

# Spline Function Estimates of the Impact of Equal Pay Legislation: The Ontario Experience

Morley Gunderson

Volume 40, numéro 4, 1985

URI : <https://id.erudit.org/iderudit/051377ar>

DOI : <https://doi.org/10.7202/051377ar>

[Aller au sommaire du numéro](#)

Éditeur(s)

Département des relations industrielles de l'Université Laval

ISSN

0034-379X (imprimé)

1703-8138 (numérique)

[Découvrir la revue](#)

Citer cet article

Gunderson, M. (1985). Spline Function Estimates of the Impact of Equal Pay Legislation: The Ontario Experience. *Relations industrielles / Industrial Relations*, 40(4), 775–792. <https://doi.org/10.7202/051377ar>

# *Spline Function Estimates of the Impact of Equal Pay Legislation The Ontario Experience*

**Morley Gunderson**

*The purpose of this paper is to analyse the time pattern of male-female wage differentials with a view towards determining whether or not equal pay legislation has narrowed the male-female wage gap.*

The purpose of this paper is to analyse the time pattern of male-female wage differentials with a view towards determining whether or not equal pay legislation has narrowed the male-female wage gap. The expected time pattern and the expected impact of the legislation is first discussed. This leads to a formulation of an estimating equation relating the male-female wage gap to time, legislative changes and other determinants of the wage gap. The data is then discussed, followed by the empirical results and a comparison to other studies. This work builds upon earlier work (Gunderson, 1976) which utilized the same basic data source, but for a shorter time period, for a somewhat different subset of occupations, and with a different statistical procedure for measuring the impact of the legislation.

## **EXPECTED TIME PATTERN**

According to Becker (1957, pp. 6-10) market participants can be regarded as having a «taste for discrimination»; hence, the amount «purchased» will depend positively on income and negatively on the cost of discriminating. He also indicates that tastes for discrimination can reflect

---

• GUNDERSON, Morley, Director, Centre for Industrial Relations and Professor, Department of Economics, University of Toronto.

\*\* Without implicating them for any of the results or conclusions, I am indebted for helpful comments and discussion to John Ham, Jonathan Leonard, Angelo Melino and Dale Poirier. David R. Smith not only did an excellent job as a research assistant but provided substantive comments as well. I am also indebted to officials in Labour Canada, in particular to Ruta Logan and Alan Porter, for their assistance in obtaining some of the unpublished data. The research was financed by a research grant from the Social Sciences and Humanities Research Council of Canada.

imperfect information that can change over time. These arguments suggest that discrimination can increase over time as more of it is «purchased» with additional wealth but that it may decrease over time as competitive forces reduce costly discrimination and as information is acquired which highlights the cost of discriminating, and helps break down discriminatory stereotypes.

The large influx of women into the labour market in recent years may also have reduced female wages, especially if their larger numbers pose a greater threat and hence increase discrimination (Becker, 1957, p. 8), or if they have to be employed in firms with a greater «taste» for discrimination, the existing female workforce already having sorted itself into firms with the lowest taste for discrimination (Becker, 1957, p. 35; Ashenfelter, 1970, p. 409). On the other hand, greater numbers bring greater knowledge and this may lead to a decline in discrimination (Becker, 1957, p. 8; Zellner, 1972, p. 158). In addition, to the extent that the increased labour force participation is expected to be more continuous and permanent this may favourably affect the wages of women (Lazear, 1979, p. 345).

The growth of the white-collar and service sectors that has gone on over time may have served to sustain the demand and hence wages of female workers. This may have been reinforced by a decline in the monopsony power of employers as female mobility and flexibility in labour market activities increased.

Clearly the expected time trend of male-female wage differentials is ambiguous in theory, given the variety of forces working in opposite directions. In addition these forces themselves may take on different relative importance over time, suggesting that the time pattern of male-female wage differentials may change directions over different intervals. In the absence of data on these various underlying determinants, and since the focus of the analysis is on changes in the time pattern emanating from equal pay legislation, the empirical work will simply utilize a nonlinear time trend variable. This reduced form reflects the net impact of these various factors but does not enable a disentangling of the separate contribution of each of the determinants of the time pattern of male-female wage differentials.

In the short-run, unemployment fluctuations are also expected to alter the male-female wage differential. As Ashenfelter (1970, p. 411) points out when unemployment is low the perceived cost of discrimination may increase because of the general scarcity of labour and the restrictive practices of craft unions may dissipate (the latter factor probably being more important for his analysis of black-white discrimination than our analysis of sex discrimination). On the other hand, low unemployment may be associated

with increased labour force participation of female workers to the extent that the discouraged worker effect dominates the added workers effect, and this may prevent female wages from rising much in periods of tight labour markets; in essence their greater flexibility of labour force participation makes quantity adjustments more likely than price adjustments.

Legislative changes may also cause a shift in the time pattern of male-female wage differentials. From an economic perspective, legislation increases the expected cost of discrimination by an amount depending upon the probability of being caught and the expected cost if caught. The expected cost in turn can be a combination of fines, retroactive, current and future wage adjustments as well as an «image» cost. Legislation may also serve as an information role encouraging the parties to reevaluate their pay procedures; this in turn could reduce discrimination arising from misinformation.

These arguments suggest that any legislative change that reduced misinformation or raised the cost of discrimination would reduce the male-female wage differential. This could occur even if discrimination did not exist because firms may simply pay women more to avoid possible legal action.

However, it is possible that in the long-run equal pay legislation may actually widen the gap. This could be the case if the legislation makes it difficult for women to accept lower paying jobs in return for training or experience, or if employers become reluctant to hire females for fear of subsequent charges of discrimination, although equal employment opportunity legislation is designed to prevent such a response. In addition the reduced demand for the higher priced female labour in the covered sector may increase the crowding of females in the uncovered sector, lowering their wages even more (Beller, 1979, p. 308; Sawhill, 1973, p. 384), and covered firms may try to avoid compliance by changing their technology to require fewer minority workers at all wage levels (Beller, 1978, p. 363).

In the subsequent empirical work the legislative change that will be analysed is the enactment of equal pay legislation into Ontario's *Employment Standards Act* effective January 1, 1969. Prior to that time equal pay was the responsibility of the Human Rights Commission which relied mainly on persuasion rather than the courts, usually acted only on complaints, operated under very limited resources and dealt with numerous other aspects of human rights. In contrast, the Employment Standards Branch carries out routine investigations as well as dealing with complaints, is mandated to follow through on complaints, and protects persons making a complaint by anonymity and provisions in the Act against reprisals. For these reasons the legislative change is expected to influence the time pattern of male-female wage differentials in Ontario beginning in 1969.

## ESTIMATING EQUATION

The previous discussion suggests that the impact of the equal pay legislation be tested in a framework that allows a high degree of flexibility for the male-female wage differential to change over time but that captures any change in that time pattern that occurs as a result of the legislation. Spline functions are suited to this purpose since they allow for flexibility in the time pattern and they enable testing for the impact of the legislation by specification of a shift point (interior knot) at the time of the legislative change. Spline functions are developed and extensively discussed in Poirier (1976). The fact that a polynomial spline of degree  $n$  is continuous in the  $(n-1)$ th derivative ( $n \geq 1$ ) means that change emanating from the legislation is parameterized as smooth rather than involving an abrupt break in the structure of the underlying time pattern. The shift point was specified at the time of the legislative change, rather than a later period, because the legislation was actually passed a year prior to its enactment, its enactment was at the very beginning of 1969, the legislative change was a transferral of legislation rather than enactment of new legislation, and the spline function captures a phased adaptation to a legislative change.

Other formulations for capturing the change in the time pattern of the male-female earnings gap in response to legislative changes are obviously possible. A dummy variable shift parameter can capture any shift in the intercept associated with a legislative change, and the dummy variable may interact with the post-legislative time period to allow for a change in slope as well as intercept. Separate regressions could be run in the pre- and post-legislation periods and the similarity of the underlying structure tested by an F test. Nonlinear functions of various forms could also be specified to allow the effect of the legislation to phase-in over a period of time. Spline functions are utilized here because they provide a very flexible functional form, impose few restrictions on the time pattern of the male-female wage differential, and yet enable a simple but rigorous test of whether or not a legislative change involved a structural change in the time pattern.

In order to allow considerable flexibility in the time pattern of male-female wage differentials a basic cubic spline function was utilized with one interior knot at the time when the legislative change was introduced. This allows the male-female wage differential to be a nonlinear function of time and for the direction of the relationship to change more than once over the sample period. Specifically, the following cubic spline is specified:

$$Y_t = b_0 + b_2 T^2 + b_3 T^3 + b_4 (T-68)_+^3 + b_5 U_t + \sum_{j=6}^k b_j X_{jt} \varepsilon_t \quad (1a)$$

where  $Y_t$  is the proportionate male-female wage differential,  $(W_m - W_f) / W_f$ ;

T is time coded as the last two digits of the sample data, 1946-1979;  $(T-68)_+$  is the spline term coded zero for the years 1946-1968, and its actual value in the years 1969-1979 (i.e., 1,2,3...11);  $U_t$  is the aggregate unemployment rate;  $X_{jt}$  is the set of other explanatory variables believed to influence the male-female wage differentials; and  $\epsilon_t$  is the error term. The significance of the legislation in changing the time pattern of the male-female wage differential is tested by the hypothesis  $H_0: b_4 = 0$  with a conventional t-test.

## DATA

The model is tested on time series data on male-female wage rates for narrowly-defined occupations obtained from Labour Canada, *Wage Rates, Salaries and Hours of Labour* (Ottawa, Information Canada, annual). This is a unique data set in that it provides male and female wage data for a large number of narrowly-defined occupations over an extended period of time. The data is from an establishment survey representing substantially complete coverage of all establishments with twenty or more employees.

The importance of the narrowly defined occupations is that it minimizes the need to control for worker and job characteristics that are important determinants of wage differentials. Conventionally such characteristics are controlled for by including measured proxies in the earnings equations (usually run separately for males and females). It is well known, however, that such proxies are often unavailable or only imperfectly measure such important factors as experience, on-the-job training, absenteeism and turn-over. Furthermore, efforts to control for these factors by restricting the analysis to subsamples of men and women who are expected to be similar in their labour market behaviour (e.g., never married men and women over age 30) run the risk of being subject to sample-selection biases.

Using narrowly-defined occupations minimizes the need to control for these factors because it is reasonable to assume that males and females do substantially similar work within each occupation, at least in this particular data set since: (a) the occupations have well-specified detailed job requirements based on the six digit *Dictionary of Occupational Titles* categories (b) when there are subtle differences within an occupation they are subcategorized in the DOT classification system as class A, class B etc., which are then treated as different occupations in this analysis, and (c) when there are obvious discrepancies between the work of males and females then they are put into different groupings. These observations also highlight the fact that this analysis focuses only on intra-occupational wage differences by sex; it does not deal with the larger issue of inter-occupational wage differences and occupational segregation.

The virtue of using narrowly-defined occupations to control for human capital characteristics is that each of these characteristics is not required to be equal within a given occupation, only their *composite* or net effect is required to be the same. Thus age or education or training or even unmeasured variables like effort or initiative are allowed to trade-off against each other; what matters is that the worker does the requirements of the job irrespective of the inputs used to meet those requirements.

Even if the productivity of males and females are not the same within each occupation it seems reasonable to assume that their relative productivities change very slowly over time and that this will be captured in the variables used to reflect the long run trend and short run business cycle fluctuations. Thus any change in the male-female wage gap that occurred at the time of a legislative change could be attributed to the legislation even though some of the gap may reflect productivity differences.

The data analysis is restricted to one province, Ontario, because the legislation is provincial and also because this minimizes the need to control for regional differences. Although the complete data set represents a large number of occupations, only nine had complete data for the full period 1946-1979. Because the data is based on establishment reports and is not a systematic survey over time, it is not possible to get accurate figures on the distribution of men and women over time. However, they are occupations for which there is a significant number of men and women, that being one of the criteria for separate reporting for males and females. The extent of any potential sample selection bias from the nonrandom nature of the data set is unknown. This raises the possibility that women could have moved out of those occupations where the legislation was ineffective and into those where it was more effective. The opposite also could have occurred if employers reduced their employment of females in response to the legislation requiring higher pay.

A larger working paper (Gunderson, 1984), available from the author on request, gives more detailed information on the data. Such detail includes the predicted male-female wage differential for selected years, the average quantitative effect of the legislation over the post legislative period calculated for each occupation, the actual wage data, and the Ontario unemployment rate based on the Labour Force Survey.

## **EMPIRICAL RESULTS**

As indicated previously, the use of narrowly-defined occupations reduces the need to control for various wage determining characteristics (the

X variables of equation 1a). Hence, the basic estimating equation of (1a) reduces to:

$$Y_t = b_0 + b_1T + b_2T^2 + b_3T^3 + b_4(T-68)^3 + b_5U_t + \epsilon_t \quad (1b)$$

### Tests for Pooling

Equation (1b) was estimated by ordinary-least-squares separately for each of the nine occupations over the period 1946-1979, and the results presented in Table 1. In addition, a single regression was run on the pooled occupations, both with and without a set of occupational dummy variables. Chow tests (F tests) yielded significant F statistics at the .01 level, indicating that the coefficients are significantly different across occupations, irrespective of whether or not the occupations are separated by an intercept term. In essence, the underlying time pattern of male-female wage differentials is sufficiently different to preclude pooling the data into a single regression.

In spite of this, the pooled regression results with separate occupational intercepts are presented in the last column of Table 1 simply for expositional purposes. The pooled coefficients are sufficiently representative of the nonpooled ones to be useful to summarize the results.

### Spline Function Results and Impact of Legislation

The main result of the spline estimates is that after controlling for the long-run trend and short-run cyclical fluctuation of the male-female wage gap the equal pay legislation did not usually have a significant impact on narrowing the gap. The legislation variable was associated with a reduced wage gap in only one of the nine occupations and the narrowing was statistically insignificant. In the other eight occupations the legislation was actually associated with a widening of the gap although that widening was statistically significant in only one occupation. In general then, one can conclude that the Ontario equal pay legislation was usually not associated with a statistically significant change in the male-female wage gap in this data set, and the change was more often a widening rather than a narrowing of the gap.

The unemployment variable was also often of an unexpected sign; that is, periods of high unemployment were associated with a reduced male-female wage gap in six of the nine occupations (statistically significant in three of the six). In only one occupation was increased unemployment associated with a widening of the gap. Possibly the high unemployment



reduced the labour force participation of females more than males therefore bolstering their wages in spite of the loose labour market.

### Some Illustrative Calculations

Because of the complex functional form of the cubic spline function, the coefficient estimates of Table 1 by themselves do not provide a picture of what is happening to the male-female wage gap over time. However, the time pattern can be illustrated by differentiating the spline function (equation 1b) with respect to time, setting this equal to zero, and then using the quadratic formula to solve for the inflection points. (Details of the calculations and a table giving the inflection points, a calculation of the magnitude of the gap at those inflection points and a calculation of the average effect of the legislation over the post legislative period, is given for each occupation in the larger working paper, Gunderson, 1984).

The calculation can be best illustrated by reference to the equation for all occupations. Over the period 1946-1979 the average male-female proportionate wage differential was .346. The time pattern of that differential was one of narrowing from a value of .359 in 1946 until the year 1952 when the gap reached a minimum of .258, thereafter it widened until the year 1968 when the gap reached a maximum of .432, and thereafter again narrowed, with the gap expected to reach a new minimum of .299 in the year 1981.

With some notable exceptions, this time pattern appears fairly similar across the occupations. That is, most start out with a narrowing of the gap until the early 1950's, after which the gap begins to increase again until the late 1960's (although there is considerable variation as to when the maximum gap is reached) and thereafter falls usually throughout the remainder of the sample period.

Although the gap did usually fall throughout the post-legislation period, this appeared to be part of the normal time trend of the gap. As the legislative spline variable indicated, the legislative change did not appear to lead to a narrowing of the gap over and above the normal time patterns; in fact it usually widened.

The quantitative impact of the legislation can be calculated as  $b_4(T-68)^3$  from equation 1b. This calculation for the «all occupations» equation indicates that the legislation was associated with a widening of the gap that averaged .08 (the same as the average of the effect of the nine occupations) over the 1969-79 period. This is approximately 18 percent (.080/.432) of the gap that prevailed in 1968, the year immediately before the legislative change. Not much emphasis should be put on this magnitude, however,

TABLE 1

Spline Function Coefficients<sup>a</sup>  
(t-Statistics in parenthesis)<sup>b</sup>

Term	Occupations <sup>c</sup>										All <sup>d</sup>
	Symbol	1	2	3	4	5	6	7	8	9	
Constant	$b_0$	11.9429** (2.87)	11.4122* (2.66)	9.4515 (1.21)	18.0496** (2.79)	19.1897** (3.41)	31.6908** (3.85)	38.4698** (4.99)	10.9914 (1.70)	19.2881* (2.38)	18.9148** (5.46)
Time	$b_1$	-0.6294** (-2.95)	-0.5681* (-2.59)	-0.5296 (-1.32)	-0.9401** (-2.84)	-0.9096** (-3.15)	-1.6258** (-3.86)	-1.9315** (-4.89)	-0.5504 (-1.66)	-0.9709* (-2.21)	-0.9617** (-2.21)
Time sq. (10 <sup>-2</sup> )	$b_2$	1.1219** (3.11)	0.9623* (2.59)	0.9821 (1.45)	1.6324** (2.91)	1.4401** (2.95)	2.7615** (3.88)	3.200** (4.79)	0.9427 (1.68)	1.6402* (2.34)	1.6315** (5.44)
Time cube (10 <sup>-4</sup> )	$b_3$	-0.6608** (-3.28)	-0.5367 (-2.59)	-0.5854 (-1.54)	-0.9284** (-2.97)	-0.7417* (-2.72)	-1.5286** (-3.84)	-1.7277** (-4.64)	-0.5336 (-1.70)	-0.9186* (-2.21)	-0.9068** (-2.21)
Legislation (10 <sup>-4</sup> )	$b_4$	4.4820** (4.72)	0.9244 (0.95)	2.2535 (1.26)	2.4518 (0.66)	-0.4545 (-0.35)	2.1104 (1.13)	2.4730 (1.41)	1.1002 (0.75)	2.9413 (1.60)	2.0313* (2.57)
Unemp. % (10 <sup>-2</sup> )	$b_5$	-1.8548* (-2.29)	-0.1571 (-0.19)	2.7049 (1.77)	-0.1028 (-0.82)	-4.3410** (-3.96)	-4.4875** (-2.80)	-5.0380** (-3.36)	-0.8791 (-0.70)	1.1858 (0.75)	-1.0289 (-1.52)
Pooled		n.a. <sup>e</sup>	0.0406	0.1271**	0.0038	0.0429	0.0669*	0.0495	-0.0055	-0.0646*	
Regression <sup>e</sup>		(1.57)	(4.90)	(-0.15)	(1.65)	(1.91)	(2.57)	(1.91)	(-0.21)	(2.48)	
R-squared		0.62	0.50	0.70	0.53	0.77	0.78	0.86	0.57	0.45	0.35
Durbin-Watson <sup>f</sup>		1.77	2.25	1.99	1.57	2.02	1.65	2.48	1.08	1.67	
Mean dependent var.		0.318	0.358	0.445	0.314	0.360	0.384	0.367	0.312	0.253	0.346

a. The dependent variable is the proportionate male-female wage gap,  $Y = (W_m - W_f)/W_f$ , coded in cents per hour.  
b. \*\*Significant at .01 level, \*significant at .05 level, where the critical values on a two-tailed test respectively are 2.76 and 2.05. F statistics for the overall relationship were always significant at the .01 level and hence are not reported.  
c. The nine occupations (with industry affiliation in parenthesis) based on most recent titles are:  
1. Baker helper (Bakeries)  
2. Paekaeger, bakery products (Bakeries)  
3. Cutter, hand (Hosiery and other knit goods)  
4. Knitting machine tender (Hosiery and other knit goods)  
5. Inspector (Motor vehicle parts and accessories)  
6. Machine tool operator, production (Motor vehicle parts and accessories)  
7. Product assembler (Motor vehicle parts and accessories)  
8. Assembler, production (Electrical industrial equipment)  
9. Coil-winding-machine tender, automatic (Electrical industrial equipment)  
d. The pooled regression coefficients are for «all occupations» when the occupations are separated by a dummy variable intercept term. That is, the pooled regression for all occupations is the column of coefficients for «all» occupations and the row of coefficients for the «pooled regression» term.  
e. Reference category for the occupation dummy variable. Coefficients on the other occupations are interpreted as the effect on the proportionate wage gap of being in the particular occupation as opposed to the reference occupation.  
f. No evidence of serial correlation except for occupation 8 which exhibited positive serial correlation at the .05 level but inconclusive at the .01 level.

given the unexpected sign on the legislative term and the fact that it was usually statistically insignificant. Also, the particular formulation of the cubic spline function constrains the legislative effect as captured by the spline term to increase over time. While this may be a reasonable formulation if the legislation is having its intended effect of reducing the wage gap, it may not be a reasonable formulation if the legislation is associated with a widening of the gap. This is especially the case in simulating the effect of the legislation in years that are distant from the year when the legislation was introduced.

For illustrative purposes, the slope of the function can also be evaluated during the first year of the legislation in 1969 (i.e.,  $\partial Y / \partial T$  ( $T = 69$ )) and in the latest year of the sample period (i.e.,  $\partial Y / \partial T$  ( $T = 79$ )). This slope reflects both the effect of the time trend and the legislation in that year. Reflecting the fact that the gap had usually reached its maximum value in the late 1960's, it declined in most occupations in 1969, the first year of the legislative change. For example, for «all occupations» the gap narrowed by .005 in 1969 from its peak of .432 in 1968, representing only about a one percent (.005/.432) reduction in the gap in that year. As indicated earlier, this reduction was more part of the normal time pattern rather than reflecting a structural change in the underlying relation that occurred at the time of the legislative change.

The slope in 1979 illustrates that the gap was still usually narrowing at the end of the sample period but by a very small amount and the narrowing could be expected to stop soon after 1979. For example, by 1979 the «all occupations» results indicate the gap to be narrowing by only .009 in that year, clearly an inconsequential amount relative to the overall gap of approximately 30 percent at that time.

### SOME COMPARISONS

A perspective on the results of this study can be provided by a comparison with other econometric studies of the impact of anti-discrimination legislation, as given in Table 2 and reviewed in Gunderson (1985). The tabulation is designed to *highlight* the main results that are relevant to a comparison with this study. By necessity in such a summary tabulation, exceptions and qualifications are omitted and an emphasis is placed on the general tenor rather than specific details and the full range of results of those studies.

Most of the studies are only of indirect relevance since they focus on black/white differentials and how they have changed in response to the

numerous legislative initiatives of the equal employment opportunity (EEO) laws emanating from the *Civil Rights Act* of 1964. The results are inconclusive: some show significant gains but most show changes that are insignificant or often significant losses to minority groups.

The studies that are of most relevance for comparisons are those that focus on female/male comparisons — Gunderson (1975, 1976), Beller (1976, 1979, 1980) and Chiplin, Curran and Parsley (1980). The results of this present study confirm those done by the author based on different data and methodology. Based on cross section regressions of male-female wage differentials in the same establishments, equal pay legislation did not narrow the male-female wage gap (Gunderson, 1973). Similarly, based on time series regressions utilizing the same basic data source as employed in this study, but for a shorter period 1946-1971 and for a somewhat different subset of the occupations, the legislation was found to be insignificant when tested by a simple dummy variable shift parameter (Gunderson, 1976).

Based on her extensive analyses of United States' data, Beller (1976) does find that Title VII provisions of the *Civil Rights Act* of 1964 did significantly improve the earnings position of all females although the gains were usually insignificant for black females. These provisions dealt with both wage and employment discrimination, however, and they could be expected to have a more substantial impact on wages than would only equal pay provisions as analysed in our study. In addition, the gains referred to absolute gains for females rather than relative to males which is the focus of our analysis. In her more recent studies, Beller (1979, 1980) does find that the legislation did improve the earnings position of females relative to males, but that the gains were generally statistically insignificant.

While his results did show a moderate and significant improvement for blacks, Leonard (1984a, p. 151) also concludes that «Title VII legislation leads to sometimes negative but generally insignificant changes for white females». He suggests that «the demand shifts for females may simply be swamped by the ongoing massive increase in labour supply. In addition, many of the early Title VII cases focused on racial rather than gender discrimination. The apparent ineffectiveness of anti-discrimination policy in promoting female employment remains an interesting question for further research».

Leonard's analysis also indicates that the affirmative action provisions of the U.S. federal contract compliance program have not helped white females as much as other groups, notably blacks for whom it has significantly increased both their employment growth (Leonard, 1984b,c) and occupational advancement (Leonard, 1984c). For white females, the ef-

**TABLE 2**  
**Econometric Studies\* of the Effect of Anti Discrimination Legislation**

Study	Country	Estimation	Data Year <sup>b</sup>	Legislation	Dependent Variable	Groups <sup>c</sup>	Legislative Effect <sup>d</sup>
Landes (1968)	U.S.	OLS	1960	State fair Employment	weekly earnings	black/white males	insig. gain
Ashenfelter (1970)	U.S.	OLS	1950-66	1964 EEO	annual earnings	black/white males	insig.
Freeman (1973)	U.S.	OLS	1947-71	1964 EEO	annual earnings	black/white females	insig.
Vrooman (1974a)	U.S.	OLS	1948-71 <sup>e</sup>	1964 EEO	annual earnings	black/white males	sig. gain
Gunderson (1975)	Canada (Ontario)	OLS	firms 1968, 1969	Equal Pay	hourly wages	black/white females	sig. gain
Gunderson (1976)	Canada (Ontario)	OLS	1946-71	Equal Pay	hourly wages	black/white males	sig. gains
Ashenfelter and Heckman (1976)	U.S.	OLS	matched firms 1966 and 1970	Fed. Contract Compliance	employment, occup. position	female/male	insig.
Goldstein and Smith (1976)	U.S.	OLS	matched firms 1970 and 1972	Fed. Contract Compliance	employment	female/male	insig.
Heckman and Wolpin (1976)	U.S. (Chicago)	2SLS <sup>f</sup>	matched firms 1970-73	Fed. Contract Compliance <sup>g</sup>	employment	black/white males	sig. gain
Beller (1976)	U.S.	OLS	1967-74	1964 EEO	weekly earnings	black/white males	no gain
Butler and Heckman (1976)	U.S.	2SLS <sup>h</sup>	1948-74	1964 EEO	annual earnings	black/white males	sig. gain
						black/white females	sig. gain
						black/white males	insig.
						black/white females	sig. gains
						black/white males	usually insig.
						black/white females	sig. gains
						black/white males	insig.
						black/white females	insig.

Beller (1978)	U.S.	GLS, RLS, 2SLS <sup>g</sup>	matched firms 1966 and 1970	1964 EEO	employment, wages	black/white males	sig. gain insig. losses
Beller (1979)	U.S.	OLS	1968, 1972 1975	1964 EEO	weekly earnings	females/ males	insig. gains small gains
Beller (1980)	U.S.	OLS	1968-74	1964 EEO	weekly earnings	females/ males	sig. gains <sup>h</sup>
Chiplin, Curran and Parsley (1980)	Britain	OLS	1949-75	Equal Pay	hourly wages	females/ males	6.6% gain 1967-74
Beller (1982)	U.S.	OLS	1967,1971,1974	1964 EEO	prob. of being in male occup.	females/ males	sig. gains insig.
Leonard (1984a)	U.S.	OLS	1966, 1978	1964 EEO	employment	blacks/white females	sig. gains sig. gains
Leonard (1984b,c)	U.S.	OLS	1974, 1980	Fed. Contract Compliance	employment	black males black females white females	sig. gains sig. gains mixed <sup>k</sup>
Leonard (1984c)	U.S.	OLS	1974, 1980	Fed. Contract Compliance	occupational advance	black males black females white females	sig. gains sig. gains mixed
Leonard (1984d)	U.S.	OLS	1978	Fed. Contract Compliance	wages	non-white males	sig. gains sig. gains

a. Refers to published studies that use econometric techniques specifically to test the impact of legislation.  
 b. Data periods e.g., 1950-66, imply time series analysis of that period.  
 c. Groups analysed relative to another group are denoted, for example, by black/white.  
 d. When groups are analysed relative to other groups, the term «gains» implies that the legislation improved the economic position (dependent variable) of the minority group relative to the majority group. «Sig.» denotes statistically significant and «insig.» denotes statistically insignificant.  
 e. Based on Current Population Survey; similar results were obtained from the Continuous Work History data for 1957-69, and the results persisted over time when updated in Vrooman (1974b) for males.  
 f. To correct for the possibility that contract awards and reviews may be endogenous.  
 g. Results presented here are total short run effects for awards only from their Table 2; the results for reviews are generally statistically insignificant or quantitatively smaller, and the long-run results magnify the effects. Their results also indicate that the minority gains are confined to blue-collar occupations and that minority employment increases the probability of receiving a contract but has no effect on the probability of a compliance review.  
 h. To account for changes in the relative supplies of blacks and whites that may occur in response to transfer programs.  
 i. GLS to correct for heteroskedasticity; RLS to restrict the coefficient on the linear or quadratic enforcement term to zero; 2SLS to account for the possibility that enforcement measures are a function of discrimination.  
 j. Most attributed to incomes policy rather than equal pay.  
 k. Gains were associated with establishments covered under federal contract compliance but losses if they underwent a compliance review.

fects are often mixed, albeit on net they are usually positive but not as large as for other groups and hence their relative position usually is not improved.

Based on British data, Chiplin, Curran and Parsley (1980, pp. 112-116) do find the male-female wage gap to have narrowed significantly after the introduction of equal pay legislation. However, they provide calculations to indicate that about six percentage points of the increase in the female to male wage ratio from .59 to .67 came about because of the incomes policy, with equal pay responsible for about two percentage points in the improvement.

Clearly, our finding of an insignificant effect of equal pay legislation on the male-female wage differential is not at variance with the results of other studies. Perhaps as a conservative statement it would be safe to say that the particular equal pay legislation analysed in this study does not appear to have had an effect, and that this result is not at variance with the results of studies of other jurisdictions.

This finding of no significant impact of equal pay legislation is somewhat puzzling given that there are good theoretical reasons, as discussed previously, for expecting the legislation to narrow the gap, at least somewhat. The apparent ineffectiveness may reflect a variety of factors. The scope of legislation is limited by the fact that it applies only to substantially similar jobs within the same establishment, and such intra-establishment wage differentials are generally believed to be small relative to the wage gap that can arise from establishment and occupational differences (Gunderson, 1985). Resources devoted to enforcement may have been insufficient to ensure compliance, a possibility that is enhanced by empirical evidence linking enforcement and effectiveness (Beller, 1982, Leonard, 1984b,c). Compliance with the legislation may also have been evaded by subcontracting, creating segregated product lines and reduced hiring, especially with respect to the more vulnerable jobs.

It is also possible that the statistical procedures that were utilized were simply not able to capture the true effect of the legislation. The cubic spline function is an extremely flexible functional form and hence may leave little room for the effect of legislation to be captured by the spline term (albeit such flexibility is also appropriate given the indeterminacy of the normal time pattern and the fact that the adjustment to the legislation is likely to be slow). Also, the nonlinear time trend and the use of homogeneous, narrowly-defined occupations may not have fully controlled for the effect of other variables that were also changing over time, notably the influx of women and youths who may have depressed female wages even further, were it not for the legislation. The legislation may even have drawn women

into the labour force who otherwise would not have entered because of the wage gap, and their supply influx may have mitigated any reduction in wages. Lastly, there is always the potential problem in empirical studies that try to measure the impact of legislative intervention, that the legislative response may be endogenous and its existence correlated with certain unobservable variables that are the true causal variables affecting the wage gap. Accounting for this possibility would require modelling the existence of the legislation itself, rather than treating it simply as an exogenous explanatory variable.

Sorting out the relative importance of these various possible explanations for the apparent ineffectiveness of the legislation is beyond the scope of this paper. At this stage all that can be said is that the legislation does not appear to have narrowed the male-female earnings gap, and that this is consistent with the results of other studies of the same legislation as well as much (but not all) of the evidence on the effect of similar legislation in other jurisdictions.

#### REFERENCES

- ASHENFELTER, O., Changes in Labor Market Discrimination Over Time, *Journal of Human Relations*, 5, Fall 1970, pp. 403-430.
- ASHENFELTER, O. and J. HECKMAN, «Measuring the Effect of an Antidiscrimination Program», In *Evaluating the Labor-Market Effects of Social Programs*, Edited by O. Ashenfelter and J. Blum, Princeton, Industrial Relations Section, 1976.
- BECKER, G., *The Economics of Discrimination*, Chicago, University of Chicago Press, 1957.
- BELLER, A., «EEO Laws and the Earnings of Women», *Industrial Relations Research Association Proceedings*, Madison, Wisconsin, University of Wisconsin, 1976, pp. 190-198.
- , «The Economics of Enforcement of Title VII of the Civil Rights Act of 1964», *Journal of Law and Economics*, 21, Oct. 1978, pp. 350-380.
- , «The Impact of Equal Employment Opportunity Laws on the Male-Female Earnings Differential», In *Women in the Labor Market*, Edited by C. Lloyd, E. Andrews and C. Gilroy, New York, Columbia University Press, 1979, pp. 304-330.
- , «The Effect of Economic Conditions on the Success of Equal Employment Opportunity Laws: An Application to the Sex Differential in Earnings», *Review of Economics and Statistics*, 62, Aug. 1980, pp. 370-387.
- , «Occupational Segregation by Sex: Determinants and Changes», *Journal of Human Resources*, 17, Summer 1982, pp. 371-392.



- BUTLER, R. and J. HECKMAN, «The Impact of the Government on the Labor Market Status of Black Americans; A Critical Review», In *Equal Rights and Industrial Relations*, Madison, Industrial Relations Research Association, 1977, pp. 235-281.
- CHIPLIN, B., M. CURRAN and C.J. PARSLEY, «Relative Female Earnings in Great Britain and Impact of Legislation», In *Women and Low Pay*, Edited by P. Sloan, London, Macmillan, 1980, pp. 57-126.
- FREEMAN, R., «Changes in the Labor Market for Black Americans, 1948-1972», *Brookings Papers on Economic Activity*, No. 1, 1973, pp. 67-131.
- GOLDSTEIN, M. and R. SMITH, «The Estimated Impact of the Antidiscrimination Program Aimed at Federal Contractors», *Industrial and Labor Relations Review*, 29, July 1976, pp. 523-543.
- GUNDERSON, M., «Male-Female Wage Differentials and the Impact of Equal Pay Legislation», *Review of Economics and Statistics*, 57, Nov. 1975, pp. 462-469.
- , «Time Pattern of Male-Female Wage Differentials», *Relations Industrielles/Industrial Relations*, 31, No. 1, 1976, pp. 57-70.
- , «Discrimination, Equal Pay and Equal Opportunities in the Labour Market», In *Work and Pay: the Canadian Labour Market*, Edited by C. Riddell, Ottawa, Royal Commission on the Economic Union, 1985, forthcoming.
- HECKMAN, J. and K. WOLPIN, «Does the Contract Compliance Program Work?», *Industrial and Labor Relations Review*, 29, July 1976, pp. 544-64.
- LANDES, W., «The Economics of Fair Employment Laws», *Journal of Political Economy*, 76, July/August 1968, pp. 507-552.
- LAZEAR, E., «Male-Female Wage Differentials. Has the Government had any Effect?», In *Women in the Labour Market*, Edited by C. Lloyd, E. Andrews and C. Gilroy, New York, Columbia University Press, 1979, pp. 331-351.
- LEONARD, J., «Anti-Discrimination or Reverse Discrimination: The Impact of Changing Demographics», Title VII, and «Affirmative Action on Productivity», *Journal of Human Resources*, 19, Spring 1984a, pp. 145-174.
- , «Employment and Occupational Advance Under Affirmative Action», *Review of Economics and Statistics*, 66, August 1984b, pp. 377-385.
- , «The Impact of Affirmative Action on Employment», *Journal of Labor Economics*, 2, October 1984c, pp. 439-463.
- , *Splitting Blacks? Affirmative Action and Earnings Inequality Within and Across Races*, National Bureau of Economic Research, Working Paper 1327, April 1984d.
- POIRIER, D., *The Econometrics of Structural Change: With Special Emphasis on Spline Functions*, New York, North-Holland, 1976.
- SAWHILL, E., «The Economics of Discrimination Against Women: Some New Findings», *Journal of Human Resources*, 8, Summer 1973, pp. 383-395.
- VROOMAN, W., «Changes in Black Workers' Relative Earnings: Evidence from the 1960's», In *Patterns of Racial Discrimination, Vol. II: Employment and Income*, Edited by G.M. von Furstenberg, A. Horowitz and B. Harrison, Lexington, Mass., D.C. Heath, 1974a, pp. 167-187.

———, «Changes in the Labor Market Position of Black Men Since 1964», *Industrial Relations Research Association Proceedings*, Madison, Wisc., University of Wisconsin, 1974b, pp. 294-301.

ZELLNER, H., «Discrimination Against Women, Occupational Segregation, and the Relative Wage», *American Economic Review Papers and Proceedings*, 62, May 1972, pp. 157-160.

### ***Estimation statistique de l'impact de la législation ontarienne en matière des salaires***

L'objectif de la présente recherche est de mesurer à l'aide de l'analyse de régression (moindres carrés ordinaires), l'impact de la législation en matière d'égalité salariale sur la réduction de l'écart de salaires entre sexes. L'intérêt de l'approche réside dans la spécification fonctionnelle de la variable dépendante, le différentiel de salaires entre sexes, par rapport à la législation et au temps écoulé. La forme proposée est une fonction cubique par rapport au temps écoulé à laquelle s'ajoute une variable de tendance de troisième puissance à partir du moment de la mise en application de la législation. Il s'agit d'une fonction polynomiale en sillon («spline»). Une telle spécification vise à vérifier si le différentiel de salaires entre sexes évolue de façon non linéaire dans le temps et comporte des changements de direction. Il postule également, dans le cas où la législation exercerait un effet autonome significatif sur le différentiel, que cet effet ne s'exerce pas en un seul moment soit lors de la mise en application de la législation, mais sur plusieurs périodes et de façon graduelle. La possibilité de variations cycliques dans le différentiel est également prise en compte dans le modèle par l'introduction d'une variable cyclique conventionnelle (le taux de chômage) et linéaire.

Chacune de ces variables (le temps, la législation et la conjoncture) représente en fait divers facteurs ou forces à l'oeuvre et qui influent dans des directions parfois opposées sur le différentiel de salaire entre sexes. Ainsi, l'effet net de chacune sur le différentiel reste a priori indéterminé.

Le modèle mathématique proposé est appliqué à l'estimation des effets des variables ci-dessus dans le cas de neuf professions, étroitement définies, pour la province d'Ontario. Les données sur les différentiels de salaire entre sexes pour ces neuf professions proviennent de l'enquête annuelle de Travail Canada sur les taux de

salaires. La période couverte va de 1946 à 1976. C'est en 1969 que la province d'Ontario introduisait dans sa législation sur les normes du travail le principe de l'égalité en matière de salaires. Le recours à des professions étroitement définies et pour une seule province permet de réduire au minimum la nécessité de contrôler l'effet de diverses variables susceptibles d'influer sur le différentiel de salaire entre sexes comme les différences entre région et les différences entre les individus en termes de capital humain et entre les caractéristiques des emplois.

Les résultats montrent bien en général un mouvement de réduction dans le différentiel de salaire entre sexes dans les professions concernées. Plus spécifiquement, on assiste à une phase de réduction du différentiel jusqu'au début des années 1950, puis le différentiel s'accroît jusqu'à la fin des années 1960 pour à nouveau diminuer graduellement pendant le reste de la période d'observations. Par contre, la législation en matière d'égalité des salaires n'a pas, du moins sur la base des données utilisées et dans le cadre de la forme fonctionnelle retenue, contribué à la réduction du différentiel tandis que la variable taux de chômage, un indicateur de degré de resserrement sur le marché du travail, est positivement associée à la réduction du différentiel.

Ce résultat quelque peu surprenant de l'inefficacité de la législation n'est pas en contradiction avec les résultats d'autres études économétriques sur le sujet, y compris celles déjà effectuées par l'auteur antérieurement. De plus, même si des études américaines plus récentes font état d'effets positifs de ce type de législation dans le cas de la plupart des minorités, les résultats demeurent souvent ambigus pour les femmes de race blanche c'est-à-dire non significatifs ou encore minimes.

En terminant, l'auteur explore quelques pistes d'explications possibles à cette apparente inefficacité de la législation, entre autres, l'insuffisance des moyens de contrôle des autorités, la portée relativement limitée de la loi et la procédure statistique elle-même. Il est possible que la spécification de la variable législative laisse peu de place à la manifestation d'un effet propre à celle-ci, que la forme non linéaire ne rende pas compte adéquatement de phénomènes comme l'entrée accrue des femmes et des jeunes sur le marché du travail, ou encore que la législation soit elle-même endogène dans le modèle.