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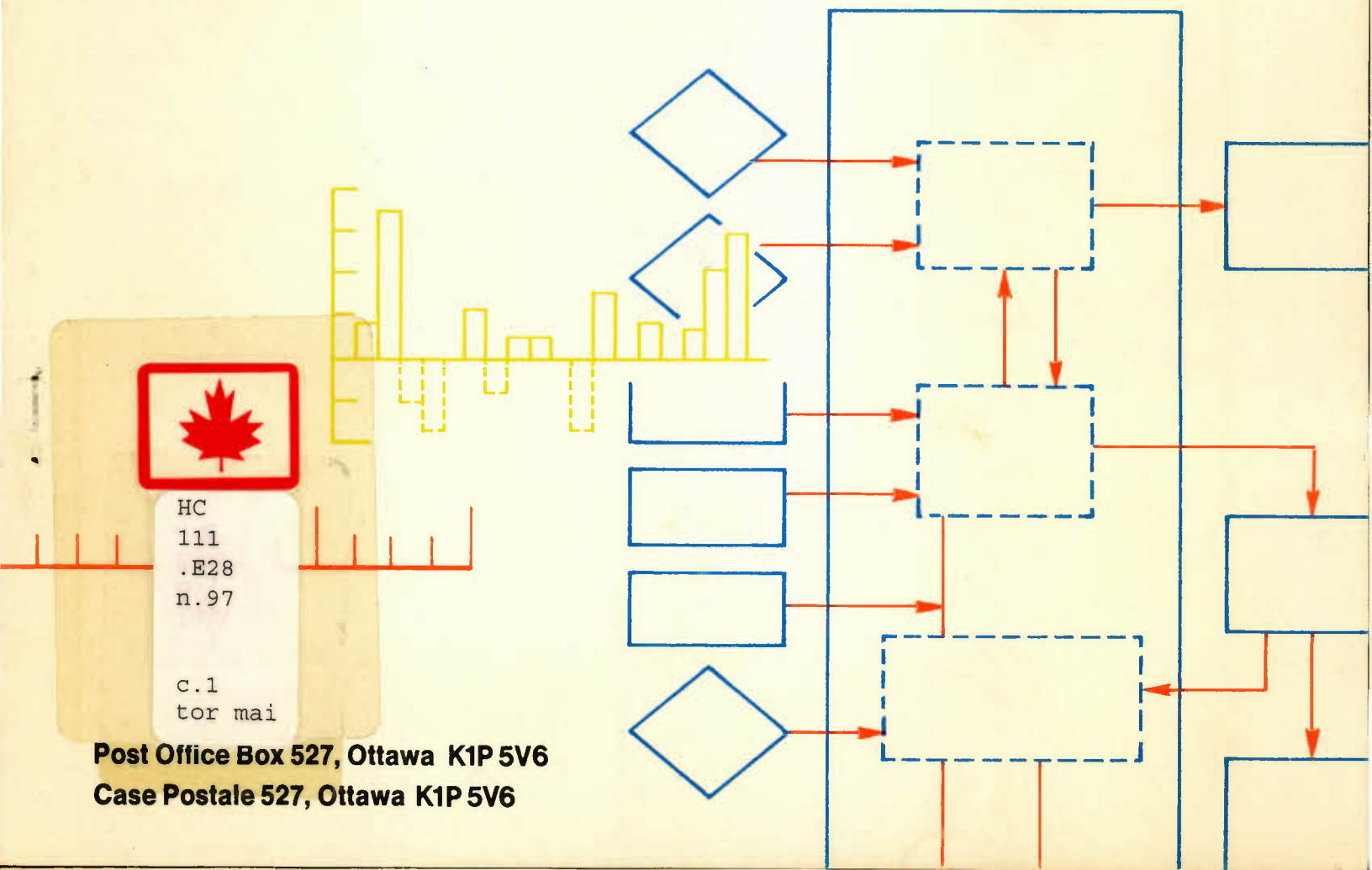

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# Determinants of Work Hours in Canada

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## Outline

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## Abstract

Data for both the United States and Canada indicate that the process of decline in length of the work week has been slowing down in recent years. Starting with this information, the purpose of this paper is twofold. First, an attempt is made to demonstrate the importance of the time dimension of the economy's aggregate labour input. The components of this time dimension, including issues of current concern such as time lost due to work-related accidents and illness, and industrial disputes, are outlined. The crucial role of productivity in accommodating reductions in working hours is illustrated.

Second, two previous studies of the determinants of the length of the work-week are examined. The potential relevance of supply-side variables in the Canadian context is demonstrated by using Canadian data in a model constructed originally for the United States. It is concluded that an appropriate model of the determinants of working hours must encompass both supply- and demand-side variables, and, accordingly a two-simultaneous equation system is constructed and estimated for Canada and for eight selected industries. Results generally lend support for the relationships hypothesized and the technique employed.

## Résumé

Les données relatives aux Etats-Unis et au Canada indiquent qu'au cours des dernières années, le processus de diminution de la durée de la semaine de travail a ralenti. A partir de ces renseignements, les auteurs du présent document visent un double but. En premier lieu, ils tentent de démontrer l'importance de la dimension temporelle de l'intrant global de travail dans l'économie. Ils définissent ensuite les composantes de cette dimension temporelle, y compris certaines préoccupations actuelles, comme le temps perdu à cause des accidents de travail, de la maladie et des conflits industriels. Le document illustre le rôle crucial de la productivité dans la réduction des heures de travail.

En deuxième lieu, les auteurs examinent deux études antérieures sur les facteurs qui déterminent la durée de la semaine de travail. La pertinence possible des variables de l'offre dans le contexte canadien est démontrée à l'aide de données canadiennes utilisées dans un modèle construit initialement pour les Etats-Unis Les auteurs en concluent qu'un modèle appropriée des déterminants des heures de travail doit inclure les variables de l'offre et de la demande, et, en conséquence, ils élaborent un système à deux équations simultanées, dont ils font l'estimation pour le Canada et pour huit industries choisies. En général, les résultats corroborent les relations postulées et le technique utilisée.

## Acknowledgements

All members of the Council's Social Indicators Group commented helpfully on an earlier version of this paper. We thank Surendra Gera in particular for his important suggestions, and Jocelyne Parisien for her patience with our hieroglyphics. Remaining shortcomings are the responsibility of the authors alone.

## 1. Introduction

The secular decline in the length of the average working week has accounted for a significant element in the historical erosion of work-life hardship. Technological change and its attendant improvements in productivity have enabled the release of an increasing number of units of labour to enjoy increasing amounts of leisure.

A glance at Figure 1 serves to confirm the downward trend of the weekly hours series in both the United States and Canada.[1] A more interesting feature, however, is the "flattening out"[2] of the series, reflecting a deceleration in the rate of decline in the length of the work-week. The two features prompt an interest in the underlying determinants of the length of the work-week, and the present study is, accordingly, an attempt to shed some empirical light on these factors.

The organization of the paper is as follows. The next section is designed to lend some perspective to the investigation insomuch as the relevance and significance of the topic reside not only in its relation to the social and cultural effects of increasing leisure time, but also in its implications for potential aggregate output.

Section III examines the work of two previous researchers in this field, contrasts their different approaches, and indicates the shortcomings of each. The need to take account of both demand

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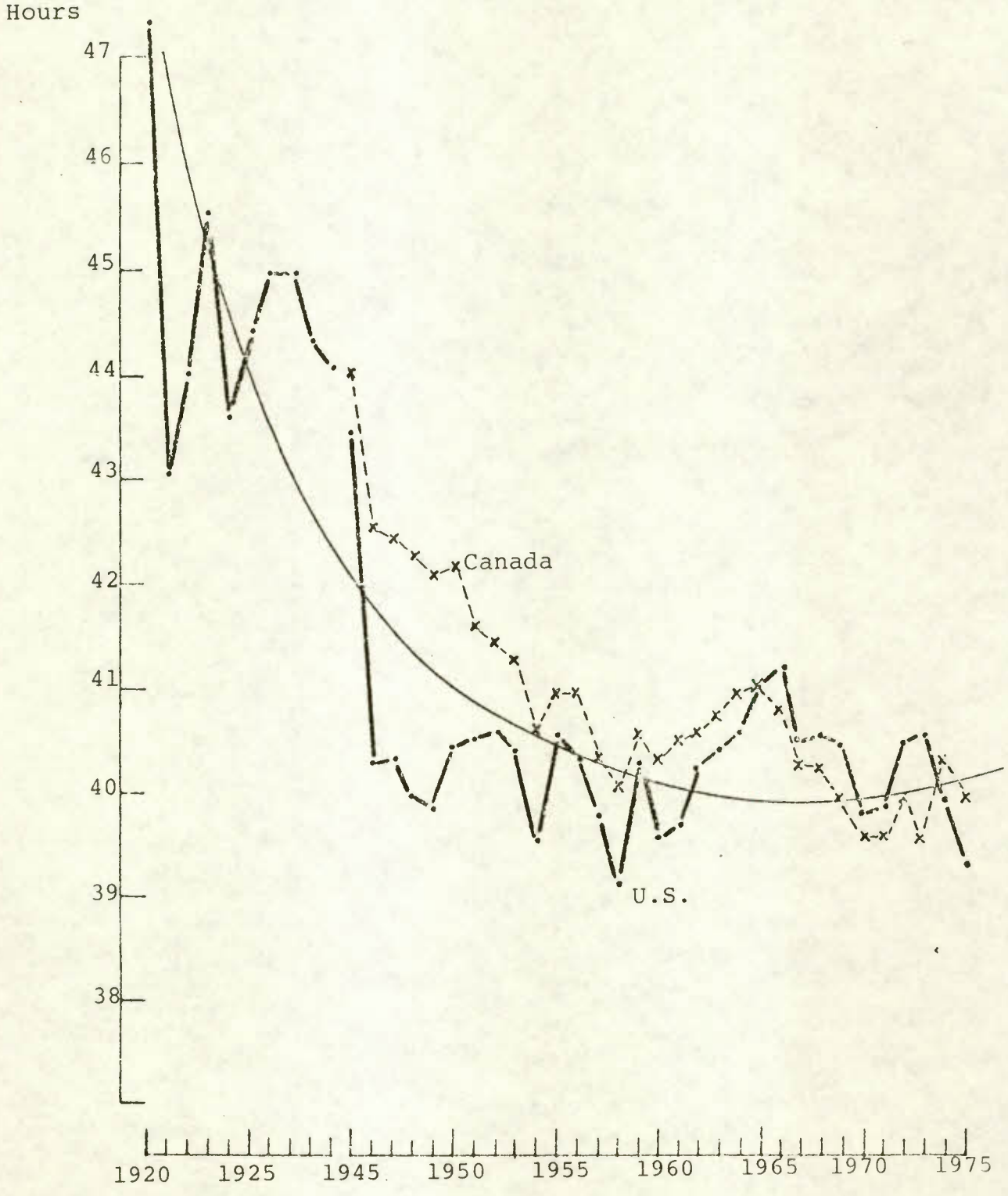
1 The anomalous periods of the Great Depression and the Second World War, respectively, have been omitted.

2 A freehand curve has been superimposed on the plotted series to emphasize this phenomenon.

Figure 1

THE SLOWDOWN IN THE DECLINE
OF THE LENGTH OF THE WORK WEEK:
PAID HOURS IN U.S. AND CANADIAN
MANUFACTURING INDUSTRIES



and supply-side variables suggests the utilization of a two-simultaneous equation model, estimated with the aid of the two-stage least squares technique, as described in Section IV. A detailed description of the data then follows in Section V, with a discussion of the results in Section VI. Concluding comments and observations are contained in Section VII, and three appendices deal with technical details arising in the main text.

## 2. The Relevance and Significance of Hours of Work

Hours of work undoubtedly constitute an important aspect of the general well-being of individuals and of society as a whole. Elimination of dawn-to-dusk labour, day in, day out, month after month -- and the chilling mental and physical consequences attendant upon such labour -- has rightly been an implicit or explicit goal of many societies. Historically, technological and economic progress have, of course, freed the majority of workers in the developed world from the hardships associated with extremely long hours. Indeed, so far has the trend progressed that it has become popular in recent years to speculate about the sociocultural consequences of the advent of the 'leisure society'. The question of hours continues to be an enormously important economic factor since it is an important element in the employment contract which not only determines the effective rate of remuneration -- of interest to workers and employers alike -- but also reflects the amount of leisure time afforded to society by the utilization of its productive resources.

The importance of working hours is perhaps demonstrated most poignantly from the macroeconomic standpoint, however, when it is borne in mind that hours constitute an integral dimension of labour input in the aggregate production function.

Consider, for example, the following identity.

$$\sum_{i=1}^{E} H_i q_i = Q \qquad (1)$$

in which $H_i$ and $q_i$ are the hours worked per week and the average output produced per hour, respectively, of individual $i$. $Q$ is aggregate weekly output of the economy when the product of hours and output per hour is summed over the E individuals employed in the economy.

The significance and complexity of the time dimension of manhours may now be seen if we write,

$$H_{it} = \left[\frac{(ws) - (v + h + l + a + d) + (o)}{52}\right]_{it} \qquad (2)$$

in which

$w$ = number of weeks of the year worked by individual $i$
$s$ = individual $i$'s standard working week, in hours
$v$ = number of hours of paid vacation time
$h$ = number of hours of paid statutory holidays
$l$ = number of hours of paid leave for sickness, accidents, etc.
$a$ = number of hours of absenteeism
$d$ = number of hours of work stoppage due to industrial disputes or equipment failures
$o$ = hours of overtime.

Expression (2) shows the average "effective" length of the working week for individual $i$ in year $t$. This breakdown of actual hours worked is particularly useful when incorporated in an expression for potential labour input in the economy.

We define average weekly hours per individual in year $t$ as,

$$H_{at} = \sum_{i=1}^{E} H_{it}/E \tag{3}$$

average manhour productivity as

$$q_{at} = \sum_{i=1}^{E} q_{it}/E \tag{4}$$

and the labour force as the product of the participation rate ($p$) and the working age population ($P$),

$$L = pP \tag{5}$$

Assuming constant returns to scale[3] we may then write potential average aggregate output per week in year $t$ as

$$Q_t^* = p_t P_t \left\{ \sum_{i=1}^{E} \left[ \frac{(ws) - (v + h + l + a + d) + o}{52} \right]_{it} \Big/ E \right\} q_{at} \tag{6}$$

This expression is instructive insomuch as we may examine the various components in turn and assess the implications for $Q_t^*$ of changes in those components.

With respect to $p_t P_t$, first of all, it seems likely that the enormous increases in the participation of women in recent years will begin, sooner or later, to diminish in magnitude. At the same

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3 We have attributed to the unemployed the same number of working hours, and productivity, as for the employed. We also abstract from the cyclical effects on the participation rate.

time, however, the secular trend towards early retirement and longer periods of schooling will further limit the size of $p$. The rate of growth of the working age population, $P_t$ is unlikely in the next decade to equal the growth rates of the recent past, particularly in view of changes in immigration laws.

As for the terms defining hours of work, it is clear that standard hours have decreased considerably during the course of the twentieth century and that supply-side pressure for further reductions will continue in the future. The actual number of weeks worked by an individual per year, $w$, is demand-determined and expansible, but obviously has a finite upper limit of 52. Vacations and statutory holidays have also increased over the years, and may be expected to continue to do so.[4] It is unclear whether workers may be expected to take increasing amounts of sick or special leave, $l$, in the future, but there are indications that absenteeism, $a$, is becoming an increasingly costly phenomenon in industry.[5] The loss of working time due to industrial disputes has certainly been higher in the last decade than in any other similar period since the Second World War,[6] but it is hazardous to speculate about the future course of this variable. Overtime hours, $o$, are, like $w$, demand-determined, but are also subject to an upper limit.

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4 Though it should be noted that Italy recently reduced the number of statutory holidays on the grounds that they were too much of an economic drain.

5 See Kelly, L.A., *Absenteeism: Results of a Survey*, Queen's University Industrial Relations Centre, 1975.

6 Labour Canada, *Strikes and Lockouts in Canada 1974-75*, Ottawa: Supply and Services, 1977.

What this description clearly indicates is the crucial importance for potential labour supply of those factors which together constitute hours of work. Furthermore, if (6) is summarized as,

$$Q_t^* = L_t H_{at} q_{at} \qquad (7)$$

then, the deceptively simple but very significant corollary of the limits to the growth of the labour force, combined with the expected continued diminution of hours of work, described above, is the critical importance of improvements in productivity.

It is apparent, therefore, that hours of work may be viewed not only in the light of cultural and humanitarian concerns, but also from the standpoint of 'hard' aggregate economic considerations. What is also evident from the foregoing equations is the potential impact of the quality of working life upon the quantity and quality of aggregate labour input. That is, to the extent that problems of worker alienation and job satisfaction exist, they may be manifested in the form of such phenomena as absenteeism, sickness and accidents, and/or industrial disputes, with potential impacts upon labour supply that are clearly indicated by equations (2) and (6) above. Pending a more detailed investigation of such individual components of hours of work, however, -- and their possible relation to psychological factors -- the more modest aim of the present paper is to analyse the impact on working hours of some more general economic determinants.

## 3. Previous Research

Econometric techniques have been employed by Hameed[7] and by Owen[8] to analyse the determinants of weekly working hours in Canada and the United States, respectively. The studies are instructive in that not only do they afford a comparison of the two countries, but also exemplify emphases upon the demand-side and supply-side, respectively.

### (a) Supply-Side

Owen, examining U.S. data, draws attention to the slowing down in the rate of decline of working hours after World War II and the coincident leap in post-war birth rates. He contends that the financial responsibilities of family formation dampened workers' desires to trade income for more leisure. His regressors therefore include an earnings measure, on the assumption that higher earnings tend to permit workers to take more leisure time, and real education expenditures per capita labour force to reflect child-rearing costs. It is argued that the post-war extension of schooling that accompanied the baby-boom contributed much to the average cost of raising a child and, further, that education costs are a useful index of all child-rearing costs since they indirectly reflect trends in the time period during which children are supported at home. A final worker-oriented variable measures the relative weight in the CPI of recreation costs, and is included on the grounds that as the relative costs of leisure-time activities increase the worker will tend to opt for more work hours.

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7 Hameed, S.M.A., "Economic and Institutional Determinants of the Average Work-Week in Canada", in S.M.A. Hameed and O. Cullen (eds), *Work and Leisure in Canada*, Faculty of Business Administration and Commerce, University of Alberta, 1975, pp. 1-17.

8 Owen, J.D., "Work-Week and Leisure, An Analysis of Trends, 1948-1975", *Monthly Labor Review*, August 1976, pp. 3-8.

The approach is heavily supply-oriented in the sense that it concentrates on those factors influencing the workers' offer of work-hours in the work-leisure calculus. It appears to assume that hours of work are largely discretionary, determined by workers of their volition. While in some cases workers may have the chance to accept or reject overtime offered by a foreman it seems likely that, more generally, their scope for altering average weekly hours over a year is limited to the decision as to whether or not to take their vacation entitlement.

While Owen never actually discusses his implicit assumptions, a case might be made on their behalf as follows: to the extent that workers can convince unions that they do not want a shorter work-week, to the extent that unions can impress upon management, through collective bargaining, the aspirations of workers, and to the extent that the gains by union members filter through to the unorganized sector, then the supply-side emphasis may have some validity.

A similar model was estimated for Canada, with results which are compared to Owen's in Table 1. The Canadian parallel is approximate only, since there are inevitable differences in the nature of the data. First, while Owen's dependent variable is average paid weekly hours (adjusted for paid holiday and vacation) for all male non-agricultural, non-student employees, we were constrained to the use of average paid weekly hours (similarly adjusted) for all manufacturing employees. Our corresponding set of explanatory variables is a close approximation to those in the

U.S. study, though one final limitation is that while the American time series runs from the turn of the century, the Canadian begins in 1950.

Table 1

PERCENTAGE CHANGE* IN WEEKLY HOURS RESULTING FROM A ONE PER CENT CHANGE IN EXPLANATORY VARIABLES: LINEAR REGRESSION RESULTS FOR CANADA AND THE U.S.

| | Canada | | | | U.S.A. | |
|---|---|---|---|---|---|---|
| | % Change | t-Ratio | b† | mean† | % Change | t-Ratio |
| Real hourly earnings | -.32 | -7.15 | -4.699 | 2.50 | -.20 | -4.78 |
| Child Rearing costs | .04 | 3.64 | 0.003 | 489.45 | .10 | 4.55 |
| Recreation Costs | .12 | 2.00 | 4.386 | 0.99 | * | * |
| Weekly Hours | | | 37.18 | | † | |
| $R^2$ | | | .92 | | .98 | |
| Durbin Watson Statistics | | | 1.25 | | 1.94 | |
| Sample Size (years) | | | 22 | | 75 | |

Notes: † Owen chose to present his results in a % change manner rather than the conventional b-coefficient display. See Appendix I for an explanation of the relation between these two methods.

* Owen chose not to present any results for his relative cost of recreation variable.

Sources: For the U.S.A., Owen *op.cit.* p. 6. For Canada, our own estimates. The hours data are weekly hours paid by manufacturing hourly rated workers taken from *Canadian Statistical Review*, 1970, Statistics Canada 11-003, Table 19 and *Review of Employment and Average Weekly Wages and Salaries*, Statistics Canada, 72-202. The child rearing arts are actually real per capita labour force total expenditure on education taken from *Survey of Educational Finance*, Statistics Canada 81-208, Table 7. The relative cost of recreation is the recreation component of the consumer pure index, 1971-based, CANSIM Series No. 626429; the CPI itself is in CANSIM Series No. 626429. The hourly earnings series is taken from the *Canadian Statistical Review*, 1970, Statistics Canada, 11-0033, Table 18, and the *Review of Employment and Average Weekly Wages and Salaries* Statistics Canada, 72-202.

The results indicate, for both countries, the anticipated positive (and statistically significant) impact of education costs upon weekly hours worked, and the negative (and likewise significant) effect of hourly earnings. The results for recreation costs are not shown in Owen's paper -- probably because of statistical insignificance. In the Canadian case, also, the variable appears 'just' significant and has, interestingly enough, the 'correct' sign.

(b) Demand-side

The work of S.M.A. Hameed[9] views hours of work as deriving from the conditions and techniques of production. During an economic upswing employers will utilize existing personnel more intensively and ultimately hire more workers and/or schedule increasing amounts of overtime. The variable used to capture this effect is the capacity utilization rate, which is presumed, *a priori*, to be positively related to hours of work. However, one may conceive a situation in which, while total labour hours of input are expanded, this may be achieved by increasing the number of persons in employment so that the average number weekly hours worked per individual actually decreases. To take account of the possibility of employers' hiring more persons rather than scheduling more hours, Hameed introduces an 'employment utilization rate'.

Apart from economic conditions, labour productivity will also affect the number of person-hours required in the production

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9 *op.cit.*

process, so output per unit labour input was included in Hameed's analysis.

His final variable is the level of earnings which, in a manner reminiscent of Owen, he contends "has contributed to the *workers' decision* to work fewer hours ... (and), buy more leisure".[10]

Hameed's results are displayed in Table 2, below. Like those of Owen, they are unfortunately reported by the author in a rather incomplete and inconclusive form, and omit the values of estimated parameters and their associated t-statistics. The analysis is disaggregated to seven manufacturing industries and indicates the generally weighty impact of the capacity utilization and earnings variables and the negligible influence of the employment rate.

Table 2

RESULTS OF SIMPLE AND MULTIPLE REGRESSIONS OF HOURS PAID ON VALUE ADDED PER MAN-HOUR (P), CAPACITY UTILIZATION (C), EMPLOYMENT RATE (E), AND WEEKLY EARNINGS ($W_e$); FOR SEVEN MANUFACTURING INDUSTRIES OF CANADA, 1945-1965

| Equation Number | Explanatory Variables | $100.R^2$ by Manufacturing Industry | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Food and Beverages | Textiles | Paper Products | Iron and Steel | Transportation | Oil, Coal, Non-Metal Minerals | Chemicals |
| 1 | P | 48.93 | 34.40 | 67.05 | 10.39 | 19.67 | 70:02 | 53.83 |
| 2 | C | 74.67 | 44.50 | 84.11 | 19.63 | 14.30 | 87.67 | 92.86 |
| 3 | E | 62.54 | .46 | 18.20 | 11.54 | 1.47 | 31.58 | 28.66 |
| 4 | $W_e$ | 73.31 | 53.44 | 91.08 | 43.02 | 52.21 | 83.77 | 92.46 |
| 5 | P, C | 78.59 | 52.65 | 84.21 | 23.94 | 19.97 | 87.88 | 94.41 |
| 6 | P, C, E | 81.31 | 52.98 | 88.70 | 24.77 | 20.76 | 91.43 | 94.66 |
| 7 | P, C, E, $W_e$ | 81.77 | 57.68 | 95.54 | 78.42 | 84.66 | 91.47 | 95.12 |
| Standard Error of Estimate | | 1.79 | 2.59 | 1.39 | 2.67 | 1.54 | .69 | .81 |
| Durbin-Watson Statistic | | 1.99 | 2.57 | 1.26 | 2.31 | 2.16 | 1.97 | n.a. |

Source: Hameed, *op.cit.*, page 10.

10 Hameed, *op.cit.*, p. 10, Emphasis ours.

## 4. The Model

The foregoing discussion of the approaches of Hameed and of Owen suggests the propriety of employing a model which can incorporate both the demand-side and the supply-side factors affecting weekly hours of work. Our specification therefore involves two simultaneous equations with two endogenous variables, $H$ and $W$. The semi-structural equations are

$$H_t^s = A_0 + A_1 W_t + A_2 E_t + A_3 R_t + U_t \quad \text{supply equation} \quad (1)$$

$$H_t^d = b_0 + b_1 W_t + b_2 P_t + b_3 C_t + V_t \quad \text{demand equation} \quad (2)$$

where $H = H^s = H^d$ = average weekly hours actually worked by all workers in Canada,

$W$ = average earnings per hour actually worked in constant 1961 dollars,

$E$ = index of child-rearing costs expressed as a ratio the 1961-based CPI; described in Appendix II,

$R$ = per capita personal expenditure on recreation equipment services in 1961 dollars,

P = labour productivity measured as 1961-based index of real domestic product per employee,

$C$ = capacity utilization rate (percentages), the calculation of which is described in Appendix III, and

$U, V$ = error terms;

$H$ and $W$ are endogenous variables, $t$ = 1941 to 1973.

To estimate these relations it was necessary to put them into one reduced form equation to calculate the wages variable $W$, and then to substitute this "purged" $\hat{W}$ back into equation (1) in order to explain the labour supply of hours. Two-stage least squares is, in other words, the technique of solution. Stage 1 involves the $W_t$ reduced form equation, stage 2 the supply equation.

$$\text{(stage 1)}\quad W_t = \left(\frac{A_0 - b_0}{b_1 - A_1}\right) + \left(\frac{A_2}{b_1 - A_1}\right)E_t + \left(\frac{A_3}{b_1 - A_1}\right)R_t + \left(\frac{b_2}{b_1 - A_1}\right)(-P_t)$$

$$+ \left(\frac{b_3}{b_1 - A_1}\right)(-C_t) + \left(\frac{U_t - V_t}{b_1 - A_1}\right)$$

$$\text{or}\quad W_t = \delta_0 + \delta_1 E_t + \delta_2 R_t + \delta_3(-P_t) + \delta_4(-C_t) + U_t^* \qquad (3)$$

from which we get a calculated wage term $\hat{W}$ purged of its stochastic elements and substitute it into our supply equation:

$$\text{(stage 2)}\quad H_t^s = A_0 + A_1\hat{W}_t + A_2E_t + A_3R_t + U_t^* \qquad (4)$$

Some discussion of the rationale underlying the selection of the variables seems in order before turning to a description of the characteristics of the data employed.

The earnings measure, $W$, is considered a relevant inclusion from both the supply and the demand sides. It is contended by Owen for example, that real increases in hourly earnings have encouraged workers to enjoy more leisure time. In addition to this income effect, however, it must be pointed out that there is also an offsetting substitution effect in the sense that, in some ranges rising wage-rates constitute an increased opportunity cost of

leisure. The final net impact of increased earnings will depend on the relative strengths of the price and income elasticities of hours with respect to wages. Or, as Milton Friedman puts it, "much depends on the ... value attached (by the worker) to goods purchased with money (earned) through the market, relative to goods that can be acquired (that is, pleasure) through non-market activity".[11]

From the employer's side, also, earnings per hour are an important consideration insomuch as neo-classical wage theory suggests that the entrepreneur chooses to operate with that level of labour input which equates its marginal cost to its marginal revenue product. The important point concerns the interdependence of the determination of wages and hours. We have seen the ways in which wages may affect hours but, equally, the intensity with which the labour input is utilized will affect its productivity and the wage rate it can command. One might also argue, from the supply side, that insofar as individuals have a notion of target earnings and the constraint of a standard number of hours per week, they will implicitly choose a reservation wage-rate. This simultaneity suggests the need to treat the wage rate not as a predetermined variable but rather as one which is endogenous to the system.

Child rearing expenses, $E$, are included on the grounds that the rising costs of maintaining the larger post-war families may have contributed to the deceleration of work-week reduction.

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11 Friedman, M., *Price Theory*, Chicago: Aldine, 1965, p. 204.

The supply-side orientation and rationale for this variable were discussed in section 3, above. Suffice it to say at this point that Owen's measure of education expenditures as a proxy for child-rearing costs was felt to be inadequate for the purpose at hand, on the grounds that schooling is only one facet of raising a child. Accordingly, we employ an index of the expense of a more comprehensive basket of child-rearing goods.[12]

Next, consider the cost of recreation goods, *R*. While it has been contended that the effect of increasing affluence may cause many workers to take more leisure time rather than more earned income, it is also hypothesized that the commercialization of leisure time pursuits has increased their costs substantially. Leisure time has, in other words, become the basis for an industry which has spawned an increasingly sophisticated array of highly-prized leisure-goods.[13] Paradoxically, the purchase of such goods may in some cases be achieved only by sacrificing part of the leisure time in which they may be enjoyed. One might therefore anticipate a positive impact of "per capita expenditure on recreation goods", *R*, upon hours.

Labour productivity, *P*, is introduced on the grounds that to the extent that qualitative improvements in the economy's aggregate inputs improve output per man-hour then, in principle, hours may be reduced without sacrificing output. An important corollary of this

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12 Section 5, below, provides a more detailed description of the data used for each of the variables.

13 For example, snowmobiles, colour TV's summer cottages, hi-fi sets, golf club membership, etc..

proposition is, of course, that slower productivity gains retard the potential for reductions in working hours.[14]

Our final determinant of hours of work is capacity utilization *C*, for which actual output is taken as a percentage of "the maximum output obtainable under normal technological and market conditions".[15] One might surmise that, as the economy draws closer to full utilization of its capital stock, hours of labour will be extended, probably through overtime, to meet the increased production requirements.

As far as the effects of capacity utilization upon the endogenous wage variable are concerned, it should be borne in mind that in certain instances the relationship may be asymmetric, in the following sense. A *fall* in the rate of capacity utilization may lead to lay-offs of the most recently-acquired, less-experienced and/or lower skilled members of the work force, and the retention of the more highly-skilled (and higher-paid) workers who might be difficult to replace during the subsequent cyclical upswing.[16] In

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14 Another aspect of the relationship is that in certain cases, over certain ranges of labour input, there may be a positive feedback of reduced hours upon productivity. If shorter hours reduce fatigue, increase alertness, and improve job satisfaction, then performance may be enhanced. See Evans, A.A., *Hours of Work in Industrialized Countries*, Geneva: ILO, 1975, p. 47.

15 Statistics Canada, Construction Division, National Wealth and Capital Division, *Capacity Utilization Rates in Canadian Manufacturing By Quarters, 1961 - Second Quarter 1976*, p. vi.

16 This concept of "labour hoarding" is discussed in Blain, L., "Recent Developments in Aggregate Labour Productivity", *Bank of Canada Review*, January 1977, pp. 1-15. Note that stagnant or declining output coupled with labour hoarding imply underemployment and falling average output per man-hour.

this way the average wages of the employed work force may actually *increase* during a recession. At the same time, however, a sharp upswing in economic activity accompanied by increasing rates of capacity utilization may lead to relative labour shortages and upward pressure on wages.

5. The Data

There exist three major definitions of weekly hours which may be used in the analysis of working time. *Standard hours*, first of all, are the normally-scheduled hours worked in a week and are generally determined by legislation and/or bargaining.[17] Hours worked in excess of a standard daily or weekly total are generally referred to as "overtime" for which a premium may be paid.

*Paid hours*, secondly, are those for which the worker is paid, whether they have been worked or not. Thus, a worker whose standard work-week is 40 hours may have worked 4 hours overtime at a premium rate of "time-and-a-half", so that the hours paid for total 46. Similarly, vacations, holidays, and sick leave all constitute hours paid for but not actually worked.

*Actual hours*, finally, are those spent at the job. Thus, in the example of the last paragraph, they would include the four hours of actual overtime. They would, however, exclude all absences due to holidays, vacations, sickness, and the scheduled time that is not worked due to business slowdowns, equipment failures, and industrial disputes.

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17 Thus Economic Council of Canada Staff, for example, observe hours of 8:30 a.m. to 12:30 p.m. and 1.20 p.m. to 5:00 p.m. each day Monday through Friday for a standard work week of 38-1/3 hours.

It is apparent that the different series may each prove more appropriate for a particular purpose: standard hours are a very general indicator of one important aspect of working conditions, for example, while hours paid are critical for the computation of labour cost, and actual hours reflect business conditions.

We have chosen to use a series for average *actual* hours per week[18], on the grounds that it reflects both demand and supply factors while according closely with the concept of labour input developed in section 2, above. The measure inevitably involves certain shortcomings, however. First, it does not take into account the increasingly important factor of commuting time, nor the time invested in the acquisition of human capital. Furthermore, the *average* form of the data masks such underlying developments as movements toward the 7-hour day and/or four-week vacation, the compressed work-week, flexitime, etc..

The earnings variable, $W$, was derived from total annual wages and salaries by normalizing by number of employees and the hours series, and deflating by the CPI to yield a real hourly wage-rate for Canada and eight selected industries. The productivity variable, $P$, is also derived in a straightforward manner by dividing the 'volume indexes of real domestic product (RDP) by industry of origin' by a similarly-based index of employment.

Data for the recreation expenditures variable, $R$, were derived by adding the series for personal expenditures on recreation, sporting, and camping equipment, and recreational services,

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18 'Average Hours Worked per Week of Persons Employed' for Canada and eight selected industries. These series, and all others used in estimating the model, are drawn from the CANSIM data bank.

respectively. These were deflated by the CPI and expressed in per capita terms.

Information on child rearing costs consists of four components relating to the feeding, clothing, education, and dental care of children. Personal expenditures on educational and cultural services were indexed and merged with the food, clothing, and dental fillings components of the CPI. A more detailed description of the calculation is contained in Appendix II.

Capacity utilization is calculated by applying the capital stock series from 'Flows and Stocks of Fixed Non-Residential Capital' to the minimum capital-output ratio. The latter is the quotient of the capital stock series and the RDP series referred to above. The capacity utilization rate is then simply the ratio of actual to potential output in any year. The detailed calculation is set out in Appendix III.

## 6. Results

### (1) Canada

Table 3 displays the results of applying the two-stage least-squares technique to our model using the computer package MASSAGER. The signs of the first stage coefficients appear unexceptionable and all variables are significant. The negative impact of the capacity utilization variable is consistent with the hypothesis of labour hoarding described above: the acquisition of less skilled, less experienced and less well paid workers in cyclical upswings serves to reduce the average rate of remuneration.

Table 3

2 SLS ESTIMATES OF THE COEFFICIENTS OF THE HOURLY WAGE (W) AND HOURS (H) EQUATIONS INVOLVING LABOUR PRODUCTIVITY (P), CAPACITY UTILIZATION (C), CHILD REARING COSTS (E), AND RECREATION EXPENDITURES (R) FOR THE TOTAL DOMESTIC ECONOMY OF CANADA, 1941-1973

| Explanatory Variable | | Mean | $\hat{b}$ | t-statistic |
|---|---|---|---|---|
| Stage 1: | Dependent Variable: | W (mean = 1.65) | | ($\bar{R}^2$ = .999) |
| | E | 1.16 | 0.321 | 6.56 |
| | R | 62.37 | 0.002 | 2.27 |
| | P | 104.55 | 0.017 | 27.76 |
| | C | 92.95 | -0.007 | -5.96 |
| | Constant | 1.00 | .014 | |
| Stage 2: | Dependent Variable: | H (mean = 40.06) | | ($\bar{R}^2$ = .993) |
| | $\hat{W}$ | | -6.56 | -22.89 |
| | R | | 0.040 | 6.03 |
| | E | | .541 | 1.13 |
| | Constant | | 47.797 | |

In the second stage the computed wage variable, $\hat{W}$, and recreation expenditure, $R$, are both significant and of the expected sign. However, the child-rearing index, though of the anticipated sign, is insignificant.

(2) Industrial Disaggregation

The analysis undertaken for the total domestic economy suggests some reasons underlying the overall trend of hours in Canada. However, the differences between industries with low productivity and long hours, such as agriculture, and those with shorter and more productive hours, such as manufacturing, should prove additionally informative.

Accordingly, Table 4 presents the results of a disaggregated analysis for the eight industry sectors of agriculture;

Table 4

2 SLS RESULTS FOR THE HOURLY WAGE (W) AND HOURS (H) EQUATIONS INVOLVING LABOUR PRODUCTIVITY (P), CAPACITY UTILIZATION (C), CHILD-REARING COSTS (E), AND RECREATION EXPENDITURES (R), FOR CANADA AND EIGHT SELECTED INDUSTRIES, 1949-1973

| | Stage I: Dependent Variable (W) | | | | | | | | | | Stage II: Dependent Variable (H) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | E | | R | | P | | C | | | | $\hat{W}$ | | R | | E | | | |
| | b | t | b | t | b | t | b | t | Constant | $\bar{R}^2$ | b | t | b | t | b | t | Constant | $\bar{R}^2$ |
| Canada | 0.321 | 6.56 | 0.002 | 2.27 | 0.017 | 27.76 | -0.007 | -5.96 | 0.014 | .999 | -6.564 | -22.89 | 0.040 | 6.03 | 0.541 | 1.13 | 47.797 | .993 |
| Manufacturing | -0.326 | -1.98 | 0.004 | 0.19 | 0.019 | 12.23 | -0.010 | -3.67 | 1.451 | .985 | -1.714 | -3.07 | 0.001 | 0.05 | 1.130 | 1.01 | 40.253 | .520 |
| Mining, Milling, Oil Wells | 0.545 | 2.51 | 0.001 | 0.22 | 0.012 | 5.91 | 0.003 | 0.65 | 0.498 | .985 | -2.988 | -2.95 | 0.031 | 1.03 | 0.993 | 0.46 | 44.083 | .478 |
| Construction | 0.538 | 2.33 | 0.014 | 5.21 | 0.012 | 5.19 | -0.002 | -0.80 | -0.140 | .989 | -2.965 | -4.34 | 0.054 | 2.92 | -1.273 | -1.29 | 44.400 | .909 |
| Electric, Gas & Water Utilities | 0.132 | 0.72 | -0.004 | -1.59 | 0.003 | 0.57 | 0.025 | 2.92 | 0.713 | .988 | -2.989 | -5.20 | 0.004 | 0.24 | 2.253 | 1.64 | 41.772 | .788 |
| Transportation, Storage & Communication | 0.441 | 4.06 | -0.001 | -0.65 | 0.009 | 8.00 | -0.012 | -11.11 | 1.227 | .997 | -7.082 | -9.95 | -0.003 | -0.15 | 5.043 | 3.63 | 48.795 | .949 |
| Forestry | 0.802 | 3.21 | 0.017 | 6.59 | -0.001 | -0.74 | -0.006 | -3.14 | 0.448 | .987 | -19.554 | -6.07 | 0.299 | 4.48 | 6.456 | 2.64 | 55.126 | .925 |
| Trade | 0.418 | 1.94 | 0.006 | 1.92 | 0.014 | 3.57 | -0.017 | -1.74 | 0.454 | .977 | -3.429 | -4.03 | 0.011 | 0.83 | -2.319 | -2.45 | 46.454 | .952 |
| Agriculture | 0.016 | 0.85 | 0.002 | 6.13 | 0.0004 | 4.51 | -0.0005 | -2.42 | 0.006 | .988 | -24.478 | -0.80 | 0.109 | 1.42 | -9.260 | -3.29 | 59.179 | .737 |

forestry; mines, milling, and oil wells; manufacturing; construction; electric power, gas and water utilities; transportation, storage and communication; and wholesale and retail trade. The data manipulations described in section 5 were repeated, for each industry, for the variables *H*, *W*, *P* and *C*. The child rearing cost index, *E*, and recreation expenditures, *R*, could not be attributed to particular industries and remain as before.

The results for the individual industry sectors tend to parallel, for the most part, those for the total economy. The productivity variable, for example is positive and significant for Canada and in six of the eight industries, the exceptions being utilities, where the coefficient is insignificant, and forestry where it is negative. Similarly the capacity utilization variable is negative and significant for Canada, and for four of the eight industries, the exceptions being construction and trade, respectively, where it is negative but not significant, and utilities and mining, milling and oil wells, respectively, where it is positive. The child-rearing variable performs reasonably in five of the eight cases. Half of the industries have coefficients for the recreation variable which are insignificant, and in two of these cases the sign is negative.

These latter variables perform less well in stage two, where, however, the only glaring anomalies are the significant negative coefficients for *E* in the case of trade and of agriculture. Without attempting to be overly inventive in explaining these cases we would simply suggest tentatively that the characteristics of working time in these industries may be fairly distinctive in the

following sense. It is possible that the process of family formation may, in the case of retail trade particularly, have contributed to the trend toward part-time employment of low-paid youngsters in lieu of longer hours by full-time staff. In agriculture the process of family formation in many cases means not only extra expense but also additional help which may alleviate somewhat the long hours of the average farm worker.

Finally, it remains to point out that in stage two the computed earnings variable $\hat{W}$ is negative and significant in every case except agriculture, where it has the expected sign but is not significant.

## 7. Concluding Comments

What we hope to have demonstrated in this paper is, first, the economic importance of the hours of work issue and, second, the need to take explicit account of both demand- and supply-side influences in investigating its determinants. In pursuing the latter objective, two earlier studies of the length of the work-week were examined and our replication of the American supply-oriented model, using Canadian data indicated the potential role of supply-side influences in the Canadian context. It was determined that both demand and supply-side variables should, ideally, be incorporated and, accordingly, a two-simultaneous equation system was constructed to take account of both types of influence. The results suggest that some modest success may be claimed for the relationships posited, though the candidacy of the supply variable $E$ is less impressive in the presence of $\hat{W}$ in stage two of the estimation procedure.

To return to the first objective, an attempt was made in the second section to demonstrate the relevance of hours of work as a crucial dimension of the economy's aggregate labour input. The question of hours of work is also an important facet of rather broader social concern with the quality of working life, but it is to the economic aspect that we return for some concluding observations.

First, it is clear from the analysis of section two that, given limits to the growth of aggregate labour supply, further diminution in working hours requires improved productivity performance if aggregate output is to be maintained.

Secondly, the time lost due to sickness, accidents, strikes, absenteeism and turnover for those who are employed[19] further exacerbates the problem of potential aggregate labour input. It is in this context that recent quality of working life initiatives to improve job satisfaction, motivation, and productivity may appropriately be viewed.

Third, recent developments in Canada pose a major quandary for policy-makers, in the following sense. As the chronic unemployment problem proves increasingly insensitive to traditional treatment methods, there has been mounting discussion of policies (a) to discourage overtime and encourage the hiring of more people (b) to 'share' jobs by, for example, fragmenting a job's normal working day or week into segments to be worked by two or more people and (c) to move in the direction of more labour-intensive production processes.

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19 The thorny question of *un*employment is, for the moment, regarded as a prior one -- i.e., with a given level of "employed" labour the number of person-hours is still a crucial variable.

Two main factors, however, militate against such possibilities. In the first place, the heavy fixed costs of additional persons frequently make overtime a more attractive proposition, and the same argument works for work-sharing arrangements. But, secondly, a move to more labour-intensive production methods may serve only to further exacerbate an already worrisome problem of poor productivity performance.

## Appendix I

### ELASTICITIES AND REGRESSION COEFFICIENTS

It was noted in the body of the text that Owen decided to present his results in the form of "percentage change in the dependent variable resulting from a one per cent change in a given explanatory variable". To understand the relationship between this form of presentation, really just elasticities, and regression coefficients, observe the following:

Let $Y$ = the dependent variable, and $X_i$ = one of the regressors. Given, elasticity $N = \%\Delta Y \div \%\Delta X_i = \frac{\Delta Y}{Y} \div \frac{\Delta X_i}{Xi} = \frac{\Delta Y}{\Delta X_i} \cdot \frac{X_i}{Y}$.

If we regress $Y$ on $X_i$, we obtain the coefficient $b_i = \frac{\Delta Y}{\Delta X_i}$.

Therefore $N = b_i \cdot \frac{Xi}{Y}$.

If we arbitrarily take $X_i = \bar{X}_i$ and $Y = \bar{Y}$, then $N = b_i \cdot \frac{\bar{X}_i}{\bar{Y}}$.

If we are seeking the resulting percentage change in $Y$ per <u>one</u> per cent change in $X_i$ ($\%\Delta X_i = 1$), the solution would be $\%\Delta Y = b_i \cdot \frac{\bar{X}_i}{\bar{Y}}$

## Appendix II

### CHILD-REARING COST INDEX

Having established that there is more to raising children than just educating them, a more elaborate index has been conceived. We pinpointed four areas of concern as follows: feeding, clothing, healing and educating. The calculations involved the use of the appropriate component of the 1961-based Consumer Price Index, and weights based on 1967 consumer expenditure patterns.[1] A series for the actual components existed for all areas since 1949 with the exception of education for which we used an index of a CANSIM series entitled "personal expenditures on consumer education and cultural services", put in real and per capita terms.

Using the CPI weights, we established new weights to sum to 1.00 in a separate child-rearing basket. A weighted sum was formed and then divided by the CPI, to approximate the relative cost of raising a child. The calculations appear in Table 7.

Table 7
CALCULATION OF CHILD-REARING INDEX

| Area | Representative Series | CANSIM Series No. | CPI Weight | Weight in Child-Rearing Basket |
|---|---|---|---|---|
| Food F | Baby food component of 1961 CPI | D626202 | .1412 | .04999 |
| Clothing C | Child wear component of 1961 CPI | D626335 | 1.4548 | .51510 |
| Healing H | Fillings component of 1961 CPI | D625405 | .5562 | .19693 |
| Schooling S | Index of real personal expenditures on education | D31394 | .6721* | .23797 |
| | | | 2.8243 | 1.00000 |

$E = (.04999F + .51510C + .19693H + .23797S)/CPI.$

* The weight was first established in 1967 and not before. It is the tuition fees component weight of the current CPI.

1. The weights were obtained from Statistics Canada, *The Consumer Price Index for Canada*, Cat. No. 62-539, occasional.

## Appendix III

## CAPACITY UTILIZATION RATES

Our calculation for the annual capacity utilization series is an extension of the work done by the National Wealth and Capital Stock Section of the Construction Division at Statistics Canada.[1] We expanded the time horizon back from 1961 to 1946 and undertook the analysis for the total domestic economy and an eight-industry disaggregation. The method used is as follows:

(1) Obtain estimates of the gross capital stock, $K_i$,[2] from the series on mid-year capital stock available in CANSIM No. D877919.

(2) Form a series of capital-output ratios $K_i/Q_i$. We obtained the output series, Q, by multiplying each year of the 1961 based index of Real Domestic Product by actual 1961 value of RDP.[3]

(3) Find the minimum $K_i/Q_i$, say $(K/Q)^*$, which indicates the historical capacity peak.

(4) Divide the capital stock series by the minimum ratio from Step (3) $(K_i \div (K_i/Q_i)^*)$ to obtain a series of potential output $Q_i^P$.

(5) Finally we divide the actual output $Q_i$ by the potential output $Q_i^P$ to come up with a series of annual capacity utilization.

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1 Statistics Canada, *Capacity Utilization Rates ... op.cit.*

2 Available on CANSIM, Starting Matrix 3383.

3 The 1961 actual value of RDP is found in Statistics Canada Cat. No. 61-510, pp. 86-89. The *index* is available on CANSIM Matrix No. 383.

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