Institute for Research in Economic and Fiscal issues

IREF Working Paper Series

A comparative study of training in the private and public sectors: Evidence from the UK and the USA

Fabio Méndez
Facundo Sepúlveda

IREF Working Paper No. 201306

October 2013

Institute for Research in Economic and Fiscal issues

A comparative study of training in the private and public sectors: Evidence from the UK and the USA.

Fabio Méndez and Facundo Sepúlveda*

October 30, 2013

IREF Working Paper.

Abstract

Formal training programs are one of the main channels through which workers acquire new skills, become more productive, and experience wage growth. So far, most of the results on the effects of employer-provided training come from studying the training received by private sector workers. We extend the literature by identifying and comparing the effects of training for public and private sector workers in the US and UK. Three questions motivate our work. First, we wish to know what are the wage effects of training in each sector. Second, we are interested in how portable training is across sectors, and third, we are interested in how selective is the assignment to training programs in the public vs private sectors. We address these questions using two independent data sets from the British Household Panels Surveys (BHPS) and the American National Longitudinal Surveys of Youth of 1979 (NLSY79).

*We would like to thank the Institute for Research in Economic and Fiscal Issues (IREF) for the financial support provided. Contact Information: Fabio Méndez (fmendez1@loyola.edu) is Associate Professor of economics at the Loyola University of Maryland, USA; Facundo Sepúlveda (facundo.sepulveda@fsp.cl) is Associate Professor of economics at the Universidad de Santiago de Chile, Chile.

Contents

List of Figures

List of Tables

1 Introduction

On-the-job training programs is perhaps the most important channel through which workers update their skills after they have completed their formal education. As a result, training programs are widely regarded as a key determinant for the productivity of the labor force, the capacity of firms to incorporate new technologies into the production process, and the overall ability to sustain positive rates of economic growth (see Romer (1990), and Barro (1991) on the role of human capital as a determinant of growth).

A large empirical literature is supportive of this view. This literature[1] has produced two important results: 1. That the large majority of training episodes experienced by workers are financed by their employer (Frazis and Spletzer (2005)), even when the skills created are general and portable across jobs (Loewenstein and Spletzer (1998); Acemoglu and Pischke (1999); Parent (1999)). 2. That employer-financed training is positively and significantly associated both with higher productivity and higher wages (Black and Lynch (1996); Dearden et al (2006); Sepulveda (2010)), while self-financed training and training financed by other means are not (Veum (1999); Booth and Bryan (2005)).

One important caveat of this literature is that its results apply mostly to private sector workers. In fact, most empirical studies of employer-provided training either eliminate public employees from their sample (Parent (1999); Booth and Bryan (2005); Acemoglu and Piscke (1999)), or pool both public and private employees into one single category (Veum (1999)). Given that the government is the largest employer both in the US and across European countries, it is worth examining whether our knowledge regarding the role of training in the private sector can be extended to the government sector. Moreover, given that the relative size of the government (and the general role of the government) varies significantly between the USA and Europe, it is also worth inquiring whether any results obtained are equally applicable for the USA and Europe. We attempt to do so in this paper.

[1]There is a parallel literature that addresses the effects of public training initiatives designed to help the unskilled or the disadvantaged. In this paper, we are not concerned with such type of training programs.

More specifically, in this paper we use data from the USA and the UK regarding the training of individual workers and address some key potential differences between public-employer-provided and private-employer-provided training. We first discuss how selective the decision to train in either sector is. Selection of the most capable workers into training programs is a well established phenomenon in the private sector (see Heckman and Robb (1985) for a discussion) and one that is thought to optimize the use of resources. We would like to know whether this phenomenon is also observed in the public sector.

We then analyze the value of training in advancing a workers' wage and whether or not this effect varies between the public and private sectors. For private sector jobs, the interpretation of wages as an indicator of worker's productivity is standard. But due to the non-competitive nature of public sector activities, the same arguments cannot be applied in this sector. Thus, in order to further our understanding regarding the potentially different effects of public and private training on productivity, we also study the "portability" of training across sectors. That is, we study whether a private sector employee benefits from training programs previously obtained from a former public employer and vice versa. If public-employer provided training increases productivity, then one can expect to find a positive relationship between past episodes of this type of training and the current wages observed.

The paper then complements a body of literature that studies employer-provided training in the USA and the UK. For the USA, Lynch (1992) examines the experiences of non-college-graduated individuals (from the American NLSY79 survey) and finds that both on-the job and off-the job training episodes have a positive, significant effect on wages. A similar result is also reported by Veum (1999), who notes that wages are positively correlated with episodes of "company-financed" training but not with training episodes financed by other means. In turn, for the UK, Booth (1991), Booth (1993), and Dearden, et al. (2006), conduct similar studies and find evidence that on-the-job training has a positive effect on productivity, wages and wage growth. None of these studies addressed the potential differences between private-

employer-provided and public-employer-provided training.

In addition, the paper also complements a public discussion regarding the role of governments in training the workforce. The perception that private businessmen make better decisions when it comes to who receives training and what is taught has not been lost in the public eye. In a speech[2] made in 1989, for example, then British Prime Minister Margaret Thatcher makes this perception explicit:

> "Training is a shared responsibility. And it is one where business must be in the lead... So the government is now handing over to you, business leaders and your local partners in the community, the main responsibility for training men and women for the tasks of the 21st century. The quality you bring is leadership. That is: the ability to see what needs to be done; the capacity and courage to take the necessary decisions; and the energy to drive them through to completion."

A similar impression was portrayed during a 2012 American political debate. In this debate[3], Newt Gingrich argues for training provided to the unemployed that is provided by private enterprise; presumably because private businesses are better equipped for this task.

Using the two surveys, we construct two independent panels (one for the USA and another for the UK) of individual histories containing information on workers training incidence, employment status, and wage rates, among other relevant variables. In both of these panels, we classify training programs as either private-employer-financed (training provided to those directly employed by a private employer at no cost to the employee), public-employer-financed (programs provided to those directly employed by the government at no cost to the employee), or self-financed (training that is directly paid for by the individual, regardless of his employment status).

The results of this analysis regarding private-employer-provided training are in line with

[2]Speech launching the Training and Enterprise Councils. Made in March 10, 1989, in New Castle. Available at www.margaretthatcher.org/document/107601.

[3]For a full transcript of the debate, see foxnewsinsider.com/2012/01/17/transcript-fox-news-channel-wall-street-journal-debate-in-south-carolina

previous literature, but we offer new insights regarding the role of public-employer-provided training. With regards to how selective are employers when making training assignments, our estimations for both the US and UK samples show that private-employer-financed training is indeed selective. This finding is consistent with previous literature. But when studying the assignment of public-sector training, our analysis finds only weak evidence for selection in general and, in the case of the US, we find no evidence of selectivity based on unobserved characteristics.

Again, with regards to the effects of training on wages, our results indicate that training is positively and significantly associated with wages, in both countries and in all sectors. This result is again consistent with previous literature. However, when the training categories are studied separately, additional insights emerge. In both samples, we study the wages of workers who migrate from the public sector to the private sector and find evidence that wages in the private-sector are positively and significantly associated with training episodes provided by former public sector employers. This finding supports the notion that public training indeed improves worker's productivity and that private sector employers effectively reward greater productivity with higher wages.

A different picture emerges when studying the wages of workers who migrate from the private sector to the public sector. In the US, the evidence indicates that the skills provided by private employers are rewarded in the form of higher wages even in the case of workers that migrate to the public sector. In the UK, however, the skills provided by private employers are not rewarded when workers migrate to the public sector. This finding then suggests there are differences across public sectors in the UK and the US with regards to how productivity is rewarded. It also suggests the presence of alternative wage-determination mechanisms in the public sector, not necessarily associated with productivity.

The remaining of the paper is organized as follows: Section 2 provides a more detailed description of the data sets studied and provides an empirical account of some basic facts about the incidence of the different types of training in the USA and the UK. Next, section

3 presents a comparative study of the effects of private-employer-provided, public-employer-provided, and self-financed training programs on individuals' wages. Finally, section 4 presents concluding remarks and policy implications.

2 Data Description

We utilize data from the British Household Panel Survey (BHPS) and the American National Longitudinal Survey of Youth of 1979 (NLSY79) to construct two independent panels covering the periods 2001-2008 for the BHPS and 1988-2006 for the NLSY79. Each panel contains information on training, wages, educational achievement, and other individual characteristics. In both cases, the working samples were limited to individuals between the ages of 18 and 65 at the time of the interviews; who are not full-time students, retired, disabled, or out of the labor force due to maternity or family care; and who are not part of the armed forces. For the UK, this leaves us with an 8-year panel of 10786 individuals and a total of 44,177 individual-year observations. For the US, this leaves us with a 19-year panel of 3415 individuals and a total of 36,095 individual-year observations. As described below, we use this information to put together a joint dataset of comparable variables.

The BHPS is a survey that has followed the same nationally representative sample of individuals in the UK since 1991. The original sample included 10300 British individuals over sixteen years old. In addition, two survey extensions added nationally representative samples for Wales and Scotland in 1999, and for Northern Ireland in 2001. In the paper, we utilize data only from waves k (2001) through r (2008) of the BHPS. This allows us to utilize a larger cross sectional sample and to preserve consistency in the measure of training; as a new format for the training-related questions was introduced after the 1998 wave. In this new format, the questions cover up to three training episodes since September of the previous year and provide information on where the training occurred, its duration, and how it was financed.

The BHPS surveys are conducted mainly between September and November. The surveys asks individuals whether or not they have received any training (other than that obtained via full-time education) and to report how many training episodes they have taken part of since September of the previous year. If the individuals report having received training, the survey then asks them for detailed information about the three most recent episodes. This information includes the sources of financing used, broken down into the following categories: 1- Training was provided free of charge. 2- Individual paid for the training (self-financed) 3- Employer or future employer paid. 4- Training paid by government programs such as the New Deal Scheme or the Training for Work program. 5- Other. The survey also contains information on the job status of the individual (employed for pay, self-employed, unemployed, or not in the labor force) and on the type of employer if applicable (private firm, local or national government office, or self-employed).[4]

In turn, the data for the USA comes from National Longitudinal Survey of Youth of 1979 (NLSY79). The NLSY79 follows a sample of 12,686 individuals who were 14 to 22 years old in 1979, with annual interviews until 1994 and biannual interviews from 1996 to 2006. The questions on training change in 1989. From 1989 onwards, the survey records information on up to 4 new training episodes per wave and up to two episodes that were not completed at the time of the previous interview, making it one of the best sources of information on training at the individual level, and allowing for a precise match of the information contained in the training variables constructed with the BHPS survey.

As with the BSHP, the NLSY survey also records the detailed information regarding the source of financing for all training episodes. The specific categories of financing considered

[4]At first glance, the fact that detailed information in the BHPS is recorded only for the three most recent episodes (and not on the total episodes actually experienced) seems to be a cause of concern for the analysis. A closer look at the data, however, suggests that concerns about the underreporting of training are not likely to bias the results significantly. In the survey, even though no information is collected for any training programs beyond the third, respondents are asked to report the total number of training courses received. Approximately 96% of all the individuals in the sample report having fewer than 4 training courses in any given year; and about 90% of those who report having received at least 1 training report fewer than 4 training courses. Thus, even though in our study we utilize only the training episodes for which we have detailed information, we believe this is not likely to bias our results.

in the NLSY survey are: 1- Self or Family (self-financed). 2- Employer. 3- Training paid by government programs such as the job-training partnership act, the trade adjustment act, the job corps program, the work incentive program, the veterans's administration, or the vocation rehabilitation programs. 4- Other. Also similar to the BSHP, the NLSY contains information on the job status of the individual (employed for pay, self-employed, unemployed, or not in the labor force) and on the type of employer if applicable (private firm, local or national government office, or self-employed). Thus, the training variable definitions used are identical across the BSHP and NLSY79 samples.

We classify training episodes into three main categories: private-employer-financed, when training is paid by the individual's employer and that employer is a private firm; public-employer-financed, when training is paid by the individual's employer and that employer is a local or national government office; and self-financed, when the training courses are paid by the individual who received the training. The sum of all training episodes in these main categories is calculated and recorded as a separate variable called "aggregate training". Programs financed by third parties, including government funded training programs aimed at the unemployed and disadvantaged, are not used in the analysis. Programs which are reported to be provided free of charge are also excluded.

We record the number of training episodes received by an individual, for all training categories and during all years in our sample period. We also compute stock measures of training by adding all training episodes of a particular category that were received by an individual since the first year of the sample and until the year in course. The resulting stock measures are labeled *Private tr* (for private-employer-financed training), *Public tr* (for public-employer-financed training), *Self tr* (for self-financed training), and *Aggregate tr* (for the aggregate training category). The conversion of training to a stock variable is essential for our study, since it allows us to capture a measure of the human capital accumulated by an individual.

In addition to the training variables, we construct variables for the individuals log hourly

wages (*Wages*), a dummy equal to one if the individual was a private-sector worker (*Private sector*), a dummy for male (*Male*), age, educational attainment dummies for High School (*HS and more*) and College (*College*). The variable construction is consistent across panels, with some minor differences. In the case of hourly wages, for example, we utilize the actual hourly wages for both the BHPS and the NLSY, but for the case of the BHPS, when information on wages was missing, we replaced it with information on the usual or expected hourly wages (as reported by the individual).

Summary statistics for the most important variables in our datasets are shown in table 1. The corresponding definitions are provided in table 8 of the appendix. As shown in table 1, the educational attainment is very similar across the UK and the US samples. College graduates are 21% of the sample in the BHPS and 27% in the NLSY. Individuals with high school, but no college diploma, amount to 68 and 65% respectively. The proportion of males is also similar across datasets, 47% for the BHPS and 50% for the NLSY. Note that since our regressions will be controlling for these background characteristics, moderate differences across samples should not present difficulties when interpreting the results. Table 1 also shows that all stock measures of training are larger in the UK than in the USA, which suggest that training is more frequent in the UK.

To obtain a better idea of the observed incidence of training, we present in Table 2 the annual -as opposed to cumulative- incidence of employer-paid and self-financed training episodes for both public and private sector workers. Columns represent worker groups: public or private sector workers in either the US or UK, and rows represent employer financed and self financed training episodes. Each cell is then the average annual training episodes that are either employer or self financed for the relevant worker group.

The table provides a number of insights into the incidence of training. First, a comparison of the two rows shows that in both sectors most training is financed by the employer and not by the individual himself. Second, public sector employees have much higher levels of training than their private sector counterparts: the aggregate number of training episodes

Table 1: Summary statistics

sample	variable	mean	sd	max	min	N
NLSY	aggregate tr	0.98	1.61	15.00	0.00	36095.00
	public tr	0.08	0.50	8.00	0.00	36095.00
	private tr	0.79	1.43	15.00	0.00	36095.00
	self tr	0.01	0.11	1.00	0.00	36095.00
	college	0.27	0.44	1.00	0.00	36095.00
	hs and more	0.65	0.48	1.00	0.00	36095.00
	private sector	0.94	0.24	1.00	0.00	36095.00
	male	0.50	0.50	1.00	0.00	36095.00
	wage	6.84	0.70	13.96	0.20	36095.00
BHPS	aggregate tr	1.94	2.90	27.00	0.00	44177.00
	public tr	0.69	1.98	27.00	0.00	44177.00
	private tr	0.96	2.07	24.00	0.00	44177.00
	self tr	0.05	0.25	3.00	0.00	44177.00
	college	0.21	0.41	1.00	0.00	44177.00
	hs and more	0.68	0.47	1.00	0.00	44177.00
	private sector	0.69	0.46	1.00	0.00	44153.00
	male	0.47	0.50	1.00	0.00	44177.00
	wage	1.56	0.49	5.55	-6.50	44177.00

for private sector workers is .1 in the US and .3 in the UK. For public sector workers these numbers are .17 and .5 respectively.

Finally, this table also shows that training is indeed more prevalent in the UK than in the US. Adding up the columns under "Total" shows that workers in the US participate in .11 training episodes in average, while the number is .36 for workers in the UK. While the NLSY does report lower training incidence than other US surveys, such as the Survey of Income and Program Participation, the differences seen here most likely reflect a higher use of formal training channels in the process of skill acquisition among UK individuals[5]

[5]Our findings regarding the average incidence of training in the UK are similar to those reported in Arulampalam et al (2003) and Arulampalam et al (2004), who study earlier waves of the BHPS and the European Household Panel surveys, respectively.

Table 2: Incidence of training

	Govt		Private		Total	
	US	UK	US	UK	US	UK
Employer	0.16	0.44	0.09	0.26	0.10	0.31
Self	0.01	0.06	0.01	0.04	0.01	0.05

2.1 Basic Facts about Training in the UK and the USA.

We now present descriptive evidence regarding the three questions that guide this paper. With regards to whether individuals who receive training are selected differently in the private sector than in the public sector, figure 1 illustrates how training is assigned across individuals who have a college degree and those who do not. Selection here is observed in the form of higher number of training episodes for college graduates, who plausibly are faster learners, than for non college graduates. We see that in both countries selection exists in the public and private sectors. However, the extent of selection seems to be larger in the private sector. The ratio of training episodes assigned to college vs. non college graduates is 1.4 and 1.31 in the US and UK public sectors respectively and is 1.67 and 1.74 , in the same order, for the private sector. This simple comparison thus suggests that while both public and private employers select their more able workers to receive training, the selection is more pronounced in the private sector.

Selection is likely to be based both on observed characteristics (such as education, gender, race) and characteristics that may be observable to the employer but not observed in our data (such as ability, enthusiasm, related work experience). In the next section, we examine the possibly more interesting question of selection based on characteristics that are observed by the firm but are not documented in our dataset.

We turn now to the question of the wage effects of training. In this section, we examine the simple correlations between these variables. Table 3 shows the correlation between our stock measure of aggregate training and individual wages for government and private workers in both countries, with p-values shown below the estimates. Note that in all cases the

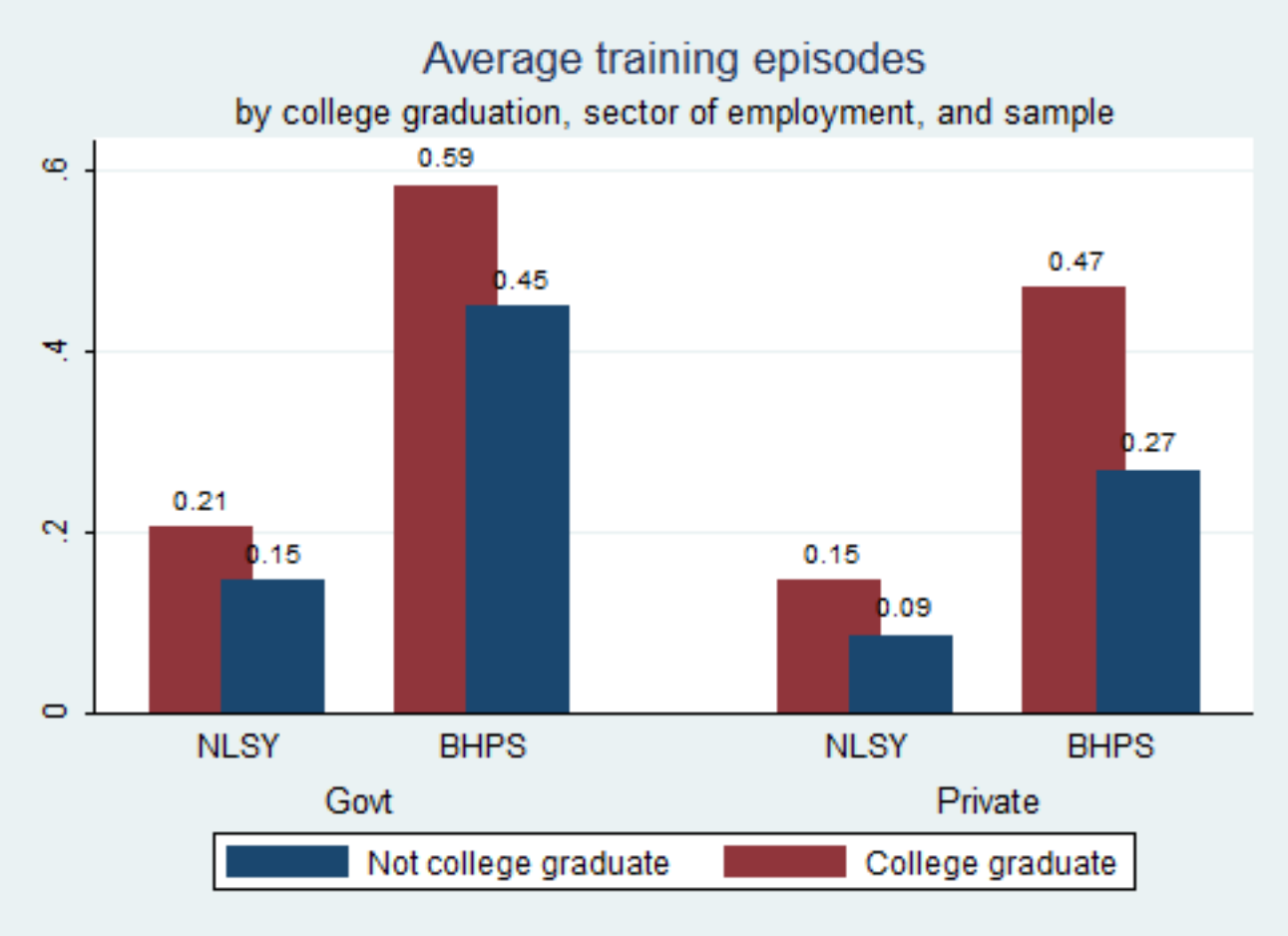

Figure 1: Selection into training based on college degree

correlations are positive, suggesting there is a positive effect of training on wages, regardless of the type of employer. In the next section, we examine whether these indicative results stand more rigorous econometric analysis, including controlling for individual characteristics, and partialing out individual fixed effects.

Finally, table 4 presents correlations between the stocks of public-employer-provided and private-employer-provided training and wages of both public and private sector workers. This table illustrates the extent to which training is portable across sectors. If training is portable, public sector training increases wages when workers migrate to the private sector, and vice versa. Note that in both countries the correlation between wages and same sector training is larger than that between wages and the other sector training. Only in the case of private training and wages of UK public servants the correlation is no different from zero, suggesting that the skills learned in the private sector are not rewarded in the public sector. Otherwise, the raw data does suggest some degree of portability. We also revisit this issue in the next section.

Table 3: Training-wage correlations

	Govt	Private
US	0.27	0.19
	0.00	0.00
UK	0.18	0.25
	0.00	0.00

Table 4: Portability of training

	US		UK	
	Govt	Private	Govt	Private
Pub training	0.29	0.04	0.19	0.05
	0.00	0.00	0.00	0.00
Priv training	0.08	0.21	0.00	0.26
	0.00	0.00	0.99	0.00

3 Regression Analysis

As is standard in the literature, we focus on estimating the reduced form effect of training on wages. This approach reduces what can be a complex task of estimating a system of equations, to a simpler estimation of one single equation and a small set of coefficients. It is then worth discussing the theoretical arguments behind our empirical exercise. The standard theory on the effects of training on wages is laid out in Becker (1962). In Becker's model, training is thought to increase the set of skills available to an individual worker and thus, his productivity. The skills acquired through training can be general (training leading to the accumulation of skills that can be used in other jobs, or firms) or firm-specific (training leading to the accumulation of skills that cannot be used in other jobs, or firms).

In a competitive labor market workers would have an incentive to pay for general training, since workers' wages increase together with the productivity gains it generates either for his current or future employer. In contrast, when the training is firm specific, the workers have no incentive to pay for it and it is the firm who has the incentive to pay. The reason for this is that when training is specific to the firm, the worker's reservation wage without training is no different that his reservation wage with training; but the worker's productivity with training is greater than his productivity without. Nonetheless, if a bargaining process takes place between the worker and the firm over the wages before and after training, then it is possible for both the firm and the worker to have an incentive to pay for firm-specific training.

A flaw associated with this set of standard theoretical predictions is that it does not match the available evidence regarding how training is financed. Acemoglu and Pischke (1999), for example, observed that much of the training that is financed by the employer is also general in nature. Consequently, in order to better explain these facts, newer theoretical models often deviate from the competitive assumption by explicitly including some degree of monopsonistic power by the firm, significant between-jobs switching costs, or asymmetric information regarding the workers' skills, among other elements.

In all these models, employer-provided training is linked to higher wages via an increase in productivity, even when the gains in productivity are shared between the worker and the employer. Only when the firm has complete monopsonistic power it is possible for training not to be linked to higher wages. Similarly, self-financed training is linked to higher wages, either because it increases the worker's productivity in his current job or because it allows him to acquire skills needed for a different, higher-paid job. It is not clear, however, whether employer-financed training would have greater (or smaller) wage effects than self-financed training.

In turn, with regards to the effect of public-employer provided training on the wages of workers, the theoretical arguments available are less conclusive. There is a literature that explores publicly funded training programs for disadvantaged groups like the unemployed or disabled; but this literature does not match our focus. In here, we are interested in exploring the effects of training paid by the public sector on the wages of workers. So, in some ways, the type of public-employer-financed training that we study in this paper resembles private-employer-financed training. However, the fact that many public institutions are not disciplined by competitive markets makes it difficult to interpret wages as a measure of productivity, like it is usually done for the private sector. Furthermore, given the bureaucratic mechanisms that often govern the determination of wages and job advancement opportunities in the public sector, it is also very difficult to interpret the training-wage or training-productivity relationships as causal. The relationship between public-employer provided training and wages is thus highly unexplored.

This is why it is misleading to compare coefficients across sectors. For concreteness, suppose that the public sector requires employees one training program to gain promotion, even though the training in question does not add any useful skill in the new job. Suppose now that, concerned with the lack of training of public sector employees, the requirement for promotion is increased to two training programs. Even though the returns to training are nil, and the coefficient on training for public employees should be zero if this coefficient

were to measure productivity, we will observe a positive coefficient in the first case of low training requirements, and the same coefficient will be halved in the second case. Before we have a better understanding of how individuals are promoted and are assigned to training in the public sector, no useful information can be derived from these coefficients regarding the exact role that training may play on the productivity of a public employee.

3.1 Statistical model

Our main econometric specification follows that of Booth and Bryan (2005); where individual wages are a function of human capital stocks and other characteristics. In this specification, the effects of training on individual hourly wages are thought to be captured by the following equation:

$$Wage_{i,t} = \beta_0 + \beta_1 Private\ tr + \beta_2 Public\ tr + \beta_3 Self\ tr + \beta_4 Y + \mu_i + \upsilon_{i,t}. \qquad (1)$$

Where $Wage_{i,t}$ is the natural logarithm of the hourly wage of an individual i at time t, $Private\ tr$ is the cumulative number of private-employer-financed training episodes received up to that point in time, $Public\ tr$ is the cumulative number of public-employer-financed training episodes received up to that point in time, and $Self\ tr$ is the cumulative number of self-financed training received up to that point in time. The training received by an individual is then treated as a stock. Finally, Y is a vector of control variables, including our gender dummy ($Male$), educational attainment indicators, and a quadratic age term.

The error term in this model is composed by an individual, time invariant effect μ_i and an individual time-variant effect $\upsilon_{i,t}$. We attempt to address potential estimation biases as much as possible with the data at hand. A particular concern is that the presence of unobserved individual components correlated with both training and earnings (and the error term μ_i) can lead to biased estimates of the training coefficients. If, for example, more able or self-motivated individuals were more likely to receive training, then the standard OLS

estimation of equation (1) would yield upward-biased coefficients on the different training measures, since they would be capturing the unobserved effect of ability (or motivation) on earnings. When such unobserved factors do not vary across time, however, one can effectively eliminate this source of bias by taking advantage of the time dimension in the data and estimating the parameters of interest using individual fixed-effects.

We thus rely on fixed-effects estimations for our analysis, and provide standard OLS estimations for comparison purposes. However, even though the estimated coefficients that result from the fixed-effects estimation of equation (1) are free of potential biases resulting from time-invariant unobserved components, they are not free from potential biases related to time-variant unobserved components. In equation (1), the term $\upsilon_{i,t}$ is a time-variant individual component of the error term. If this error component is related to the independent variables, then our estimation of equation (1) using fixed-effects would suffer still from potential biases.

Besides the problem of identifying potential causality and self-selection biases in the estimated coefficients, the conclusions obtained from an estimation of equation (1) face a more fundamental limitation: that one can not observe productivity directly, but only wage rates. When identifying the effects of training, one is ultimately interested in how much more productive an individual becomes after obtaining an extra unit of training. In the private sector, an argument can be made that competitive wages should approach marginal productivities (see Hellerstein *et al* (1999) and Lazear (1979), among others, for qualifications to this argument). In the public sector, as mentioned before, this argument is harder to make. Instead, any effects of training on wages implied by our estimation of the parameters in equation (1) could rather be interpreted as the existence of a career ladder in the public sector, where training allows workers to move up or down the ladder.

One might obtain a clearer picture of how the training provided by public employers affects the productivity of workers, by looking at the portability of these training episodes. That is, by examining whether public-employer-provided training has positive effects on the

wages of workers when they migrate to the private sector. If in fact these training programs have an effect on productivity, then that effect should reflect in the salaries of workers even after they migrate from one sector to the other.

In order to do that, we modify our baseline specification to include several interaction terms designed to capture the differential effects of public-employer-provided and private-employer-provided training. In particular, we estimate the following modified equation:

$$\begin{aligned} wage_{i,t} &= \beta_0 + \beta_1 Private\ tr + \beta_2 Public\ tr + \beta_3 Self\ tr + \beta_4 Private\ sector + \theta Y \qquad (2) \\ &\quad + \beta_5 Private\ tr \times Private\ sector + \beta_6 Public\ tr \times Private\ sector + \mu_i + \upsilon_{i,t}. \end{aligned}$$

Where the variable *private sector* is a dummy variable equal to 1 if the individual is currently working for a private employer. All other variables are defined as before.

The estimation of equation (2) allows us to identify differential effects of each type of training for both public and private sector workers. Here, the interaction terms "switch on" when the training recipient is currently a private sector worker, and become equal to zero in the case of a public sector worker. Note that an extra private-employer financed training program increases a private workers wage by $Private\ tr + Private\ sector \times Private\ tr$ percent, while it increases the wage of the same worker if she migrated to the public sector by $Private\ tr$ percent. We expect the coefficient on $Private\ sector \times Private\ tr$ to be nonnegative since this private-employer-provided training is aimed at private sector workers.

A useful way to measure the portability of private training episodes is through the ratio $P_{priv} = \frac{Private\ tr}{Private\ tr + Private\ sector \times Private\ tr}$. Maximum portability of private-employer-provided training implies a value of $P_{priv} = 1$, since in this case we should observe the same, positive effects in both sectors (and therefore ($Private\ sector \times Private\ tr = 0$) while $Private\ tr > 0$). In contrast, minimum portability of private-employer-provided training implies a value of $P_{priv} = 0$, since in this case we should observe this type of training is only valuable in the private sector (so that $Private\ sector \times Private\ tr > 0$ but $Private\ tr = 0$).

Similarly, regarding the portability of public-employer-provided training, the corresponding measure is the ratio $P_{pub} = \frac{Public\ tr + Private\ sector \times Public\ tr}{Public\ tr}$, or the ratio between the returns to public training for private workers (the numerator) versus its return to public sector workers (the denominator). Note that, as this type of training is designed for public sector workers, we should expect the coefficient on $Private\ sector \times Public\ tr$ to be non positive. Thus, as before, maximum portability of public-employer-provided training corresponds to $P_{pub} = 1$, since in this case we should observe the same, positive effects in both sectors (so that $Private\ sector \times Public\ tr = 0$ while $Public\ tr > 0$). Minimum portability of public-employer-provided training implies a value of $P_{pub} = 0$, since in this case we should observe this type of training is only valuable in the public sector (so that $Private\ sector \times Public\ tr = -Public\ tr < 0$).

3.2 Results

The results of our estimations are presented in tables 5 to 7. Tables 5 and 6 present the results of using equation (1) in the econometric specification. Table 7 presents the results of using equation (2) instead. Table 5 shows the results on the wage effects of training for the US sample. Column 1 presents OLS estimates of the baseline model using aggregate training episodes only. Column 2 presents the corresponding OLS estimations when the different categories of training are used instead. As shown, the results suggest a strong, positive relationship between aggregate training and wages. Furthermore, when the training categories are disaggregated, both private and public employer financed training appear positively and significantly associated with wages; but no such relationship appears in the case of self-financed training.

Columns 3 and 4 of table 5 add quadratic terms to the specification, allowing for nonlinear returns to training. Except for self-financed episodes, all linear terms are positive and the quadratic terms are negative, suggesting positive but decreasing marginal returns to training. The coefficient on self financed episodes is negative so, at least at low levels of training, the

correlation between such training programs and wages is negative.

Finally, the fixed effects estimation of the baseline model are shown in columns 5 and 6. These are our preferred estimations since they are free of potential endogeneity biases resulting from time-invariant omitted variables. In column 5, the coefficient on aggregate training is positive and significant. Its magnitude implies that an extra training episode of average duration increases wages by 2 percent. In turn, column 6 shows estimates for the disaggregated training categories. There again, the estimated coefficients indicate wages are positively affected by both public and private training, while we obtain a puzzling negative coefficient on self financed training.

Table 6 shows the corresponding results for the UK sample. The results for the UK are very similar to those obtained for the US. The estimated coefficient on aggregate training is positive and significant. The coefficients on the private-employer-provided and public-employer-providing training are also positive and significant, and similar in magnitude across specifications. Overall, however, the effects of training on wages seem smaller in the UK than in the US.

The previous results must be interpreted as the value of training averaged across sectors. The coefficient on private training in column 6, for instance, reflect the higher wages earned by workers with more private training programs both in the private and in the public sector. Next, we examine the differential effects of each type of training for both public and private sector workers. Such differentiation will allow us to study the question of the portability of training across sectors, and the selection of training recipients within each sector.

Table 7 presents the results of estimating equation 2 with standard OLS and FE techniques. The table shows the results for both US (first three columns), and UK (last three columns) workers. For the issue of portability, we first examine to what extent private sector training is portable, that is, increases workers wages when they migrate to the public sector. Then, we study the portability of public training.

For the US, the coefficient on *Private tr* is positive and significant in both the OLS

(columns 1 and 2) and FE (column3) specifications. The coefficient on the interaction *Private sector* × *Private tr* is positive and significant in the OLS estimates but the significance disappears in the FE estimates. Our preferred FE specification then indicates that the skills provided by private employers are rewarded in the form of higher wages even in the case of workers that migrate to the public sector. For the UK data, however, the opposite is true. Here (column 6), private training has a positive and significant value for private sector workers, but it has no value in the public sector. Our preferred specification then indicates that the skills provided by private employers in the UK does not translate in higher public sector wages.

In turn, with regards to the portability of public training, the evidence displayed in table 7 shows that the coefficient on *Public tr* is everywhere positive and significant, while the coefficient on the interaction term is, at least in the FE columns, no different from zero. Public training then seems fully portable in both datasets. Both in the UK and the US, the training that is provided to public workers is later valued in the form of higher salaries when workers migrate to the private sector

Finally, the question of selection into training based on unobserved characteristics can also be examined using table 7. The important observation is that if there is selection based on individual attributes that make training more valuable to the worker, such as her ambition, drive, or learning ability, the measured returns to training should decrease after controlling for these time invariant attributes. Our strategy to identify selection is then to compare OLS and Fixed Effects coefficients.

Recall that the returns to private sector training for private sector workers is *Private tr* + *Private tr* × *Private sector*. For the US, this effect is .07 in the OLS specification of column 2, and drops to .04 in the FE specification of column 3. For the UK, similarly, the sum of the two coefficients is .048 in the OLS estimates (column 5), and .01 in the FE estimates (column 6). As mentioned before, such drop in the measured returns to training in the private sector is an established result in the literature. For public sector workers, the returns to public

sector training is the coefficient on *Public tr*. In the US this coefficient is the same in the OLS and FE estimates of columns 2 and 3, indicating that no selection takes place. In the UK, by contrast, the coefficient drops from .02 (column 5) to .007 (column 6), suggesting there is some selection taking place.

In both the OLS and the FE models, the R-squared statistic is low. A low R-squared in these regressions only means that a number of factors not included in the equation, as well as pure randomness, also have explanatory power for the observed variation of the dependent variable, in this case wages. Noticeably, omitting variables has no consequence for the identification of a casual effect between training and wages unless one or more of the omitted variables are correlated with training and wages simultaneously (which is another way to phrase the problem of endogeneity). As explained before, this potential endogeneity problem is likely to affect the OLS estimates more than the FE estimates. In the particular case of the FE models, since the individual-specific means of each variable are removed, the estimates are not based on differences across individuals, only across time for each individual. This is the reason why the R squared values are lower in the FE regressions than in the OLS regressions. This is also the reason why we prefer the FE estimates over the OLS estimates.

4 Summary of Results and Policy Implications

This paper provides a comparative study of different types of employer-provided training for both the US and the UK. Overall, we find that training is more prevalent in the UK than in the USA. In our data, the average worker in the US reported having 0.27 training episodes per year; while the average worker in the UK reported having 0.79 training episodes per year. This finding applies equally for workers in the private and public sectors. The average number of training episodes reported by a private-sector worker in the US equaled 0.25, compared to 0.7 in the UK. Similarly, the average number of training episodes reported by a public-sector worker in the US equaled 0.02, compared to 0.1 in the UK.

At the same time, we find that ratios of employer-provided training to self-financed training are very similar across the private sectors in these countries but not so in the public sector. In line with previous literature, we find that most of the training that takes place in the private sector is financed by the employer and not the employee. The ratio of employer-provided training to employee-financed training in the private sector is 1.77 in the US and 1.70 in the UK. In contrast, the ratio of employer-provided training to employee-financed training in the public sector is 1 in the US and 1.5 in the UK. The differences in the amount of training provided suggests there are important differences in the provision of training between these two nations and that government policies are at least partially responsible for those differences.

That training is provided by private-sector employers should not be surprising. On-the-job training is widely regarded as the main channel through which firms equip their workers with the skills required to adapt to new technologies and become more productive. On-the-job training is also likely to be complementary to investments in physical capital. Employers then have a clear motive for providing their workers with training. Neither should it be surprising that private-sector employers select their most able workers as the ideal recipients of training; for these workers are more likely to provide the highest return to investment.

The evidence we discussed in this paper is consistent with that view. This evidence suggests that private sectors in the US and the UK are highly selective of the workers they train. When looking at the number of training episodes received by individuals with different levels of education, for example, we find that college educated workers in the private sector receive much more training than non-college graduates. In the US private sector, the ratio of training episodes received by college graduates to those received by non-college graduates equaled 1.67 and for the UK that ratio was 1.74.

In contrast, when we analyze the training decisions in the public sector we find evidence of a much weaker selection process. Looking at the education levels again, the ratio of training episodes received by college graduates to those received by non-college graduates

equaled 1.31 in the UK public sector and 1.4 in the US public sector. These numbers imply a 32% reduction in education-based selectivity of the UK public sector compared to that of the private sector, and a 20% reduction in the selectivity of the US public sector compared to the private sector. The evidence regarding selectivity based on unobserved components, also points to a smaller selectivity taking place in the public sector and, in the case of the US public sector, the evidence suggests that no selectivity of that kind takes place at all.

Such a lack of selectivity suggests that public sector employers allocate resources less efficiently than their private sector counterparts and suggests a challenge for policy makers. Our results show that training, like other forms of human capital formation, yields important benefits to the productivity of workers. However, in order to maximize these benefits, training should presumably be given to those who are more able to begin with and who are more likely to experience greater gains in productivity. We find evidence that public sector employers are not as efficient as private employers in that function. Thus, one policy implication that may be derived from our results is the need for public institutions to reform the reward mechanisms; such that training is given on the base of merit and productivity.

With regards to the effects of training, we find evidence that employer-provided training is positively and significantly associated with workers' wages; both in the private and the public sectors. Self-financed training, however, is not found to have a positive effect on wages. These findings then suggest a second policy implication: that any incentives given for the training of the workforce should target the employer and not the employee. Ms. Thatcher's remarks thus coincide with our findings in that training is likely to yield greater benefits when it is led by the knowledge and needs of the employer.

The returns to private sector training in general are lower for the UK. In our preferred specifications, an additional episode of training is associated with a 2% increase in wages for the US and with a 0.7% increase for the UK. When broken down into categories, an additional training episode provided by a private-sector employer is associated with a 4% increase in the wages of a private sector worker in the US and with a 1% increase in the UK.

Given that training is found more frequently in the UK, this finding might be rationalized as reflecting a degree of decreasing marginal returns. But the difference in the returns to training between the US and the UK is striking; specially when looking at the returns of public-employer-provided training. Future studies then should question what the optimal level of training is, and whether the returns to public-employer provided training justify the costs.

We also find another important difference in the returns to training across the US and the UK. Both in the UK and the US the skills provided by public employers are rewarded in the form of higher wages; even in the case of workers that migrate to the private sector. This finding reinforces the notion that training indeed adds to the productivity of workers and that the private sector employers effectively reward that productivity with higher wages. The skills provided by former private employers in the US are also rewarded with higher wages when workers migrate from the private to the public sector. In the UK, however, the skills provided by former private employers are not rewarded when workers migrate to the public sector.

The evidence then suggest that wages in the public sector might not always be tied to productivity. It may also help explain differences in the efficiency of public institutions in the US and the UK. In general, public institutions should be better off when the quality of its workforce is high. But if general skills and productivity are not effectively rewarded in public sector jobs, then the incentives for highly productive individuals to work in the public sector will diminish and the efficiency of public institutions would be negatively affected. Thus, a final policy implication of this study is that public institutions should develop incentive schemes that reward all skills accumulated by individuals, including those accumulated outside the public sector.

Table 5: Wage effects of training: NLSY

	OLS1	OLS2	OLS3	OLS4	FE1	FE2
	(1)	(2)	(3)	(4)	(5)	(6)
Aggregate tr	.07		.12		.02	
	(.002)***		(.005)***		(.003)***	
Private tr		.07		.13		.02
		(.003)***		(.005)***		(.004)***
Public tr		.10		.16		.06
		(.007)***		(.02)***		(.01)***
Self tr		-.01		-.04		-.05
		(.008)		(.02)***		(.01)***
Aggregate tr sq			-.01			
			(.0008)***			
Private tr sq				-.01		
				(.0009)***		
Public tr sq				-.01		
				(.004)***		
Self tr sq				.01		
				(.005)**		
College	.57	.56	.56	.55	-.004	-.004
	(.01)***	(.01)***	(.01)***	(.01)***	(.03)	(.03)
HS and more	.23	.22	.22	.22	-.04	-.03
	(.01)***	(.01)***	(.01)***	(.01)***	(.03)	(.03)
Male	.32	.32	.32	.32		
	(.007)***	(.007)***	(.007)***	(.007)***		
Age	.07	.07	.06	.06	.11	.11
	(.007)***	(.007)***	(.007)***	(.007)***	(.006)***	(.006)***
Age squared	-.0009	-.001	-.0008	-.0008	-.001	-.001
	(.0001)***	(.0001)***	(.0001)***	(.0001)***	(.0000801)***	(.0000801)***
Obs.	36095	36095	36095	36095	36095	36095
R^2	.15	.16	.16	.16	.03	.04

*** significant at 1%,** significant at 5%,* significant at 10%

Table 6: Wage effects of training: BHPS

	OLS1	OLS2	OLS3	OLS4	FE1	FE2
	(1)	(2)	(3)	(4)	(5)	(6)
Aggregate tr	.02		.04		.007	
	(.0007)***		(.002)***		(.001)***	
Private tr		.03		.04		.009
		(.001)***		(.002)***		(.001)***
Public tr		.03		.05		.007
		(.001)***		(.002)***		(.001)***
Self tr		-.01		-.01		-.001
		(.002)***		(.005)***		(.004)
Aggregate tr sq			-.001			
			(.0001)***			
Private tr sq				-.001		
				(.0002)***		
Public tr sq				-.002		
				(.0002)***		
Self tr sq				.0004		
				(.001)		
College	.60	.60	.59	.60	.10	.10
	(.008)***	(.008)***	(.008)***	(.008)***	(.03)***	(.03)***
HS and more	.23	.23	.22	.23	.01	.01
	(.007)***	(.007)***	(.007)***	(.007)***	(.02)	(.02)
Male	.21	.20	.21	.20		
	(.004)***	(.004)***	(.004)***	(.004)***		
Age	.06	.06	.06	.06	.06	.06
	(.001)***	(.001)***	(.001)***	(.001)***	(.002)***	(.002)***
Age squared	-.0006	-.0006	-.0006	-.0006	-.0006	-.0006
	(.0000151)***	(.000015)***	(.0000151)***	(.000015)***	(.0000278)***	(.0000279)***
Obs.	44177	44177	44177	44177	44177	44177
R^2	.28	.28	.28	.29	.05	.05

*** significant at 1%,** significant at 5%,* significant at 10%

Table 7: Portability of training

	OLS1US	OLS2US	FEUS	OLS1UK	OLS2UK	FEUK
	(1)	(2)	(3)	(4)	(5)	(6)
Private tr	.03	.03	.04	-.005	-.008	-.004
	(.02)*	(.02)*	(.02)**	(.005)	(.004)*	(.004)
Public tr	.10	.06	.06	.03	.02	.007
	(.009)***	(.009)***	(.01)***	(.001)***	(.001)***	(.001)***
Self tr	-.02	-.01	-.05	.0001	-.01	-.0008
	(.008)***	(.008)	(.01)***	(.003)	(.002)***	(.004)
Private sector × Private tr	.07	.04	-.02	.06	.04	.01
	(.02)***	(.02)**	(.02)	(.005)***	(.004)***	(.004)***
Private sector × Public tr	.01	.02	.006	.004	-.009	-.003
	(.02)	(.02)	(.02)	(.005)	(.004)**	(.003)
Private sector	-.18	-.17	.009	-.17	-.12	-.05
	(.02)***	(.02)***	(.02)	(.006)***	(.005)***	(.007)***
College		.56	-.004		.58	.10
		(.01)***	(.03)		(.008)***	(.03)***
HS and more		.22	-.03		.22	.009
		(.01)***	(.03)		(.007)***	(.02)
Male		.32			.22	
		(.007)***			(.004)***	
Age		.07	.11		.06	.06
		(.007)***	(.006)***		(.001)***	(.002)***
Age squared		-.001	-.001		-.0006	-.0006
		(.0000999)***	(.0000801)***		(.0000149)***	(.0000279)***
Obs.	36095	36095	36095	44153	44153	44153
R^2	.05	.16	.04	.08	.29	.05

*** significant at 1%,** significant at 5%,* significant at 10%

References

[1] Acemoglu, Daron and Pischke, Jorn-Steffen (1999). The Structure of Wages and Investment in General Training *Jounal of Political Economy*, vol.107, pp. 539-572.

[2] Arulampalam, Wiji, Booth, Alison L. and Bryan, Mark (2003). Training in Europe. *Journal of the European Economic Association*, vol.2, no. 1-2, pp. 346-360.

[3] Arulampalam, Wiji, Booth, Alison L. and Bryan, Mark (2004). Training and the New Minimum Wage. *The Economic Journal*, vol. 114, no. 494, pp. C87-C94.

[4] Barro, Robert J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics*, vol. 106, no. 2, pp. 407-443.

[5] Becker, Gary S. (1962). Investment in Human Capital: a Theoretical Analysis. *Journal of Political Economy* , vol. 70, no. 5, pp. 9-49.

[6] Black, Sandra E and Lynch, Lisa M, (1996). "Human-Capital Investments and Productivity," *American Economic Review*, vol. 86, no. 2, pp. 263-67.

[7] Booth, Alison L. (1991). "Job-Related formal training: Who receives it and what is it worth?" *Oxford Bulletin of Economics and Statistics*, vol. 53, no. 3, pp. 281-294.

[8] Booth, Alison L. (1993). "Private Sector Training and Graduate Earnings". *The Review of Economics and Statistics*, vol. 75, no. 1, pp. 164-170.

[9] Booth, Alison L. and Mark L. Bryan (2005). "Testing some predictions of human capital theory: new training evidence from Britain" *Review of Economics and Statistics*, vol. 87, no. 2, pp. 391-394.

[10] Dearden, Lorraine, Reed, Howard and Van Reenen, John (2006). "The impact of training on productivity and wages: Evidence from British panel data", *Oxford Bulletin of Economics and Statistics*, vol. 68, no. 4, pp 397-422.

[11] Frazis, Harley and James R. Spletzer (2005). "Worker training: what we?ve learned from the NLSY79." *Monthly Labor Review*, february, pp. 48-58

[12] Heckman, James and Robb, Richard. (1985). "Alternative methods for evaluating the impact of interventions: An overview". *Journal of Econometrics*, vol. 30, no. 1–2, pp. 239267.

[13] Hellerstein, Judith K., David Neumark and Kenneth R. Troske. (1999) "Wages, Productivity, And Worker Characteristics: Evidence From Plant-Level Production Functions And Wage Equations," *Journal of Labor Economics*, vol. 17, no. 3, pp. 409-446.

[14] Lazear, Edward P. (1979). "Why Is There Mandatory Retirement?" 'emphJournal of Political Economy, vol. 87, no. 6,pp.1261-84.

[15] Lynch, Lisa M (1992). "Private-Sector Training and the Earnings of Young Workers". *The American Economic Review*, vol. 82, no. 1, pp. 299-312.

[16] Loewenstein, Mark A. and James R. Spletzer (1998). "Dividing the Costs and Returns to General Training". *Journal of Labor Economics*, vol. 16, no. 1, pp. 142-171

[17] Parent, Daniel (1999). "Wages and Mobility: The Impact of Employer?Provided Training". *Journal of Labor Economics*, vol. 17, no. 2, pp. 298-317.

[18] Romer, Paul M. (1990). "Endogenous Technological Change". *Journal of Political Economy*, vol. 98, no. 5, pp. S71-S102.

[19] Sepulveda, Facundo (2010). "Training and productivity: evidence for US manufacturing industries". *Oxford Economic Papers*, vol. 62, no. 3, pp. 504-528.

[20] Veum, Jonathan R. (1999). "Training, Wages, and the Human Capital Model". *Southern Economic Journal*, vol. 65, no. 3, pp. 526-538

5 Appendix

Table 8: Variable description

variable	**description**
Aggregate tr	accumulated number of training episodes
Public tr	accumulated public training episodes
Private tr	accumulated private training episodes
Self tr	accumulated self financed training episodes
Male	dummy for male
College	dummy for college degree
HS and more	dummy for high school and more
Private sector	dummy for working in the private sector
Wage	log wage rate, constant prices