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Determinants of the Demand for Manpower Training : Some Empirical Results
Facteurs déterminants de la demande de formation de la main-d'oeuvre : résultats empiriques

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Résumé de l'article

Le présent document offre un modèle à court terme de la demande de formation de la main-d'oeuvre. La méthode utilisée ici est essentiellement économique. On suppose que la demande de formation est fonction de la valeur présente estimée des avantages nets. Les avantages économiques qui découlent de la formation reposent sur la différence de revenu qui mesure la modification apportée à la productivité du travailleur grâce à la formation. Comme les attentes de l'individu en matière de différence de revenu ne varieront pas en courte période, la demande à court terme de formation de la main-d'oeuvre dépendra principalement des coûts.

Le principal élément des coûts pour le stagiaire éventuel est celui du traitement perdu par suite de la formation. On a calculé approximativement ces coûts selon les niveaux de chômage qui permettent d'estimer le montant des gains que perdra le stagiaire au cours de la période de formation.

Les facteurs saisonniers influent également sur la demande de formation de la main-d'oeuvre ; c'est pourquoi nous incluons également ces variables à titre de facteurs déterminants supplémentaires. Les résultats de la régression ont indiqué que la demande varie avec les niveaux de chômage et qu'elle est de nature saisonnière, c'est-à-dire qu'elle est faible au cours du premier trimestre et élevée au quatrième.

Cette étude nous permet donc de conclure que la demande de formation de la main-d'oeuvre, contrairement à d'autres formes d'enseignement, est influencée par les changements qui se produisent dans le cycle économique, tels que mesurés par les niveaux de chômage, et que la politique de main-d'oeuvre actuelle joue un rôle contracyclique en combattant le chômage.

Determinants of the Demand for Manpower Training

Some Emperical Results

Larry R. Truesdell

> The author develops a short-run model for the demand of manpower training. It is shown that the short-run demand for manpower training is sensitive to the levels of unemployment as well as to seasonal factors. Various functional forms are also investigated.

INTRODUCTION

Interest has recently been expressed by the Organization for Economic Co-Operation and Development (1970), P.E. Sultan (1970), and the Department of Manpower and Immigration (1968) in training programs as a remedy for cyclical unemployment.

A viable training program may be useful in combating business cycles by imparting working skills to individuals during periods of high unemployment and preparing them for jobs made available in the subsequent upswing. Without flexible manpower training programs sensitive to changes in labour market demand, these programs will have difficulty in meeting structural changes occurring in the economy.

Work relating the effects of manpower training programs to levels of unemployment has been undertaken in Canada by Dennis Maki (1972) who estimated the effect on monthly unemployment rates of seasonal variations in the number of persons enrolled in the Canada Manpower Training Program. Similar

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work has been undertaken by Malcolm Cohen (1969) in the United States. Frank Denton (1972) has undertaken work based on transition probabilities sensitive to various levels of unemployment to simulate the flows of people into and out of adult training programs. John Crean (1973) has recently shown that unemployment rates averaged over a period of time serve as significant variables explaining high schools retentions and subsequently demonstrate that economic considerations play a significant role in student enrolment decisions.

The assumption of economic rationality has also been fundamental to the work on investment in training carried out by J. Mincer (1958) and G.S. Becker (1962).

This paper focusses on the demand for training offered under the Canada Manpower Training Program and examines the relationship between the demand for training and levels of unemployment. Unlike the model developed by John Crean (1973) on high school detentions, the model presented in this paper is short run and geared to explain the demand for manpower training. Unlike other forms of education, manpower training programs offer courses of shorter duration compared with formal education programs.

In Section II a model is constructed to explain the demand for manpower training courses. Section III provides a description of the data and estimation methods used while Section IV presents the empirical results with policy implications.

THE MODEL

The existing literature on the economics of education usually views education as an investment good. Individuals are assumed to invest in education until the marginal rate of return from additional education is equal to some market rate of interest. The approach taken by this paper is that manpowwer training is a form of human investment with an individual willing to undertake training if the expected stream of benefits exceeds the present costs of training.

Let the costs of undergoing training be represented by :

$$(1) \quad C(t) = C(X_{1t}, X_{2t}, \text{---} X_{nt}) \; ; \; C_t = \int_0^m C(t) \, e^{-rt} dt$$

where $C(t)$ = costs of training at time = t

C_t = present value of training costs at time t = 0

X_{it} = i'th determinant of $C(t)$; i = 1,2, - - - n

m   = number of time periods for which costs accrue to training

r   = discount rate

It will be assumed that $C(X_{1t}, X_{2t}, - - - X_{nt})$ is defined in a closed region of n-dimensional space and that $C(X_{1t}, X_{2t}, - - - X_{nt})$ is sectionally continuous in that space.

Let the benefits be hepresented by :

(2) $B(t) = B(X_{1t}, X_{2t}, - - - X_{pt})) ; B_t = \int_0^k B(t) \ e^{-rt} dt$

where $B(t)$ = benefits of training at time t

B_t = present value of benefits at time t = 0

X_{jt} = j'th determinant of $B(t)$; j = 1,2, - - - p

k   = number of time period for which benefits accrue to training

$B(X_{1t}, X_{2t}, - - - X_{pt})$ will be assumed to be defined in a closed region of p-dimensional space and sectionally continuous. The demand for training will be determined by the present value of net benefits. Assume a linear demand function :

(3) $D_t = D(B_t - C_t), \dfrac{\partial D(B_t - C_t)}{\partial B_t} > 0, \dfrac{\partial D(B_t - C_t)}{\partial C_t} < 0$

where D_t = the demand for training at time t = o.

The individual is assumed to be a profit maximizer and will undergo training if $B_t - C_t > 0$; this inequality defines the efficiency maximizing condition of the investment decision.

Since we are operating under conditions of uncertainty, the demand for training will be a function of expected net benefits. Equation (3) then becomes

(4) $D_t = D\big(E(B_t) - E(C_t^t)\big)$.

The analysis that will be presented in this paper is basically economic and static in nature, ignoring the dynamics of occupational and sectoral structures.

We will ignore non-financial benefits and costs since these will be difficult to measure. Economic benefits accruing to training are primarily based on an income differential measuring changes in worker productivity attributable to training. This income differential is measured by the difference between expected incomes with and without training. An unbiased estimate of equation (2) may therefore, be approximated by :

(5) $E[B_t] = E\left[\int_0^{k_1} [W^1(t) - W(t)]\ e^{-rt}\ dt\right]$

$W^1(t) = W^1(X_{1t}, X_{2t}, \text{- - -} X_{pt})$; $W(t) = W(X_{1t}, X_{2t}, \text{- - -} X_{p\text{-}s,t})$

where   s   = number of training related determinants of B_t

where W_1 = earnings with training

$\qquad$ W   = earnings without training.

We shall further assume that a potential trainee forms his expectations about his future income from the time in which he completes his training until retirement. He will be assumed to form his expectation about incomes with and without training on the basis of past and recent information on occupations. Since he will be averaging over a number of years and discounting these differentials until retirement, it is unlikely that an individual's expectation of these income differentials will vary over a short period of time or be sensitive to short-run changes in labour demand. Short-run variations in the demand for training will not be explained by long-run changes in expected income differentials. Because of this, a short-run demand function will depend primarily on costs. In addition, since training is an investment with a long payoff period the attractiveness of training will depend primarily on changes in costs. Ralph Smith (1971)

has shown that the largest component of costs of manpower training programs has been opportunity costs associated with foregone earnings with allowance for probable changes in the trainee's labour force status over the training period. A trainee will form some idea of foregone earnings on the basis of past and recent incomes averaged over a period of time. Since this component of expected foregone earnings will remain relatively constant in the short run, the probability of being employed will be the main varying determinant of expected foregone earnings in the short run. Unlike other forms of education in which the training period is of several years duration, manpower training courses are often of several months only Expected foregone earnings will, therefore, vary with the probability of being employed over the training period. This in turn will be determined by the demand for labour which we will approximate by unemployment levels.

We may, therefore, express expected costs as a function of unemployment :

(6) $E(C_t) = E[C(U_t)'], \dfrac{\partial E[C(U_t)]}{\partial U_t} < 0$

where U_t = level of unemployment at time t.

Because benefits are constant in the short run we arrive at a short-run demand function expressed by :

(7) $D_t = D^1(E[C_t]), \dfrac{\partial D^1(E[C_t])}{\partial C_t} < 0$

or

(8) $D_t = D^1(E[C(U_t)], \dfrac{\partial D^1(E[C(U_t)])}{\partial U_t} > 0$

To be classified as unemployed an individual must not have worked at all during the reference week and must have made an attempt to seek work during the previous four weeks. Since various changes in the numbers of individuals unemployed and willing to enter manpower training programs also depends on fluctuations in weather conditions, the opening and closing of schools, holiday periods, and fluctuations in industry production schedules, it is appropriate to include seasonal variables as additional determinants in our demand function, so that (8) becomes :

(9) $D_t = D^{11}(E[C(U_t)], S_t)$

S_t = seasonal factors.

The model has been developed in such a way that it will be possible to isolate the effects of seasonal factors from economic conditions and to determine if economic factors are important, apart from seasonality considerations.

We shall further assume that the influence of variations in the discount rate are negligible because of imperfections in the capital market. It will be further assumed that, in the short run, institutional restrictions are negligible while tastes remain unchanged. These last two assumptions will be subsequently tested.

DATA AND FUNCTIONAL FORMS

A number of linear and non-linear forms using quarterly data from the first quarter of 1967 to the first quarter of 1973 were fitted with the seasonally adjusted level of unemployment, the seasonally adjusted unemployment rate, and seasonal dummy variables serving as independent variables with the number of individuals authorized for public full-time skill training serving as the dependent variable. The number of individuals authorized in a given quarter indicate the number of persons who were willing to enter training and who met the eligibility criteria.

Preliminary estimates of the demand for training using linear and polynomial trends as well as training allowances as additional explanatory variables indicated that these variables were not statistically significant. It may be concluded that changes in tastes or institutional factors were not significant determinants of demand in the short run. The preferred functional forms that were estimated using ordinary least squares are provided below :

$$(10.0) \quad D_t = a_o + b_o U_t + c_o D_2 + d_o D_3 + e_o D_4$$
$$(10.1) \quad D_t = a_1 + b_1 UR_t + c_1 D_2 + d_1 D_3 + e_1 D_4 \, ;$$
$$(10.2) \quad D_t = a_2 + b_2(1/U_t) + c_2 D_2 + d^2 D_3 + e_2 D_4 \, ;$$
$$(10.3) \quad D_t = a_3 + b_3 (1/UR_t) + c_3 D_3 + d_3 D_3 + e_3 D_4 \, ;$$
$$(10.4) \quad D_t = a_4 + b_4 \log_e U_t + c_4 D_2 + d_4 D_3 + e_4 D_4 \, ;$$
$$(10.5) \quad D_t = a_5 + b_5 \log_e UR_t + c_5 D_2 + d_5 D_3 + e_5 D_4.$$

where D_t = number of individuals authorized for public full-time institutional skill training under the Canada Manpower Training Program in the t'th quarter

U_t = number of persons unemployed and seeking work in Canada in the t'th quarter, seasonally adjusted

UR_t = national unemployment rate for the t'th quarter, seasonally adjusted

D_i = seasonal dummy variable

$\quad$ = 1 in i'th quarter

$\quad$ = 0 otherwise

$\quad i$ = 2, 3, 4.

The above theory suggests that $b_0 > 0$, $b_1 > 0$, $b_2 < 0$, $b_3 < 0$, $b_4 > 0$, and $b_5 > 0$.

STATISTICAL RESULTS AND CONCLUSIONS

The regression results are presented in Table 1. Experimentation with alternative functional forms indicated that 10.0 to 10.5 were preferrable. All of the independent variables were statistically significant at the five per cent level for a two-tailed test. The Durbin-Watson test at the five per cent level indicated that autocorrelation was not a problem in any of the estimated equations. An application of the Goldfeld-Quandt test indicated that we may reject the hypothesis of heteroskedasticity at the five per cent level for each equation.

An analysis of the results indicates that the demand for skill training is best explained by the reciprocal of the number of individuals unemployed and seasonal dummy variables. Of the set of functional forms relating the number of persons referred to training with the level of unemployment, the reciprocal of the number of persons unemployed is more highly significant than any of the other functional forms. From a theoretical point of view estimated equations 10.2 and 10.3 are preferrable, since the estimated number of individuals willing to undergo training has been restricted to positive numbers. From both a statistical and theoretical point of view equation 10.2 is the preferred one.

TABLE 1

Regression Results

Equation	Constant	U_t	UR_t	$(1/U_t)$	$(1/UR_t)$	$logU_t$	$logUR_t$	D_2	D_3	D_4	R^2	D.W.
10.0	−5,795.5 (−1.68)	.0256* (3.60)						3,604.9* 1.92	5,652.6* (3.01)	9,688.9* (5.16)	.72	2.08
10.1	−8,441.9* (−1.92)		2,616.2* (3.39)					3,695.1* (1.92)	5,762.6* (3.00)	9,918.8* (5.16)	.71	1.98
10.2	17,463.2* (5.14)			−5,044,573,357.3* (−3.74)				3,726.9* (2.02)	5,619.1* (3.04)	9,615.8* (5.14)	.75	2.17
10.3	19,913.5* (4.65)				−74,604.1* (−3.49)			3,795.9* (2.00)	5,707.9* (3.00)	9,747.8* (5.13)	.72	2.04
10.4	−144,139.0* (−3.53)					11,533.0* (3.68)		3,667.0* (1.97)	5,642.3* (3.03)	9,607.6* (5.16)	.74	2.12
10.5	−17,889.8* (−2.56)						14,100.8* (3.44)	3,745.8* (1.96)	5,738.8* (3.01)	9,836.2* (5.15)		2.01

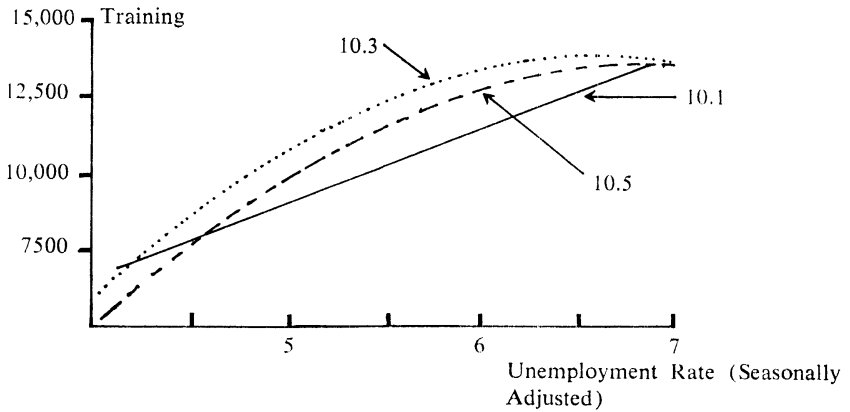* Significant at the five per cent level for a two-tailed test. estimated regression coefficient.
NOTE : The t-ratios are provided in brackets, below each.

CHART 1

The Estimated Relation Between the Number of Individuals
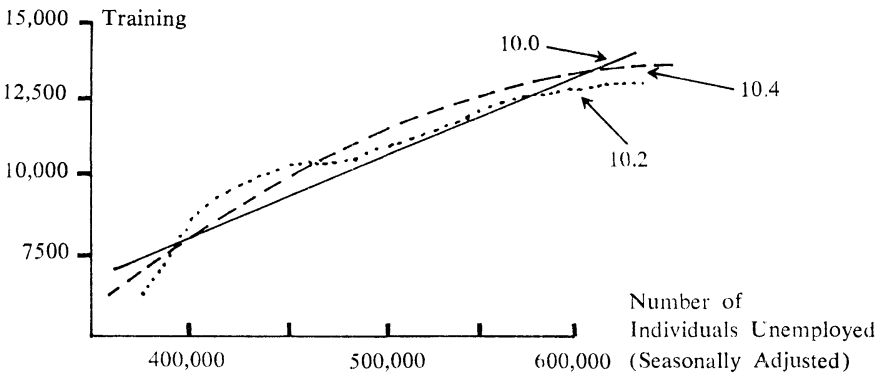Desiring Training and Unemployment Levels *

(a) Unemployment Rate

Number of Individuals Desiring

Unemployment Rate (Seasonally
Adjusted)

(b) Number of Individuals Unemployed
Number of Individuals Desiring

Number of
Individuals Unemployed
(Seasonally Adjusted)

* The dummy variables are held at their mean values. The number of trainees
authorized includes only those public full-time institutional skill trainees docu-
mented in the computer database files.

Chart 1 provides a graphical display of the estimated functional forms expressing the relationship between the demand for training and the levels of unemployment or unemployment rates, all other factors held constant.

Based on equations 10.2 to 10.5, as shown in Chart 1, the demand for training increases very quickly with increases in levels im unemployment with initial low unemployment levels, but does not increase as much for higher levels of unemployment. The demand for training is therefore, more responsive to unemployment levels for lower levels of unemployment than for higher levels.

Based on equations 10.0 and 10.1 the elasticities of demand for training with respect the level of unemployment and unemployment rate were computed to be 1.1 and 1.3 respectively. It may be concluded, therefore, that the demand for training is elastic with respect to unemployment levels. An analysis of the results also indicated that the demand for training is highly seasonal in nature, being low in the first quarter and relatively high in the fourth quarter.

These findings support the proposition that the demand for manpower training, as expressed by the number of persons willing to undergo training, is sensitive to change in the business cycle, as measured by levels of unemployment. Unlike other forms of formal education as discussed by John Crean (1973, 26) in which retention rates are not affected by the business cycle, the demand for manpower training is sentitive to short-run movements of the unemployment rate and, therefore, manpower training programs should be sufficiently flexible enough to respond to changes in labour market demand.

Expected foregone earnings, one of the main determinants of demand for manpower training fluctuate with the business cycle and effect the decision of the individual to enter a training program. It may be deduced from this study that the Canada Manpower Training Program is doing reasonably well in responding to changes in unemployment levels and is, therefore, playing a countercyclical role.

APPENDIX I/DATA SOURCES

Variable	Source
D_t	Strategic Planning and Evaluation Branch, Department of Manpower and Immigration.
U_t	Monthly Labour Force Household Survey, Labour Division, Statistics Canada.
UR_t	Monthly Labour Force Household Survey, Labour Division, Statistics Canada.

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