Does Training Generally Work? Measuring the Returns to In-Company Training

Alan Barrett and
Philip J. O'Connell

September 1997

Working Paper No. 87

E-mail. Alan.Barrett@esri.ie / Philip.@esri.ie

Section 1: Introduction

In a world of rapid technological change, where employee skills are seen as a key determinant of national competitiveness, it has become something of a mantra that the continuing training of employees is a crucial business activity. What is more, it is thought that companies may well underinvest in training. This may be due partly to the difficulty of capturing the returns if trained employees quit, or because companies are simply ignorant as to the benefits of continuing training. Whatever the reason, the possibility of underinvestment in continuing training by companies has led governments and the EU to subsidise such activities in an effort to correct the market failure (Department of Enterprise and Employment (Ireland), 1997).

Given that the importance of continuing training and the desirability of subsidising it appear to be generally held, it is somewhat surprising that the direct evidence as to the effect of such training on productivity is quite limited; in the case of Ireland, such research is simply non-existent. It is true that there has been much research on the indirect effects of training, whereby the effects of training are measured by considering the impact on wage rates across individuals of different levels of training. This approach, however, suffers from possible flaws. The assumption implicit in such work is that wages are closely related to productivity and so higher wages must result from a positive effect of training on productivity. However, we know from other research that the wage/productivity link may not be perfect. For example, Medoff and Abraham (1981) show that in a large company they were studying more experienced workers in a job category received higher wages, even though they received less favourable evaluations from supervisors than less experienced colleagues. For this reason, research is required that examines directly how productivity is effected by continuing training; specifically, there is a need to consider the issue at the firm level and to see if, and to what extent, output and productivity respond to such training.

In the study presented here, we implement this firm level approach in an effort to measure the effect of continuing training on output and productivity. Our analysis is based on a unique data set which was generated through two surveys which were conducted on a group of Irish companies at two points in time. This panel-type structure of the data set allows us to look at changes across the companies in output and productivity between 1993 and 1995 and how these changes may be related to differences in the provision of training in 1993. While some studies have been undertaken using this approach, our study has two important advantages:

- As no study of this type has ever been undertaken using data from Irish firms, the results contribute to filling an important information gap and so will be of general use to companies in Ireland and to policymakers here.

- In addition to the nation-specific advantage, the data set used in the study is considerably richer than those used in the existing studies, both in terms of sample size and variables included. This richness allows us to arrive at the most illuminating conclusion in the study: it is the type of training, and not simply the amount, which appears to be important in increasing output and productivity.

The remainder of the paper is structured as follows:

- In Section 2, we review the work which has been done in this area in which approaches similar to ours have been used.
- In Section 3, we describe our research design and our data set.
- Section 4 contains an outline of the theoretical model on which our empirical work is based.
- Our results are presented in Section 5.
- Some conclusions follow in Section 6.

Section 2: Literature Review

As was mentioned in the Introduction, the vast majority of investigations into the returns to training expenditure have approached the issue from the perspective of the individual. In addition, a number of studies have considered the issue from a national perspective by examining differences in national productivity levels and how these relate to national investments in training. Rather than discuss any of those studies, we will focus here on the few studies that share our approach, that is, measuring the returns from the perspective of the company. We will briefly outline the content of three such studies and explain the advantages of our work over these pieces.

de Koning and Gelderblom (1992)

In their paper, de Koning and Gelderblom (1992) use information from a survey of 51 companies to measure the effect of training. The companies included come from six sectors. As they are using data on training input and productivity from the one year, they encounter a statistical problem in determining the relationship between training and productivity. If they were to find that firms which had high levels of training in a particular year also had high levels of productivity, this could be for two reasons. The training may be making the workers more productive; however, firms which have higher productivity levels may also be better able to afford training. In the former case, the causation runs from training to productivity whereas in the later case the causation runs in the opposite direction. In order to overcome this problem, they must use the two-stage least squares estimation technique.

Their indicator of training intensity is the proportion of employees who participate in a training course in the year; their measure of productivity is constructed to reflect value added, that is the difference between the value of raw materials as they enter the plant and the value of sales as they leave. Although they find that higher levels of productivity tend to increase the amount of training provided, they do not find a statistically significant effect of training on productivity. It is difficult, however, to conclude from this that training has no effect on productivity; the difficulty arises because of the small sample size. This is particularly problematic given that six sectors are included.

The following points summarise the study:

- Sample size: 51 companies, from six sectors;
- Training indicator: proportion of employees who participated in a training course in the year;
- Productivity measure: value added
- Result: training had no effect on productivity

Holzer et al (1993)

The study of Holzer et al (1993) is based on a sample of firms who applied for a state training grant; all the firms are in manufacturing. With three years of information on each firm, the authors are able to look at how changes in productivity may be related to differences in training input. In this way, they did not face the two-way causation problem that confronted de Koning and Gelderblom and so were able to base their analysis on a single equation. Their training indicator is the annual hours of training per employee; their productivity measure is based on the "scrappage rate" in each firm. By "scrappage rate" they mean the proportion of output that could not be sold due to faults. Working with a sample size of between 90 and 60, they found a significant effect of training on the productivity measure across a range of equation specifications; for example, a doubling of training per worker was found to be associated with a 7 percent fall in the scrappage rate.

The finding of a positive training effect by Holzer et al is in line with the theory of training, but the interpretation of their result is limited by the nature of their dependent variable, changes in the scrappage rate. It could be that the scrappage rate fell in response to more care being taken during production; this, however, could be the result of slower as opposed to more productive processes, whereby productivity may not have increased. For this reason, the Holzer et al study still falls short of showing a clear link between training and productivity.

The following points summarise the study:

- Sample size: 60 to 90 companies, all in manufacturing;
- Training indicator: annual hours of training per employee
- Productivity measure: scrappage rate
- Result: training had an effect on productivity; for example, a doubling of training per worker was found to be associated with a 7 percent fall in the scrappage rate.

Bartel (1994)

The final study which we will mention is that of Bartel (1994). Her work is based on a survey of firms conducted in 1983 by the Columbia Business School; the survey gathered information on human resource policies in these firms, including training policies. For the purpose of the study, only information on manufacturing firms was used and this left a sample of 155 for analysis. The measure of training intensity was the proportion of seven groups of workers in each enterprise who received training; the productivity measure was "net sales". As the survey contained two years of data, Bartel, like Holzer et al, was able to overcome the two-way causation problem by estimating how the *level* of training is related to the subsequent *growth* in productivity. She found evidence of training effectiveness; for example, evaluated at the average level of her training measure, the introduction of new training produced a productivity gain of 18.86 percent.

While Bartel's study uses a preferable dependent variable than that used by Holzer et al, her measure of training remains very crude. What is more, starting from a given level of training, she measures the effects of an incremental increase in training, rather than the level of training. It is the level which is of greatest interest.

The following points summarise the study:

- Sample size: 155 companies, all in manufacturing;
- Training indicator: the proportion of seven groups of workers in each enterprise who received training
- Productivity measure: value added
- Result: training had an effect on productivity; for example, evaluated at the average level of her training measure, the introduction of new training produced a productivity gain of 18.86 percent.

From this discussion it can be seen that while the studies have contributed to filling a gap in the research on training, we are still a long way from understanding the relationship of interest. Given that the common problem across the studies is one of poor data, the data used below go some way towards reducing the size of that difficulty, for the following reasons:

- While our sample size is small relative to many cross-sectional studies, in percentage terms it is considerably larger than those used in the studies just outlined. Bartel's study uses a sample size of 155, whereas our data set contains 276 observations.

- Our information on training is richer than that available to the other researchers. With data on numbers trained, hours per trainee and types of training we can explore the question further.

Section 3: Research Design and the Data Set

The starting point for this research is the survey undertaken in 1993 and reported in Fox (1995). This is a survey of Irish industry in 1993 which asked detailed questions about training practices in a sample of enterprises. As no national register of companies was available for sampling purposes, the sample of 1,000 companies was drawn at random from the following sources: the FAS Levy/Grant Register of companies in manufacturing, construction and garages the Dun and Bradstreet register of distribution companies and the Kompass register of service companies. The survey covered companies employing more than 10 people in manufacturing industry, construction and private services. Its focus was on continuing vocational training, not initial training, and so apprentices and trainees are excluded.

A total of 654 useable returns were obtained. The information obtained includes the following:

- the activity of each company;
- its workforce and a breakdown in terms of managers, operatives etc.;
- whether or not different types of training were undertaken;
- how many days employees spent in training;
- how much the company spent on training courses, including the labour costs of employees while participating in courses.

In order to obtain the information required to measure the effects of training on turnover and productivity, it was necessary to re-survey the 654 companies at a later point in time. This was done in April and May of 1997. Given that the sample which we were re-surveying was quite small, the strategy adopted was to ensure that the response rate was as high as possible; in order to achieve this, the amount of information sought was kept to a minimum. The main pieces of information sought were as follows:

- turnover in 1993 and 1995;
- the value of fixed assets at the same two points in time;
- the size of the workforce, again in 1993 and 1995.

Excluding 12 public authorities, the original survey consisted of 642 firms. The follow-up survey achieved 292 responses, an effective response rate of 45.5%. Eliminating responses with incomplete or poor quality data reduced the number of useful cases to 276. In order to check for bias in the response we compared the second-wave cases with the first-wave and found that the distribution of companies by sector and size category was very similar in both surveys. We also found that the mean values of training measures were very similar, and not statistically different. Some descriptive statistics on the firms who responded to the second survey can be found in Table 1 in Section 5 below.

Section 4: The Model

In order to place our empirical work in a theoretical context, we will now present a model on which our estimation is based. The model is drawn from the paper by Bartel (1994). We assume that the relationship between output and inputs which holds for the companies we are studying has a Cobb-Douglas structure; its precise form is shown in Eq. 2 below. Output is a function of two inputs, capital (K) and 'effective labour' (EL). Effective labour can be thought of as the amount of labour services employed by the company. It is made up of the amount of labour employed (RL, or reported labour) and the amount of training that the workforce have received (T). It should be noted that training as we are defining it here is a "stock" variable, that is, the amount accumulated over time; the training provided to employees in any year can thus be thought of as a "flow" variable, that is the amount that is added to a stock over a period of time. The relationship between effective labour (EL), reported labour (RL) and training (T) is as follows:

$$EL = RL(1 + \lambda T) \qquad (1)$$

According to Eq. 1, if training (T) was equal to zero, effective labour (EL) and reported labour (RL) would be the same. However, as λ is a number greater than zero, if training is greater than zero, then effective labour is greater than reported labour..

The production for each firm can be written as follows:

$$Q = AK^{\beta}EL^{\gamma} \qquad (2)$$

where β and γ are numbers greater than zero, as is A.

Substituting Eq. 1 into Eq. 2 gives

$$Q = AK^{\beta}(RL(1 + \lambda T))^{\gamma} \qquad (3)$$

This equation tells us nothing new; its usefulness arises as part of our effort to arrive at a model which we will be able to estimate and which will tell us about the relationship between training and output and productivity. In that estimation, we will want to work with a more simple model and so we will perform another adjustment. We take the natural logarithm of both sides of Eq 3 which gives us the following:

$$\ln Q = \ln A + \beta \ln K + \gamma \ln RL + \gamma\lambda T^{2} \qquad (4)$$

Estimating an equation such as Eq. 4 could potentially produce a biased estimate of the effect of training on output; this would arise if there are unobserved characteristics of firms which are correlated with training (T) and which effect output (Q). For example, if the managers of a firm are particularly effective, they may be able to generate high productivity and to have funds made available for training. In this case we will observe high productivity and high levels of training, but without information on manager quality, we might be lead to overstate the contribution of training to the high productivity. Assuming these unobservable characteristics are unchanged over time, the bias problem can be eliminated in the following way: we subtract a version of Eq. 4 in one year from a version in subsequent year. In this way we are modelling changes in variables, as can be seen in Eq. 5:

$$\ln Q_t - \ln Q_{t-1} = \beta(\ln K_t - \ln K_{t-1}) + \gamma(\ln RL_t - \ln RL_{t-1}) + \gamma\lambda(T_t - T_{t-1}) + \alpha X + \varepsilon_t - \varepsilon_{t-1} \quad (5)$$

where ε_t and ε_{t-1} are error terms, $T_t - T_{t-1}$ is the training provided over a year, or alternatively, the increase in the stock of training and X is a vector of control variables.

[2] This transformation uses the approximation ln (1+ x) = x for small x.

To summarise so far, Eq. 5 says that changes in output are influenced by changes in a range of variables including changes in the amount of training which the employees possess (T_t - T_{t-1}); this quantity is equal to the amount of training provided to employees in a given year. Estimates of Eq. 5 will be presented below.

While the effect of training on output is of interest, we are also interested in the effect of training on productivity. Hence, we need to alter the model so that the dependent variable is output per worker. Returning to Eq. 3, we divide through by reported labour (RL), thereby producing output per worker (Q/RL) as follows:

$$Q/RL = AK^{\beta}RL^{\gamma-1}(1+\lambda T)^{\gamma} \quad (6)$$

Again, in order to arrive at a model that can be estimated using linear techniques, the logarithm of both sides is taken. This leads to the following:

$$\ln(Q/RL) = \ln A + \beta \ln K + (\gamma-1)\ln RL + \gamma\lambda T + \alpha X + \varepsilon \quad (7)$$

As was the case with output, it is possible that the estimation of Eq. 7 could produce a biased estimate of the effect of training on productivity. So again, we difference Eq. 7 which leads to the following:

$$\ln(Q_t/RL_t) - \ln(Q_{t-1}/RL_{t-1}) = \beta(\ln K_t - \ln K_{t-1}) + (\gamma-1)(\ln RL_t - \ln RL_{t-1}) + \gamma\lambda(T_t - T_{t-1}) + \varepsilon_t - \varepsilon_{t-1} \quad (8)$$

This equation says that changes in output are related to a range of variables, including training. Eq. 5 and Eq. 8 encapsulate the core concern in this study and so their estimation will be presented below.

We should stress that when we talk about training we are referring to training undertaken in 1993 and reported in the survey of Fox (1995), which was described in Section 3. In order to see if this training is related to output or productivity changes, we will be using the difference in the firms' output and productivity levels between 1993 and 1995, reported in the later survey and described in Section 3 also. In essence, we are asking if training in 1993 brought about output and productivity growth between 1993 and 1995.

Section 5: Results

Descriptive statistics

Before presenting the results of our estimation of Eq. 5 and Eq. 8, we will present some descriptive statistics on our sample of firms. These are contained in Table 1. While most of the variable titles are self-explanatory, some require explanation. 'Labour Productivity' is turnover divided by the number of employees. The definitions of 'Specific Training' and 'General Training' are determined by the 1993 survey. The companies were asked to categorise their training into that which could be used outside their firm (general) and that which would be useful only within (specific). Clearly, this was designed to capture Becker's distinction in training types (Becker, 1975).

Table 1
Summary Statistics on Principle Variables

	Firms with no training in 1993		Firms which trained in 1993	
	Mean	Std. Dev.	Mean	Std. Dev.
Turnover 1993 (IR£,000s)	2,569	3,264	28,363	66,520
Prop. Change in Turnover	.31	.32	.18	.26
Labour Productivity (IR£1,000s)	104	140	142	216
Prop. Change in Labour Productivity	.04	.40	.02	.37
Assets, 1993 (IR£1,000s)	5,027	27,206	9,947	47,938
Prop. Change in Assets	.13	.37	.14	.35
No. of Employees, 1993	33	33	200	477
Prop. Change in No. of Employees	.12	.45	.14	.36
Training Days/Employees	0	--	2.19	3.13
Trainess/Employees	0	--	.46	.33
Training Expenditure/ Payroll	0	--	2.09	2.96
Specific Training Days/Employees	0	--	1.04	1.93
General Training Days/ Employees	0	--	.93	2.09
No. of Cases	52		224	

Of the 276 firms who responded to the second survey, 52 reported in the 1993 survey that they had conducted no training in that year. For the 224 companies that did undertake training in 1993, the average amounts of training can be summarised in the following statistics: on average, employees had 2.19 days of training, .46 of all employees received some training and training expenditure amounted to 2.19 percent of payroll. It is clear from the table that the firms which undertook some training are larger firms, in terms of turnover, number of employees and fixed assets. One surprising point to emerge from the table is that both turnover and productivity grew faster in the non-training firms. This initial view points to a less than simple relationship between these output measures and training. However, in order to isolate the separate effects of the different variables which might influence output and productivity it is necessary to employ multivariate regression.

Results with changes in output as the dependent variable

In Table 2, we present the results of estimating Eq. 5, derived above but presented again here for clarity:

$$\ln Q_t - \ln Q_{t-1} = \beta(\ln K_t - \ln K_{t-1}) + \gamma(\ln RL_t - \ln RL_{t-1}) + \gamma\lambda(T_t - T_{t-1}) + \alpha X + \varepsilon_t - \varepsilon_{t-1} \quad (5)$$

Three specifications of the model are shown, each containing a different definition of the training variable. In Specification 1, training is defined as the number of days of training per employee. The corresponding variable in Specification 2 is the proportion of employees who received training. In Specification 3, training is defined as expenditure on training as a proportion of payroll. Although variables representing the various sectors from which the firms are drawn were included in earlier estimations of the model, they were not significant and had no impact on the other coefficient estimates. For this reason, estimates of the simplest form of the model are shown in the table.

Table 2
Dependent Variable: Proportionate Change in Turnover, 1993-1995
(t-values in parenthesis)

	(1)	(2)	(3)
		Training Variable:	
	Training Days/ Employees	Trainees/ Employees	Training Expend/ Payroll
Training	.004	.046	.003
	(.78)	(1.03)	(.55)
Change in Assets	$.282^{***}$	$.285^{***}$	$.283^{***}$
	(6.05)	(6.21)	(6.04)
Change in Employment	$.240^{***}$	$.238^{***}$	$.233^{***}$
	(4.49)	(4.48)	(4.34)
Intercept	$.096^{***}$	$.086^{***}$	$.100^{**}$
	(4.70)	(3.40)	(5.05)
Adj R^2	.25	.25	.25
N	210	210	210

$^{*}p < .10$, $^{**}p < .05$, $^{***}p < .01$, (two-tailed tests)

Given our primary interest in the effect of training, the results on this variable are most noteworthy. The estimates reveal that the effect of training on output growth, controlling for the effects of capital and labour growth, is not significantly different from zero. This same result also emerged from the equations in which we included variables which captured the different sectors from which the firms were drawn.

An initial reaction to this might be that our data are too imprecise to capture the effect. However, a quick look at the rest of the table shows that this simple response is probably not the case. The effects of increases in both capital and labour are measured with statistical precision, as can be seen from their t-values across both specifications. It could also be argued that the effect of training is felt most directly on productivity changes and not on output changes. If this is true then the estimation of Eq. 8 should show a significant effect of training.

Results with changes in productivity as the dependent variable
The estimation of Eq. 8 is shown in Table 3; again, we will present Eq. 8 for clarity:

$$\ln(Q_t/RL_t) - \ln(Q_{t-1}/RL_{t-1}) = \beta(\ln K_t - \ln K_{t-1}) + (\gamma-1)(\ln RL_t - \ln RL_{t-1}) + \gamma\lambda(T_t - T_{t-1}) + \varepsilon_t - \varepsilon_{t-1} \quad (8)$$

Table 3
Dependent Variable: Proportionate Change in Labour Productivity, 1993-1995
(t-values in parenthesis)

	(1)	(2)	(3)
		Training Variable:	
	Training Days/ Employees	Trainees/ Employees	Training Expend/ Payroll
Training	.005 (.89)	.053 (1.19)	.004 (.71)
Change in Assets	.262*** (5.82)	.266*** (6.00)	.263*** (5.81)
Change in Employment	-.759*** (-14.14)	-.761*** (-14.26)	-.768*** (-14.29)
Intercept	.097*** (4.74)	.085*** (3.37)	1.00*** (5.08)
Adj R^2	.51	.52	.51
N	212	212	212

* $p < .10$, ** $p < .05$, *** $p < .01$, (two-tailed tests)

As was the case in our estimation of Eq. 5, we have used three definitions of training. We also included variables representing sectors in earlier estimations but excluded them because of their lack of any impact on the model.

Once again, we find that the impact of training is statistically indistinguishable from zero. The large, negative effect of the change in employment on productivity is perhaps surprising but can be explained as follows. If a firm has a large increase in its workforce, a high proportion of the workforce will be inexperienced and so less productive. In addition, the more experienced staff will be diverted from their tasks while assisting the newcomers. Hence, the negative coefficient is not surprising. The size of the effect may still appear to be an overestimate; however, Bartel in her estimation of Eq. 8 found a value identical to this across a range of specifications. This raises the important issue of the effects of new hires on productivity and how new hires can be optimally spaced.

To summarise our initial round of estimation, we could not identify an effect of training on either output growth or productivity growth, using our initial measures of training. While we might have expected the possibility that the effect of training could be smaller than was generally thought, the finding of no effect seems implausible. At this point, we can exploit the relative richness of the dataset and ask if some *types* of training have an impact.

Analysing the effects of different types of training

In order to the investigate this possibility of a differential impact of training types, we draw on the distinction introduced in Table 1, that of specific and general training. As discussed above, general training is defined in the 1993 survey as being training that could be used outside the firm; specific training, on the other hand, is only of use within the firm. In the case of each type of training, we know the number of days spent on each by all employees; hence, we can compute the number of general and specific training days per employee in each firm. We then multiply these variables by the training measures used in the estimations presented in Tables 2 and 3, thus producing interaction terms. The resulting variables are as follows:

(a) Specific Training Days (STD)/ Total Training Days (TTD) x Total Training Days (TTD)/ Employees (RL)

= STD/ RL , that is, specific training days per employee.

The same type of variable was created for General Training Days (GTD).

(b) STD/ TTD x Trainees (Tr)/ RL. The first part of the variable gives the proportion of training that is specific. In order to scale it up to be a measure of specific training input, we multiply by a measure of training intensity, that is the proportion of the workforce which is trained. Again, the same type of variable was created for GTD.

(c) STD/ TTD x Training Expenditure (TE)/ Payroll (P). This is similar to (b) in that the proportion variable STD/TTD needs to be scaled up. The scaling variable this time is the alternative measure of training intensity. The corresponding GTD variable was also created.

Using the general and specific training variables just described, we re-estimated Eq. 5 and Eq. 8 with the two training variables in each of the three specifications. Looking firstly at Eq. 5, the results are presented in Table 4.

The most striking point in Table 4 is that general training now has a positive and statistically significant effect on output growth. The direction and significance is consistent across all specifications. The effect of specific training cannot be distinguished from zero and this is also consistent across all specifications. This implies that the findings of no measurable effect in Tables 2 and 3 were masking the different impacts of general and specific training.

Table 4
Dependent Variable: Proportionate Change in Turnover, 1993-1995
Differentiating General and Specific Training
(t-values in parenthesis)

	(1)	(2)	(3)
		Training Variable:	
	Training Days/ Employees	Trainees/ Employees	Training Expend/ Payroll
Specific Training	-.011	-.098	-.010
	(-.08)	(-.075)	(-1.26)
General Training	.015**	.161**	.022**
	(2.00)	(2.45)	(2.19)
Change in Assets	.281***	.276***	.291***
	(6.10)	(6.04)	(6.27)
Change in Employment	.261***	.245***	.238***
	(4.83)	(4.65)	(4.47)
Intercept	.099***	.089**	.094**
	(4.90)	(3.68)	(4.84)
Adj R^2	.27	.27	.27
N	210	210	210

* $p < .10$, ** $p < .05$, *** $p < .01$, (two-tailed tests)

In Table 5 we present the results of the re-estimation of Eq. 8 using the general and specific measures of training. The effects uncovered in Table 4 are seen again in the effect on changes in productivity. While general training consistently shows a positive and significant effect, the effect of specific training is consistently indistinguishable from zero.

Table 5
Dependent Variable: Proportionate Change in Labour Productivity, 1993-1995
Differentiating General and Specific Training
(t-values in parenthesis)

	(1)	(2) *Training Variable:*	(3)
	Training Days/ Employees	Trainees/ Employees	Training Expend/ Payroll
Specific Training	-.010 (-1.179)	-.095 (-1.22)	-.009 (-1.17)
General Training	.016** (2.08)	.170*** (2.61)	.023** (2.28)
Change in Assets	.261*** (5.86)	.257*** (5.84)	.270*** (6.04)
Change in Employment	-.738*** (-13.60)	-.754*** (-14.29)	-.763*** (-14.32)
Intercept	.100*** (4.95)	.089*** (3.64)	.095*** (4.87)
Adj R^2	.52	.53	.53
N	212	212	212

* $p < .10$, ** $p < .05$, *** $p < .01$, (two-tailed tests)

The figures in Tables 4 and 5 show that general training has a statistically significant effect on both the change in output and in productivity. The figures, however, are less useful in getting a sense of the magnitude of the effect, due to the logged form of the dependent variable. In order to derive a meaningful measure of the effect of training, it is necessary to evaluate the impact at particular values of the training variables. This is done by calculating the product of the variable's value and the coefficient estimate and then calculating the value of e to that power[3]. The results of these calculations are presented in Table 6 for both the output and productivity equations and the three measures of general training.

[3] Drawing on the notation of the model, we calculate $e^{\lambda\gamma(\text{training})}$.

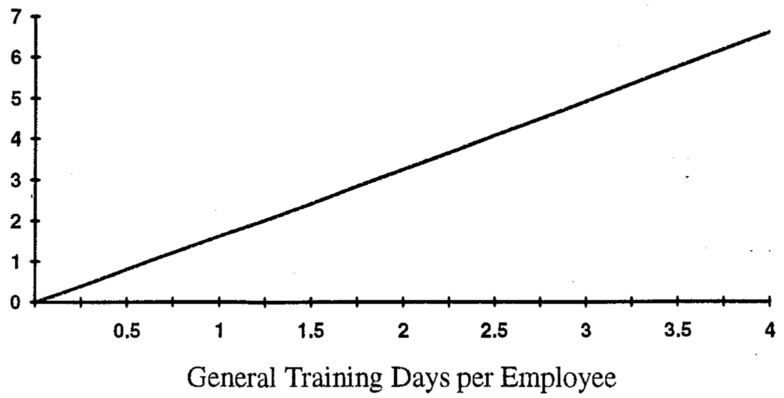
Table 6
Evaluating the Effects of Training on Productivity at Mean Training Values

Training Measure	Mean	Beta	Effect
		Turnover	
General Training Days/Employee	0.75	0.015	1.011
General Training *Trainees/Employees	0.5	0.161	1.084
General Training *Training Exp/Payroll	0.76	0.022	1.017
		Productivity	
General Trainng Days/Employee	0.75	0.016	1.012
General Training*Trainees/Employees	0.5	0.17	1.089
General Training*Training Exp/Payroll	0.76	0.023	1.018

The 'effect' column shows that a firm which provided the average level of general training days per employee experienced a growth in turnover of 1.1 percent between 1993 and 1995 because of that training. Similarly, for a firm that provided the average proportion of its employees with training, that is 50 percent, output growth of 8.4 percent was experienced. The percentage effects on productivity are very similar.

In order to illustrate how the percentage gain in productivity varies with the level of general training days per employee, we evaluate a range of values and plot them in Figure 1. It should be viewed with some caution, especially for values away from the sample mean. From Table 6 we know that the average level of general training days per employee was .75; this level of general training yields a percentage productivity gain of 1.2 percent. From Figure 1, it can be seen that a doubling of this input to 1.5 days per employee would produce a productivity gain of around 2.5 percent, although again, this is somewhat tentative.

Figure 1
The Impact of General Training Days on % Change in Productivity



Section 6: Conclusion

Our objective in this paper has been to estimate the effect of continuing training on output and productivity, using information drawn from Irish companies. What we have discovered is that the relationship between training, broadly defined, and these other variables is not simple. Instead, we have discovered that the type of training matters; in particular, training which is general in nature yields a positive impact whereas training which is specific to the company does not yield an impact which is statistically different from zero.

This finding gives rise to the obvious question of why this should be the case. There may be a number of explanations. First, companies which offer general training may be displaying a more rounded approach to human resource management than companies who only train for the immediate tasks at hand. It may be the broader human resource policies which produce the positive effects and not the general training alone. Second, it could be that while some firms described certain activities as being 'specific training' in their responses to the 1993 survey, others may have viewed these same activities as routine parts of overall operations. If this occurred, no impact of specific training would be derived from the data. It is likely that general training was more accurately reported across firms and so the positive effect could be identified.

The nature of the true explanation for the result we have uncovered clearly determines what the policy conclusion should be. For this reason, it is important that further work be done to develop this explanation. In addition, it is important that work be undertaken which examines the effects of training expenditure and the impact of training workers with different tasks in the firm. However, from the work undertaken and presented here we can say that while some types of training have been shown to have a positive effect of output and productivity, this cannot be said of other types of training. Hence, it is important that firms take care in designing their training strategies and it is equally important that governments aim their subsidies towards effective training.

References

Bartel, A. (1994), "Productivity Gains from the Implementation of Employee Training Programs", *Industrial Relations* Vol. 33.

Becker, G. (1975), *Human Capital* (2nd Edition), New York: Columbia University Press.

de Koning, J. and Gelderblom, A. (1992), "Company Training: Volume, Underinvestment and Return", a paper presented to the fourth annual conference of the European Association of Labour Economists, University of Warwick.

Department of Enterprise and Employment (1997), *White Paper on Human Resource Development*, Dublin: Stationery Office.

Eurostat (1997), *Labour Costs: Principal Results*, Luxembourg: European Commission.

Holzer, H., Block, R., Cheatham, M. and Knott, J. (1993), "Are Training Subsidies for Firms Effective? The Michigan Experience", *Industrial and Labour Relations Review* Vol. 46.

Fox, R. (1995), *Company Training in Ireland*, Dublin: FAS.

Medoff, J. and Abraham, K. (1981), "Are Those Paid More Really More Productive? The Case of Experience", *Journal of Human Resources* Vol. 16.

National Economic and Social Council (1993), *Education and Training Policies for Economic and Social Development*, NESC Report No. 95, Dublin: NESC.

O'Connell, P.J. and Lyons, M. (1995), *Enterprise-Related Training and State Policy in Ireland: The Training Support Scheme*, Dublin: ESRI.

O'Farrell, P.N. and Hitchens, D. (1989), *Small Firm Competitiveness and Performance*, Dublin, Gill and Macmillan.

Organisation for Economic Cooperation and Development (1995), *Economic Survey - Ireland 1995*, Paris: OECD.

Roche, F. and Tansey, P. (1992), *Industrial Training in Ireland*, Report to the Industrial Policy Review Group, Dublin: Stationery Office.