CONTEMPORARY ECONOMIC POLICY

A COMPARATIVE STUDY OF TRAINING IN THE PRIVATE AND PUBLIC SECTORS: EVIDENCE FROM THE UNITED KINGDOM AND THE UNITED STATES

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Formal training programs are one of the main channels through which workers become more productive and experience wage growth. So far, however, most of the results on the effects of employer-provided training come from studying the training received by private sector workers only. We extend the literature by identifying and comparing the effects of private-employer-provided and public-employer-provided training in the United States and the United Kingdom. We address this question using two independent data sets from the British Household Panels Surveys and the American National Longitudinal Survey of Youth of 1979. (*JEL* J24, J31, J40)

I. INTRODUCTION

On-the-job training programs are perhaps the most important channel through which workers update their skills after they have completed their formal education and are widely regarded as a key determinant for the productivity of the labor force, the capacity of firms to incorporate new technologies, and the overall ability to sustain positive rates of economic growth. Aligned with this view, a large empirical literature has documented both the determinants of training and its effects on workers' productivity. 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 (Acemoglu and Pischke 1999; Loewenstein and Spletzer 1998; Parent 1999). (2) That employer-financed training is positively and significantly associated with higher productivity and higher wages (Black and Lynch 1996; Dearden, Reed, and Van Reenen 2006; Sepúlveda 2010), while self-financed training and training financed by other means is not (Booth and Bryan 2005; Veum 1999).

One important caveat of this body of work, however, 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 (Acemoglu and Pischke 1999; Booth and Bryan 2005; Parent 1999), or pool public and private employees together into one single category (Veum 1999). But given how the government is amongst the largest employers in most countries, it is worth examining whether our knowledge regarding the role of employer-provided training in the private sector can be extended to the government sector as well, and whether the results are different for countries in which the government has traditionally played a greater role in the training of the workforce than for others.

We attempt to do so in this article. More specifically, in this study we gather data from the United States and the United Kingdom, and

*The authors would like to thank the Institute for Research in Economic and Fiscal Issues for the financial support provided.

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

ABBREVIATIONS

BHPS: British Household Panel Survey
FE: Fixed Effects
NLSY79: American National Longitudinal Survey of Youth of 1979
OLS: Ordinary Least Squares

Contemporary Economic Policy (ISSN 1465-7287)
Vol. 34, No. 1, January 2016, 107–118
Online Early publication July 20, 2015

doi:10.1111/coep.12120

examine the effects of both, public-employer-provided and private-employer-provided training, on the wages of individual workers. We utilize data from the British Household Panel Survey (BHPS) and the American National Longitudinal Survey of Youth of 1979 (NLSY79) and construct two independent panels (one for the United States and another for the United Kingdom) 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).

With these data at hand, 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 reflect optimal decisions by firms. 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 across public and private employers. Additionally, 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, for example, then one can expect to find a positive relationship between past episodes of this type of training and the current wages earned by private sector workers.

With regard to the selectivity of training assignments, our estimations for both the United States and the United Kingdom show that private-employer-financed training is indeed selective. 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 United States, we find no evidence of selectivity based on unobserved characteristics. In turn, with regards to the effects of training on wages, our results indicate both, private-employer-provided and public-employer-provided training, are positively and significantly associated with wages. For the United States, we find an additional training episode provided by a private-sector employer is associated with a 2% increase in wages, and an additional training episode provided by a public-sector employer is associated with a 6% increase. For the United Kingdom, we find an additional training episode provided by a private-sector employer is associated with a 0.9% increase in wages, and an additional training episode provided by a public-sector employer is associated with a 0.7% increase.

Furthermore, our results show private sector workers in either country benefit from training episodes previously obtained from former public-sector employers, while public sector workers benefit from training episodes previously obtained from former private-sector employers only in the United States. These findings give support to the notion that public-employer-provided training improves workers' productivity in similar ways as private-employer-provided training does, but raise additional questions as to why private training might not be fully portable to the public sector.

The paper complements an ample literature on the effects of training. For the United States, Lynch (1992) examines the experiences of non-college-graduates 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. For the United Kingdom, Booth (1991, 1993) and Dearden et al. (2006), conducted similar studies and found 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. The remainder of the article is organized as follows: Section II describes the data sets studied, Section III presents our main econometric analysis, and Section IV presents our concluding remarks.

II. DATA DESCRIPTION

We utilize data from the BHPS and the 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 United Kingdom, this leaves us with an 8-year panel of 10,786 individuals and a total of 44,177 individual-year observations. For the United States, this leaves us with a 19-year panel of 3,415 individuals and a total of 36,121 individual-year observations.

The BHPS is a survey that has followed the same nationally representative sample of individuals in the United Kingdom since 1991. The original sample included 10,300 British individuals over 16 years old. In addition, two survey extensions added nationally representative samples for Wales and Scotland in 1999, and for Northern Ireland in 2001. In this study, 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 ask 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 in 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; and (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).[2]

In turn, the data for the United States comes from NLSY79. The NLSY79 follows a sample of 12,686 individuals who were 14–22 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 onward, the survey records information on up to four 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 in the United States, and allowing for a precise match of the information contained in the training variables constructed with the BHPS survey.

As with the BHPS, the NLSY survey also records the detailed information regarding the source of financing for all training episodes. The specific categories of financing considered 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 Administration, or the Vocation Rehabilitation Programs; and (4) other. Also similar to the BHPS, 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 in the BHPS and NLSY79 are similar enough for us to construct a common classification of training episodes.

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

2. 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 underreporting of training is 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 four training courses in any given year; and about 90% of those who report having received at least one training report fewer than four training courses.

training courses are paid by the individual who received the training. A separate account of "aggregate training" was also constructed as the sum of all training episodes in these main categories. 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 in these training categories during all years in our sample period. We then 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).

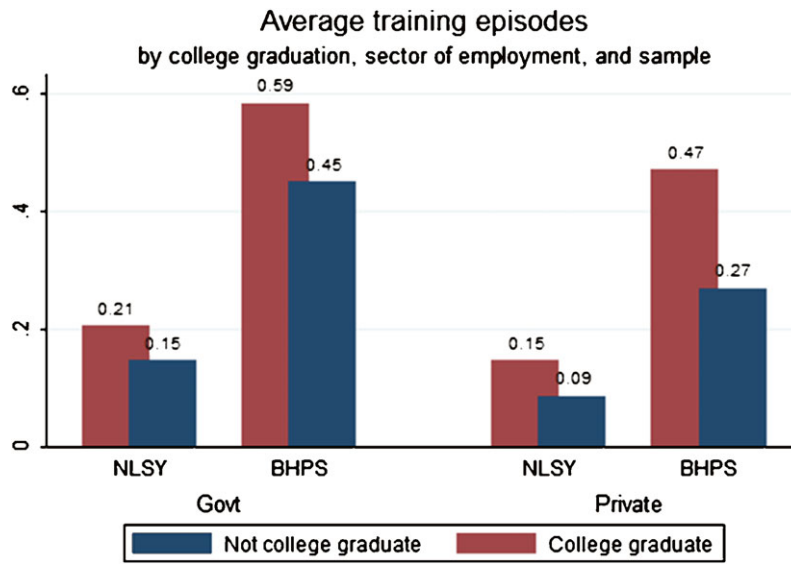
Summary statistics for the most important variables in our dataset are shown in Table 1. For continuous variables, reported summary statistics include the mean, standard deviation (SD), minimum and maximum values (min and max), as well as the number of nonmissing observations (*N*). For dichotomous variables we also report their observed frequency (freq). As shown in Table 1, summary statistics across samples are similar in several respects: the educational attainment is very similar across the UK and the U.S. 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.

At the same time, Table 1 shows all stock measures of training are larger in the United Kingdom than in the United States. While the NLSY79 does report lower training incidence than other U.S. surveys (as observed by Barron, Berger, and Black 1997), the differences seen here most likely reflect a higher use of formal training channels in the process of skill acquisition among UK individuals, and are fully consistent with previous papers in this literature. Arulampalam, Booth, and Bryan (2004), for example, estimate training

TABLE 1
Summary Statistics

Sample	Variable	Mean	SD	max	min	freq	*N*
NLSY	Aggregate tr	0.98	1.61	15.00	0.00		36,121
	Public tr	0.08	0.50	8.00	0.00		36,121
	Private tr	0.79	1.43	15.00	0.00		36,121
	Self tr	0.11	0.44	8.00	0.00		36,121
	College	0.27	0.44	1.00	0.00	9,752	36,121
	HS and more	0.65	0.48	1.00	0.00	23,479	36,121
	Private sector	0.94	0.24	1.00	0.00	33,954	36,121
	Male	0.50	0.50	1.00	0.00	18,060	36,121
	Wages	2.23	0.70	9.35	−4.40		36,121
BHPS	Aggregate tr	1.94	2.90	27.00	0.00		44,177
	Public tr	0.69	1.98	27.00	0.00		44,177
	Private tr	0.96	2.07	24.00	0.00		44,177
	Self tr	0.29	0.84	14.00	0.00		44,177
	College	0.21	0.41	1.00	0.00	9,277	44,177
	HS and more	0.68	0.47	1.00	0.00	30,040	44,177
	Private sector	0.69	0.46	1.00	0.00	30,482	44,153
	Male	0.47	0.50	1.00	0.00	20,763	44,177
	Wages	1.56	0.49	5.55	−6.50		44,177

FIGURE 1
Selection into Training Based on College Degree



incidence in Britain to be 41% using data from the European Community Household Panel; while Loewenstein and Spletzer (1998) report training incidence in the United States to be only 12% using NLSY79 data comparable to ours.[3] Others such as Bassanini et al. (2005), who compare training incidences across countries directly using OECD data, found that the United Kingdom has both "higher participation and higher annual hours of training" than the United States.

Figure 1 provides further detail regarding the training incidences observed in each sample. The figure shows the average number of training episodes experienced on an annual basis (as opposed to cumulative), disaggregated across private and public sectors and across educational categories. As expected, the figure shows training is more prevalent in the United Kingdom than in the United States, both for the private and the public sectors; and that public sector employees receive higher levels of training in general. In addition, Figure 1 illustrates how training is allocated across individuals with different educational attainment. Selection here is observed in the form of higher number of training episodes for college graduates, who plausibly are faster learners, than for noncollege 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. noncollege graduates is 1.4 and 1.31 in the U.S. and UK public sectors, respectively, and is 1.67 and 1.74, in the same order, for the private sector. Selection is likely to be based both on observed characteristics (such as education, gender, and race) and characteristics that may be observable to the employer but not observed in our data (such as ability, enthusiasm, and 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.

Finally, Table 2 provides a first look at the relationship between training and wages. This table presents the average wage for groups of workers with different training experiences. The first row shows statistics for individuals without training, the second row for individuals with positive stocks of aggregate training, and the last two rows for individuals with positive stocks of public-employer-financed and private-employer-financed training, respectively. Noticeably, average salaries for public sector workers in

3. In our data, the average worker in the United Kingdom reported having 0.36 training episodes per year, while the average worker in the United States reported having 0.11 episodes.

TABLE 2
Wages by Training Group

	NLSY		BHPS	
	Public	**Private**	**Public**	**Private**
No training	2.28	2.11	1.58	1.40
Aggregate tr > 0	2.55	2.38	1.72	1.62
Public tr > 0	2.60	2.49	1.74	1.63
Private tr > 0	2.42	2.11	1.67	1.41

both the United States and the United Kingdom are higher than average salaries of private sector workers. This puzzling fact has been previously documented in both cross-sectional and longitudinal studies (Krueger 1988).

The simple comparisons in Table 2 suggest there is a positive relationship between training in general and wages: The average wage of individuals with at least some type of training (aggregate tr > 0) is greater than the average wage of individuals without training (no training) in both the private and public sectors, and in both samples. When looking at the effects of the particular training categories, however, the results are less clear-cut. Individuals with positive stocks of public-employer-financed training (public tr > 0) have greater wages than those with no training, both in the private and public sectors of both samples. In contrast, individuals with positive stocks of private-employer-financed training (private tr > 0) have greater wages than those with no training only in the public sector. We examine all these effects more carefully in the next section.

III. REGRESSION ANALYSIS

As is standard in the literature, we focus on estimating the reduced form effect of training on wages. 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:

$$(1)\quad \text{Wage}_{i,t} = \beta_0 + \beta_1 \text{Private tr} + \beta_2 \text{Public tr} + \beta_3 \text{Self tr} + \beta_4 Y + \mu_i + \upsilon_{i,t}$$

where $\text{Wage}_{i,t}$ 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 term in age.

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 ordinary least squares (OLS) estimation of Equation (1) would yield upward-biased coefficients on the different training measures, as 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 (FE).

We thus rely on FE estimations for our analysis, and provide standard OLS estimations for comparison purposes.[4] However, even though the estimated coefficients that result from the FE 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 explanatory variables, then our estimation of Equation (1) using FE would still be biased.

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 cannot 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,

4. Additional random-effects estimations yield very similar results and are available upon request.

an argument can be made that wages paid by profit-maximizing firms operating in competitive labor markets, are good indicators of marginal productivities (see Hellerstein, Neumark, and Troske 1999; Lazear 1979, among others, for qualifications to this argument). In the public sector, however, 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 the effect should be reflected 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:

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

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.

Equation (2) allows us to estimate the 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 zero in the case of a public sector worker. Note that an extra private-employer-financed training program increases a private worker's wage by $\beta_1 + \beta_5$ percent, while it increases the wage of the same worker if she migrated to the public sector by only β_1 percent. We then expect the coefficient β_5 to be nonnegative since private-employer-provided training is intended for private sector workers.

A useful way to measure the portability of private training episodes is through the ratio $P_{\text{priv}} = \beta_1/(\beta_1 + \beta_5)$. Maximum portability of private-employer-provided training implies a value of $P_{\text{priv}} = 1$, as in this case we should observe the same, positive effects in both sectors (and, therefore, $\beta_5 = 0$ while $\beta_1 > 0$). In contrast, minimum portability of private-employer-provided training implies a value of $P_{\text{priv}} = 0$, as in this case we should observe this type of training is only valuable in the private sector (so that $\beta_5 > 0$ while $\beta_1 = 0$).

Similarly, regarding the portability of public-employer-provided training, the corresponding measure is the ratio $P_{\text{pub}} = (\beta_2 + \beta_6)/\beta_2$, 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 β_6 to be nonpositive. Thus, as before, maximum portability of public-employer-provided training corresponds to $P_{pub} = 1$, as in this case we should observe the same, positive effects in both sectors (so that $\beta_6 = 0$ while $\beta_2 > 0$). Minimum portability of public-employer-provided training implies a value of $P_{\text{pub}} = 0$, as in this case we should observe this type of training is only valuable in the public sector (so that $\beta_2 + \beta_6 = 0$).

A. *Results*

The results of our estimations are presented in Tables 3–5. Tables 3 and 4 show the estimation results of Equation (1) for the U.S. and UK samples, respectively. In both of these tables, the first column presents OLS estimates of the baseline model using aggregate training episodes only. The second column presents the corresponding OLS estimations when the different training categories are entered separately. Columns 3 and 4 allow for nonlinear returns to training by adding quadratic terms to the specification, as suggested by Frazis and Loewenstein (2005) and, finally, the FE estimations of the baseline model are shown in columns 5 and 6. These FE results are our preferred estimations since they are free of potential biases resulting from time-invariant omitted variables.[5]

5. In addition to estimating Equation (1), we estimated two alternative specifications: one in which the number of years that workers have been in the sample was added as a control variable, and another in which training stocks depreciated over time at an exogenous rate. The results of these estimations were consistent with the ones we report here. Only in one instance, the results changed: when the coefficient on aggregate training in the United States lost significance after controlling for the workers' years in the sample. The results are available upon request.

TABLE 3
Wage Effects of Training: NLSY

	OLS1 (1)	OLS2 (2)	OLS3 (3)	OLS4 (4)	FE1 (5)	FE2 (6)
Aggregate tr	.07		.13		.02	
	(.007)***		(.02)***		(.007)**	
Private tr		.07		.13		.02
		(.008)***		(.02)***		(.009)**
Public tr		.10		.17		.06
		(.01)***		(.03)***		(.01)***
Self tr		−.007		−.05		−.04
		(.02)		(.03)		(.02)
Aggregate tr sq			−.01			
			(.003)***			
Private tr sq				−.01		
				(.004)***		
Public tr sq				−.02		
				(.006)**		
Self tr sq				.01		
				(.008)*		
College	.57	.57	.56	.55	.0007	.001
	(.03)***	(.03)***	(.03)***	(.03)***	(.07)	(.07)
HS and more	.23	.23	.22	.22	−.03	−.03
	(.02)***	(.02)***	(.02)***	(.02)***	(.04)	(.04)
Male	.32	.32	.32	.32		
	(.02)***	(.02)***	(.02)***	(.02)***		
Age	.07	.07	.06	.06	.11	.11
	(.01)***	(.01)***	(.01)***	(.01)***	(.01)***	(.01)***
Age squared	−.0009	−.0009	−.0008	−.0008	−.001	−.001
	(.0002)***	(.0002)***	(.0002)***	(.0002)***	(.0002)***	(.0002)***
Obs.	36,121	36,121	36,121	36,121	36,121	36,121
R^2	.16	.16	.16	.16	.03	.04

***Significant at 1%; **significant at 5%; *significant at 10%.

The results for the United States presented in Table 3 show a positive and significant relationship between aggregate training and wages across all columns. In column 5, the coefficient on aggregate training implies that an extra training episode of average duration increases wages by 2%. Similarly, when the training categories are disaggregated, both private- and public-employer-financed training appears positively and significantly associated with wages in all regressions. In column 6, the estimated coefficients imply that an extra training episode of average duration increases wages by 2% if provided by a private employer and by 6% if provided by a public employer. Only for the case of self-financed training there appears to be is no significant relationship with wages. At the same time, except for self-financed episodes, all linear terms are positive and the quadratic terms are negative, suggesting positive but decreasing marginal returns to training.

Table 4 presents the corresponding estimation results for the UK sample. As shown in this table, the results for the United Kingdom are very similar to those obtained for the United States. The estimated coefficient on aggregate training is always positive and significant, the coefficients on the private-employer-provided and public-employer-provided training are also positive and significant in all specifications, and no significant relationship is found between self-financed training and wages. Quantitatively, the estimated coefficients for the United Kingdom are smaller than those for the United States. But as individuals in the NLSY are observed, on average, for twice as many periods as those in the BHPS, the coefficients cannot be directly compared across samples. Instead, if the shorter time span by which UK individuals are observed leads us to underestimate their accumulated training, then one should adjust the estimated coefficients for the United Kingdom downward in order to obtain comparable effects.

Finally, Table 5 presents estimation results of Equation (2). As explained before, the alternative specification used here allows us to study

TABLE 4
Wage Effects of Training: BHPS

	OLS1 (1)	OLS2 (2)	OLS3 (3)	OLS4 (4)	FE1 (5)	FE2 (6)
Aggregate tr	.02		.04		.007	
	(.001)***		(.003)***		(.001)***	
Private tr		.03		.04		.009
		(.002)***		(.004)***		(.002)***
Public tr		.03		.05		.007
		(.002)***		(.004)***		(.002)***
Self tr		−.01		−.01		−.001
		(.005)**		(.009)*		(.005)
Aggregate tr sq			−.001			
			(.0002)***			
Private tr sq				−.001		
				(.0003)***		
Public tr sq				−.002		
				(.0003)***		
Self tr sq				.0004		
				(.002)		
College	.60	.60	.59	.60	.10	.10
	(.01)***	(.01)***	(.01)***	(.02)***	(.03)***	(.03)***
HS and more	.23	.23	.22	.23	.01	.01
	(.01)***	(.01)***	(.01)***	(.01)***	(.02)	(.02)
Male	.21	.20	.21	.20		
	(.008)***	(.008)***	(.008)***	(.008)***		
Age	.06	.06	.06	.06	.06	.06
	(.002)***	(.002)***	(.002)***	(.002)***	(.003)***	(.003)***
Age squared	−.0006	−.0006	−.0006	−.0006	−.0006	−.0006
	(.0000272)***	(.0000272)***	(.0000272)***	(.0000271)***	(.0000352)***	(.0000353)***
Obs.	44,177	44,177	44,177	44,177	44,177	44,177
R^2	.28	.28	.28	.29	.05	.05

***Significant at 1%; **significant at 5%; *significant at 10%.

the portability of training across sectors, and the selection of training recipients within each sector, by estimating the differential effects of each type of training for public and private workers. The table shows OLS and FE estimation results for both the United States (first three columns) and the United Kingdom (last three columns). To facilitate interpreting these results, we calculate the total effects of public and private training on each sector and report them separately at the bottom of the table. In columns 3 and 6, we also report the results from the estimation of the model without the interaction term between public training and private sector employment, which was never statistically different from zero.

We first examine to what extent public sector training is portable, that is, increases workers' wages when they migrate to the private sector. The evidence on the portability of public-employer-provided training shows a consistent message across countries and specifications. As shown in Table 5, the coefficient on Public tr is always positive and significant, while the coefficient on the interaction term Private sector × Public tr is never significantly different from zero when using our preferred FE specification. Public training then appears fully portable (with a portability ratio $P_{\text{pub}} = (\beta_2 + \beta_6)/\beta_2$ of 1) both in the United Kingdom and the United States. These findings then suggest public-employer-provided training improves workers' productivity in similar ways as private-employer-provided training does.

The evidence on the portability of private-employer-provided training, in contrast, shows a marked difference between samples. For the United States, the estimated coefficient on Private tr is positive and insignificant in the OLS estimations (columns 1 and 2), but positive and significant at the 1% level in the preferred FE estimation (column 3). At the same time, the estimated coefficient on the interaction Private sector × Private tr is positive and significant in the OLS estimations, but negative and significant in the FE estimates. Thus, our results suggest that the skills provided by private

TABLE 5
Portability of Training

	OLS1US (1)	FE1US (2)	FE2US (3)	OLS1UK (4)	FE1UK (5)	FE2UK (6)
Private tr	.01	.04	.04	−.005	−.004	−.004
	(.02)	(.01)***	(.01)***	(.008)	(.005)	(.005)
Public tr	.08	.06	.06	.02	.007	.007
	(.01)***	(.01)***	(.01)***	(.002)***	(.002)***	(.002)***
Self tr	−.03	−.04	−.04	−.02	−.0008	−.0008
	(.02)	(.02)	(.02)	(.005)***	(.005)	(.005)
Private sector × Private tr	.06	−.02	−.02	.04	.01	.01
	(.02)***	(.01)**	(.01)**	(.008)***	(.005)***	(.005)***
Private sector × Public tr	−.0000311	.007		−.01	−.003	
	(.03)	(.02)		(.007)**	(.004)	
Private sector	−.16	.01	.01	−.07	−.05	−.05
	(.03)***	(.01)	(.01)	(.01)***	(.01)***	(.01)***
College	.53	.0004	.0006	.61	.10	.10
	(.03)***	(.07)	(.07)	(.02)***	(.03)***	(.03)***
HS and more	.19	−.03	−.03	.24	.009	.009
	(.03)***	(.04)	(.04)	(.01)***	(.02)	(.02)
Age	.07	.11	.11	.06	.06	.06
	(.01)***	(.01)***	(.01)***	(.002)***	(.003)***	(.003)***
Age squared	−.0009	−.001	−.001	−.0006	−.0006	−.0006
	(.0002)***	(.0002)***	(.0002)***	(.0000281)***	(.0000351)***	(.0000351)***
Effects of training						
Priv-tr-on-priv-sector	.07	.02	.02	.04	.01	.01
	(.009)***	(.009)*	(.009)*	(.002)***	(.002)***	(.002)***
Priv-tr-on-pub-sector	.01	.04	.04	−.005	−.004	−.004
	(.02)	(.01)***	(.01)***	(.008)	(.005)	(.005)
Pub-tr-on-priv-sector	.08	.06	.06	.001	.004	.007
	(.03)**	(.02)***	(.01)***	(.007)	(.005)	(.002)***
Pub-tr-on-pub-sector	.08	.06	.06	.02	.007	.007
	(.01)***	(.01)***	(.01)***	(.002)***	(.002)***	(.002)***
Obs.	36,121	36,121	36,121	44,153	44,153	44,153
R^2	.11	.04	.04	.25	.05	.05

***Significant at 1%; **significant at 5%; *significant at 10%.

employers are highly portable, and rewarded in the form of higher wages for workers who migrate into the public sector. In fact, using FE estimated coefficients, the portability ratio $P_{\text{priv}} = \beta_1/(\beta_1 + \beta_5)$ yields a value of 2, which suggests private-employer-provided training is not only valued in the public sector, but valued at a premium.

For the United Kingdom, in contrast, the estimated coefficients suggest private-employer-provided training is not portable. As shown in columns 4–6, the estimated coefficient on Private tr was not significantly different than zero in any of the specifications, while the estimated coefficient on the interaction Private sector × Private tr was always positive and significant at the 1% level. These results then suggest that private training in the United Kingdom has a positive and significant value for private sector workers, but it has no value in the public sector (with a portability ratio $P_{\text{priv}} = \beta_1/(\beta_1 + \beta_5)$ of 0 for the preferred FE results).

The difference in the portability of private-employer-provided training between the United States and the United Kingdom could be explained by the influence of specific wage-determination mechanisms present in the UK public sector but not in the United States. Alternatively, it could also be explained by differences in the degree of labor market imperfections observed. If firms hiring in more imperfect labor markets have greater incentives to invest in general skills, as proposed by Acemoglu and Pischke (1999), then differences in the degree of labor market imperfections found in the United Kingdom and the United States could lead to differences in the skills sets provided by private employers in those countries. Here, more labor imperfections would lead to more general training being provided by private employers and

to greater portability as a result. Unfortunately, with the data at hand we are unable to test these alternative explanations any further.[6]

The question of selection into training based on unobserved characteristics can also be examined using Table 5. 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 FE coefficients. Recall that the returns to private sector training for private sector workers is $(\beta_1 + \beta_5)$. For the United States, this effect is 0.07 in the OLS specification of column 1, and drops to 0.02 in the FE specification of columns 2 and 3. For the United Kingdom, similarly, the effect is 0.04 in the OLS estimate and 0.01 in the FE estimates. As mentioned before, such a drop in the measured returns to training in the private sector is an established result in the literature. For public sector workers, the corresponding returns to public sector training in the public sector suggest very little selection takes place in the United States while some selection takes place in the United Kingdom. In the United States, the estimated effect of public training on the wages of public workers is similar across the OLS and FE estimates (0.08 and 0.06, respectively). In the United Kingdom, the estimated effect drops from 0.02 to 0.007.

IV. CONCLUSION

This study provides a comparative study of different types of employer-provided training for the United States and the United Kingdom. In both samples, and in accordance with previous literature, we find evidence that employer-provided training is positively and significantly associated with workers' wages. For the United States, the results from our preferred specifications indicate an additional episode of training is associated with a 2% increase in wages. For the United Kingdom, in turn, an additional episode of training is associated with a 0.7% increase in wages.

In addition, in order to compare the effects of training provided by private and public employers, two separate accounts of private-employer-provided and public-employer-provided training were created. For the case of the United States, our results indicate an additional training episode provided by a private-sector employer is associated with a 2% increase in wages, while an additional training episode provided by a public-sector employer is associated with a 6% increase. For the United Kingdom, an additional training episode provided by a private-sector employer is associated with a 0.9% increase in wages, while an additional training episode provided by a public-sector employer is associated with a 0.7% increase.

Both in the United Kingdom and the United States, 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. The skills provided by private employers to workers who migrate to the public sector, however, were found to be associated with higher wages only for the U.S. sample.

6. We conducted additional regressions where the effects of training experienced in current and previous jobs were estimated separately for both, the public and private categories. Our results again showed private training is always portable in the United States and not portable in the United Kingdom. While public training is portable in both the United States and the United Kingdom. The results did not allow us to draw any further conclusions regarding the role of general and specific training. They are available upon request.

REFERENCES

Acemoglu, D., and J. Pischke. "The Structure of Wages and Investment in General Training." *Journal of Political Economy*, 107(3), 1999, 539–72.

Arulampalam, W., A. Booth, and M. Bryan. "Training in Europe." *Journal of the European Economic Association*, 2(1-2), 2004, 346–60.

Barron, J. M., M. C. Berger, and D. A. Black. "How Well Do We Measure Training?" *Journal of Labor Economics*, 15(3), 1997, 508–28.

Bassanini, A., A. Booth, G. Brunello, M. De Paola, and E. Leuven. "Workplace Training in Europe." IZA Discussion Paper No. 1640, 2005

Black, S. E., and L. M. Lynch. "Human-Capital Investments and Productivity." *American Economic Review*, 86(2), 1996, 263–67.

Booth, A. L. "Job-Related Formal Training: Who Receives It and What Is It Worth?" *Oxford Bulletin of Economics and Statistics*, 53(3), 1991, 281–94.

———. "Private Sector Training and Graduate Earnings." *Review of Economics and Statistics*, 75(1), 1993, 164–70.

Booth, A. L., and M. L. Bryan. "Testing Some Predictions of Human Capital Theory: New Training Evidence from Britain." *Review of Economics and Statistics*, 87(2), 2005, 391–4.

Dearden, L., H. Reed, and J. Van Reenen. "The Impact of Training on Productivity and Wages: Evidence from British Panel Data." *Oxford Bulletin of Economics and Statistics*, 68(4), 2006, 397–422.

Frazis, H., and M. A. Loewenstein. "Reexamining the Returns to Training Functional Form, Magnitude, and Interpretation." *Journal of Human Resources*, 40(2), 2005, 453–76.

Frazis, H., and J. R. Spletzer. "Worker Training: What We Have Learned from the NLSY79." *Monthly Labor Review*, 128(2), 2005, 48–58.

Heckman, J., and R. Robb. "Alternative Methods for Evaluating the Impact of Interventions: An Overview." *Journal of Econometrics*, 30(1-2), 1985, 239–67.

Hellerstein, J. K., D. Neumark, and K. R. Troske. "Wages, Productivity, and Worker Characteristics: Evidence from Plant-Level Production Functions and Wage Equations." *Journal of Labor Economics*, 17(3), 1999, 409–46.

Krueger, B. A. "Are Public Sector Workers Paid More Than Their Alternative Wage? Evidence from Longitudinal Data and Job Queues," in *When Public Sector Workers Unionize*, edited by R. B. Freeman and C. Ichniowski. Chicago: University of Chicago Press, 1988, 214–42.

Lazear, E. P. "Why Is There Mandatory Retirement?" *Journal of Political Economy*, 87(6), 1979, 1261–84.

Loewenstein, M. A., and J. R. Spletzer. "Dividing the Costs and Returns to General Training." *Journal of Labor Economics*, 16(1), 1998, 142–71.

Lynch, L. M. "Private-Sector Training and the Earnings of Young Workers." *American Economic Review*, 82(1), 1992, 299–312.

Parent, D. "Wages and Mobility: The Impact of Employer Provided Training." *Journal of Labor Economics*, 17(2), 1999, 298–317.

Sepúlveda, F. "Training and Productivity: Evidence for US Manufacturing Industries." *Oxford Economic Papers*, 62(3), 2010, 504–28.

Veum, J. R. "Training, Wages, and the Human Capital Model." *Southern Economic Journal*, 65(3), 1999, 526–38.