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EMPLOYMENT EFFECTS OF ON-THE-JOB HUMAN CAPITAL ACQUISITION *

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ABSTRACT: This paper quantifies the joint effect of on-the-job training and workers' on-the-job learning decisions on aggregate employment. We present an Index of On-the-job Human Capital Acquisition (OJHCA), based on data from the OECD Program for the International Assessment of Adult Competencies. The objective of the index is to capture both formal and informal learning in the workplace. We document a strong positive association between the two components of our index, i.e., on-the-job training and on-the-job learning. We also show that the index is positively correlated with employment across OECD economies. To explain these stylized facts, we build a search and matching model with on-the-job human capital acquisition that depends on both on-the-job training provided by firms and on the workers' level of on-the-job learning. We calibrate the model to the Canadian economy and adjust the learning and training marginal costs to match cross-country levels in the human capital index. We compare the model's predictions with the data and we conclude that differences in marginal costs are necessary to match the differences observed in employment rates across countries. We also extend the model including payroll taxes and education. The model is able to reproduce the observed differences in employment rates between countries with the highest and the lowest level of OJHCA.

JEL Codes: E24, J24, J64

Keywords: Employment, labor productivity, human capital, search and matching

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1 Introduction

In recent decades, workforce skills have become increasingly more demanding with firms and workers having to adapt to more complex technologies (for example, see, OECD, 2006, 2010, 2011). In this regard, participating in specific job training activities, as well as on-the-job learning, have gained in importance since these activities enable workers to update their competencies and also acquire new specific skills. In addition to the positive effects on labor productivity, these activities also make the workplace more attractive for workers, increasing their participation and, hence, boosting the employment rate (OECD, 2004, Chapter 4). This paper explores the role of human capital and, in particular, on-the-job human capital acquisition in explaining differences in employment rates across OECD economies.

First, we present an index of on-the-job human capital acquisition (OJHCA) using data from the OECD Program for the International Assessment of Adult Competencies (PIAAC). This index combines two other indexes: an on-the-job training index and an index that measures the learning in the workplace. The former comprises formal on-the-job training sessions or training activities, while the latter includes the learning of new work-related competencies from interaction with co-workers and supervisors, and the learning workers acquire from the tasks they perform on their own (learning-by-doing).

Secondly, we build a search and matching model with endogenous job destruction and with on-the-job human capital acquisition that depends on both the on-the-job training received per worker and the level of on-the-job learning. In our model, training activities induce workers to increase their learning in the workplace in order to raise their wages and to offset part of the training costs transferred from firms to workers. An increase in the two components of the OJHCA index boosts the job finding rate but has an ambiguous effect on the job destruction rate. The overall employment effect of the OJHCA index is not clear and is therefore, entirely an empirical question.

To quantify the employment effects of on-the-job human capital acquisition we calibrate the model to the Canadian economy. Specifically, we simulate the observed cross-country differences in the OJHCA index by adjusting the marginal costs of training and learning and compare the model's predictions for employment rates with actual data. In general, the model performs well in explaining the positive association observed between human capital and employment rates. On average, a one-percentage-point increase in the human capital index increases the employment rate by 0.59 percent, similar to the 0.61 percentage points estimated in the data. The model is also able to reproduce 84.4% of the differences in employment rates between the group of countries with the highest and lowest levels of human capital.[1]

We implement an additional exercise in which we use the exogenous variation of training

[1]For this analysis we divide the entire distribution into three parts (tertiles), each containing a third of the population (countries).

and learning from the data and keep the marginal costs fixed to the benchmark economy (Canada). In this case the model performs very poorly since it is unable to capture employment differences. This result enable us to support the premise that variations in marginal costs are necessary to understand differences in employment rates across countries.

Then, we consider two candidates to explain differences in employment rates across countries by affecting the marginal costs of training and learning: i) payroll taxes and, ii) education. First, we document that payroll taxes paid by the firm are negatively correlated not only with employment rates but also with the human capital acquisition index. According to our theoretical model, taxes do not only increase employment opportunity costs, as in Prescott (2004), but they also increase the implicit marginal cost of learning because they reduce the net wages received by workers. As a result, the worker's incentive to learn on-the-job falls and, due to its complementarity, reduce the level of training provided by the firm. Second, formal education increases the net returns of training investment by firms and reduces workers effort to learn. This is in line with the observed complementary between on-the-job training and formal education founded in previous studies (e.g., Cairó and Tomaz, 2017). We extend the model incorporating both payroll taxes and formal education. This extended version is able to reproduce the differences observed in employment rates and explain almost 30% of the observed gap in OJHCA between countries in the highest and the lowest tertiles of on-the-job human capital. Our simulations also show that taxes exert a grater influence on employment rates while formal education generates a higher impact on OJHCA.

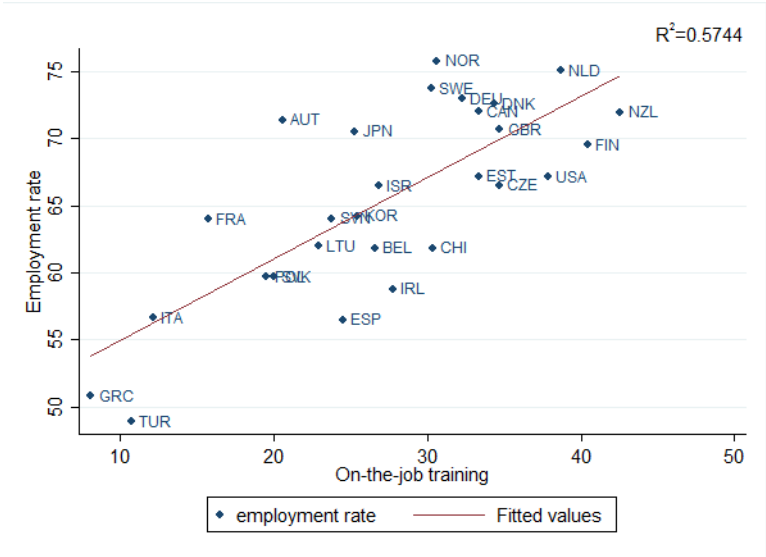
As our model incorporates both training and learning decisions, we believe that it is a good instrument to improve our understanding of how the different components of on-the-job human capital acquisition affect labor markets. To the best of our knowledge, this is the first paper to use a model to study the joint effects of on-the-job training and workers' on-the-job learning decisions on employment rates.

This paper has obvious parallels with studies documenting a positive association between on-the-job training and employment. In a broader ranging report, the OECD (OECD, 2004, Chapter 4) presents empirical evidence of a positive relationship between job training participation and aggregate employment rates after controlling for formal education, GDP growth and labor market institutions. Figure 1 presents the raw positive correlation between on-the-job training and the employment rate for OECD countries.[2] It shows that training has a strong positive correlation with employment ($R^2 = 0.57$ in the OLS regression).

Moreover, since the seminal studies conducted in human capital theory, (e.g. Arrow, 1962; Mincer, 1962) learning in the workplace/learning by doing (proxied by work experience) has been considered a key determinant of labor and economic outcomes. More recently, several studies have focused on the role of workplace learning (i.e., learning from co-workers and

[2]Drawing its data from PIAAC, the training variable measures the proportion of workers receiving on-the-job training over the last 12 months.

Figure 1: Training vs. employment rates



Data source: OECD-PIAAC.

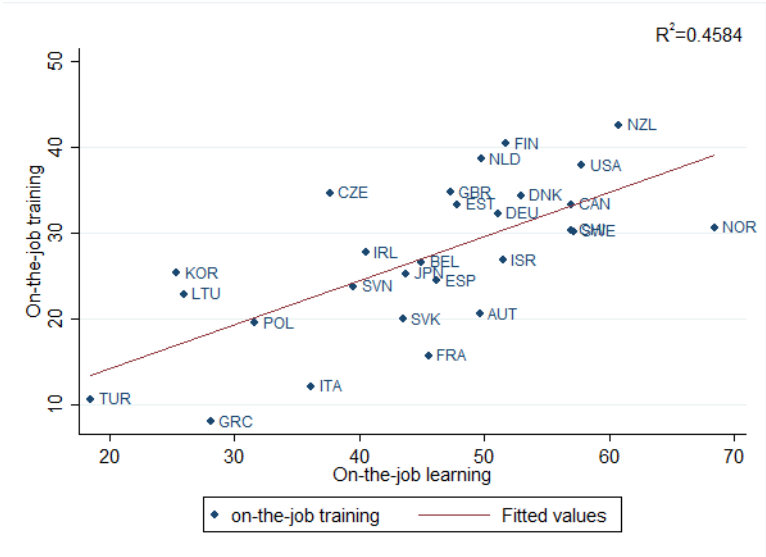
supervisors and learning-by-doing) as a determinant of economic performance (e.g. Grip, 2008; Destré et al., 2008). Barron et al. (1997) show the importance of these learning processes in the U.S. Specifically, these authors document that, during the first quarter following the hiring of a new worker, more than one-third of training (54.5 hours) is provided through a "learning by watching co-workers" process, while the other two-thirds correspond mainly to formal sessions of on-the-job training or training activities provided by supervisors and co-workers. In the same vein, Bishop (1996) finds that learning-by-doing plays an important role in the increase in employee productivity during the first two years of job tenure in the firm. Thus, learning through experience and learning from co-workers and supervisors would seem to capture the essence of on-the-job learning. In a recent paper, Ferreira-Sequeda et al. (2016) present evidence of complementarity between on-the-job training and on-the-job learning for both temporary and permanent employees in OECD countries. Figure 2 presents a strong positive association between on-the-job training and learning.[3] At the same time, Figure 3 shows that the relation between human capital acquired on-the-job and the employment rate is strengthened when we combine training and learning activities as a measure of on-the-job human capital acquisition.[4] Notice that the R^2 from the linear regression between on-the-job human capital and employment is 0.66, which is higher than the 0.57 obtained when we regress on-the-job training and employment (Figure 1).[5]

[3]The learning index corresponds to the percentage of individuals involve in learning-by-doing and learning from co-workers or supervisors at least once a week.

[4]Section 2 describes on-the-job training, learning and human capital indexes in greater detail.

[5]The positive relationship between employment and OJHCA remains significative after controlling for share of workers with tertiary education as a proxy of the level of formal education.

Figure 2: On-the-job training and learning



Data source: OECD-PIAAC.

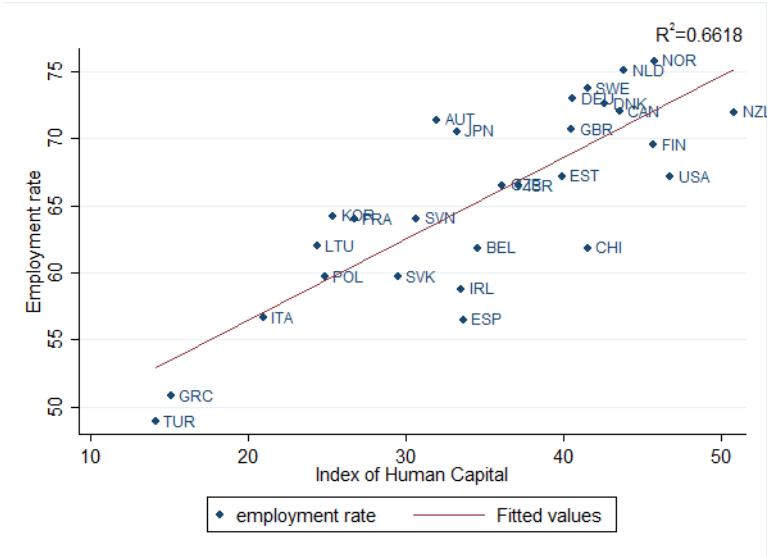
Finally, we explore the relative importance of general and specific human capital acquired on-the-job in accounting for differences in labor market outcomes across OECD economies. Becker (1964), in a perfect labor market set-up, concludes that firms have incentives to provide firm-specific training because it is not transferable to other firms, but firms only invest in general training when workers accept a lower wage to cover its costs. However, Acemoglu and Pischke (1999a,b), in presence of frictions in the labor market, show that firms find optimal to offer general training to workers. Specifically, firms make higher profits from trained workers because their wages increase less than productivity. Then, we extend the baseline model by assuming that workers can transfer some of their on-the-job acquired skills from job to job. We conclude that the employment rate increases with the portability of skills but do not affect the relative employment rates across countries if the skills portability rate is the same.

The remainder of this paper is organized as follows. In section 2 we describe our indexes of on-the-job training, learning and human capital acquisition. Section 3 presents the model. Section 4 contains the calibration and main quantitative exercises and, finally, section 5 concludes.

2 On-the-job human capital acquisition index

In this section, we construct an Index of On-the-Job Human Capital Acquisition, based on data drawn from the PIAAC. The aim of the index is to capture both formal and informal learning in the workplace. As a measure of formal learning, the index includes information

Figure 3: Human capital acquired on-the-job and employment



Data source: OECD - PIAAC.

about worker participation in formal training programs provided by employers. In the case of informal learning, the index incorporates both worker interactions with co-workers and supervisors and, the acquisition of skills through learning-by-doing.

The PIAAC has developed and conducted the Survey of Adult Skills. This survey assesses adult (16-65 year-olds) proficiency in three key information-processing skills: literacy, numeracy and problem solving in technology-rich environments. The survey has been performed in over 33 OECD countries (two rounds: the first from August 2011 to March 2012 in 24 countries and the second from April 2014 to March 2015). Among others, the PIAAC survey measures skills in the workplace, specifically, the relevance of on-the-job training and learning in the workplace (from co-workers/supervisors and from the worker's own experience).[6]

We use three variables from the PIAAC survey to build our **on-the-job Human Capital Acquisition Index (OJHCA)**. First, we use the on-the-job training variable (OJT) which measures whether the worker claims to have attended (or not) formal training sessions organized in the workplace or provided by their supervisors or colleagues over the preceding 12 months. Second, using two qualitative variables, we build an on-the-job learning index (OJL). Specifically, we consider: i) how often workers declare having learned new work-related competencies from co-workers or supervisors (learning from co-workers) and, ii) how often the workers' jobs involve learning-by-doing from the tasks that they perform (learning-by-doing). In all three cases, we normalize these indexes by considering the different scales of the raw data before integrating them into the OJHCA index.[7]

[6]For details see, *http://www.oecd.org/skills/piaac/*.

[7]Owing to problems of data availability in relation to some of the variables we use in the analysis, we had

On-the-job training index

The OJT index measures just how widespread formal training activities are at the country level (extensive margin). Specifically, in building this index, we draw on responses to the following question in the PIAAC survey:

"**During the last 12 months, have you attended any organised sessions for on-the-job training or training by supervisors or co-workers**?"

Given that the answer to this question is either "yes" or "no", we can compute the OJT index as the percentage of individuals who have been receiving on-the-job training during the last 12 months:

$$Index\ OJT\ = \frac{yes}{total} * 100.$$

Figure 4 (left-hand panel) presents the histogram for the OJT index. As can be seen, the index shows sizable variation across countries. More specifically, the index ranges from countries in which less than 10 percent of workers reported having participated in formal on-the-job training sessions in the preceding year to countries in which formal training sessions involve more than 40 percent of employees (see Table A.1 in the appendix).

On-the-job learning index

In building this index, we draw on responses to a further two PIAAC questions:

1. "**In your own job, how often do you learn new work-related things from co-workers or supervisors**?"

2. "**How often does your job involve learning-by-doing from the tasks you perform**?"

The possible answers to both questions are as follows: Never (0); Less than once a month (1); Less than once a week but at least once a month (2) ; At least once a week but not every day (3); Every day (4). Then, we compute the two indexes as the percentage of individuals participating in these activities at least once a week.

$$Index\ learning\ from\ coworkers\ = \frac{more\ than\ once\ a\ week}{total} * 100,$$

to exclude four countries from our sample. Thus, our final sample is made up of 29 of the 33 OECD countries surveyed.

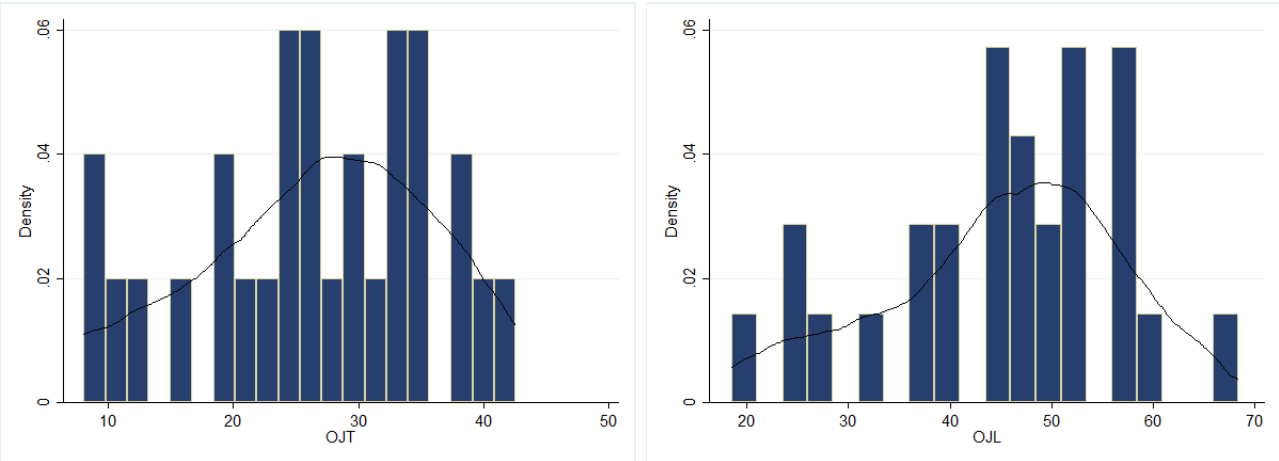
$$Index\ learning\ by\ doing\ =\ \frac{more\ than\ once\ a\ week}{total} * 100.$$

These partial indexes are then integrated to compute the OJL index as the geometric mean.

$$Index\ OJL\ =\ \sqrt{Index\ learning\ from\ coworkers\ \times\ Index\ learning\ by\ doing}.$$

Figure 4 (right-hand panel) presents the histogram for the OJL index. As with the training index, the OJL index shows substantial variation across countries, ranging from almost 20 to almost 70 percent (see Table A.1 in the appendix).

Figure 4: OJT & OJL



Data source: OECD-PIAAC.

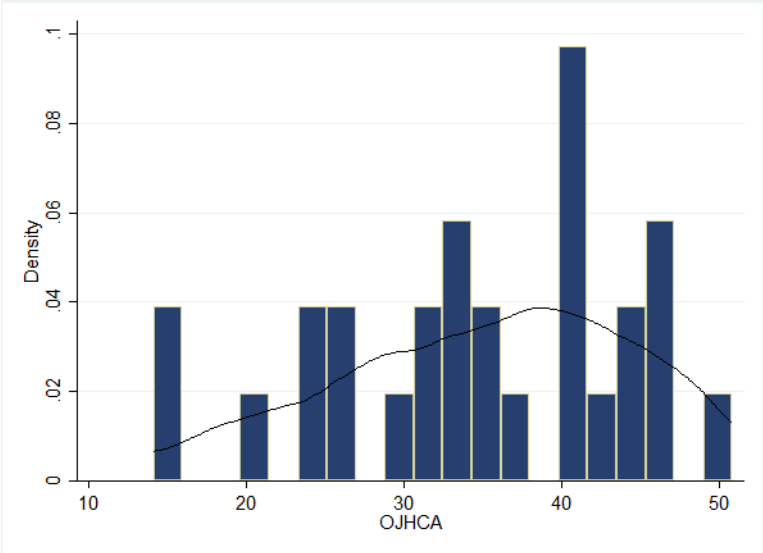
On-the-job human capital acquisition

Finally, we integrate the training and learning indexes (OJT and OJL) to compute the OJHCA index by taking the geometric mean of these two indexes.

$$Index\ OJHCA\ =\ \sqrt{Index\ OJT\ \times\ Index\ OJL}. \tag{1}$$

Figure 5 shows that the OJHCA index varies considerably across the OECD countries, reflecting the high degree of dispersion in both of its components (the OJT and OJL indexes).

Figure 5: On-the-job human capital acquisition index



Data source: OECD-PIAAC.

3 The model

The economy of the model consists of a measure of 1 risk-neutral, infinitely-lived workers and risk-neutral, infinitely-lived firms. Workers and firms discount future payoffs at a common rate r and capital markets are perfect. Time is continuous. There are two type of workers, employed and non-employed (unemployed) workers making up the working age population.[8]

3.1 Job and worker value functions

There is a time-consuming and costly process of matching unemployed workers and job vacancies, which is captured by a standard constant-return-to-scale matching function:

$$m(u, v) = m_o u^{\alpha} v^{(1-\alpha)}, \tag{2}$$

where u denotes the number of unemployed workers, v is the number of vacancies, and α and m_o are the matching function parameters.

[8]For simplicity, we put together both unemployed and inactive workers. This assumption is not unrealistic since many OECD countries show high flows between employment and inactivity. For example, according to the Eurostat labor market flow statistics, 52% of ins to employment and 60% of outs from employment are from/to inactivity. In turn, and according to the Bureau of Labor Statistics, the flows between employment and inactivity represent more than 70% of the total flows to/from employment in the U.S.

Hence, the aggregate rates at which unemployed workers find jobs, $f(\theta) = m(u, v)/u$, and vacancies are filled, $q(\theta) = m(u, v)/v$, both depend on the vacancy-unemployment ratio θ (labor market tightness). Note as well that $f(\theta) = \theta q(\theta)$, $f'(\theta) > 0$, and $q'(\theta) < 0$.

Each firm has a constant returns to scale production technology with labor as the sole production factor. The firm's output per worker y depends on the human capital acquired on-the-job and a firm-specific productivity x arriving at the flow rate λ and draw from a cumulative distribution $G(x)$ in the range $[0, \tilde{x}]$. It also depends on a parameter A common to all firms that captures the determinants of labor productivity other than those related to human capital acquired on-the-job. Job-specific human capital depends on both the on-the-job training per matched worker ξ and on the level of on-the-job learning l. The former corresponds to organized sessions for on-the-job training or training activities by supervisors and/or co-workers and is decided by the firm in order to maximize the value of job position $J(x)$. The latter is decided by the worker to maximize the value of being employed $W(x)$ and includes on-the-job learning of new work-related things from interaction with co-workers and supervisors and from the tasks workers perform on their own (learning-by-doing). We also assume a concave relationship between labor productivity and the level of job specific human capital which is the geometric mean of ξ and l. Specifically, we assume that a filled job produces $y = xA\,(\xi l)^{\frac{\phi}{2}}$ with $\phi \in (0, 1)$. In turn, firms pay wages $w(x)$ and incur linear training costs $\mu\xi$ with $\mu \geq 0$. The firm has a choice after the realization of the new shock, x' arriving at the rate λ, whether to destroy or to continue the job position. In case of job destruction, the firm will open a new vacancy and incur in a capital loss represented by $J(x') - V$, where V stands for the value that the firm attributes to a vacant position. A max operator captures this decision. If the job position survives, the firm has to give up the old value $J(x)$ for the new value $J(x')$.

A vacancy may either be filled or not. If the position is not filled, the firm incurs a flow cost c. A vacancy is filled at the endogenous rate $q(\theta)$, yielding a positive value $J(\tilde{x}) - V$, where $\tilde{x}$ is the maximum idiosyncratic productivity. Thus, as in Mortensen and Pissarides (1994) we assume that new jobs are created at maximum productivity since the firm can choose its product and technology before but not after the job is created. The values V and $J(x)$ are given by the following expressions:

$$rV = -c + f(\theta)(J(\tilde{x}) - V), \tag{3}$$

$$rJ(x) = xA\,(\xi l)^{\frac{\phi}{2}} - w(x) - \mu\xi + \lambda \left[\int_0^{\bar{x}} \max\left(J(x'), V\right) dG(x') - J(x) \right]. \tag{4}$$

A free entry condition assumption is added for vacancies. This means that firms open up vacancies until the expected value of doing so becomes zero, $V = 0$. Therefore, using (3) we

obtain a job creation condition

$$J(\tilde{x}) = \frac{c}{q(\theta)}. \tag{5}$$

We also consider that job positions generating negative surplus will be destroyed. Thus, firms destroy all jobs with idiosyncratic productivity below the reservation value R,

$$J(R) = 0. \tag{6}$$

As a result, the job destruction rate is just the product of the arrival rate of the shock λ and the proportion of jobs with productivity below R, that is,

$$s(R) = \lambda G(R). \tag{7}$$

An unemployed individual obtains a value b and, with rate $f(\theta)$, finds a job that yields net value $W(\tilde{x}) - U$, where $W(\tilde{x})$ and U stand for the value that the worker attributes to employment and unemployment, respectively. Employed workers earn the endogenous wage $w(x)$ and incur on-the-job learning costs σl. These learning costs can be related, for example, to the leisure forgone when the worker allocates part of his daily rest or breaks at work to improve his job specific skills. If the job is destroyed after the realization of the new shock the worker returns to the unemployment status and incur in a capital loss represented by $W(x') - U$. In contrast, if the job survive when x' arrives, the worker loses $W(x)$. The values associated with different worker status - that is, unemployed U and employed $W(x)$ - are given by the following expressions:

$$rU = b + f(\theta)(W(\tilde{x}) - U), \tag{8}$$

$$rW(x) = w(x) - \sigma l + \lambda \left[\int_0^{\bar{x}} \max\left(W(x'), U\right) dG(x') - W(x) \right]. \tag{9}$$

3.2 Wage determination

We assume that wages are set through bilateral Nash bargaining. Since neither workers nor employers can instantaneously find an alternative match partner in the labor market, and since hiring decisions are costly, a match surplus $S(x)$ exists and is equal to $J(x) + W(x) - U$. To divide this surplus between the firm and the worker, we assume wages to be the result of bilateral Nash bargaining. The Nash solution is the wage that maximizes the weighted product of the worker's and the firm's net return from the job match. The first-order condition yields the following equation:

$$(1 - \beta)(W(x) - U) = \beta J(x), \tag{10}$$

where β and $1 - \beta$ represent the bargaining power of the worker and the firm, respectively.

3.3 Closing the model

To close the model we assume that firms choose the training level ξ that maximizes the firms value of job position $J(x)$,

$$\max_{\xi} J(x), \tag{11}$$

and workers choose the learning effort l that maximizes the worker's value of being employed $W(x)$,

$$\max_{l} W(x). \tag{12}$$

3.4 Stationary equilibrium

Dynamics of employment

The working age population is normalized to one and the fact that individuals are either employed or unemployed is considered,

$$e + u = 1. \tag{13}$$

Then, using equation (13) and given the state-contingent ratio of vacancies to unemployment θ the employment rate evolve according to the following backward-looking differential equation:

$$\dot{e} = -s(R)e + f(\theta)(1 - e). \tag{14}$$

At equilibrium, $\dot{e} = 0$. Thus, we obtain the equilibrium employment rate

$$e = \frac{f(\theta)}{s(R) + f(\theta)}. \tag{15}$$

Equilibrium wage

To find the equilibrium wage, we first calculate $W(x) - U$ using equations (8) and (9), then we plug it in equation (10) together with equations (4) and (5). After some algebra, we obtain

$$w(x) = \beta \left[xA\left(\xi l\right)^{\frac{\phi}{2}} - \mu\xi + c\theta \right] + (1 - \beta)(b + \sigma l). \tag{16}$$

Equation (16) expresses the wage as the sum of the fraction of the surplus that accrues to the worker and the value to the worker outside the match plus the part of the on-the-job learning costs the worker passes to the firm. Notice that, in contrast to training costs, learning costs increase wages.

On-the-job training and on-the-job learning

Assuming that both, workers and firms, internalize the effect of ξ and l on wages, and using equations (4), (9), (11), (12) and (16), the first-order conditions for the optimal level of on-the-job training and on-the-job learning yield

$$\xi = \left(\frac{xA\phi}{2\mu} l^{\frac{\phi}{2}} \right)^{\frac{1}{1-\frac{\phi}{2}}}, \tag{17}$$

$$l = \left(\frac{xA\phi}{2\sigma} \xi^{\frac{\phi}{2}} \right)^{\frac{1}{1-\frac{\phi}{2}}}. \tag{18}$$

Equations (17) and (18) show that the training decisions taken by the firm complement the efforts made by the workers in their on-the-job learning process. This complementarity takes place because training induces workers to increase their learning activities in the workplace in order to raise their wages and, then, to offset part of the training costs transferred from firms to workers.

Job destruction by firms

Substituting the wage equation (16) into the value of the firm (equation 4) and knowing that $J(R) = 0$, we use $(r+\lambda)J(x') - (r+\lambda)J(R)$ to obtain $(r+\lambda)J(x') = (1-\beta)(x' - R)A\,(\xi l)^{\frac{\phi}{2}}$. Finally, we substitute this last expression into the integral of equation (4), to get the equilibrium job destruction condition, which is:

$$0 = (1-\beta)\left\{ A\,(\xi l)^{\frac{\phi}{2}} \left[R + \frac{\lambda}{(r+\lambda)} \int_0^{\bar{x}} (x' - R)\, dG(x') \right] - \mu\xi - \sigma l - b \right\} - \beta c\theta. \tag{19}$$

Job creation by firms

Using $(r+\lambda)J(\tilde{x}) = (1-\beta)(\tilde{x} - R)A\,(\xi l)^{\frac{\phi}{2}}$ and equation (5), we obtain the job creation condition, which implies that the expected value of filling a position must be, at equilibrium, equal to the cost of opening the vacancy,

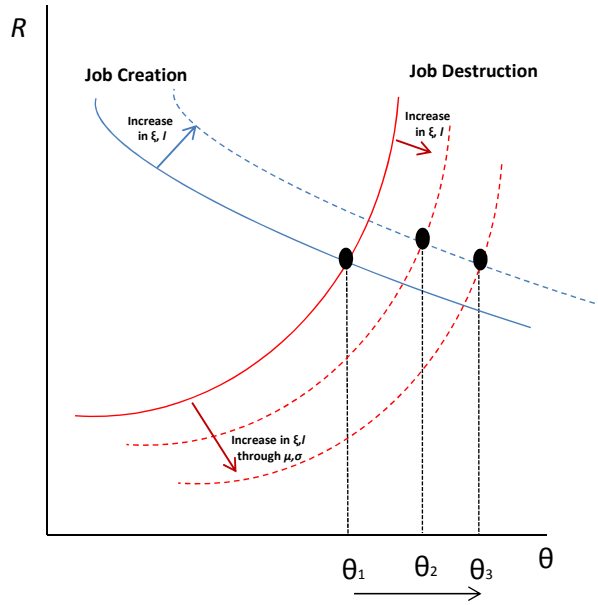
$$\frac{c}{q(\theta)} = (1-\beta)\frac{(\tilde{x} - R)}{(r+\lambda)} A\,(\xi l)^{\frac{\phi}{2}}. \tag{20}$$

3.4.1 Employment effects of on-the-job human capital acquisition

To analyze the impact of on-the-job human capital acquisition on employment we use equations (19) and (20). These two equations jointly determine θ and R and, therefore, the job finding and separation rates. As Figure 6 shows, equation (19) defines an upward sloping curve while equation (20) defines a downward sloping curve in (R, θ) space. In the first case, it slopes up

because at higher θ the wage of the workers increase and so more marginal jobs are destroyed (R increases). In turn, the second equation 19 is an upward sloping curve because a higher job destruction threshold (R) implies a lower surplus value for new jobs, lowering the number of vacancies and, therefore, reducing labor market tightness θ.

Figure 6: Effects of on-the-job human capital on reservation productivity R and market tightness θ



An increase in both components of on-the-job human capital shifts both the job creation and the job destruction curves to the right increasing θ but with unclear effect on R. Thus, the job finding rate $f(\theta)$ will increase but the job destruction rate $s(R)$ can increase or decrease depending on the relative shift of the two curves. If the shift in job destruction is higher than the one in job creation, then R and $s(R)$ will fall. As a result, the employment rate (equation 15) increases. In contrast, if the job destruction (equation 19) shifts by more than the job creation (equation 20) the job destruction rate increases with an unclear effect on the employment rate. In sum, according to our theoretical model the overall employment effect of an increase in ξ and l is not clear and it is thus entirely an empirical question.

It is interesting to emphasize that if the increase in on-the-job human capital is due to a reduction in marginal training μ or learning σ costs, then the job destruction rate will shift to the right by even more, generating an additional increase in θ and a potential reduction in R, increasing the employment rate.

4 Calibration and simulated results

This section undertakes a quantitative assessment of the role of training and learning investments in generating cross-country patterns observed for both human capital acquisition on the job and employment. First, we calibrate the model parameters using Canada as our benchmark economy. Second, we obtain the marginal costs in every country that reproduces the levels of on-the-job training and learning as observed in the data. This exercise enables us to analyze the role of training and learning separately and conclude that differences in marginal costs across countries are key to quantifying the differences observed in employment rates. To understand differences in marginal costs, we analyze two important determinants of employment and human capital acquisition on the job: payroll taxes and education. Finally, we analyze the role of the portability of skills across jobs within a country as another source of potential heterogeneity across countries.

4.1 Calibration

We calibrate the model at a quarterly frequency in order to match it with several empirical facts of the Canadian economy. We chose Canada because it has all the relevant information necessary to calibrate parameters and, in contrast to the U.S., it represents an average economy in the relationship between on-the-job human capital and employment as shown in Figure 3.[9] Some of the targets and calibrated parameters correspond to the main year of the PIAAC (2012). Thus, our calibration is in line with the on-the-job human capital acquisition index presented in section 2 for the Canadian economy. Table 1 summarizes all the calibrated parameters and presents the steady state values of the endogenous variables.

We target an average employment to working-age population rate $e = 61.7\%$ (OECD database). Following Zhang (2008), we set the job separation rate at $s(R) = 0.090$, the interest rate at $r = 0.012$ and the matching function elasticity parameter at $\alpha = 0.54$. We also target the elasticity of job separations to productivity to be $\varepsilon_{s,y} = -1.81$ (Zhang, 2008).[10]

Equation (15) implies a job finding rate of $f(\theta) = 0.2326$. Moreover, we normalize job market tightness to $\theta = 1$ and use the matching function (2) to obtain the matching parameter $m_0 = f(\theta)/\theta^{1-\alpha} = 0.2326$. In addition, we set the workers' bargaining power equal to the matching function elasticity parameter at $\beta = \alpha = 0.54$, consistent with Hosios (1990) efficiency condition.

[9] Qualitative results do not change while quantitatively they change very little if we calibrate to the U.S. instead of Canada and adjust the aggregate productivity parameter A to match an average economy in terms of employment and human capital.

[10] Specifically, we use both the relative standard deviation and the correlation coefficient between labor productivity and the separation rate presented in Table 2 of Zhang (2008) to calculate $\varepsilon_{s,y}$. Thus, and similar to Mortensen and Nagypal (2007), we calculate $\varepsilon_{s,y}$ using the following OLS regression coefficient $\varepsilon_{s,y} = \rho_{s,y} \times \frac{\sigma_s}{\sigma_y} = -0.396 \times \frac{0.096}{0.021} = -0.0181$.

Table 1: Calibrated parameter values for the Canadian economy

Parameter	Value	Source/Target
Interest rate, r	0.012	Zhang (2008)
Standard deviation for the distribution of log x, σ_x	0.200	Sala et al. (2012)
Arrival rate of the idiosyncratic productivity shock, λ	0.2275	$\varepsilon_{s,y} = -1.81$,
Initial idiosyncratic productivity, $\tilde{x}$	1.3895	$G^{-1}(0.95, 0, \sigma_x)$
Matching function elasticity, α	0.540	Zhang (2008)
Matching function scale, m_o	0.145	Solves (2)
On-the-job human capital elasticity, ϕ	0.2326	Own estimation
Productivity residual, A	0.2264	Solves $y = \overline{x}A\,(\xi l)^{\phi/2}$
Marginal training costs, μ	0.0035	Solves training eq.(17)
Marginal learning costs, σ	0.0018	Solves learning eq. (18)
Cost of vacancy, c	0.1719	Solves JC eq. (20)
Employment opportunity cost, b	0.4421	Solves JD eq. (19)
Workers' bargaining power, β	0.540	$\alpha = \beta$, Hosios (1990)
Variable		
Employment rate, e^*	0.617	OECD
Separation rate, $s(R^*)$	0.090	Zhang (2008)
Labor market tightness, θ^*	1.000	Normalization
Job finding rate, $f(\theta^*)$	0.2326	Solves empl eq. (15)
Wages, w^*	0.7607	Solves (16)
Labor productivity, y^*	1.000	Normalization
Reservation productivity, R^*	0.9484	Solves $s(R) = \lambda G(R)$
On-the-job training index, ξ^*	33.3	PIAAC
On-the-job learning index, l^*	56.9	PIAAC
On-the-job human capital index, h^*	43.5	PIAAC

We normalize labor productivity to $y = 1$ and calibrate its components using information from section 2. Specifically, we use PIAAC data to set the level of on-the-job training ξ and on-the-job learning l at 33.3 and 56.9, respectively. Then, the total level of on-the-job human capital acquisition is equal to $h = (\xi l)^{\frac{1}{2}} = 43.5$, while its contribution to the total labor productivity $h^{\phi} = 2.3819$ can be calculated using the estimated constant elasticity $\phi = 0.23$. We estimate this elasticity from the following regression: $\ln(y_c) = a_0 + \phi \ln(h_c) + \epsilon_c$, where subscript c indicates the country, y_c is the GDP per working-age population, a_0 is the constant regression coefficient, h_c is the level of on-the-job human capital acquisition in every country, and ϵ_c the error term.[11]

We assume that for every period all continuing jobs draw a new observation of their idiosyncratic productivity from a common distribution with cdf $F(x)$. As in Ramey et al. (2000), we assume a lognormal distribution. There exists a threshold productivity R such

[11] All the data come from the OECD database. To check the robustness of our estimated results, we run an additional regression controlling for the share of workers with tertiary education as a proxy of the level of formal education. We obtain a statistically significant ϕ equal to 0.23 again.

that all jobs with productivity below that threshold yield a negative surplus and are therefore destroyed. Since the density of the lognormal distribution takes positive values over the positive real line, there is no maximum productivity as such. In order to make this concept operational, we just assume that $\tilde{x}$ is the 95th percentile, $\tilde{x} = F^{-1}(0.95)$. From Sala et al. (2012), we assume that $\log(x)$ has mean $\mu_x = 0$ and standard deviation $\sigma_x = 0.2$. Then, the arrival rate of the idiosyncratic productivity shock is set to $\lambda = 0.2275$ to match the elasticity of job separations to productivity. We obtain a productivity for new matches $\tilde{x} = 1.3895$, a mean productivity $\overline{x} = E(x|x > R) = 1.146$, and a reservation productivity $R = 0.9484$. Finally, we obtain a labor residual productivity $A = y/(\overline{x}h^{\phi}) = 0.2264$.

We next calculate the parameters of the firms training costs $\mu = 0.0035$ and the workers learning costs $\sigma = 0.0018$ using equations (17) and (18), in each case. The vacancy costs parameter $c = 0.1719$ and the opportunity cost of employment $b = 0.4421$ are obtained simultaneously by solving job creation and destruction equations (20) and (19). Finally, the equilibrium wage $w^* = 0.7607$ is obtained using the wage equation (16).

4.2 Cross-country differences

Countries are treated as being identical to the benchmark economy except in their marginal costs of learning σ and training μ. We use the parameters summarized in Table 1 and equations (17) and (18) to compute σ and μ that generate the levels of learning l and training ξ observed in each country. Considering this exogenous variation in σ and μ, we address the following question: how much of the observed differences of employment rates e can be explained by the model?

Figure 7 shows the data versus the simulated values of employment rates. In general, the model performs well in explaining the positive relationship observed in the data between human capital and employment. The regression lines show that, on average, the model predicts that one additional point in the human capital index increases the employment rate by 0.59 percentage points, which is similar to the 0.61 percentage points estimated from the data. Notice, that the model is able to match the observed differences in employment rates between the countries with the highest and lowest level of human capital (New Zealand and Turkey, respectively). The model is not able, however, to account for the variation in the employment rates observed for countries with similar levels of human capital. This is particularly the case of countries that are in the middle of the distribution of human capital index.

To better understand heterogeneities across countries, Table 2 presents the simulation results for the levels and differences in employment rates predicted by the model. Specifically, we compare the results for an average economy in each tertile of on-the-job human capital distribution. T1 includes 9 countries with the lowest values of OJHCA, while T3 includes the

Figure 7: Human capital and employment

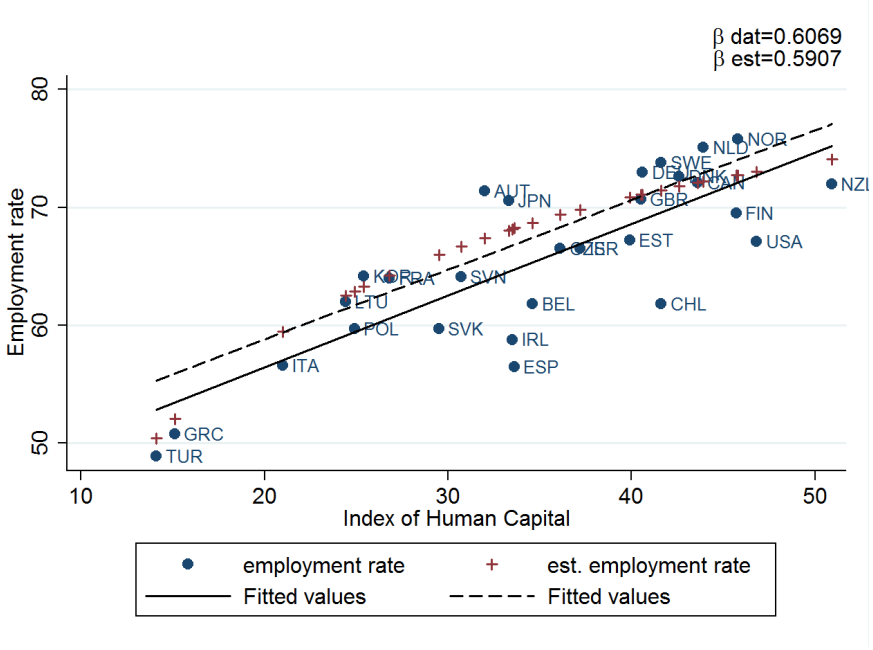


Table 2: Employment levels and gaps by tertile in OJHCA

Employment	T3	T2	T1	dif32	dif31
Data	**71.1**	**66.3**	**58.9**	**4.8**	**12.2**
1) Benchmark ($\sigma_i \to l_{data}, \mu_i \to \xi_{data}$)	72.5	69.5	62.2	3.0	10.3
2) Fixed mc ($\mu_{can}, \sigma_{can}, l_{data}, \xi_{data}$)	71.8	73.3	74.2	-1.5	-2.4
3) Learning ($\xi_{can}, \mu_{can}, \sigma_i \to l_{data}$)	72.1	70.3	67.1	1.8	5.0
4) Training ($l_{can}, \sigma_{can}, \mu_i \to \xi_{data}$)	72.6	70.9	66.3	1.7	6.3

Notes: The average rate of OJHCA in each group is T1=23.5, T2=36.1, T3=44.7.

highest 9, and T2 10 countries in the middle of the distribution.[12] As already noted in Figure 7, the benchmark model (simulation 1) performs quite well both in levels and differences. In particular, the model accounts for 62.5% of the employment differences between T3 and T2, and 84.4% between T3 and T1.

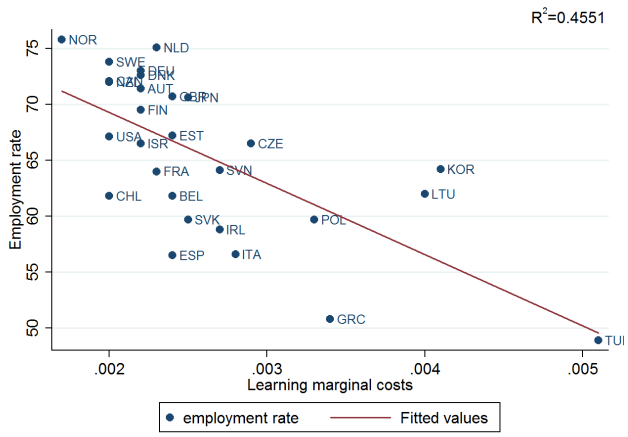
We next perform an exercise where we assume that countries are identical to the benchmark economy except in their levels of training and learning, and take these values directly from the data. In contrast to the benchmark exercise, we do not consider equations (17) and (18) from the model. We use the exogenous variation of training and learning from the data to account for differences in employment rates. Marginal costs are fixed across countries and equal to the

[12]Ordered from the minimum to the maximum level of on-the-job human capital index, we find Turkey, Greece, Italy, Lithuania, Poland, Korea, France, Slovak Republic, and Slovenia in T1, Austria, Japan, Ireland, Spain, Belgium, Czech Republic, Israel, Estonia, UK, and Germany in T2, and Sweden, Chile, Denmark, Canada, Netherlands, Finland, Norway, United States, and New Zealand in T3.

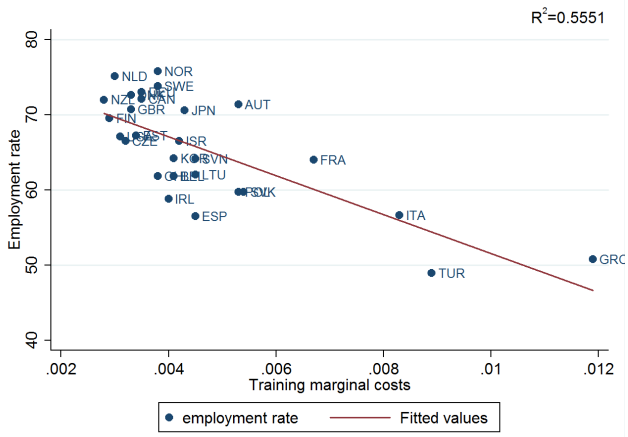
benchmark economy (Canada). The simulation 2 in Table 2 presents the results. The model performs very poorly since it is not able to capture employment differences across countries at all. This implies that variation in marginal costs are necessary to understand differences across countries in employment rates due to differences in on-the-job human capital acquisition. Figure 8 shows the negative relation between employment rates and marginal costs of learning in the left panel, and between employment and marginal costs of training in the right panel. These marginal costs come from the benchmark simulation and their negative relationships with employment are in line with the positive relationships of employment with the levels of training and learning presented in section 2.

Figure 8: Employment and marginal learning and training costs

(a) Learning marginal costs and employment



(b) Training marginal costs and employment



Source: OECD database.

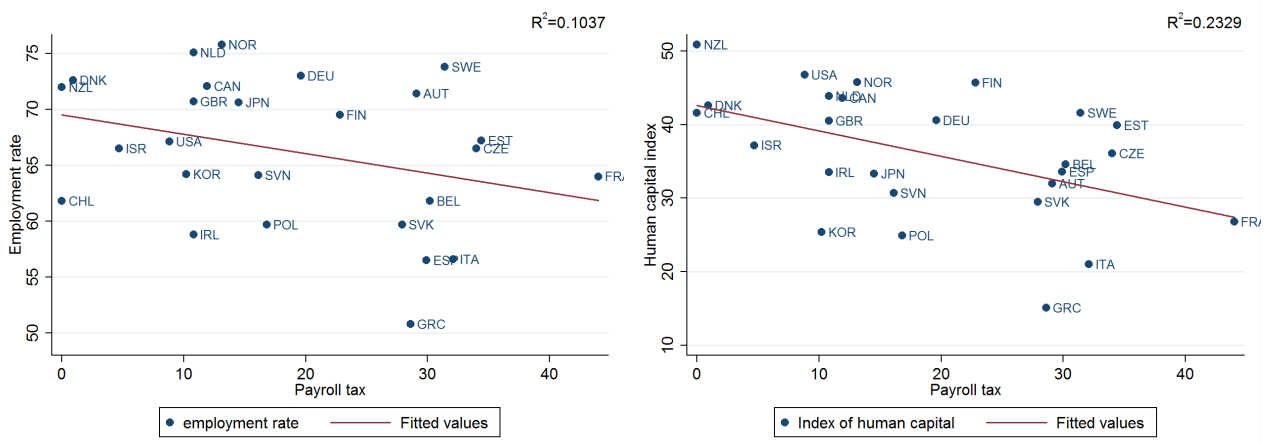
Note that two countries may have the same human capital levels but different simulated employment rates. This happens because although different levels of training and learning can generate the same level of human capital, they have different marginal costs that generate different employment rates. Simulations 3 and 4 in Table 2 show the decomposition of the contribution of learning and training in accounting for differences in employment rates. Differences in the marginal costs of learning and training account for more or less the same amount between countries in the groups T3 and T2, 1.8 and 1.7 out of 3.0, respectively. However, although differences are not large, learning accounts for a smaller fraction of the differences between T3 and T1 than training, 5.0 and 6.3 out of 10.3, respectively, which stems from the higher differences observed in marginal costs of training in T1 with respect to T3 in comparison to marginal costs of learning (see Figure 8).

4.3 Payroll taxes, education and on-the-job human capital

In previous section we have provided evidence of the importance of the marginal costs of learning and training determining investments in human capital acquisition and their implications for employment. In this section, we consider two candidates, payroll taxes and education, to explain differences across countries of both OJHCA and employment rates. We start by explaining how payroll taxes affect both the employment opportunity cost (in line with previous literature, such as Prescott, 2004) and the marginal costs of learning. Then, we consider a quantitative exercise to analyze the impact of formal education on the marginal costs of learning and training . Finally, we combine payroll taxes and education to explain differences in employment rates across countries.

Figure 9: Employment, OJHCA and payroll taxes

(a) Employment and payroll taxes (b) OJHCA and payroll taxes



Source: OECD database.

We observe that payroll taxes paid by the firm are negatively correlated not only with employment but also with the OJHCA index.[13] The left panel in Figure 9 shows the negative relation between payroll taxes and employment. While the right panel of Figure 9 shows the negative relation between taxes and the OJHCA index. To explore the quantitative implications of payroll taxes, we expand our model including the payroll taxes τ legally paid by employers. In particular, employer payroll taxes increase the labor cost for firms modifying the value of a job position as follows:

$$rJ(x) = xA\left(\xi l\right)^{\frac{\phi}{2}} - (1+\tau)w(x) - \mu\xi + \lambda\left[\int_0^{\bar{x}} \max\left(J(x'), V\right) dG(x') - J(x)\right]. \tag{21}$$

[13] Although income taxes paid by the worker have the same theoretical implications, we do not include them because they do not show a significant correlation with the on-the-job human capital index.

Then, the equations of job destruction, wage and learning investment that characterize the stationary equilibrium are as follow:

$$\beta c\theta = (1-\beta)\left\{A\left(\xi l\right)^{\frac{\phi}{2}}\left[R+\frac{\lambda}{(r+\lambda)}\int_0^{\bar{x}}(x'-R)\,dG(x')\right]-\mu\xi-(1+\tau)(\sigma l+b)\right\}, \quad (22)$$

$$w(x) = \frac{\beta}{(1+\tau)}\left[xA\left(\xi l\right)^{\frac{\phi}{2}}-\mu\xi+c\theta\right]+(1-\beta)(b+\sigma l), \quad (23)$$

$$l = \left(\frac{xA\phi}{2(1+\tau)\sigma}\xi^{\frac{\phi}{2}}\right)^{\frac{1}{1-\frac{\phi}{2}}}. \quad (24)$$

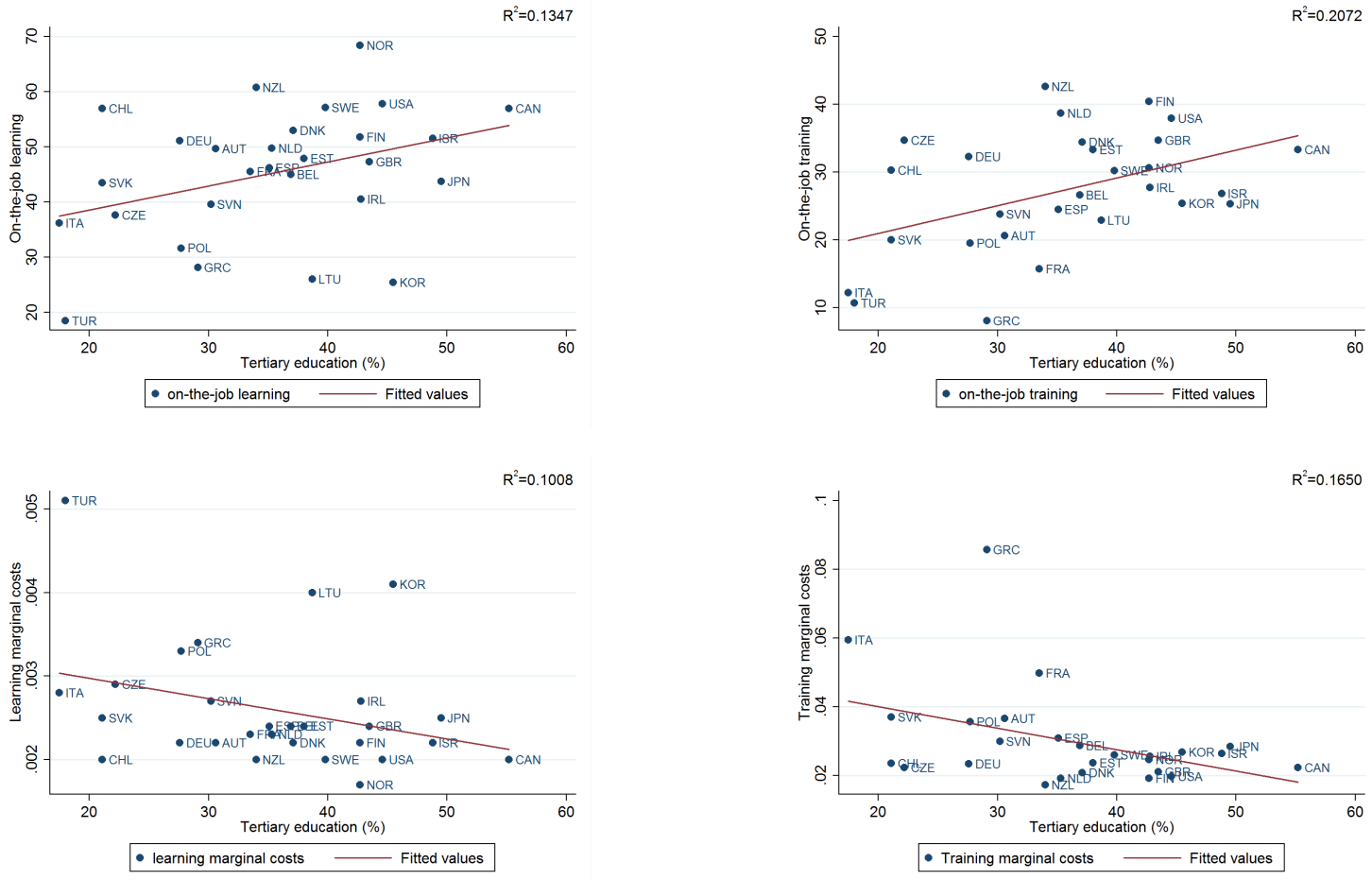
Hence, taxes reduce the total surplus and, as a result, wages fall (equation 23). Moreover, taxes increase the implicit marginal cost of learning from σ to $(1+\tau)\sigma$ (equation 24), which reduces the level of learning l and, by complementarity, bring down the level of training provided by the firm ξ. Taxes are equivalent to increase both the opportunity cost of employment b and the marginal cost of learning σ as can be seen in the job destruction condition (22). From a graphical point of view, τ shifts the job destruction curve to the left in Figure 6, reducing θ and increasing R. As a result, the employment rate falls according to equation 15.

The second candidate to explain differences in marginal costs across countries is the level of education. Graphs in the upper part of Figure 10 show the positive relation between the proportion of individuals with tertiary education and both learning and training indexes. Moreover, the graphs in the bottom part of Figure 10 show a negative relation between learning and training marginal costs and the proportion of population with tertiary education. Formal education increases the net returns of firm's training investment and reduces the worker's effort to learn. This explanation is in line with the observed complementarity between on-the job training and formal education found in several studies (see e.g., Cairó and Tomaz, 2017)). We incorporate the decreasing relationship between the proportion of highly educated individuals and the marginal costs of training and learning in the model, considering that both the marginal costs are a function of education:

$$\sigma = \sigma_e(edu)^{\psi} \text{ and } \mu = \mu_e(edu)^{\kappa}. \quad (25)$$

Then, we use these definitions (25) to estimate the parameters $\psi = -0.286$ and $\kappa = -0.585$. Specifically, we apply logarithms to expressions in (25) and then estimate OLS regressions between our simulated marginal costs of learning and training in the benchmark economy and the observed levels o tertiary education. Finally, we set σ_e and μ_e to match the marginal costs of the benchmark economy (Canada).

Figure 10: OJHCA and tertiary education



Source: OECD and PIAAC databases.

Table 3 summarizes the results of the model considering payroll taxes and education on employment and on the OJHCA.[14] The first block reports the simulated effects on employment e, while the second shows what happens with OJHCA h. When we introduce payroll taxes (simulation 2) the model performs well with respect to employment while the model performs better when we introduce tertiary education (simulation 3), explaining inter-tertile differences on OJHCA. Specifically, simulation 2 accounts for 71.3% and 6.1% of the observed differences in employment and OJHCA between T3 and T1, respectively. In turn, simulation 3 explains 21.3% and 25.5% of the differences in employment and OJHCA between T3 and T1. When payroll taxes and education become operative (simulation 4), the model is able to explain 101.6% and 28.8% of the differences between T3 and T1 in employment rates e and OJHCA h, respectively . In other words, when taxes and education affect the marginal costs of training and learning, the model is able to reproduce the observed differences in e and explains almost 30% of the observed gap in h between the third and the first tertile of countries in the OJHCA level . It is also important to highlight that the model with taxes and education (simulation 4) is able to match quite well the positive relationship observed between employment and tertiary education across OECD economies (see Figure 11).

Table 3: Employment levels and gaps by tertile in OJHCA ($\psi = -0.286$ and $\kappa = -0.585$)

Block 1 **Employment**	T3	T2	T1	dif32	dif31
Data	**71.1**	**66.3**	**58.9**	**4.8**	**12.2**
1) Benchmark ($\sigma_i \to l_{data}, \mu_i \to \xi_{data}$)	72.5	69.5	62.2	3.0	10.3
2) Taxes ($edu_{Can}, \tau_{data}, \sigma_{Can}, \mu_{Can}, \xi_{simul}, l_{simul}$)	72.6	66.0	63.9	6.6	8.7
3) Edu ($edu_{data}, \tau_{Can}, \sigma_{simul}, \mu_{simul}, \xi_{simul}, l_{simul}$)	69.4	69.1	66.8	0.4	2.6
4) Edu and tax ($edu_{data}, \tau_{data}, \sigma_{simul}, \mu_{simul}, \xi_{simul}, l_{simul}$)	70.0	62.4	57.6	7.6	12.4
Block 2 **OJHCA**					
Data	**44.7**	**36.1**	**23.5**	**8.6**	**21.2**
1) Benchmark ($\sigma_i \to l_{data}, \mu_i \to \xi_{data}$)	44.7	36.1	23.5	8.6	21.2
2) Taxes ($edu_{Can}, \tau_{data}, \sigma_{Can}, \mu_{Can}, \xi_{simul}, l_{simul}$)	43.6	42.6	42.3	1.1	1.3
3) Edu ($edu_{data}, \tau_{Can}, \sigma_{simul}, \mu_{simul}, \xi_{simul}, l_{simul}$)	36.2	35.4	30.9	0.8	5.4
4) Edu and tax ($edu_{data}, \tau_{data}, \sigma_{simul}, \mu_{simul}, \xi_{simul}, l_{simul}$)	36.3	34.7	30.2	1.6	6.1

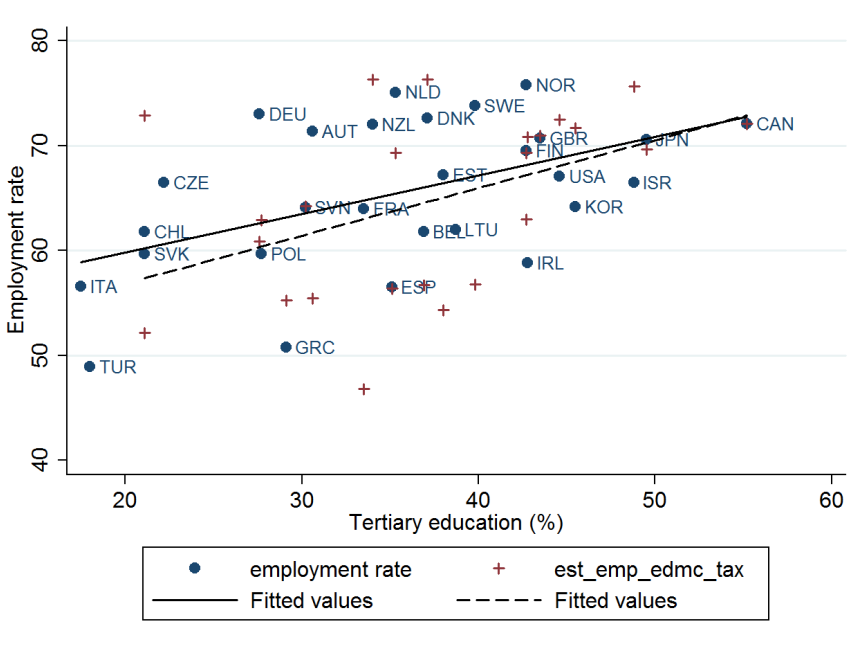
Data: OECD. Notes: The average tax rates in each group are T1=11.1%, T2=21.8% and T3=25.1%. The average levels of tertiary education in each group are T1=29.0%, T2=37.5% and T3=39.2%.

4.4 General and specific human capital

Up to this juncture, we have assumed human capital acquired on-the-job to be specific. This assumption implies that firms and workers alike always incur training and learning costs when a job position is created. However, workers can transfer some of their skills from one job to

[14] The benchmark scenario (simulation 1) is the same as the one presented in Table 2.

Figure 11: Tertiary education and employment across OECD economies



another, even if they spend some time unemployed before finding a new job. This assumption allows them to avoid incurring new training and learning costs to achieve the same level of productivity as that acquired in the previous job. The portability of these skills, known as general skills, and their relative importance have been studied extensively (e.g., Topel, 1991; Altonji and Shakotko, 1987). From an empirical perspective, Barron et al. (1989) using the 1982 U.S. Employment Opportunity Pilot Project, show that at least 50% of on-the-job training is general. More recently, Mahone (2016) uses the National Longitudinal Survey of Youth and estimates that between 53% and 68% of job training is transferable from one position to another.

To explore the relative importance of general and specific human capital equilibrium in accounting for the differences in employment across the OECD economies, we modify the benchmark model of section 3. Specifically, we assume that a proportion γ of the on-the-job human capital $(\xi l)^{1/2}$ acquired in each period as general. This means that workers and firms can use general skills g in all jobs without incurring additional learning and training costs. We assume, however, that g depreciates at a rate δ generating the following law of motion of the general human capital g:

$$\dot{g} = \gamma\,(\xi l)^{\frac{1}{2}} - \delta g. \tag{26}$$

Now, the firms production function includes not only ξ and l but also g, modifying the value function $J(x)$ of the firm as follows:

$$rJ(x) = xA\,(g + \xi l)^{\frac{\phi}{2}} - w(x) - \mu\xi + \lambda\left[\int_0^{\bar{x}} \max\left(J(x'), V\right) dG(x') - J(x)\right]. \tag{27}$$

The rest of the model's equations remain unchanged and, in equilibrium, the job creation, destruction, learning, and training conditions become

$$\frac{c}{q(\theta)} = (1-\beta)\frac{(\bar{x}-R)}{(r+\lambda)}A\left((1+\frac{\gamma}{\delta})\xi l\right)^{\frac{\phi}{2}}, \tag{28}$$

$$0 = (1-\beta)\left\{A\left((1+\frac{\gamma}{\delta})\xi l\right)^{\frac{\phi}{2}}\left[R+\frac{\lambda}{(r+\lambda)}\int_0^{\bar{x}}(x'-R)\,dG(x')\right]-\mu\xi-\sigma l-b\right\}-\beta c\theta, \tag{29}$$

$$\xi = \left(\frac{xA\left(1+\frac{\gamma}{\delta}\right)^{\phi}\phi}{2\mu}l^{\frac{\phi}{2}}\right)^{\frac{1}{1-\frac{\phi}{2}}}, \tag{30}$$

$$l = \left(\frac{xA\left(1+\frac{\gamma}{\delta}\right)^{\phi}\phi}{2\sigma}\xi^{\frac{\phi}{2}}\right)^{\frac{1}{1-\frac{\phi}{2}}}. \tag{31}$$

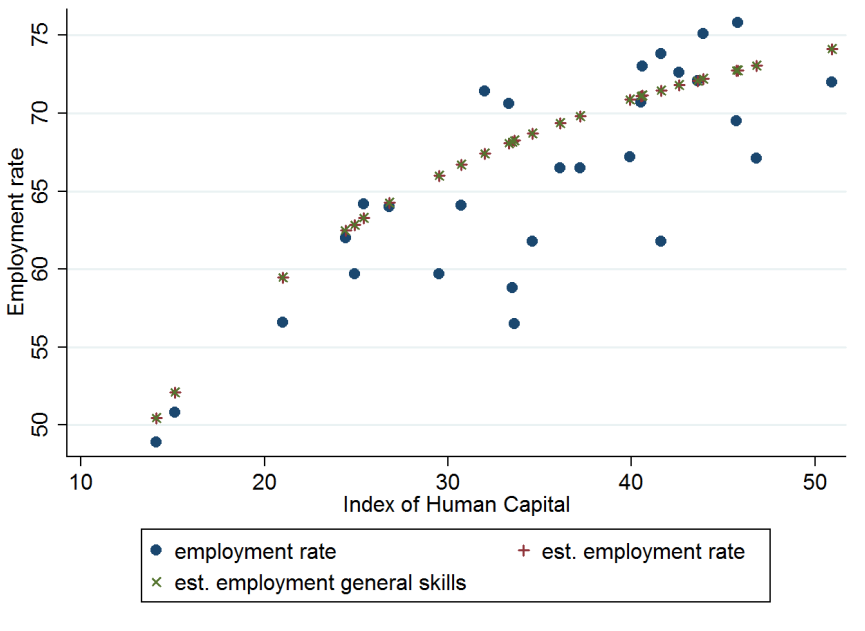
Notice that setting $\dot{g}=0$ in equation (26) means $g=\frac{\gamma}{\delta}(\xi l)^{\frac{1}{2}}$. Hence, the stationary general human capital level depends negatively on the depreciation rate and positively both on the level of investment on human capital made in each period and on the fraction of human capital that becomes general.

The presence of general human capital g increases the output of the firm and, therefore, its net profit by a factor of γ/δ, increasing job creation and its employment share. Additionally, and according to equations (30) and (31), both ξ and l also depend positively on γ/δ implying that, due to the portability of skills, firms and workers now have greater incentive to invest in training and learning.

Finally, it is also straightforward to see that if all countries have the same γ and δ, then the relative output per worker and, therefore, the relative net profit of the firms across countries will depend only on the differences in l and ξ. This means that general human capital does not play an additional role to that assumed for specific human capital (see above) in explaining the observed differences in employment rates across OECD economies. To illustrate this result, Figure 12 compares the simulated employment shares in our benchmark scenario without general human capital $\gamma=0$ with respect to a scenario in which 50% of the human capital acquired on the job becomes general ($\gamma=0.5$). In both cases, we recalibrate the parameters of the model to match the same targets as in section 4.1.[15] As you can see, both the model with general and the model with specific skills simulates the same employment rates across countries.

[15]Following Mahone (2016), the conversion rate to general human capital is set at $\gamma=0.50$ and we assume a quarterly human capital depreciation rate of 0.25% using information from Weber (2014), who estimates an annual depreciation rate of 1% for human capital acquired through vocational training.

Figure 12: Employment effects of general and specific skills



5 Conclusion

In today's globalized economies, competitiveness is a key element of economic development. In 2010, the European Union and its Member States established a new agenda for growth, under the name of the Europe 2020 Strategy. The strategy identified five objectives in the fields of employment, innovation, education, social inclusion and climate that the Member States agreed to adopt as national targets. In their attempts to achieve these targets, on-the-job human capital acquisition can be considered an essential tool given that workforce skills are increasingly gaining in importance, requiring firms and workers alike to adapt to the use of more complex technologies. Against this backdrop, it is vital that we improve our understanding of the way in which the different components of human capital -including, formal on-the-job training and workers' on-the-job learning,- affect labor market outcomes.

In this paper, we explored the role of on-the-job human capital adquisition in explaining differences in employment among OECD countries. We built an index of on-the-job Human Capital Acquisition (OJHCA) for 29 OECD economies using PIAAC data. The index, which combines formal on-the-job training and informal learning in the workplace, reveals substantial variations across countries. On top of that, the index finds a strong, positive association between on-the-job training and learning. Moreover, it is also positively correlated with employment rates.

To explain these raw stylized facts, we built a search and matching model incorporating on-the-job human capital acquisition that depends on both on-the-job training determined by firms and workers' decisions regarding on-the-job learning. According to the model, an

increase in both components of on-the-job human capital increase the job finding rate but has an unclear effect on the job destruction rate. Thus, the overall employment effect of OJHCA is not clear and is entirely an empirical question. To quantify the employment effects of OJHCA, we calibrated the model to the Canadian economy and adjusted the learning and training costs to match the observed cross-country levels in the human capital index. We compared the model's predictions with the data and conclude that differences in marginal costs are necessary to match the differences in employment rates observed across countries. On average, the model predicts that one additional point in the OJHCA index increases the employment rate by 0.59 percentage points, which is similar to the 0.61 percentage points estimated from the data.

Finally, we considered payroll taxes and education (through their effects on the marginal costs of training and learning) as candidates to explain differences in both employment rates and OJHCA. The extended model was able to reproduce the observed differences in employment rates and explain almost 30% of the observed gap in OJHCA betwen the tertile of OECD economies with the highest and lowest level of human capital.

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Appendix

Table A.1: On-the-job human capital, training and learning indexes

Country	**OJT**	**OJL**	**OJHCA**
Austria	20.6	49.7	32.0
Belgium	26.6	45.0	34.6
Canada	33.3	56.9	43.6
Czech Republic	34.7	37.7	36.1
Germany	32.3	51.1	40.6
Denmark	34.4	52.9	42.6
Spain	24.5	46.2	33.6
Estonia	33.3	47.9	39.9
Finland	40.4	51.7	45.7
France	15.7	45.5	26.8
Great Britain	34.7	47.3	40.5
Ireland	27.7	40.5	33.5
Italy	12.2	36.2	21.0
Japan	25.3	43.8	33.3
Korea	25.4	25.4	25.4
Netherlands	38.7	49.8	43.9
Norway	30.6	68.4	45.8
Poland	19.5	31.7	24.9
Slovak Republic	20.0	43.5	29.5
Sweden	30.2	57.1	41.6
United States	37.9	57.8	46.8
Chile	30.3	57.0	41.6
Greece	8.1	28.1	15.1
Israel	26.8	51.5	37.2
Lithuania	22.9	26.0	24.4
New Zealand	42.6	60.8	50.9
Slovenia	23.8	39.6	30.7
Turkey	10.7	18.5	14.1

Source: Based on PIAAC data.

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