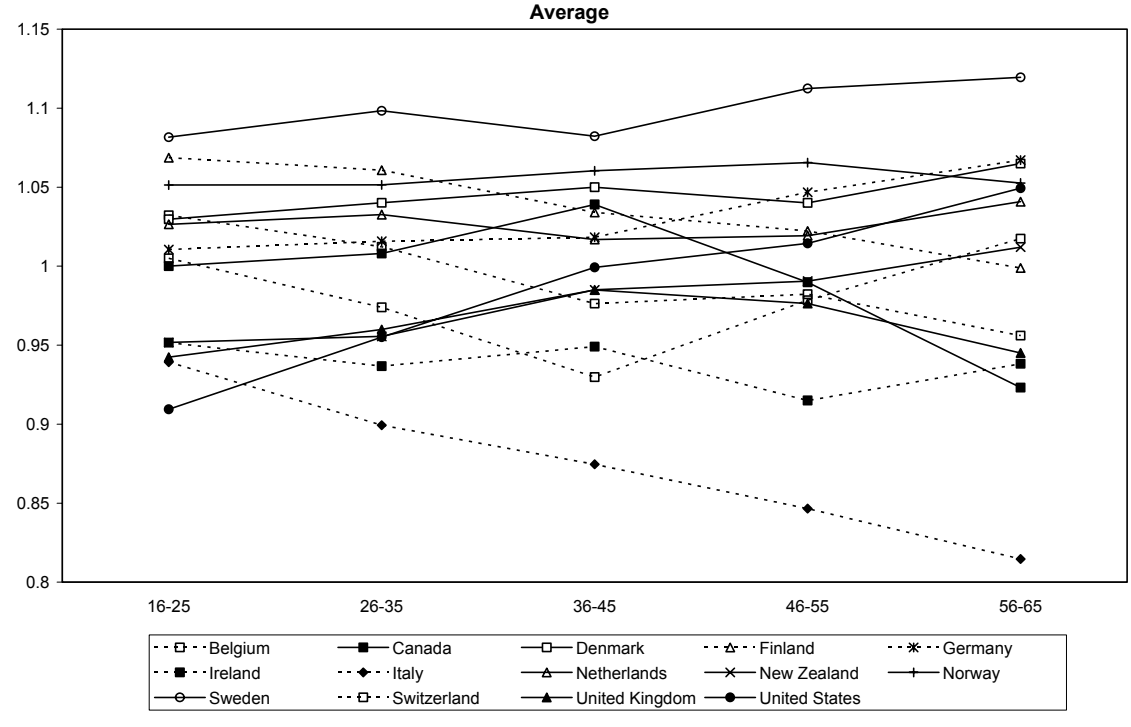
Our first explanatory variable is the average literacy skills of individuals in each age-group, which is intended to capture the complementarity between general human capital and job-related training.[2] As mentioned earlier, the positive relationship between human capital, measured by educational attainment, and training is well established at the microeconomic level. However, for the purpose of explaining cross-country differences in training, literacy test scores appear to be more appropriate measures of human capital than educational attainment, for three reasons. First, the international comparison of educational attainment data may be unreliable given the substantial variations in education systems across countries. Second, the skills acquired through education may vary across age-groups given that their investments in formal education were done in

[2] Brunello and Medio (2001) have proposed a search equilibrium model, in which there is a complementarity between training and education, to explain international differences in training investments and education levels.

different time periods. Third, the human capital acquired through initial education is likely to depreciate throughout an individual's life, and additional skills may be accumulated during ones' career through training and experience. Literacy tests are direct measures of the human capital that individuals possess at the time of receiving training.

The IALS provides literacy test scores over three broad domains: prose, document and quantitative. Our literacy measure is the average score of individuals in each population subset over the three domains. In each of these three domains, the IALS measures a fairly wide range of skills of various difficulty levels, and that are generally expected to increase productivity in most types of occupations. These indicators should therefore be viewed as measures of general human capital. Average literacy scores are presented in Figure 2.

Figure 2: Average Literacy Scores of Workers by Age-Groups Relative to the Cross-Country Average



In contrast to its training performance, Sweden has the highest literacy scores in all age-groups. At the other end, apart from the youngest cohort, Italy has the lowest literacy in all groups, and their scores relative to the cross-country average decrease rapidly as we move from the youngest to the oldest group. Interestingly, old Americans have relatively high literacy scores, with the cohort of 56 to 65 years old ranking fifth. However, the relatively young Americans perform quite poorly, with the youngest cohort ranking last in our set of fourteen countries. Norway, Denmark and Finland rank near the top in all age-groups, while in addition to Italy, literacy scores in Ireland and in the UK are systematically below average.

Unfortunately, indicators of wage compression could not be constructed from the IALS. Data on wage income is not directly comparable across countries and is not available for all countries in our sample. Therefore, we use wage compression indicators taken from the OECD (1999). The indicator of overall wage compression is the ratio of the upper wage earnings limit of the ninth to the first deciles. This overall measure of wage compression can also be divided into measures of wage compression below and above the median wage earnings, using respectively the upper earnings limit of the fifth to the first deciles and of the ninth to the fifth deciles. In order to avoid issues of endogeneity when regressing training on wage compression, we use wage compression indicators for the year preceding that of the training measures. Table 1 presents our three wage compression indicators for the fourteen countries.

TABLE 1: Indicators of Wage Compression

	Wage percentiles 90/10	Wage percentiles 50/10	Wage percentiles 90/50
Belgium	2.25	1.43	1.57
Canada	4.02	2.21	1.82
Denmark	2.17	1.38	1.57
Finland	2.29	1.39	1.65
Germany	2.32	1.44	1.61
Ireland	4.63	2.87	1.61
Italy	2.80	1.75	1.60
Netherlands	2.59	1.54	1.68
Norway	3.08	1.77	1.74
New Zealand	1.98	1.32	1.50
Sweden	2.13	1.34	1.59
Switzerland	2.71	1.62	1.67
United Kingdom	3.33	1.79	1.86
United States	4.16	2.05	2.03

Source: OECD (1999).

Dispersion in the overall wage distribution is highest in Ireland, the US, Canada, the UK and New Zealand, in decreasing order. Above the median wage earnings, dispersion is highest in the US, the UK and Canada. In contrast, there is generally more wage compression in the four Scandinavian countries and in Belgium.

Rates of unionization and unemployment across countries in 1994[3] are taken from OECD (1996) and OECD (1995), respectively. The intensity of R&D activity is measured by total R&D expenditures as a share of GDP. The data comes from the OECD *Research and Development Expenditure in Industry* database. Finally, we control for the industrial structure of each country by including in the set of regressors the value added shares of particular industries relative to the total economy. These value added shares are taken from the OECD *STAN Indicators* database. The industry classification includes nine industries. However, most of them were not found to have a significant effect on training. Therefore, in all regressions reported below, we include as regressors only the three industries that are generally found to have a significant effect on training. These

[3] Rates of unionization are for 1993 in Canada, Italy, Netherlands and Norway and for 1995 in Finland.

industries are: 1) agriculture, forestry and fishing; 2) manufacturing; and 3) finance, insurance and business services.[4]

4- Results

As a starting point, we estimated the country fixed effects following equation (1). As mentioned above, the information provided by these fixed effects is somewhat limited given that we can only control for the age structure and literacy. However, as we will see below, age and literacy are among the most important determinants of training levels across countries, and their effect is highly robust. Results are presented in Table 2 for various population subsets. For the training of all employed individuals aged between 16 and 65 (first column), the country fixed effects are positive and significant at the one percent level for Denmark, Finland, Norway, New Zealand, UK and the US. They are negative and significant at the one percent level in Belgium, Germany, Ireland and Sweden, and at the five percent level for the Netherlands. The fixed effects are generally stable when excluding either the youngest or oldest age-group or when restricting the sample to either men or women (second to fifth columns).

[4] The other industries are: 1) mining and quarrying; 2) electricity, gas and water supply; 3) construction; 4) wholesale and retail trade, restaurants and hotels; 5) transport, storage and communication; 6) community, social and personal services.

TABLE 2: Country fixed effects

	Dependent variable: percentage of employed individuals that received job-related training – Various sub-populations				
	Total population	Age-groups: 26 to 65	Age-groups: 16 to 55	Men	Women
Belgium	-0.146 [a]	-0.119 [a]	-0.170 [a]	-0.149 [a]	-0.150 [a]
	(0.035)	(0.027)	(0.033)	(0.044)	(0.028)
Canada	0.040	0.014	0.043	0.071 [b]	0.015
	(0.028)	(0.011)	(0.036)	(0.029)	(0.029)
Denmark	0.178 [a]	0.179 [a]	0.211 [a]	0.153 [a]	0.205 [a]
	(0.033)	(0.043)	(0.016)	(0.029)	(0.042)
Finland	0.099 [a]	0.102 [a]	0.121 [a]	0.076 [a]	0.130 [a]
	(0.025)	(0.031)	(0.018)	(0.023)	(0.032)
Germany	-0.140 [a]	-0.127 [a]	-0.157 [a]	-0.148 [a]	-0.127 [a]
	(0.022)	(0.024)	(0.016)	(0.030)	(0.017)
Ireland	-0.073 [a]	-0.089 [a]	-0.084 [a]	-0.076 [a]	-0.076 [a]
	(0.021)	(0.019)	(0.026)	(0.026)	(0.026)
Italy	-0.067 [c]	-0.044 [c]	-0.093 [b]	-0.047	-0.103 [b]
	(0.036)	(0.025)	(0.042)	(0.039)	(0.045)
Netherlands	-0.044 [b]	-0.058 [a]	-0.033	-0.017	-0.070 [a]
	(0.019)	(0.013)	(0.021)	(0.022)	(0.024)
Norway	0.129 [a]	0.129 [a]	0.149 [a]	0.117 [a]	0.147 [a]
	(0.020)	(0.025)	(0.014)	(0.026)	(0.029)
New Zealand	0.046 [a]	0.035 [a]	0.055 [a]	0.047 [a]	0.046 [c]
	(0.014)	(0.011)	(0.012)	(0.016)	(0.027)
Sweden	-0.253 [a]	-0.240 [a]	-0.277 [a]	-0.290 [a]	-0.209 [a]
	(0.031)	(0.037)	(0.019)	(0.035)	(0.037)
Switzerland	-0.005	-0.003	-0.018 [c]	0.019	-0.030 [c]
	(0.015)	(0.019)	(0.010)	(0.016)	(0.018)
United Kingdom	0.141 [a]	0.123 [a]	0.160 [a]	0.146 [a]	0.129 [a]
	(0.028)	(0.028)	(0.023)	(0.026)	(0.033)
United States	0.095 [a]	0.098 [a]	0.094 [a]	0.098 [a]	0.093 [a]
	(0.005)	(0.006)	(0.010)	(0.010)	(0.019)

Notes: White heteroscedasticity standard errors are shown in parentheses below the estimated coefficients; a: significant at 1% level; b: at 5% level; c: at 10% level.

More interestingly, let us now consider regression results based on the setup of equation (2). Results for samples of all individuals, men and women separately, and excluding either the youngest or oldest age-groups are presented in Tables 3 to 5, respectively. In all cases, we included in the list of regressors either the indicator of overall wage compression, measured by the earnings ratio of the ninth to the first deciles of the distribution, or the indicators of compression below and above the median wage earnings. Since the incentives to train may differ substantially between the youngest workers (aged 16-25) who have recently joined the labor market, the oldest workers (aged 56-65) that are approaching retirement, and the rest of the population, we estimated some regressions for samples that exclude these groups. However, as will be seen below, results are generally not affected significantly by sample changes.

The first important point to note from our analysis is that the average literacy level within each age-group has a positive and highly significant effect on the percentage of individuals that receive training, and that holds for all population subsets considered. This result, which concords with the microeconomic evidence regarding the effect of education on the likelihood that individuals receive training, is not surprising given that the general skills of individuals are likely to determine their ability to acquire new skills through job-related training. Hence, the return on a training investment is likely to be higher for individuals who initially have greater human capital.

TABLE 3: The determinants of job-related training across countries

	Dependent variable: percentage of employed individuals that received job-related training	
Literacy	0.230 [a]	0.171 [a]
	(0.046)	(0.048)
Wage ratio 90/10	3.741 [a]	
	(1.211)	
Wage ratio 50/10		-13.972 [a]
		(3.795)
Wage ratio 90/50		57.468 [a]
		(10.554)
Unionization	-0.147	-0.087
	(0.119)	(0.105)
Unemployment	2.211 [a]	0.648
	(0.591)	(0.551)
R&D intensity	5.111 [c]	-4.184
	(2.676)	(3.450)
Agriculture, forestry and fishing	1.651 [b]	0.340
	(0.702)	(0.722)
Manufacturing	-3.435 [a]	-1.305 [b]
	(0.370)	(0.498)
Finance, insurance and business services	-0.172	-2.406 [a]
	(0.328)	(0.467)
Age group 26-35	-0.972	-2.710
	(1.398)	(2.026)
Age group 36-45	-2.702 [b]	-3.520 [c]
	(1.327)	(2.023)
Age group 46-55	-4.390 [a]	-6.787 [a]
	(1.237)	(2.023)
Age group 56-65	-16.046 [a]	-19.197 [a]
	(1.380)	(3.001)
Adjusted R^2	0.97	0.92

Notes: White heteroscedasticity standard errors are shown in parentheses below the estimated coefficients; a: significant at 1% level; b: at 5% level; c: at 10% level.

Note that, in contrast to empirical studies of training performed at the individual level, the estimated effect of literacy in our macro-approach may capture the potential complementarity between job-related training and the overall level of human capital in the workforce that would result from human capital externalities. Job-related training may be more valuable to workers in economies that are well-endowed in human capital.

Moreover, one could argue that the positive relation between the educational attainment of individuals and their likelihood of receiving training partly reflects the fact that employers use educational attainment as a signal about which workers have the greater ability to succeed in training programs. Our results establish a clear relation between training and a direct measure of human capital and would therefore be inconsistent with this hypothesis. Hence, there seems to be a genuine link between general human capital and the return from job-related training.

Let us now turn to the effect of wage compression on training. Note first that the value of our indicator decreases with the level of compression. Therefore, a positive relation between compression and training would produce a negative regression coefficient. In the first column of Table 3, we report the results of the regression that includes the indicator of overall wage compression. The estimated coefficient is found to be positive and highly significant, which suggests that compression over the entire wage distribution tends to discourage training. However, if we include compression below and above the median wage earnings, the results (reported in the second column of Table 3) indicate that compression at the top of the distribution leads to lower training, but that compression at the bottom has the opposite effect. Regressions reported in Tables 4 and 5 show that these results holds in all population subsets considered. The estimated coefficients of compression below and above the median wage are highly stable and significant at the one-percent level for all sub-samples.

TABLE 4: The determinants of job-related training across countries for men and women

	Dependent variable: percentage of employed individuals that received job-related training			
	Men		Women	
Literacy	0.247 [a]	0.165 [a]	0.210 [a]	0.176 [a]
	(0.050)	(0.054)	(0.048)	(0.046)
Wage ratio 90/10	3.601 [a]		3.234 [b]	
	(1.257)		(1.249)	
Wage ratio 50/10		-11.047 [a]		-17.070 [a]
		(3.890)		(4.163)
Wage ratio 90/50		56.143 [a]		59.941 [a]
		(11.661)		(10.471)
Unionization	-0.197	-0.093	-0.134	-0.109
	(0.122)	(0.115)	(0.118)	(0.098)
Unemployment	2.336 [a]	0.929	2.218 [a]	0.464
	(0.635)	(0.618)	(0.586)	(0.544)
R&D intensity	3.948	-4.791	6.507 [b]	-3.152
	(2.788)	(3.582)	(2.545)	(3.438)
Agriculture, forestry and fishing	1.368 [c]	0.036	2.080 [b]	0.636
	(0.740)	(0.739)	(0.791)	(0.822)
Manufacturing	-3.390 [a]	-1.641 [a]	-3.423 [a]	-1.015 [c]
	(0.427)	(0.534)	(0.367)	(0.520)
Finance, insurance and business services	-0.182	-2.162 [a]	-0.160	-2.715 [a]
	(0.352)	(0.490)	(0.389)	(0.511)
Age group 26-35	-0.333	-0.110	-2.251	-3.797
	(1.988)	(2.652)	(2.091)	(2.407)
Age group 36-45	-1.560	-2.614	-1.922	-3.825
	(2.049)	(2.380)	(2.066)	(2.489)
Age group 46-55	-7.560 [a]	-8.484 [a]	-3.666	-5.444 [b]
	(1.891)	(2.355)	(2.654)	(2.750)
Age group 56-65	-15.542 [a]	-18.174 [a]	-13.869 [a]	-18.483 [a]
	(1.982)	(3.210)	(2.705)	(3.230)
Adjusted R^2	0.93	0.88	0.82	0.86

Notes: White heteroscedasticity standard errors are shown in parentheses below the estimated coefficients; a: significant at 1% level; b: at 5% level; c: at 10% level.

These results suggest that the costs of investments in the training of low-wage workers tend to be supported by employers, whereas high-wage workers tend to pay for their own training. As a result, compression at the bottom of the wage distribution increases the incentives of firms to invest in the skills of low-wage workers. In contrast, compression at the top of the wage distribution tends to reduce the private benefits that individuals can capture by investing in their own skills. Of course, even if firms do not support the costs of training for high-wage workers, some of the training costs may still be paid directly by firms but shifted to workers through lower wages.

Note that the absolute value of the coefficient of compression above the median is much larger than that of compression below the median in all regressions, which explains that overall compression lowers training. Moreover, the fact that the effect of compression at the top of the wage distribution dominates is consistent with the well-established result that training participation tends to be concentrated among individuals with relatively high human capital and wages.

The rate of unionization is usually thought to affect training. In principle it could affect training indirectly through its effect on wage compression, or more directly if, for a variety of reasons, unions bargain for higher training investments by firms. If the indirect effect tends to dominate, then as for wage compression, the effect could go in either direction, depending on whether firms or workers support the bulk of training costs. At the empirical level, evidence of a positive effect of unionization on training has been found in Green, Machin and Wilkinson (1996) and Booth, Francesconi and Zoega (2003) for the UK and by Dustmann and Schoenberg (2004) for Germany, among others. In all our regressions, the estimated coefficient of unionization is negative but insignificant. This finding appears consistent with our results regarding the effects of wage compression.

Note that if unionization affects training only through its effect on wage compression, it may be inappropriate to include both the rate of unionization and indicators of wage compression as explanatory variables. Therefore, we conducted a series of regressions,

reported in Table A.1 of the appendix, where the rate of unionization is excluded. Results, especially the effect of wage compression, remain essentially unchanged.

The effect of the unemployment rate on training is always positive but only significant when overall wage compression is included in the set of independent variables. The positive effect of unemployment on training could capture the fact that the opportunity cost of training for both firms and workers may be lower when production is relatively low. Instead of laying-off workers, firms may choose to make investments in skills that will be profitable later. Likewise, employees may work fewer hours, leaving them more time to undertake training programs.

There is some empirical evidence on the relationship between innovation or technology adoption and training (e.g. Baldwin and Johnson, 1996; Rao, Tang and Wang, 2002; Turcotte, Léonard and Montmarquette, 2003). Typically, firms that innovate and adopt new technologies face new skill requirements that are fulfilled through training. Hence, we should expect to observe a positive link between the intensity of R&D activity across countries and the levels of training. However, our results are somewhat mixed on that issue. The estimated coefficients for R&D expenditures as a share of GDP vary substantially in the different regressions and are usually not significant. In a series of regressions that are not reported, we replaced the R&D intensity variable by the share of investment in GDP as a way to capture more generally the level of technology adoption across countries and the potential broader complementarities between physical capital and skills. However, doing so did not significantly change the results.[5]

[5] We used both the share of investment in GDP in 1993 and the average over the period 1990-1995 in order to smooth business cycle effects. The estimated effect was not significantly different between the two measures.

TABLE 5: The determinants of job-related training across countries for different age-groups samples

	Dependent variable: percentage of employed individuals that received job-related training			
	Age-groups 26 to 65		Age-groups 16 to 55	
Literacy	0.220 [a]	0.157 [a]	0.252 [a]	0.173 [a]
	(0.061)	(0.048)	(0.050)	(0.053)
Wage ratio 90/10	3.519 [b]		3.957 [a]	
	(1.535)		(1.172)	
Wage ratio 50/10		-16.680 [a]		-16.876 [a]
		(2.920)		(4.678)
Wage ratio 90/50		60.172 [a]		65.609 [a]
		(8.160)		(12.031)
Unionization	-0.102	-0.076	-0.173	-0.098
	(0.143)	(0.105)	(0.135)	(0.129)
Unemployment	2.009 [b]	0.389	2.646 [a]	0.751
	(0.758)	(0.514)	(0.640)	(0.623)
R&D intensity	2.413	-4.178	5.909 [b]	-4.553
	(2.484)	(2.809)	(2.824)	(3.958)
Agriculture, forestry and fishing	0.693	0.199	2.076 [a]	0.534
	(0.582)	(0.575)	(0.719)	(0.814)
Manufacturing	-3.073 [a]	-0.963 [a]	-4.019 [a]	-1.439 [b]
	(0.445)	(0.320)	(0.380)	(0.613)
Finance, insurance and business services	-0.030	-2.519 [a]	-0.232	-2.750 [a]
	(0.417)	(0.421)	(0.347)	(0.581)
Age group 26-35			-1.222	-1.497
			(1.311)	(1.946)
Age group 36-45	-0.410	-1.289	-2.872 [b]	-2.070
	(1.335)	(0.899)	(1.302)	(2.038)
Age group 46-55	-2.481	-3.761 [a]	-4.423 [a]	-6.391 [a]
	(1.607)	(0.888)	(1.058)	(1.903)
Age group 56-65	-13.987 [a]	-16.460 [a]		
	(2.454)	(1.671)		
Adjusted R^2	0.93	0.97	0.98	0.94

Notes: White heteroscedasticity standard errors are shown in parentheses below the estimated coefficients; a: significant at 1% level; b: at 5% level; c: at 10% level.

As mentioned earlier, we control to some extent for differences in industrial structure across countries by including in the list of independent variables the share of value added of particular industries in total GDP. The share of production in agriculture, forestry and fishing is found to have a positive effect on training, although this effect is not always significant. In contrast, the shares of production in manufacturing and in finance, insurance and business services are found to have a negative effect on training, although only the effect of manufacturing is always significant.

Finally, all our regressions include dummy variables for all age-groups except the youngest. Results clearly show that age has a negative effect on training, which is not surprising given that the return on training should be substantially affected by the number of years remaining in the productive life of individuals. Again, this result is consistent with microeconomic evidence (e.g. Turcotte, Léonard and Montmarquette, 2003).

A series of pooled least squares estimations are reported in Table A.2 of the appendix. The general direction of the results remains unchanged, although the effects of most variables are estimated less precisely with pooled least squares than with generalized least squares. The negative effect on training of wage compression above the median remains significant at the one-percent level in all cases, while the positive effect of compression below the median wage is significant at the five-percent level for both sexes and women, and at the ten-percent level for men. Not surprisingly, the R-squared are also lower under pooled least squares.

5- Policy Discussion and Conclusions

The main result of this paper is that wage compression below the median has a positive effect on the proportion of workers that receive job-related training, while compression above the median wage has the opposite effect. This finding suggests that the allocation of training costs between firms and workers differs over the wage distribution. As a result, the nature of inefficiencies in training decisions and appropriate corrective policies may vary for different segments of workers. Moreover, if policy measures cannot be

easily targeted at particular groups of workers, the choice of policy instruments may involve a trade-off between the training of high-wage versus low-wage workers.

The positive relationship between compression at the bottom of the wage distribution and training suggests that the cost of training for low-wage workers is largely supported by employers and that investment in the general skills of these workers is likely to be sub-optimal. Therefore, there is an efficiency role for policy, and instruments to promote the training of low-wage workers should probably focus on firms' incentives to invest in skills. On the other hand, the negative estimated effect of compression at the top of the wage distribution on training suggests that high-wage workers largely support the cost of investment in their own skills. Wage compression reduces the private benefit of skills to workers and therefore lowers training. Thus, appropriate policies to promote training among high-wage workers should probably focus on the barriers to training faced by these workers. The most significant barriers may well be credit constraints and time constraints.

Several instruments are potentially available to increase the incentives of firms to invest in skills. For example, allowing the use of pay-back clauses may be a useful policy to directly target one of the main causes of firms' under-investment in training. Pay-back clauses essentially stipulate that workers who leave their job after receiving employer-paid training are required to reimburse part of the costs of training. Pay-back clauses are allowed in a number of countries, including Germany, Italy, Netherlands, Norway and Switzerland (OECD, 2003). Such arrangements reduce the ability of other firms to poach trained workers and therefore lower the positive externality of training investments towards potential future employers. The disadvantage of pay-back clauses is that they may reduce the incentives of credit-constrained workers to invest in their own skills by accepting lower wages from firms that provide training. Hence, our results suggest that pay-back clauses would be particularly inappropriate if the objective is to promote training among relatively high-wage workers.

In contrast to pay-back clauses, a training certification program would tend to have the opposite effects. In particular, it would increase the incentives of workers to invest in training by improving their ability to capture the return on their investment when settling wages with future employers. As a result, it would likely have a positive effect on training among relatively high-wage workers. However, it would tend to reduce the incentives of current employers to invest in training by improving the outside options of trained workers. Hence, it could lead to lower training among relatively low-wage workers. Therefore, our results suggest that training certification programs may be desirable if they can be restricted to relatively specialized skills.

Several other policy instruments would not be subject to such a sharp trade-off between the training of high-wage versus low-wage workers. Examples include corporate tax credits or subsidies for training expenditures. In fact, tax credits and subsidies offered either to employers or employees would tend to encourage training whether the economic incidence of training costs falls on firms or workers. Training investments may also be increased, among both high-wage and low-wage workers, through legislation that makes it mandatory for firms to invest some specified annual amount on training, possibly as a share of their payroll. This type of legislation has been used previously in a few countries, including Canada, France, and the UK. Note however that such a policy will tend to result in wasteful expenditures if low investment levels in particular sectors or for specific groups of workers reflect low returns on skills, rather than distortions in investment decisions.

As mentioned above, our results suggest that in order to promote training among relatively high-wage workers, policy measures may need to focus on the barriers to training faced by workers, rather than altering firms' incentives. Some specific measures could be used to target the credit and time constraints faced by workers who would otherwise choose to invest in their own skills. It is well known that borrowing for the purpose of investing in human capital is difficult given that human capital cannot usually be used as collateral. Therefore, government loan programs or training-savings accounts, possibly co-financed by the government and workers, may be justified.

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Appendix

TABLE A.1: The determinants of job-related training across countries – excluding the unionization variable

	Dependent variable: percentage of employed individuals that received job-related training				
	Both sexes	Men	Women	Age-groups 26-65	Age-groups 16-55
Literacy	0.138 [a]	0.131 [a]	0.137 [a]	0.128 [a]	0.137 [a]
	(0.025)	(0.030)	(0.032)	(0.027)	(0.019)
Wage ratio 50/10	-13.743 [a]	-11.050 [a]	-16.573 [a]	-16.308 [a]	-16.694 [a]
	(3.699)	(3.872)	(4.027)	(2.703)	(4.500)
Wage ratio 90/50	60.212 [a]	59.256 [a]	62.875 [a]	62.173 [a]	68.761 [a]
	(10.171)	(11.069)	(10.267)	(8.306)	(11.873)
Unemployment	0.331	0.578	0.090	0.081	0.436
	(0.374)	(0.394)	(0.423)	(0.288)	(0.437)
R&D intensity	-4.939	-5.937	-3.949	-4.548	-5.552
	(3.533)	(3.609)	(3.570)	(2.945)	(4.117)
Agriculture, forestry and fishing	0.162	-0.233	0.428	0.090	0.290
	(0.731)	(0.742)	(0.816)	(0.602)	(0.824)
Manufacturing	-1.134 [b]	-1.398 [a]	-0.844 [c]	-0.830 [a]	-1.247 [b]
	(0.462)	(0.477)	(0.490)	(0.306)	(0.559)
Finance, insurance and business services	-2.289 [a]	-2.045 [a]	-2.569 [a]	-2.409 [a]	-2.614 [a]
	(0.439)	(0.479)	(0.484)	(0.374)	(0.507)
Age group 26-35	-2.928	-0.160	-3.858		-1.952
	(1.979)	(2.525)	(2.471)		(1.931)
Age group 36-45	-3.838 [c]	-2.929	-4.057	-1.361	-2.811
	(1.967)	(2.210)	(2.478)	(0.835)	(1.911)
Age group 46-55	-7.370 [a]	-9.290 [a]	-6.174 [b]	-4.005 [a]	-7.228 [a]
	(1.894)	(2.125)	(2.659)	(0.721)	(1.676)
Age group 56-65	-20.672 [a]	-19.912 [a]	-19.991 [a]	-17.357 [a]	
	(2.387)	(2.546)	(2.825)	(1.139)	
Adjusted R^2	0.92	0.88	0.86	0.97	0.94

Notes: White heteroscedasticity standard errors are shown in parentheses below the estimated coefficients; a: significant at 1% level; b: at 5% level; c: at 10% level.

TABLE A.2: The determinants of job-related training across countries – Pooled least squares estimations

	Dependent variable: percentage of employed individuals that received job-related training					
	Both sexes		Men		Women	
Literacy	0.249 [a]	0.107 [c]	0.267 [a]	0.131 [b]	0.226 [a]	0.090
	(0.054)	(0.061)	(0.055)	(0.064)	(0.055)	(0.061)
Wage ratio 90/10	3.519 [c]		3.794 [b]		3.356 [c]	
	(1.788)		(1.718)		(1.972)	
Wage ratio 50/10		-10.761 [b]		-9.134 [c]		-12.216 [b]
		(4.575)		(4.648)		(4.917)
Wage ratio 90/50		57.195 [a]		53.666 [a]		59.918 [a]
		(13.720)		(14.592)		(13.450)
Unionization	-0.205	-0.063	-0.277 [b]	-0.132	-0.132	-0.004
	(0.127)	(0.130)	(0.128)	(0.134)	(0.129)	(0.129)
Unemployment	2.083 [a]	0.927	2.215 [a]	1.055	1.985 [a]	0.850
	(0.678)	(0.705)	(0.688)	(0.743)	(0.703)	(0.704)
R&D intensity	2.279	-2.956	2.476	-2.980	2.419	-2.756
	(3.314)	(3.598)	(3.302)	(3.666)	(3.461)	(3.721)
Agriculture, forestry and fishing	0.973	0.555	0.967	0.401	1.081	0.729
	(1.046)	(0.812)	(1.035)	(0.827)	(1.129)	(0.907)
Manufacturing	-2.919 [a]	-1.772 [a]	-3.067 [a]	-1.904 [a]	-2.817 [a]	-1.683 [b]
	(0.524)	(0.640)	(0.516)	(0.652)	(0.566)	(0.669)
Finance, insurance and business services	-0.387	-1.782 [a]	-0.429	-1.704 [a]	-0.306	-1.871 [a]
	(0.438)	(0.623)	(0.454)	(0.636)	(0.467)	(0.660)
Age group 26-35	-0.415	-0.794	2.214	1.986	-3.180	-3.777
	(4.874)	(4.329)	(5.119)	(4.641)	(4.808)	(4.233)
Age group 36-45	-0.720	-1.988	0.092	-0.930	-1.630	-3.142
	(4.849)	(4.308)	(4.907)	(4.375)	(5.009)	(4.468)
Age group 46-55	-3.586	-6.428	-3.499	-5.625	-3.990	-7.368 [c]
	(1.891)	(4.187)	(4.684)	(4.300)	(4.670)	(4.397)
Age group 56-65	-13.347 [a]	-19.126 [a]	-12.237 [b]	-16.934 [a]	-15.027 [a]	-21.318 [a]
	(4.485)	(4.791)	(4.787)	(4.889)	(4.358)	(4.773)
Adjusted R^2	0.48	0.58	0.47	0.56	0.47	0.57

Notes: White heteroscedasticity standard errors are shown in parentheses below the estimated coefficients; a: significant at 1% level; b: at 5% level; c: at 10% level.