Wage Compression and Training Across Canadian Provinces

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I. Introduction

After the seminal contributions of Becker (1964) it was widely accepted that in a perfectly competitive labour market firms would not pay for general training; defined as any skill that could be used with another employer. Becker argued that the rent created from training, in frictional market, would directly benefit the worker who, assuming away transaction costs, could easily leave the incumbent firm; for this reason firms would not be willing to incur the cost of general training as they would not, therefore, be able to recoup their costs.

In Becker's model the onus of general training lies with the worker who fully benefits from training. And because workers capture the entire rent from training Becker argues that there is no reason for failure in obtaining the socially optimal level of training in the absence of credit constraints; a problem which if present can be easily remedied through government intervention.

Although Becker's conclusions were challenged by later economists it was not until the works of Acemoglu and Pischke (AP henceforth) that they were completely contradicted (1998, 1999a, 1999b).[1] AP argue that under the right conditions firms are willing to

[1] Authors such as Glick and Feuer (1984), Feuer et al. (1987), and Bishop and Kang (1984) modeled economies in which firms contribute towards the cost of general training when it is accompanied by firm specific training (as mentioned in Katz and Ziderman). While others such as Eckaus (1963) and Katz and

finance employee training. What sets apart the AP model from others is the concept of wage compression; the key to constructing a model in which not only is it possible for firms to cover the cost of general training but it is actually profitable for them to do so.

Also necessary in the AP model is imperfect labour markets without which workers would receive their full marginal products making it impossible for firms to recoup the costs of training; if, however, labour markets are not perfectly competitive then workers' wages would be less than their marginal products and firms could potentially capture a part if not all of the rent created from training.

Acemoglu and Pischke (1999b) outline some labour market structures which create the frictions that allow firms to profit from their investments in general training. Such structures included the presence of asymmetric information, transaction costs, efficiency wage and self-selection constraints, weather general and firm specific training are complementary, and labour market institutions such as unions and minimum wage laws; the common thread between these being their ability to distort the wage structure in such a way that allows firms to recoup the cost of training.

The presence of these mechanisms allows the AP model to conclude that it will be workers and not firms who will be unwilling to pay for general training. Acemoglu and Pischke also claim that their model is more in line with what is actually happening in labour markets around the world, using as an example the German labour market where firms offering apprenticeships cover the entire cost of training. They do however, also

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Ziderman (1990) touched on the possibility of a general training cost sharing between the employer and worker.

point out that the structure of the labour market plays a key role in the amount of general training offered by firms; comparing the German labour market to that of the United States they claim that the labour market institutions in Germany create an environment in which it is beneficial for firms to invest in general training, whereas the institution in the US make it easier for workers to find new jobs and less beneficial for firms to provide general training (1999a).

Evidence in support of the AP model, however, has not been consistent. In their paper, AP (1998) use data from Germany to test their framework by examining the wage structure of those who enter the apprenticeship program. The evidence confirms the AP framework. In more recent studies economists have used data collected through surveys of workers in different occupations to test the AP hypothesis. The results have been somewhat varied; while Brunello (2002) and Almeida-Santos and Mumford (2004a; 2004b) have found evidence that fits the AP model, others such as Ericson (2004) and Peraita (2001) present results in support of the competitive labour market framework.

The contradicting results, however, could be due to the sample size and the means through which the data was gathered suggesting that the manner in which the data is collected can actually alter the end results. It is therefore important to acknowledge that it can become very difficult to compare the training schedules of different countries and the effect of wage compression when different surveys are used. This draws attention to the important fact that the AP model may not be very robust to changes given that the expected results may not be attained if different measures of the same variable are used or replaced by others.

In this paper we focus on the ten Canadian provinces using data gathered from the 2003 Adult Literacy and Life Skills survey; ALL a collaborative effort between the OECD and Statistics Canada. Following the Coulombe and Tremblay (2005) methodology we use data on the percentage of workers that receive job-related training and on the total hours of training an employed worker receives from the ALL survey as our dependent variables in order to test the AP model. Using as explanatory variables, measures of wage compression, literacy, unionization, business size, investment as a percentage of provincial GDP in research and development, unemployment as well as four age dummy variables.

Our results do not strongly support the AP model and in certain instances even indicate that wage compressions actually lead to a decrease in the amount of training. Tests on male workers separately do not provide much support for the model either. Testing the upper and lower half of the wage distribution also results in some unique findings in that wage compression and training are positively correlated in the upper half of the distribution rather than in the lower half as would be expected.

The rest of the paper is organized as follows, section two and three give a brief overview of the theory and empirical evidence respectively; section four describes the data; section five is an outline of our model; section six presents our results; section seven compares our results to that of Coulombe and Tremblay (2005); and section eight concludes.

II. Theory

Where Becker's model takes place within a perfect labour market Acemoglu and Pischke's model requires an imperfect labour market. They claim in contrast to Becker that in certain environments firms will be willing to pay for general training and that environment is created by an imperfect labour market. In order for their theory to work, therefore, there must exist in the labour market certain mechanisms and institutions that will cause distortions in the wage rate. In their paper Acemoglu and Pischke (1999b) outline a few mechanisms and explain how they compress the wage structure. Here we will briefly discuss some of the wage compressing mechanisms emphasized in the recent literature, and then consider in more detail a specific model where wage compression arises from asymmetric information. This will allow us to derive more explicitly the prediction that will be tested in the empirical analysis below.

First, search and monopsony power are features of labour markets that can compress the wage structure. AP explain that in an imperfect labour market there are costs associated with finding a new job and these cost reduce the worker's return to quitting and thus distort the wage structure. This, in turn, provides monopsony power to the training firm over the worker and induces training. Employers may also have some monopsony power if outside firms are not able to distinguish between high and low ability workers whereas the incumbent firm has been able to gain valuable knowledge about the ability of the worker. The firm can then use this information to its advantage when bargaining over the second period wage. We will discuss this argument in more details below.

The inability of outside firms to determine the quality or quantity of training a worker possess can also distort the wage structure and lead to firm sponsored training. Or as Katz and Ziderman (1990) point out the training a worker has received, even if general, may not be useful to the new employer, thereby decreasing the value of a trained worker and thus the wage they are willing to pay for such an employee.

Through the presence of asymmetric information the mechanisms mentioned above distort the internal wage structure, wages employees would receive at the incumbent firms, through a distortion in the outside wage, wages offered to workers by poacher firms; unlike the mechanisms mentioned above efficiency wage compresses the internal wage structure without distorting the outside wage structure. Efficiency wage requires firms to offer a wage that is higher than the marginal product of untrained labour in order to provide the right amount of incentive; it is, therefore, profitable for the firm to provide a positive level of training because by doing so they will increase worker productivity without having to increase wages.

Likewise, the next two mechanisms distort the wage structure and make it possible for firms to incur the cost of training. Minimum wage laws for example force firms to pay a set wage to all employees leaving room for an increase in productivity without necessitating an increase in wages. The minimum wage rate determines the amount of training; a high minimum wage may not allow firms to recoup costs, while one that is too low may provide no incentive for training at all.

Unions work along the same line. They enable the formation of binding contracts and set wage rates that are not necessarily equivalent to the marginal product of the worker. Their role in providing a good incentive for firm sponsored training, however, is not concrete and it has been suggested that they may even lead to a decrease in the level of training (Acemoglu and Pischke, 1999b).

A simple model

To get a better understanding of how wage compression may lead to higher training, it is useful to examine them within the context of a specific model. Our model will be that of Acemoglu and Pischke (1998; 1999a; 1999b), because wage compression arises because of asymmetric information about the ability level of workers. It is a simple two period model; at the beginning of each period firms are able to hire workers. There are two types of individuals in the economy, those with high ability, $\eta = 1$, and those with low ability, $\eta = 0$. Assuming training and ability are complimentary our production function is:

$$y = f(\tau)\eta. \tag{1}$$

Because firms are unaware of the ability of the workers in the first period they offer an amount, τ, of training to all employees and incur the entire cost, $c(\tau)$; workers will earn a wage, W, during the training period and produce y; for simplicity both first period wages and productivity are normalized to zero.

At the end of the first period, after training has taken place, firms will learn the ability of each worker. At this time the firm will present each ability type with a wage offer. Because firms will benefit from the employment of high ability workers they will offer

these individuals a second period wage $w(\tau) > 0$ as an incentive for them to remain, while low ability workers will be offered $w(\tau) = 0$. Potential recruiting firms observing only the level of training will offer a wage $v(\tau)$; if $w(\tau) < v(\tau)$ then the worker will leave the training firm. There is a chance, however, that with probability q there will be an adverse shock and the worker will leave the training firm even if $w(\tau) \geq v(\tau)$. The presence of these high ability workers in the unemployment market ensures the outside wage, $y(\tau)$, will be greater than zero. A positive outside wage, however, also means that low ability types will opt to leave the training firm. This in turn guarantees that although positive the outside wage will not be equal to the marginal product of the worker.

Taking all this into account what remains to be determined is the amount of training that will be offered in the first period. Assuming that the productivity, $f(\tau)$, of each worker is independent of other workers and is strictly increasing, differentiable and concave, combining this with a strictly increasing, differentiable, convex cost function ensures that the first best level of training, τ^*, given by $f'(\tau^*) = c'(\tau^*)$ would be greater than zero. We can now compare the optimal amount of training with the equilibrium amount of training in perfect and imperfect labour markets, respectively.

Perfect Labour Market

First we will look at the predicted outcome of the model in a perfectly competitive labour market. The AP framework states that the firm bears the entire cost of training and that workers will not be able to contribute towards the cost of training by accepting a lower wage.

We know that in a perfect labour market workers' wages are equal to their marginal product, $w(\tau) = f(\tau)$, and firm profits are pushed down to zero. A perfect labour market also means that workers are able to quit at no cost and because all training is general the outside wage $v(\tau) = f(\tau)$. Since $w(\tau) = f(\tau) = v(\tau)$ the firm will not be able to recoup the cost of training their employees and so the level of training offered by firms will be $\hat{\tau} = 0$.

The optimal level of training or any positive level of training under this scenario would only occur if workers are able to contribute towards the cost of their training. But because workers are the sole beneficiaries of training they will as Becker (1964) points out have to incur the entire cost and only in the absence of credit market failures the equilibrium level of training will be the first-best level, τ^*.

Frictional Labour Markets

In a frictionless labour market outside firms are not only aware of the training received by workers but also their ability. In such a market, however, outside firms, at the end of the first period, can only view the level of training the worker has received and not the worker's ability. The outside wage will be less than the productivity of the worker, $v(\tau) < f(\tau)$. There will, therefore, be a surplus that can be shared by the worker and the firm once training has taken place.

As was the case with perfect labour markets, firms in this scenario will also choose the level of training that will maximize their profits. Profits are defined as:

$$\pi(\tau) = (1 - q)[f(\tau) - w(\tau)] - c(\tau). \qquad (2)$$

Because firm profits are dependent on second period wages of workers firms will estimate $w(\tau)$ before choosing the level of training. In determining $w(\tau)$ we assume that workers have some bargaining power, $\beta \in [0,1]$; the second period wage of the worker is therefore,

$$w(\tau) = v(\tau) + \beta[f(\tau) - v(\tau)]. \quad (3)$$

Note that $c(\tau)$ does not enter into the equation as training costs are already sunk when the firm and worker bargain over second period wage.

Substituting $w(\tau)$ into the firm's profit function allows us to calculate the optimal level of training.

$$\pi(\tau) = (1-\beta)(1 - q)\,[f(\tau) - v(\tau)] - c(\tau). \quad (3)$$

$$\pi'(\hat{\tau}) = (1-\beta)(1-q)[f'(\hat{\tau}) - v'(\hat{\tau})] - c'(\hat{\tau}) \quad (4)$$

Rearranging the first order condition it is easy to see that in order for firms to invest in training, $\hat{\tau} > 0$, the worker's marginal product must be higher than the outside wage, $f'(0) > v'(0)$, and the product of the firm's bargaining power and employee retention rate must also be greater than zero, $(1-\beta)(1-q) > 0$. The former holds as a result of our earlier assumption and it is easy to justify the latter as a higher β decreases the difference between the actual wage and the worker's marginal product and a higher q decrease the chances of the firm to benefit from the resulting higher productivity.

It is essential for this result that the worker's wage increase by less than his marginal product; the fact that the workers' marginal products increases by more than their outside wage option given training, $f'(\tau) > v'(\tau)$, also implies that the wages of workers who

remain with the training firm will increase by less than their marginal product, $f'(\tau) > w'(\tau)$, allowing firms to make positive profits by investing in training. The level of training, $\hat{\tau}$, however, will be less than the optimal level, τ^*. Although in a frictional labour market higher levels of training actually benefit the firm more than the worker the possibility of loosing productive workers, q > 0, and the fact that workers have bargaining power over second period wages means that firms will not be willing to supply the optimal level of training.

Firms, however, will be willing to increase the level of training, $\hat{\tau}$, if the wage structure is further compressed. We will be testing this prediction in the empirical analysis below. A corollary of this is that labour market institution and other factors that are considered to cause labour market inefficiencies may actually be welfare improving. The theory thus predicts that any market mechanisms that compress the wage structure will lead to firm sponsored training.

III. Empirical Evidence of Wage Compression and Training

Prior to examining the results of our model it is useful to quickly review some of the finding in the literature. Most of the empirical literature on training and the AP model has been a microeconomic analysis of the effects of wage compression on training; the results from these studies, however, are a good indicator of what we should expect from our model.

All the papers reviewed in this section test the AP predictions in different countries across Europe and Australia in order to determine whether wage compression in these different regions lead to, as predicted by the AP model, training[2]. The authors test the probability of training with the equation taking the form

$$\text{Probit } (T_i = 1) = \Phi(\gamma X_i)^3.$$

Where Φ is the standard normal distribution, T is training, and X is the vector of explanatory variables. In this model T takes on a value of one if training takes place and zero otherwise. For explanatory variables the authors generally use variables thought to influence training such as those that reflect the "employee's ability; the quit rate; adverse demand conditions; relative bargaining strength; the costs of training; the outside wage offer; and wage compression" (Almeida-Santos and Mumford 2004a, p. 6).

Like our model, these models incorporate two dependent training variables, a binary one that measures the incidence of training, $T \in [0,1]$, and one which reflects the duration of training. These two variables are then tested against a variation of some of the explanatory variables mentioned earlier. In general the variables most often included in the models are ability which includes education, the cost of training, the quit rate measured as the amount of voluntary resignation, bargaining power estimated as a measure of unionism, the outside wage and wage compression. The overall explanatory power of their tests are significant and although the measures of the fit of the model are not high they are comparable to other studies using cross-sectional data.

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[2] All results, models and conclusions in this section originate from results and ideas presented in the following papers: Almeida-Santos and Mumford 2004a; 2004b; Brunello 2002; Ericson 2004; and Peraita 2001.

[3] Note that γ is used instead of β in the above equation because in our model β is used to represent the worker's bargaining power.

There is no direct measure of some of these variables, therefore, they are replaced by proxies which are thought to be a good indicator of the variable being measured. For example because it is not possible to get a direct measure of the outside wage proxy; in their model Almeida-Santos and Mumford (2004a) choose to replace the outside wage variable with a measure of unemployment, a series of regional dummies and a measure of the difficulty firms face when seeking replacement workers. Where as with ability a range of variables typically associated with an individual's aptitude and opportunities are chosen (2004b, S56). The cost variable also poses a measurement problem; because cost is heterogeneous it is difficult to measure and in most cases it is not possible to clearly determine which parties actually incurred the cost of training.

Another problematic variable is wage compression because proper wage data is not always available; this is not a problem for our study as we have a clear measure of wages. Using the OECD measure the authors calculate the relative wage compression, D91, as the logarithm of the ratio of the 90^{th} and the 10^{th} percentile[4]. It is important to note here that a smaller D91 is indicative of higher levels of wage compression.

The results presented by the studies differ in their finding with respect to the effects of the explanatory variables on the probability and amount of training and in their level of significance. Below we will examine some key findings with respect to the independent variables.

[4] Most authors also take a measure of the absolute wage compression. The different measures, however, do not greatly alter the results. In most of the literature the log is used, an exception to this is Brunello (2002) who measures wage compression without taking the log of the percentiles. Likewise our measure of the wage differential are calculate without taking the log.

Bishop (1997) explains that the relationship between education and training will be positive if education and training are complementary and training increases ability. In general the findings present a positive and significant relationship between the level of education and the incidence of training with the exception of Almeida-Santos and Mumford (2004b) who found limited evidence that workers with less education were significantly less likely to partake in training; they also conclude that workers with low ability in their model were not found to be significantly less likely to receive training (2004a). But as predicted by the theory they found that the negative relationship between age and training was maintained.

With respect to unemployment and unionism the results are not as clear cut. It is expected that both unemployment and unionization will have a positive relationship with training. Testing the British labour force Almeida-Santos and Mumford (2004a) found that unionism was positively and significantly associated with training; while their study in Australia found that unionism was insignificant. The impact of unionization is not uniform. The disappointing results in this case, however, can be explained if unions are viewed as a source that strengthens the bargaining power of the worker. Viewed in this light the negative relationship does not detract from the AP model but actually builds on it as the model predicts that an increase in the bargaining power of the worker, β, will lead to a decrease in the firm's incentive to invest in general training; an increase in β ensures that the worker retains a higher portion of the rent generated from training.

Most studies also look at the difference in the amount of training received by male and female workers. While some studies found that the amount of training received by

females was not significantly more or less than males (Almeida-Santos and Mumford 2004b), other studies presented the opposite results (Almeida-Santos and Mumford, 2004a). Overall, however, the results indicate that females do receive less training than males. Almeida-Santos and Mumford point out that this may be because females are generally in positions that require less training.

In general it is more likely that the effects of wage compression on training will be positive and significant with male workers. The results on the effects of wage compression are not robust. The AP model predicts that in the presence of labour market institutions and factors which lead to imperfect labour markets, firm sponsored training will occur as a result of the compressed wage structure. This does not appear to be the case. The results, although positive in some cases are not always significant.

In his study of the Swedish labour market, Ericson (2004), concludes that wage compressions actually result in a decrease in the amount of training; Peraita (2001) finds similar results for Spain. While Almeida-Santos and Mumford (2004a; 2004b) as well as Brunello (2002) find results in support on the non-competitive model of training.

IV. The Data

The data on training incidences in this paper were drawn from the Adult Literacy and Life Skills Survey (ALL) that took place in 2003. The ALL survey, a cooperative effort between a number of countries, builds on the framework of the International Adult Literacy Survey (IALS) and is "designed to provide participating countries ... with

information about the skills of their adult population"[5]. The format of the survey also allows for comparisons between countries and their different regions or provinces. The 2003 round of the survey was comprised of seven countries, amongst which were Canada, Switzerland, the United States, Italy, Bermuda, Norway and the Mexican State of Nuevo Leon.

The Canadian leg surveyed participants ranging between the ages of 16 to 65 within the ten provinces; using the information gathered on training, literacy and wages along with other variables we test the AP model. The survey consisted of two parts a background questionnaire and an assessment of literacy which was broken down into three components: prose, document and quantitative literacy.

The survey asked participants to specify the type of training, if any, they had received within the last twelve months and to indicate whether the training was job or career related, educational or recreational. The survey also asked participants to identify the parties that contributed towards the cost of training as well as to approximate the number of hours and days spent on training.

Data on job related training used in this paper is not restricted to firm sponsored training. Workers could actually be paying for their training through a lower initial wage making it difficult to determine who actually incurs the cost of training. Data on job related training, therefore, accounts for all job related training and not just firm sponsored training and was extracted from the survey in two forms: the percentage of employed workers who received training within a twelve month period, and the total number of hours spent training.

[5] Quote taken from website: http://nces.ed.gov/surveys/all

Table 1 below outlines the duration and incidence of training, broken down into the different age cords, within the different provinces. In general workers within the 26 to 45 age groups receive the most amount of training. What is interesting to note, however, is that the higher levels of wage compression do not correspond to either of these two groups; it is actually in the first age group that we find some of the lowest values of our wage compression variable, D91, defined as the ratio of the 90^{th} and 10^{th} percentile of the wage distribution. In BC for example the highest incidence of training is 34.5% and occurs within the 36-45 age group, but the lowest level of D91 is associated with the 16-25 age group.

The data in table one also allows us to compare the level of training within the ten provinces. The highest percentage of training occurs in Alberta for workers in the 36-45 age group. For the duration of training, however, it is workers in the 26-35 year age group in Ontario that top the list. And the highest amount of wage compression is associated with workers in the 16-25 age group in PEI. Examining the incidence and duration of training within the provinces we also find that in most cases the path of training within the age groups follows the theory which predicts an upside down 'U' shaped outcome in which workers in the bottom and top age cords receive the least amount of training.

Table 1. Incidence of Training (Percentage and Total Hours) and Wage Compression. Broken down by Age group and province

		16-25	26-35	36-45	46-55	56-65
AB	Incidence	23.96	25.32	36.55	30.98	21.37
	Duration	76,857	101,439	159,149	120,650	30,012
	D91	3.28	3.68	3.79	4.67	5.07
BC	Incidence	19.46	24.76	34.50	31.99	22.38
	Duration	57,585	100,983	192,922	161,934	46,560
	D91	2.27	3.33	4.00	4.29	5.80
MB	Incidence	10.63	26.38	20.74	22.06	21.00
	Duration	10,657	32,439	31,313	28,737	12,449
	D91	2.31	3.52	3.31	3.90	4.68
NB	Incidence	15.80	18.25	28.66	17.95	22.10
	Duration	9,882	13,700	27,091	15,293	5,612
	D91	3.19	2.79	3.72	3.71	3.63
NF	Incidence	22.95	14.31	18.40	17.35	14.23
	Duration	7,721	7,606	12,093	9,148	2,138
	D91	2.29	4.48	4.25	4.44	4.07
NS	Incidence	10.73	29.28	28.80	30.17	26.15
	Duration	6,259	28,186	34,054	30,286	8,709
	D91	2.54	3.46	4.20	3.83	5.27
ON	Incidence	14.60	28.83	21.08	20.35	9.87
	Duration	140,438	404,456	374,302	279,229	61,773
	D91	2.62	3.46	3.45	4.20	4.08
PE	Incidence	7.02	30.76	14.55	17.93	14.68
	Duration	735	4,235	2,635	2,761	831
	D91	1.89	2.51	3.72	4.42	3.42
QC	Incidence	15.96	27.05	23.78	24.70	17.16
	Duration	81,494	211,412	251,206	225,232	54,181
	D91	2.47	3.07	3.58	4.53	4.88
SK	Incidence	17.12	32.67	21.62	32.00	22.57
	Duration	12,111	31,507	25,766	35,875	12,188
	D91	3.01	4.65	3.75	3.92	10.68

Source: Measures computed from the 2003 ALL survey.

V. The Model

In this section I briefly outline the methodology of the model being tested. Replicating the Coulombe and Tremblay (2005) empirical analysis for the Canadian provinces we test

the impact of wage compression on the level of training. We use as our dependent variables duration and incidence of training. The equation tested by our model takes the form

$$\tau = \beta X + \epsilon, \tag{5}$$

where X is a matrix of independent variables and ϵ is our error term. Following the AP framework we regress the two training variables against indicators of wage compression and other variables that are thought to affect levels of training.

Our model is comprised of six independent variables and four dummy variables. Our wage compression is calculated as the ratio of the different wage percentiles. The first, D91, is the ratio of the 90^{th} and the 10^{th} percentile. We also test the effects of the upper, $90^{th}/50^{th}$ percentiles (D95), and the lower, $50^{th}/10^{th}$ percentile (D51), distributions. The second variable used in our regression is literacy. Literacy in the ALL survey is defined as the ability to use and understand written, numerical, or analytical information. Participants were tested in three different areas of literacy: prose, document, and quantitative; scores from these three test were then added together and the average of these scores were used as measures of literacy.

The data is broken down into five different age groups: 16-25, 26-35, 36-45, 46-55, and 56-65, as well as by gender. Using literacy instead of education as is done in the micro literature may be a better indicator of skills and ability in general but it is not the same thing as the amount of schooling one has completed; however, as it is a measure of skill we do expect that literacy and training will be complementary.

Also included in our regression, as independent variables, are business size, the average size of a firm, measured as the number of employees in which individuals form the different age cords are employed, as well as investment, as a share of provincial GDP, on research and development.[6] We expect that higher levels of investment in research and development will lead to higher levels of training as the need arises to either build on or acquire new skills.

Two other variables which are expected to compress the wage structure and thus lead to firm sponsored training in the AP model are the rate of unionization and unemployment.[7] We completed our model with four age group dummies in order to test the pattern of training.

Using panel data, organized into five ten year age groups and broken down by province, we test the relationship between training and our independent variables. Our model thus consists of a total of fifty observations and ten cross sections. Estimations are performed using generalized least squares.

VI. Results

As mentioned in the previous section results using micro data to test the relationship between training and wage compression are somewhat mixed. While some have found evidence in support of the AP Model (Brunello 2002; Almeida-Santos and Mumford 2004a; 2004b) other studies suggest that Becker's theories may be a better fit (Ericson

[6] Data on Business size was extracted from the ALL survey; while R&D numbers were taken from the following Statistics Canada Table: http://www40.statcan.ca/l01/cst01/scte02a.htm.

[7] Numbers for Unemployment were taken from Stats Canada, Labour Force Historic Review 2004, 71F0004XCB; while numbers for our unionization variable were taken from 'Perspectives on Labour and Income' a Stats Canada publication.

2004; Peraita 2001). In general however, these papers present some common results one of which is the strong evidence in support of the complimentarity between education and training.

Unlike these studies which use data on the level of education, however, we test the level of literacy against training along with the unionization rate, unemployment rate, business size as well as four age dummies. The overall explanatory power of our test on incidence of training are good as is the fit; this does not hold, however, for duration of training. Our results are as follows.

Numbers from training incidences are in general thought to be more reliable. Therefore, we first look at the results from our regressions using data on the percentage of employed workers who received training within a twelve month period; the results are presented in tables 2, 3 and 4. Table 2 presents our results over the entire working population, while tables 3 and 4 are outputs from tests on incidence of training for male and female employees separately; when running these tests we replace the literacy and union variable with gender specific literacy scores and unionization rates. The tables are also broken down into three columns; in column 2, we report the results of regressions that use the indicator of compression over the entire wage distribution (D91), while columns 3 and 4 report regressions using compression at the bottom or at the top of the wage distribution are used as explanatory variables.

The results although not supportive of the AP model are somewhat robust to changes; the outputs from these regressions are more stable and give a better indication of whether the

AP model or Becker's is a better fit for the way the Canadian economy works with respect to training.

Table 2. GLS (Cross Section Weights) regression with measures of wage compression. Dependent variable: Incidence of Training

	Total Distribution D91	Upper End of Distribution D95	Lower end of Distribution D51
Wage Compression	4.863**	-30.701**	9.516**
	(2.341)	(14.662)	(4.393)
Literacy	0.001	0.245**	0.003
	(0.040)	(0.080)	(0.037)
Business Size	0.003	0.007	0.003
	(0.004)	(0.004)	(0.004)
Research and Development	1.185	-1.499	0.681
	(0.993)	(1.194)	(0.967)
Unionization	-0.211	-0.008	-0.222
	(0.145)	(0.176)	(0.148)
Unemployment	-0.336	0.170	-0.226
	(0.261)	(0.459)	(0.262)
Tdummy2	10.209**	9.579**	10.363**
	(1.850)	(1.889)	(1.916)
Tdummy3	8.876**	11.185**	8.998**
	(2.056)	(2.443)	(2.148)
Tdummy4	8.897**	12.321**	9.074**
	(1.941)	(2.428)	(1.978)
Tdummy5	3.721*	12.380**	4.026*
	(2.173)	(3.533)	(2.114)

* significant at 10% ** Significant at 5%
Standard errors in brackets

Looking at the table 2 we see that wage compression coefficient is significant; the coefficient, however, is positive for the measure of total distribution. This also holds for female and male workers, tables 3 and 4 below. The fact that total distribution, D91, is positive and significant suggests that there is a negative relationship between wage compression and training indicating that wage compression will actually reduce the amount of training. The results are, therefore, more in line with Becker's model rather than the AP model; these results imply that within the Canadian provinces it is more

likely that workers rather than firms are paying the cost of training. Wage compression reduces the private return of training accruing to workers and leads them to invest less in their own skills. But as mentioned earlier the results were not robust when other variables were added to the regression.

Directing our attention to the third column of table two we see that there is a positive and significant relationship between training and wage compression for the upper half of the wage distribution. And although the relationship holds for both female and male workers (refer to tables three and four below) it is only significant for the lather group. We can conclude, therefore, that for the upper half of the wage distribution the average level of training will increase the more compressed the wage structure becomes supporting the AP model. As for the lower half of the distribution, results in column four, the coefficient is positive and significant for all three groups.

What is surprising however, is the fact that compression at the bottom of the wage distribution dominates within the three groups. One potential cause of this may be that minimum wage laws and participation in unions within the Canadian provinces actually force firms to pay workers a wage that is more in line with marginal products. It would, therefore, not be surprising that wage compression in the second half of the distribution would be negative but not dominate. In general individuals in the upper distribution would be less likely to be a members of a union.

Table 3. GLS (Cross Section Weights) regression with measures of wage compression. Dependent variable: Incidence of Training For Female Workers.

	Total Distribution D91	Upper End of Distribution D95	Lower end of Distribution D51
Wage Compression	3.715*	-11.354	5.878
	(2.190)	(11.381)	(4.184)
Literacy	-0.001	0.127	0.012
	(0.039)	(0.076)	(0.034)
Business Size	0.006	0.004	0.005
	(0.004)	(0.005)	(0.004)
Research and Development	0.689	-0.305	0.196
	(0.825)	(0.928)	(0.872)
Unionization	-0.032	0.086	0.004
	(0.146)	(0.164)	(0.151)
Unemployment	-0.628*	-0.609*	-0.663*
	(0.335)	(0.336)	(0.322)
Tdummy2	7.586**	8.686**	7.485**
	(1.712)	(1.846)	(1.707)
Tdummy3	9.616**	11.968**	9.894**
	(1.772)	(2.407)	(1.734)
Tdummy4	8.803**	11.300**	8.843**
	(1.983)	(2.705)	(1.948)
Tdummy5	1.562**	6.512*	1.898
	(2.230)	(3.648)	(2.131)

* significant at 10% ** Significant at 5%

Standard errors in brackets

Turning our attention to the unionization and the unemployment variables we find that they are unstable and in most cases not significant. Looking down column 2 of table 2 we find that both the unemployment and unionization variable are negative but not significant. For female workers both are also negative but only unemployment is significant; the opposite holds for male workers for whom unionization is negative and significant but unemployment is actually positive.

Table 4. GLS (Cross Section Weights) regression with measures of wage compression. Dependent variable: Incidence of Training For Male Workers.

	Total Distribution D91	Upper End of Distribution D95	Lower end of Distribution D51
Wage Compression	5.772*	-35.047**	10.286**
	(2.923)	(15.950)	(5.032)
Literacy	0.0001	0.287**	0.008
	(0.954)	(0.082)	(0.052)
Business Size	0.001	0.006	0.001
	(0.005)	(0.005)	(0.005)
Research and Development	2.254	-2.081	1.438
	(1.263)	(1.528)	(1.087)
Unionization	2.254*	-0.137	-0.366*
	(0.190)	(0.219)	(0.194)
Unemployment	0.078	0.761	0.211
	(0.311)	(0.477)	(0.300)
Tdummy2	11.133**	8.244**	11.164**
	(2.269)	(2.544)	(2.377)
Tdummy3	7.352**	9.124**	7.375**
	(2.420)	(2.552)	(2.511)
Tdummy4	8.142**	11.071**	8.320**
	(1.964)	(2.341)	(1.988)
Tdummy5	4.148	12.463**	4.373*
	(2.547)	(3.680)	(2.482)

* significant at 10% ** Significant at 5%
Standard errors in brackets

Based on these findings, however, we cannot conclude that market institutions that compress the wage structure actually decrease the amount of training; it may be the case that in the Canadian economy it is much easier for workers who are unemployed to find new jobs or the labour market can be such that unions do not have as much power as they do in some European countries; if this were the case it could be argued that because these institutions do not compress the wage structure enough that the level of training is low.

Next we look at the relationship between literacy and incidence of training. The coefficients in all three tables above are all positive but generally not significant. These results should not be viewed as an indication that education does not have an impact on

training because our measure of literacy not only takes into account the level of education but also other skills a worker may have. It may, therefore, be better to view this variable as one measure of ability, or human capital.

What is odd, however, is that when we replace incidence of training with duration of training as our dependent variable the coefficients become negative (table five through seven below). The results are not significant, with the exception of females. If viewed as a measure of ability, however, these results may not be that surprising. Empirical evidence from the literature suggests that workers with higher levels of education are more likely to receive training and what our results appear to suggest is that workers with higher literacy score may in fact be trained more frequently but that the duration of training is shorter; this conclusion fits the micro theory that more educated or literate people require less intensive training or that they are better able to retain new information and are thus trained faster.

The differences in our dummy variable coefficients for the two regressions appear to support this statement. The coefficients in table 5 are positive while those in table 3 are negative. The positive outcomes associated with the percentage of employees trained indicates that all age groups over 25 receive more training while the negative coefficients in table 3 suggest that when individuals in the 16-25 age group are trained they receive a significantly larger amount of it. Our results, therefore, suggest as do the micro findings that there is a negative relationship between age and the duration of training. The results can also be viewed as supportive of the conclusions that training is negatively correlated with experience.

Table 5. GLS (Cross Section Weights) regression with measures of wage compression. Dependent variable: Duration of Training.

	Total Distribution D91	Upper End of Distribution D95	Lower end of Distribution D51
Wage Compression	3.525	-27.636*	14.335*
	(4.122)	(16.809)	(8.265)
Literacy	-0.018	0.226**	-0.069
	(0.071)	(0.108)	(0.066)
Business Size	0.027**	0.029**	0.027**
	(0.008)	(0.010)	(0.008)
Research and Development	6.079**	3.978**	6.302**
	(1.981)	(1.690)	(1.817)
Unionization	0.087	-0.074	-0.035
	(0.316)	(0.319)	(0.341)
Unemployment	0.907*	1.789**	1.245**
	(0.536)	(0.763)	(0.619)
Tdummy2	-26.455**	-28.755**	-26.594**
	(3.715)	(3.338)	(3.607)
Tdummy3	-21.601**	-21.895**	-22.307**
	(3.311)	(2.982)	(3.333)
Tdummy4	-24.218**	-23.096**	-25.173**
	(3.114)	(2.692)	(3.183)
Tdummy5	-21.289**	-13.684**	-23.272**
	(3.444)	(5.328)	(3.550)

* significant at 10% ** Significant at 5%
Standard errors in brackets

Looking at table 5 we find as was the case with incidence of training a negative relationship between training and total wage compression. Likewise the effects of wage compression at the bottom half of the distribution dominates over the negative effects of the upper half of the distribution. These results also hold for female participants (results can be found in table 6). The coefficient for male participants, however, is negative; but not only is it not significant it is also fairly small.

Table 6. GLS (Cross Section Weights) regression with measures of wage compression. Dependent variable: Duration of Training For Female Workers.

	Total Distribution D91	Upper End of Distribution D95	Lower end of Distribution D51
Wage Compression	11.851**	-8.961	21.535**
	(3.192)	(19.193)	(6.273)
Literacy	-0.240**	-0.038	-0.229**
	(0.049)	(0.111)	(0.049)
Business Size	0.017**	0.016**	0.018**
	(0.005)	(0.006)	(0.005)
Research and Development	8.370**	6.896**	6.674**
	(1.535)	(1.782)	(1.615)
Unionization	0.651**	0.945**	0.664**
	(0.215)	(0.261)	(0.213)
Unemployment	0.337	0.514	0.552*
	(0.325)	(0.422)	(0.325)
Tdummy2	-6.818*	-5.975	-7.890**
	(3.786)	(4.219)	(3.825)
Tdummy3	-3.510	-0.764	-3.751
	(3.596)	(4.588)	(3.708)
Tdummy4	-0.541	1.7518	-0.646
	(3.969)	(5.249)	(4.098)
Tdummy5	-8.361*	-0.541	8.069*
	(4.120)	(6.757)	(4.200)

* significant at 10% ** Significant at 5%
Standard errors in brackets

The effects of unionization and unemployment, as with incidence of training, are not robust to changes and are easily influenced by small alterations in the model. Our unionization variable although positive is only significant in the case of females, unlike the unemployment variable which is only significant in table 4. The model also indicates that the rate of unionization has an ambiguous effect on training; closer examination of table 4 reveals that although the effects of unionization on hours of training are positive for the two halves of the distribution it becomes negative when they are considered together, column 2.

Table 7. GLS (Cross Section Weights) regression with measures of wage compression. Dependent variable: Duration of Training For Male Workers.

	Total Distribution D91	Upper End of Distribution D95	Lower end of Distribution D51
Wage Compression	-0.299 (5.342)	-14.373 (21.217)	-2.323 (12.387)
Literacy	0.058 (0.087)	0.111 (0.128)	0.075 (0.097)
Business Size	0.025** (0.011)	0.036** (0.011)	0.026** (0.011)
Research and Development	2.462 (4.096)	1.142 (3.262)	1.971 (3.779)
Unionization	0.555 (0.409)	0.667 (0.403)	0.556 (0.439)
Unemployment	0.265 (0.999)	0.394 (1.286)	0.123 (1.104)
Tdummy2	-37.129** (3.858)	-38.046** (3.793)	-36.078** (4.101)
Tdummy3	-30.502** (3.216)	-29.498** (3.519)	-30.177** (3.529)
Tdummy4	-31.799** (3.318)	-31.259** (3.864)	-31.466** (3.619)
Tdummy5	-36.429** (4.082)	-32.826** (6.259)	-34.941** (4.392)

* significant at 10% ** Significant at 5%
Standard errors in brackets

The outputs testing hours of training as the dependent variable do not present results that support the AP model. We cannot however, fully reject the model for that of Becker's. Overall, our analysis provides mixed evidence regarding the main prediction of the AP model.

VII. Comparison With Coulombe and Tremblay (2005) Results

It is useful to compare our provincial results to those of Coulombe and Tremblay's (2005) cross-country ones. In their study Coulombe and Tremblay test the effects of literacy and wage compression on training across fourteen OECD countries using data

gathered from the 1994 IALS survey. Unlike our study results from the Coulombe and Tremblay (2005) paper were more robust to changes. This could in large part be due to the fact that differences across countries are much larger than across provinces; it may also be due to the fact our cross-sectional information s limited in the amount information it contains.

The results obtained by our study, however, may be a good predictor of how Canada compares to other countries. Comparing the incidence of job-related training for individual age groups in Canada to those in other countries Coulombe and Tremblay (2005) find that the youngest age group receives the highest level of training, about 20% higher than the 26-35 age group; within the 26-55 age range the incidence of training remains approximately the same and then drops dramatically for the 56-65 age group. Examining our data we find that across the provinces while workers in the 16-25 age group are trained for longer periods of time the incidence of training within this age group is a lot less than the three subsequent age groups.

Overall Coulombe and Tremblay (2005) found that average literacy scores for all age groups has a significant and positive effect on the incidence of training; within our provinces we found that although the effects of literacy were positive with regards to incidence of training they were only significant for individuals in the upper half of the wage distribution.

Our results with respect to wage compression were also greatly different; where as our results suggest that individuals with lower income pay for their own training, Coulombe

and Tremblay's (2005) results indicate that high-wage workers pay for their own training while the cost of training for low-wage workers is supported by employers. And as is the case in their study the absolute value of our coefficient above the median is larger than the coefficient below the median; resulting in the overall negative effect of wage compression on the incidence of training.

As was the case with our other variables: unionization, R&D, unemployment, the Coulombe and Tremblay (2005) results like ours were not significant and somewhat mixed. Overall, however, our results although not as robust conclude, as does the Coulombe and Tremblay (2005) paper that wage compression leads to a decrease in the incidence of training within all age groups and only has a positive impact in the case of male workers.

VIII. Conclusion

Using new data from the 2003 Adult Literacy and Life Skills survey we run tests to see whether wage compression leads to training within the ten Canadian provinces, we found that in most cases both incidence and duration of training are negatively related to wage compression. Our results do, however, uphold some previous findings in the literature. We find for instance that the incidence of training increases with ability and literacy while the duration decreases.

Overall, our estimates suggest that within the Canadian provinces the AP model may not be a good representation. Although our results from incidence of training are a good fit

as is the overall explanatory power of the model, our outputs were not very stable nor are they robust to changes. Our model also suggests that other variables, such as unionization and unemployment, which are suppose to increase the level of training have no or very little effect.

The AP model predicts that market institutions and mechanisms that cause frictions in the labour market by distort the wage structure allow firms to capture a portion of the rent generated from training and thereby facilitate firm sponsored training; a result which was not supported by our model.

Ironically enough it is these mechanisms, asymmetric information in particular, that prevents an accurate examination of the AP theory. The inability to determine who pays for training, for example, does not allow us to test the actual hypothesis of the model. Although it is generally ignored when testing the AP predictions determining who pays for training is one of the most important aspects of the theory. And until it is possible to properly establish who is paying for training we will not be able to properly test the implications of the model.

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