

Estimating the Private and Social Opportunity Cost of Displaced Workers

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Abstract

This paper outlines a framework for the estimation of the opportunity cost of workers who are permanently displaced from their previous place of employment. It will also enable us to evaluate both the private and social costs of adjustment arising from labor displacement. This framework will then be applied to an empirical estimation of both the private and social opportunity cost of labor and the adjustment costs associated with workers laid off by the aircraft industry in Canada.

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ESTIMATING THE PRIVATE AND SOCIAL OPPORTUNITY COST OF DISPLACED WORKERS

Glenn P. Jenkins and Claude Montmarquette*

Introduction

AMONG the greatest obstacles to the acceptance of government policies to promote further trade liberalization or industrial rationalization are the adjustment costs which such policies would inflict on the capital and labor presently employed in the affected sectors. However, only recently has the study of alternative commercial policies begun to include explicitly the trade-off between the social costs of adjustment from shifting factors of production between sectors and the long-run efficiency and distributional benefits of such policies.¹

This paper outlines a framework for the estimation of the opportunity cost of workers who are permanently displaced from their previous place of employment.² It will also enable us to evaluate both the private and social costs of adjustment arising from labor displacement. This framework will then be applied to an empirical estimation of both the private and social opportunity cost of labor and the adjustment costs associated with workers laid off by the aircraft industry in Canada.³

The Model

In order to measure the private and social costs of adjustment it is first necessary to esti-

mate the size and nature of the income streams that the workers could expect to receive if their previous employment situation had continued into the future. Secondly, their full private and social income through time after displacement must be evaluated.

Prior to the permanent decline in a firm it typically will have provided some workers with full-time employment throughout the year while others will be employed only for part of the year. For a cross section of workers, therefore, the average expected income stream prior to displacement is not the wage rate paid by the firm but some combination of wages and unemployment insurance compensation. If a worker is unemployed for part of the year, then, in addition to the money income he will also have the opportunity to enjoy more leisure than those people who are permanently employed. As leisure usually has a positive value, this additional leisure must be added to the worker's net-of-tax money income in order to measure his full income prior to being displaced from this firm. Therefore, a worker's full private income in the absence of trade liberalization can be expressed as

$$I' = P'W'_n + (1 - P')(fUI'_n + V'), \quad (1)$$

where I' is the private income per period that a worker could expect to earn if he were not permanently laid off from the firm; P' is the proportion of time during a period that a worker could expect to spend employed if he were not permanently laid off by the firm; $(1 - P')$ is the proportion of time during a period that a worker could expect to be laid off; W'_n is the average wage net-of-income tax and unemployment insurance contributions earned by the worker prior to the permanent layoff from the firm; UI'_n is the average net-of-income-tax unemployment insurance compensation received by a worker when laid off (in Canada unemployment insurance compensation is subject to income tax); f is the proportion of time a person expects to receive unemployment insurance benefits while being unemployed; V' is the non-monetary value of the additional leisure time received if unemployed; and

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¹ Mutti (1978, 1974), Baldwin, Mutti and Richardson (1977), and Baldwin and Mutti (1973). The economic losses for the adjustment of labor to trade liberalization have been estimated for some U.S. industries by Bale (1976, 1977) and by McCarthy (1975).

² Costs of adjustment have been introduced previously into the estimation of the social opportunity cost of labor by Haveman and Krutilla (1968) and Dorsey (1968).

³ More specifically, the aircraft workers surveyed for this study were laid off between January 1972 and March 1975 in Montreal, Quebec, Canada.

“prime” refers to the values of variables prior to being laid off.

The first term of equation (1), $P'W'_n$, measures the worker’s expected employment income during a period; the second term, $(1 - P')(fUI'_n + V')$, measures the monetary and non-monetary income received when laid off.

The non-monetary value of leisure time can be estimated from the worker’s trade-off between labor market and non-labor market activities. If in a competitive labor market there is no involuntary unemployment then the net-of-tax wage rate would be equal to the value of unemployment compensation net of taxes plus the value of leisure, $W'(1 - T_m) = fUI'(1 - T_m) + V'$, where T_m is the marginal personal income tax rate that a worker pays on his incremental income.

The wages in some labor markets are not competitive because minimum wage laws and collective bargaining agreements have raised wages above their market clearing levels. As a result the marginal value of employed time to the worker will be greater than the value of unemployed time, which also includes the unemployment compensation he receives. Denoting the ratio of the actual regulated wage to the competitive wage as B we can express the relationship between the market wage rate, unemployment compensation and the non-monetary value of leisure time as $W'(1 - T_m) = B(fUI'(1 - T_m) + V')$.

Given the value of B we can solve this expression for the non-monetary value of leisure:

$$V' = \frac{W'(1 - T_m) - BfUI'(1 - T_m)}{B} \quad (2)$$

From equations (1) and (2) a worker’s private evaluation of his full income prior to layoff can be measured. However, the social or economic value of the income which the worker generates prior to layoff may differ from the private evaluation because of at least three factors. First, in a competitive economy the social value of an employed worker’s time is equal to the gross-of-tax wage rate he is paid while the private evaluation of the wage rate is made net of income taxes. Second, unemployment compensation payments are income transfers; thus, they must be subtracted from the private income stream to obtain its social value. Third, if the firm or industry is being supported by either output subsidies or tariff protection, the marginal social value of

labor’s output will be less than the private evaluation. Denoting the adjustment factor that relates the social value of a firm’s value added to its market valuation as A' , the social product of labor before layoff (I'_s) can thus be written as follows:

$$I'_s = A'P'W' + (1 - P')V' \quad (3)$$

where W' is the gross-of-income tax wage rate paid to labor and V' is estimated according to equation (2).

The second set of relationships we need to measure is the private and social income that will be produced by the workers after they are displaced from the firm. First, we will examine the movement through time of the private income obtained by the workers after layoff

Immediately after a group of N workers has been laid off from their jobs most will be unemployed and some will be retired. We denote the proportion of the workers who retire immediately as R and the proportion of $1 - R$ that are employed as P . Those workers who find work immediately will have private income equal to their net-of-tax wage in their alternative employment (W_n). The private compensation received by individuals who are still unemployed will be equal to the net-of-tax unemployment compensation received fUI_n plus the value of leisure (V). To measure the private income received by all workers who are still in the labor force, we need to weight the compensation received by those employed and unemployed by the proportions of workers in these two classes. For the $N(1 - R)$ who are initially released from the firm and who have not retired, the average level of income at a time t is evaluated as follows:

$$I(t) = P(t)W_n + (1 - P(t))(f(t)UI_n + V) \quad (4)$$

where $P(t)$ and $f(t)$ are functions of the length of time since initial layoff.

The previous employees who have now chosen to retire or leave the labor force must value their private income including leisure when retired at least as much as what they could expect to receive if they remained in the labor force. This minimum private income situation $I^r(t)$ for an average early retired worker who leaves the labor force can be expressed as follows:

$$I^r(t) = P^r(t)W_n^r + (1 - P^r(t))(f(t)UI_n + V^r) \quad (5)$$

where the superscript r refers to the value of the variables that correspond to people with the age and characteristics of those who retire or leave the labor force after being laid off.

Equations (4) and (5) must be weighted, respectively, by the number of people who were laid off but are still in the labor force and the number who have chosen to leave the labor force. These weighted results are then added together to provide a measure of the total private income (including the non-monetary value of leisure) that is received by all the workers displaced from the firm.

For labor released from the firm we would not expect the probability that an individual is employed (P) to be continuously increasing through time. This probability depends first on the worker finding alternative employment (i.e., on the duration of his unemployment) and secondly on the probability of him retaining the job (i.e., on the duration of his subsequent employment). If we break down the period following layoff into a series of intervals, by the end of the first interval after layoff the probability that a person will be employed (P) is equal to the first interval probability that he will find employment ($P(1)$). At the end of the second period the probability that a worker will be employed is equal to: (a) the probability that he found employment in the first interval $P(1)$ times the probability that he retained this employment throughout the next interval $E(1)$, plus (b) the probability that he found work during the second interval, given he did not find employment in the first interval, $P(2)(1 - P(1))$. This procedure can be extended in the same manner to any further period if the interval probabilities for finding employment and remaining employed are known.

After a long enough space of time has elapsed since the initial layoff we would expect that out of this group of N workers the flow of people who are moving from a state of unemployment to employment will just equal the flow moving from a state of employment to unemployment. When this has occurred the cumulative probabilities of employment (P) and unemployment ($1 - P$) for these workers will be stabilized around their long-run values.

Turning to the estimation of the social opportunity cost of the displaced workers we begin by measuring the social value of the income that would be generated by the workers after being

laid off. This variable would be the principal component of this labor's social opportunity cost if they were retained in their present place of employment instead of being laid off. As in the measurement of the social income prior to layoff (equation (3)), in order to evaluate the social income generated after layoff the private income must be adjusted for income taxes, unemployment compensation and other economic distortions in the activities where the laborers would find alternative employment. If we denote the adjustment factor that relates the social value of labor's output in alternative employment to its private or market valuation as (A), then the expected social value of the income generated through time by a displaced worker who remains in the labor force after layoff can be expressed as

$$I_s(t) = AP(t)W + (1 - P)(V) \quad (6)$$

where V is equal to equation (2) without the "prime."

As we have stated previously, for the workers who choose early retirement their private situation in retirement must be at least as satisfactory as their private alternatives if they remained in the labor force. However, the social opportunity cost of retired workers may be less than their private opportunity cost if they obtain their pension benefits only by stopping work. In this case these pension benefits will make the retired person willing to leave the labor force at a point when the non-monetary benefits he enjoys from retirement are still less than the private income he would generate if he continued working. Hence, the social opportunity cost of retaining a worker in an activity if his next best alternative is early retirement ($I_s^r(t)$) is his private opportunity cost if he were to remain in the labor force, less any pension benefits which are contingent upon him stopping work:

$$I_s^r(t) = P^r(t)W^r(t)(1 - T) + (1 - P^r(t))(UI(1 - T) + V^r) - \text{Pension} \quad (7)$$

where T is the average rate of personal income tax.

In evaluating the social costs of adjustment for a group of displaced workers it is also necessary to consider the impact that the layoff of these workers has on the duration of unemployment of others who are unemployed in the economy at the same time. If the individuals who are now

being laid off from our declining firm are very good substitutes for the people who are currently unemployed in the labor market, then some of the additional laid off workers will obtain jobs that would have been obtained by other people currently unemployed. Thus, when we measure the proportion of the individuals from a given group of displaced workers who are still unemployed at any point in time we will underestimate the total amount of unemployment created by this layoff. The individuals who are unemployed from the general labor market and who are substitutes for the workers from the declining industry will be unemployed for a longer period of time than they otherwise would have been.

This additional negative externality is measured by the change in the number of other people in the labor force who are unemployed in that period because of the displacement of this group of N workers, (dU_t/dN_0) , multiplied by the difference between the social opportunity cost of labor ($SOCL$) and the social value of the output that the additional unemployed labor would have produced if working (I_s). This can be expressed for any given period as

$$\text{general labor market externality in period } t \\ = (dU_t/dN_0)(SOCL - I_s). \quad (8)$$

The value of equation (8) is added to the value of equations (6) and (7) (after being weighted by the number of individuals in each group) to measure the net social value of the income generated by the N workers after their layoff.

In order to estimate (dU_t/dN_0) a general equilibrium model is required of the labor market in question.⁴ Such a model could be developed; however, the data are not available in this case to measure these general equilibrium effects on the labor market being impacted by the displacement of the aircraft workers. By estimating the social value of the income generated after layoff using only equations (6) and (7) we will overestimate the value of this variable and thus will produce an underestimate of the social costs of adjustment for displaced labor.

There are two reasons why the general labor market externality (equation (8)) may be relatively small for the layoff from a typical declining firm. First, the labor force of declining firms is

generally heavily weighted toward the older workers who are poor substitutes for the average unemployed worker in the labor market. Their training and experience are often very specific to their previous place of employment. The younger workers in most cases have either previously left the firm voluntarily or, because of the seniority rules governing the order of layoff, have been released from the firm prior to the final closure. Secondly, in cases where the short-run adjustment costs are a serious barrier to a change in economic policy (such as a lowering of tariffs), these firms are often the major employers in their communities. The unemployment created by the final closure of the firm will be large relative to the normal level of unemployment in the region; therefore, the externality imposed on workers already unemployed will be small relative to the total costs of the laid-off workers who are unemployed.⁵

The social cost of adjustment imposed by the displacement of labor is measured as the difference between the social value of the product of labor before layoff (I'_s),⁶ equation (3), and the social value of the income generated by the workers after layoff ($I_s(t) + I_s^r(t)$), equations (6) and (7). It is the value of equations (6) and (7) that reflects the social opportunity cost of retaining the workers by some means in the declining industry rather than releasing them to search for alternative employment.

To evaluate the costs of adjustment from labor displacement that would be saved by supporting the industry or firm to keep it in operation for a period of time we need to compare the present value of adjustment costs if labor is laid off now with the present value of these costs when the labor is finally released. The difference between these two present values represents the adjustment costs from labor that are saved by the economy if the displacement of labor is postponed. Of course this saving must be compared with any economic welfare costs that are incurred by keeping the firm or industry in opera-

⁵ A third factor which also decreases the negative general labor market externality arises if the released capital from the declining industry is re-employed and labor is hired to work with this capital.

⁶ It is assumed that the social value of the income produced by the workers prior to layoff is equal to what they would continue to produce if retained by the firms; however, this assumption can be relaxed by altering the appropriate parameters in equation (3).

⁴ Such a general equilibrium model has been developed and estimated by Jenkins and Kuo (1978).

tion in order to ascertain if such a policy is an appropriate one.⁷

Empirical Evaluation

A. Description of Data Base

To evaluate the private and social opportunity cost of workers who were permanently laid off from the Canadian aircraft industry between January 1, 1972 and March 24, 1975, data were obtained from three separate sources.⁸ The first data source is the employee record files from the employer of the aircraft workers. This provided information for 1,149 individuals concerning their previous employment experience, their date of layoff, age, seniority and skill.

A second source of information on the employment experience of these workers was obtained by a telephone interview.⁹ The survey provided information on the work history of the individuals from their date of layoff to the date of survey, May 15, 1975. The Unemployment Insurance Commission (UIC) provided the third source of data by matching the survey and the UIC records and presented the matched data to us in a form so that no individual could be identified. These matched UIC and survey records verified the answers to the survey questionnaire.¹⁰

⁷ Such an analysis has been carried out for the U.S. industries affected by tariff reductions by Mutti (1978) and Baldwin, Mutti, and Richardson (1977).

⁸ All data files were obtained through the cooperation of the Economic Analysis Branch, Department of Industry, Trade and Commerce, Government of Canada, Ottawa. Anyone wishing to examine these data or a sample questionnaire may request such from the above agency.

⁹ Of the 1,149 laid off workers, it was possible to contact and obtain answers to a survey questionnaire from 641 individuals. Of the 641 individuals who completed the interview, 49 individuals had retired from the labor force because of either age or illness. Twelve individuals were laid off for less than 90 days before the date of the survey. Various tests (means, variance comparisons, and data stratification) have verified that the subsample is representative of the full population with respect to age, seniority and skill variables.

¹⁰ Only three important inconsistencies were encountered:

- (1) Forty-four individuals were reported in the survey to be unemployed but did not claim any UIC benefits.
- (2) Nineteen individuals reported in the survey that they had only found a job some time after they stopped claiming UIC benefits although they were still eligible to continue receiving UIC benefits during this period.
- (3) Two individuals indicated that they were employed but refused to give details on their work history and had also collected UIC benefits for a period.

It was assumed that for cases (1) and (3) the individuals were

B. Estimation of the Determinants of the Duration of Unemployment

To measure both the workers' private income after layoff, equations (4) and (5), and the social value of the income they generate, equations (6) and (7), sets of determinants for two key parameters need to be estimated. The first set consists of the factors affecting the probabilities of finding alternative employment for different types of workers during the time after the date of layoff. The second set is the determinants of the estimated hourly wage rate received by the displaced workers prior to layoff and after finding alternative employment.¹¹

The cumulative probability of a person finding alternative employment after being laid off is expected to increase as the duration of unemployment increases. However, the rate of increase in the cumulative probability decreases through time. This hypothesis has been supported by the work of Denton for Canada and is confirmed by the results of this study (Denton, 1973; Denton, Feaver, and Robb, 1976).

As the adjustment paths of the probability of finding alternative employment may not be linear through time, it is necessary to estimate this curve in segments. Three segments were chosen: 0-30, 30-90, and greater than 90 days since layoff. All the individuals in the segment 30-90 days were laid off for at least 30 days, while the segment covering the period greater than 90 days included a variable measuring the number of days since layoff after the first 90.

The following factors were used as explana-

unemployed. The individuals in case (2) were assumed to be unemployed as long as indicated by the survey even though the length of unemployment from the survey is longer than what is shown by their UIC records. Interviews with officials of the Unemployment Insurance Commission revealed that often the unemployed individuals are not aware of the full extent to which they may collect unemployment compensation.

¹¹ Full-time or "normal" alternative employment in this analysis was defined as a position held for at least 32 days and involved more than 25 hours of work per week. While conducting this evaluation a distinction is made between workers paid on an hourly basis (blue collar workers) and others (white collar workers). Approximately 90% of the entire sample is made up of blue collar workers who have significantly different characteristics than the white collar workers. The white collar group is also very heterogeneous in nature as it includes typists, clerical, technical and professional occupations. As there were relatively few observations for the white collar workers, the results were not as reliable as for the blue collar case.

tory variables to estimate the probability of finding an alternative job during each time segment: age, seniority of worker in previous employment, number of years of formal schooling of the worker, an index of the specific skill level required by the worker to do his previous job,¹² and the local labor market conditions.¹³ The labor market condition variable was defined as the average monthly unemployment rate in the Montreal area during the time between the beginning and ending dates corresponding to the interval of the dependent variable.

In table 1 we report a statistical analysis of the influence of these factors using a probit model with the dependent variable in each interval set to one ($Z = 1$) if a worker found employment during the interval, and set to zero ($Z = 0$) if he failed to find a job during the period.¹⁴ The coefficients for the variables (age, seniority, schooling and the labor market unemployment rate) are of the expected sign and with values that are in general relatively large with respect to their standard errors. Age, seniority, and the unemployment rate of the general labor market all have a negative influence on the probability of obtaining employment. The negative effect of seniority will be partially a result of the fact that these workers have a better chance of being recalled to their previous job and also have better unemployment and separation benefits, which will lower their incentive to find another job quickly.¹⁵ The level of formal schooling was found in all cases to have a significant positive effect on the probability of finding employment. However, the variable measuring the level of

TABLE 1.—FACTORS DETERMINING THE PROBABILITY OF FINDING ALTERNATIVE EMPLOYMENT

Variables	Time Interval Since Layoff Date (Days)		
	0-30	31-90	≥ 91
Constant	.8730 (.70)	1.403 (.73)	4.797 (1.32)
Age at time of layoff (years)	-.0209 (.0076)	-.0258 (.0098)	-.0329 (.012)
Seniority (weeks)	-.000189 (.00017)	-.000471 (.0022)	-.000469 (.00026)
School (years)	.0536 (.022)	.0387 (.028)	.0401 (.031)
Skill (years)	.0165 (.026)	.0160 (.031)	.0190 (.037)
Unemployment rate	-.1937 (.100)	-.1575 (.093)	-.5811 (.160)
Time since layoff (days: 0 = 90)			.000107 (.00086)
No. of total observations	508	385	307
No. of positive observations	123	78	72
Likelihood ratio test	40.26	54.03	88.00

Note: Standard errors are in parentheses.

skill required for the previous job was not significant. This suggests that the training obtained by the aircraft workers to do their jobs in the aircraft company is specific in nature and not helpful in obtaining other employment. Somewhat surprisingly, the variable measuring the length of time since layoff in the third interval (≥ 91 days) is not highly statistically significant but it does have the correct sign. This result suggests that after an individual has been unemployed for three months the probability is very low that he will obtain employment later unless the general labor market conditions improve. Thus, the availability of additional time in searching for another job appears to have little value after the initial 90-day period.

To solve the equations in table 1 for the probability of different types of workers obtaining alternative jobs, it is necessary to calculate the mean values of the independent variables for various groups of workers. In this case we have chosen age categories to segment the survey sample as it is one of the most important variables determining the probability of finding another job. Table 2 contains the mean values of the independent variables for the three age groups.

When calculating the probability of a worker

¹² The specific vocational preparation (SVP) index was obtained from F. S. Dowe and is based on the *Canadian Dictionary of Occupations*, Dept. of Manpower and Immigration, Government of Canada, Vols. 1-2, 1971. This variable is defined in terms of years of training equivalency.

A dummy variable for female workers was first introduced in the probit analysis but was eventually dropped as it was statistically insignificant in all cases.

¹³ Statistics Canada, *Monthly Labor Force*, Catalogue no. 71-001.

¹⁴ If a worker finds a job in interval 1 then he is dropped from the sample used to estimate the determinants of the probability of obtaining a job in interval 2, and so on for successive intervals.

¹⁵ Although some collinearity exists between age and seniority, the correlation coefficient between these two variables is moderate with values of 0.70, 0.68, and 0.52 for the three intervals. Formal schooling and the level of skill required by the previous job are not correlated (correlation coefficient = 0.002).

TABLE 2.—CHARACTERISTICS OF WORKERS BY AGE GROUPS

Variable	Group 1	Group 2	Group 3
Range of ages	under 45	45 to 55	over 55
Mean age (years)	30	50	60
Mean seniority (weeks)	256	956	1120
Mean schooling (years)	10.9	9.5	9.1
Mean skill (years)	4.1	4.1	5.1
Percentage of total survey sample	23	37	40

being employed through time, we must note that the probabilities derived from the three equations in table 1 have to be accumulated. This also requires information on the probabilities of retaining a job ($E(i)$) over various periods of time after an alternative job has been found.

Unfortunately, the survey and unemployment insurance information available for this group of workers did not cover their employment experience after they obtained their first full-time job after layoff. In the estimates of the probability of being employed that are constructed below we set the value of the probability of retaining an alternative job (after one has been obtained) equal to one. This assumption will unambiguously bias upward the estimates of the private and social income generated after layoff and will reinforce the bias introduced by setting the general labor market externality, equation (8), equal to zero. These two assumptions will mean that our estimates of the private and social costs of adjustment of displaced workers will be biased downward and thus we will obtain lower bound estimates of these costs.

Calculating the cumulative probabilities of being employed after layoff for the three groups of workers with characteristics as shown in table 2, we find that for the first group of workers with a mean age of 30 years there is a 75% probability that they will find a job within three months after layoff if the labor market unemployment rate is 5%. If the labor market unemployment rate is increased to 6%, the probability of employment falls to 67%.¹⁶ After one year the probability of finding a job is 98% or 92%, depending on whether the general unemployment rate is 5% or 6%. In contrast, a worker who is 60 years old with 21.5 years of seniority has only a 27% prob-

ability of finding alternative employment within three months after layoff if the general unemployment rate is 5%. After one year the probability of this mature worker obtaining alternative employment rises to only 61%. If the general labor market has a 6% unemployment rate, the probability falls to 20% for the first 90 days and 41% for the first year after layoff. For layoff periods from one to three years, there is almost no change in the probability of obtaining alternative employment unless the general labor market unemployment rate changes.

C. Determinants of Wage Rates Received before and after Layoff

As mentioned above, in order to estimate the private and economic value of the income generated by these groups of workers after displacement from the aircraft companies it is necessary to estimate the gross-of-tax wage rates that these workers would earn in alternative employment. For purposes of estimating the private and social income generated prior to layoff (equations (1) and (3)) we must also estimate the determinants of the wage that these groups of workers were earning prior to layoff.

From the survey of aircraft workers we obtained values for their alternative wage rates that were adjusted to May 1975 prices by the consumer price escalator for the city of Montreal.¹⁷

The alternative wage was made the dependent variable in a semi-logarithmic regression and estimated as a function of the workers' age, seniority, school, skill level of last job, the average unemployment rate in the general labor market during the period of unemployment, and the workers' duration of unemployment. Also introduced in the regression was a dummy variable to account for potential discrimination against females. Results reported in table 3, column 1, show that the sex variable (female = 1, male = 0), the seniority, school, and the duration of unemployment variables all have coefficients that are quite large relative to their standard errors. This is not the case for the skill, unemployment, and age variables, which have the correct signs but whose coefficients are small relative to their standard errors.

¹⁶ The average monthly unemployment rate for the Montreal area averaged 5.5% during the period these aircraft workers were unemployed. Statistics Canada, *Monthly Labor Force*, catalogue no. 71-001.

¹⁷ Statistics Canada, *Canadian Statistical Review* publication no. 11-003.

TABLE 3.—ESTIMATION OF ALTERNATIVE AND PRIOR WAGE RATES

Variable	Alternative Wage Rate		Prior Wage Rate in Aircraft Industry	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	1.429	(.162)	1.366	(.036)
Sex (F = 1, M = 0)	-.1800	(.082)	-.0660	(.032)
Age at time of layoff (years)	-.0012	(.0017)	.000691	(.0007)
Seniority (weeks)	.00011	(.00004)	.0000687	(.00001)
School (years)	.0116	(.0052)	.0053	(.0021)
Skill (years)	.0011	(.0061)	.0106	(.0024)
Unemployment rate (%)	-.0138	(.0230)		
Duration of unemployment (days)	-.000386	(.0002)		
No. of observations	248		248	
Corrected R^2	.09		.27	
F-Ratio	4.54 ^a		19.26 ^a	

^a Significant at the 0.01 level.

The significant negative coefficient on the sex variable indicates that the hourly wage rate for females in alternative employment is approximately 18% lower than for male workers with the same age, seniority and education characteristics.

Seniority has a positive significant coefficient while the age variable has a negative value. This suggests that some general training information is contained in the seniority variable. However, the skill level rating of the last job in the aircraft industry is not significant in explaining the alternative wage rate while, we shall see, it is very significant in explaining the previous aircraft industry wage. This indicates that much of the job-related skills in the aircraft industry are specific to the firm or industry and are not general training. Finally, the significant negative coefficient for the duration of unemployment confirms the results of another recent study on this subject (Barnes, 1975).

The next step is to estimate the wage rate that the various types of workers would have earned as of May 1975 if they had been retained in the aircraft industry. The procedure is first to adjust the wage ratio for each individual at the layoff date by the consumer price index in the worker's area to bring the wage rate to May 1975 prices.¹⁸ This adjusted wage rate was then made the dependent variable in a semi-logarithmic regression where age, seniority, schooling, and the skill level of the job were used as explanatory variables. Again a sex variable was introduced to measure any wage differential due to the sex of

the worker. Table 3, column 3, contains the results of these estimations, which are quite satisfactory. The age variable is not significant but it is expected that in the context of union agreements an individual's seniority and skill level would outweigh his age in determining his wage rate.

Both seniority and schooling have a highly significant positive effect on the wage rates in the aircraft industry although point estimates (in particular for the school variable) of these effects are much lower than those found in the alternative wage rate equation. The coefficient on the sex variable indicating whether the worker is a female is both significant and negative. The size of the coefficient suggests that, on average, the hourly rate was 6% lower for a female worker than for a male having similar characteristics. This penalty for female workers is considerably smaller than the 18% penalty they suffered after leaving the aircraft industry. Finally, as mentioned previously, the high level of significance of the skill level of the job in determining wage rates in the aircraft industry combined with the evidence that it has little effect on the determination of the wage in the worker's next job outside the industry indicates that these skills are specific to either the aircraft industry or the firm.

The equations in table 3, solved for the three groups of workers whose characteristics were given in table 2, show that the wage the workers received in their alternative employment varies between 69.9% and 96.8% of the wages they earned in their previous employment. We find that the acceptance wage in alternative employment declines significantly as the duration of unemployment increases. This decline (about 12%

¹⁸ Statistics Canada, *Canadian Statistical Review*, publication no. 11-003.

over a year) may reflect a decrease in the value of unemployed time and/or poorer skills.¹⁹

D. Specification of Other Variables Required for Estimation of the Model

Before equations (1) and (3) can be evaluated it is necessary to estimate the proportion of time (P') the workers were employed, on average, by the aircraft firms. This variable is measured as the ratio of the total number of weeks the workers were employed by the firm during the three years before being released to the total potential number of weeks they could have been employed.²⁰ The value of (P') for the workers in group 1 is 0.95 and 0.98 for groups 2 and 3.

Although the aircraft industry in Canada has been infamous for the volatility in the level of its activity, the continuous layoff by the firm in question during the years immediately prior to 1972 meant that the workers who still remained in the firm were those with high levels of seniority and thus had experienced a low incidence of unemployment.

To estimate the equations outlined above it is necessary to obtain values for f , the proportion of time a person expects to receive unemployment insurance benefits while being unemployed; UC , the amount of unemployment compensation; B , the ratio of the actual wage to the competitive wage; T_m and T , the marginal and average personal income tax rate, respectively, applicable to these workers; and A' , the ratio of the social value of labor's output to its market value.

While the workers were employed by the aircraft firm, the periods of unemployment were short and well within the 52 week maximum limit allowed for collecting unemployment insurance in Canada. Therefore, in equations (1), (2) and (3) the parameter f is set equal to 1. For the estimation of private income after leaving the aircraft firm (equations (4) and (6)), f is set equal to 1 for the first 52 weeks and then 0.67 for the remaining duration of unemployment. A value of 0.67 was chosen as the welfare payments available are equal to approximately this proportion

of the regular unemployment insurance compensation. In all cases the amount of unemployment insurance claimed (UI) was the maximum rate, equivalent to \$3.47 per hour.

To estimate B for equation (2) we took the wage rates that the workers were able to obtain after leaving the aircraft firm as a proxy for the workers' competitive wages. The ratio of the workers' wage rates in the aircraft industry to their wage rates after leaving for individuals in group 1 averaged 1.05. For group 2 and group 3 the ratios were approximately equal to 1.10. For the estimation of V in equation (6) B is set equal to 1.0 for all groups because the alternative wage is close to the competitive one.

The vast majority of the workers in the aircraft industry were married with dependents. Therefore, in estimating the marginal income tax of these workers it was assumed that they were all married with an average of two dependents. Given their wages and this family situation the marginal income tax rates (T_m) applicable to these workers is approximately 25% for the period 1969 to 1975 with an average rate of income tax (T) of approximately 20%.

For the estimation of A' we must consider the other explicit and implicit subsidies or tariff protection that would continue to be enjoyed by this aircraft firm if it were to continue in operation. One of the most significant output subsidies given to Canadian aircraft industry is the very liberal credit provisions given to foreign purchasers of the output of this industry. It has been estimated that the implicit subsidy provided by these credit arrangements is equivalent to a 15% subsidy on the gross value of foreign sales by the industry or approximately 30% of the industry's value added embodied in the foreign sales (Jenkins, 1975). Not all of the output of the firm in question was exported, nor was this one subsidy the only one applicable to this sector. Therefore, for illustrative purposes the social value of labor income before layoff is calculated first by assuming a value of $A' = 1$ (no distortions) and secondly by setting the value of $A' = 0.7$ (social value of labor is 30% less than its market value).

E. Estimation of the Expected Private and Social Income of Labor before and after Layoff

With the information specified in the previous sections we are now in a position to estimate the

¹⁹ For related discussions see Barnes (1975), Gordon (1973), and Holt (1970).

²⁰ The total potential number of weeks will be 156 if the worker was hired by the firm prior to January 1969. If employed since that date then potential weeks are the number since initially hired.

private income generated by the aircraft workers before and after their layoff (equations (1), (2), (4) and (5)) and the social value of income produced by these workers before and after layoff (equations (3), (6), (7)) from the aircraft industry. The results of the estimation of these equations are presented in table 4.

We find that private income before layoff was slightly lower for the younger workers in group 1 (\$3.58 per hour) than for the other groups (\$3.84 per hour). However, for the first 90 days after leaving the aircraft firm all groups of workers earned about the same private income, which was between 91% and 95% of the previous private income for group 1 and between 87% and 89% for the others. As the time since layoff grows we find that the relative private income position of the older workers deteriorates so that in the second and third year the private income of group 3 is only 67% to 74% of their previous private income while for group 1 it is between 88% and 93%. This is caused by two factors. First, the older workers have more difficulty obtaining alternative employment, hence, more are unemployed for more than one year when the generous unemployment insurance compensation terminates. Secondly, as the duration of unemployment increases we find older workers accepting lower paying jobs and thus causing their full income to decline.

The rate of unemployment in the general labor market at the time the workers are unemployed also has a significant impact on the amount of the loss of private income. When we compare the

present value (at 10%) of private income of these workers after layoff with what they would have earned if employed in the aircraft industry we find the percentage decrease in private income is 7% for group 1, 17% for group 2, and 22% for both group 3 and early retirees if the general unemployment rate in the region is 5%. If the regional unemployment rate is 6% then the loss is equal to 11% for group 1, 23% for group 2, and 27% for group 3 and for the early retirees.

In table 4 we compare the social value of the income generated in the aircraft firm under the assumption that the firm was not receiving any other subsidies (i.e., $A = 1$) with estimates of the social value of the income produced by labor through time after leaving the aircraft firm. We find that the social value of labor's income during the first year after layoff would average between 75% and 83% of the social value of labor's income in the aircraft industry for the workers in group 1; however, for group 2 workers it will range only from 45% to 55%, for group 3 from 32% to 44%, and for early retirees it is approximately 70%. In this case the present value (at 10%) of the social loss from displacing these workers averaged over a three year period (expressed as a percentage of the present value of the social income generated by labor in the aircraft firm) would be between 8% and 16% for group 1 workers, between 34% and 48% for group 2, between 47% and 62% for group 3 and between 36% and 40% for early retirees.

However, if we recognize the fact that the Canadian aircraft industry is receiving many

TABLE 4.—PRIVATE AND SOCIAL^a INCOME OF LABOR
(dollars per hour)

Period Since Layoff (days)	Labor Market Unemployment (%)	Group 1	Group 2	Group 3	Group 4 ^b
1. Before Layoff					
—with no other distortion $A' = 1$		3.58 (4.31)	3.83 (4.70)	3.84 (4.72)	3.84 (4.72)
—assuming $A' = .70$		(3.03)	(3.29)	(3.30)	(3.30)
2. After Layoff ^c					
30	5	3.42 (2.37)	3.43 (1.68)	3.44 (1.44)	3.44 (3.44)
	6	3.30 (2.02)	3.37 (1.41)	3.38 (1.20)	3.38 (3.38)
90	5	3.40 (3.40)	3.42 (2.22)	3.40 (1.74)	3.40 (3.40)
	6	3.28 (3.03)	3.35 (1.86)	3.33 (1.43)	3.33 (3.33)
365	5	3.36 (4.14)	3.30 (3.35)	3.21 (2.71)	3.21 (3.21)
	6	3.27 (3.82)	3.19 (2.61)	3.12 (1.72)	3.12 (3.12)
≥730	5	3.34 (4.14)	3.09 (3.37)	2.83 (2.73)	2.83 (2.83)
	6	3.19 (3.85)	2.80 (2.65)	2.59 (1.95)	2.59 (2.59)

^a Social incomes are reported in parentheses.

^b The early retirees are assumed to have the same personal characteristics as group 3.

^c It is assumed that workers find jobs in sectors where $A = 1$.

other subsidies and measure the social value of labor's income in the aircraft industry using a more realistic value for A' of 0.7, the above comparisons are greatly changed. For group 1 the social value of its output after layoff averaged over the first year is now between 107% and 119% of its social product with the aircraft firm. For group 2 it is between 64% and 79%, for group 3 it is between 46% and 63% and for early retirees the social value of labor's output is approximately equal to what it was before. Through time as more of the people who remain in the labor force become employed the social value of labor after layoff increases so that for group 1 by the third year it is between 129% and 137% of labor's social product in the aircraft industry. For group 2 it is between 80% and 102%, and for group 3 it is between 59% and 83%. For early retirees the social value of income after layoff falls to between 79% and 86% of the prior social value of output by the third year because those who wait and retire after they have been unemployed two or three years do so because the value they place on retirement time is lower than the value placed by those who retire immediately after layoff.

If we now consider the social cost of displacing these workers from the aircraft firm as a percentage of the present value of their prior social product in the firm we find that over the three year period after layoff there is a social *gain* of between 20% and 31% for the workers of group 1, a social loss of between 6% and 26% for group 2, a social loss of between 24% and 46% for group 3 and a social loss of between 9% and 14% for early retirees. To evaluate the social cost of displaced labor from the closing of such a plant we must weight the social gains and losses of each group by the proportion of workers in each category. In the sample studies here the proportions are group 1 = 0.23, group 2 = 0.37, group 3 = 0.32 and early retirees = 0.08. Applying these weights to the four percentage gains and losses we estimate that the social costs of displacement are in the range of 3% to 21% of the social product of labor in the aircraft firm (assuming $A = 0.07$).

As discussed previously, our estimates of the social value of income generated after layoff will be biased upward because no estimate has been made of the general labor market externality (equation (8)) and also because of the assumption made that when a person obtained a job it is

retained permanently (i.e., $E(t) = 1, t = 1 \dots n$). Therefore, this range of values for the social cost of displacement of labor is a minimum estimate. Also the social cost of adjustment will be larger the greater is the rate of unemployment in the general labor market.

Conclusion

From the theoretical framework developed in this paper we have been able to estimate the private and social value of labor's output both before displacement from a firm as well as during the period of adjustment after layoff. This has enabled us to estimate the private costs borne by labor released from a declining firm and to estimate minimum values for the social costs of labor adjustment.

Both of these measures of adjustment costs are greatly affected by the age distribution of the displaced labor force and the rate of unemployment in the region where they are looking for alternative employment. Older workers suffer greater private losses and inflict relatively greater social losses on the economy from unemployment than do younger workers. Also those who are more poorly educated have greater adjustment costs. However, the critical determinant of the social cost of displaced labor from a declining firm is the amount of other subsidies and protection also received by the firm. The greater these are, the lower the net social cost from the plant closure, although the private costs are not changed.

While this analysis identifies the private and social benefits that potentially could be obtained by effective adjustment assistance programs, it is clear from these results that blanket policies that apply uniformly to all workers in declining firms are generally not appropriate. Such policies should be at least flexible enough to consider the age composition of the labor force, the unemployment conditions in the region, and the magnitude of other tax and subsidy distortions applicable to the sector.

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