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EFFECTS OF WAGE PARITY BETWEEN CANADA AND THE UNITED STATES ON THE CANADIAN ECONOMIC GROWTH: SIMULATION EXPERIMENTS WITH A MACRO- MODEL

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Discussion Paper No. 5

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I. Introduction

In 1968 the United Auto Workers demanded a wage-parity between the Canadian and American workers in the automobile industries, and in the same year a similar demand was put forth by the air-pilot union in its wage negotiation with the Air Canada. This wage-parity issue may become more frequent in the future because many of the Canadian unions are closely tied with their American counterparts. If the wage-parity is introduced, what and how severe will be its effects on the prices and on the Canadian economic growth ?

The present paper attempts to give some answers to this question. Recently the author built a four-sector macro model of the Canadian economy [8]. The four sectors consist of (1) agriculture, fishing and forestry, (2) mining and manufacturing, (3) construction, and (4) utilities, transportation, trade, finance, public administration and other services. Using a subset of the model we will make simulation experiments to examine possible effects of the wage-parity on the economic growth and on the price

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levels, and in general we find that the wage-parity tends to cause higher prices and slower economic growth.

In section II we present the model and in section III we discuss the estimated equations. Section IV gives the simulation results assuming the wage-parity is to start in 1969, and the wage-parity effects are compared against nonwage-parity simulation results. The period of simulation exercises is from 1969 to 1975.

II. The Model

Annual data from 1947 to 1967 are used for the estimation. In an earlier stage of the estimation it was found that a large number of distrubance terms tended to be autocorrelated judged by the values of the Durbin-Watson test statistics. To cope with this problem we employed the modified Sargan's two-stage least squares procedure (MS2SLS) given by Amamiya [1], and we used Dhrymes' scanning method [2] to estimate the coefficients of the first-order autocorrelation. The equations involving the gamma distributed lags [9] are estimated by the nonlinear least squares procedure (NLLS) given in [7], and the rest of the equations are estimated by the two-stage least squares (2SLS) or by the ordinary least squares (OLS).

In the model $\bar{R}^2$ and DW denote respectively the coefficient of determination corrected for degrees of freedom and the Durbin-Watson test statistic. The figure in parentheses below each estimated coefficient indicates the value of t-test.

All variables are defined in alphabetical order at the end of this section. Z in the gamma distributed lags is given by $Z = \sum_{k=1}^{20} k^{s-1}e^{-k}$.

Consumption functions

(1) $$Cnd/N - .5(Cnd/N)_{-1} = \underset{(10.31)}{.3008}[(Y_d/P_dN) - .5(Y_d/P_dN)_{-1}]$$

$$- \underset{(3.44)}{.2428}[P_{nd}/P - .5(P_{nd}/P)_{-1}] + \underset{(4.47)}{.2346}$$

$\bar{R}^2 = .960$
DW = 1.96
MS2SLS

(2) $$Cd/N = \underset{(.37)}{.0100}[\frac{1}{Z} \sum_{k=1}^{6} k^{s-1}e^{-k}(Y_d/P_dN)_{-k+1}] - \underset{(16.9)}{.1609}(P_{cd}/P)$$

$$+ \underset{(59.13)}{.4212}(Cd/N)_{-1} + \underset{(44.13)}{.2359}$$

$s = \underset{(72.94)}{1.9912}$

$\bar{R}^2 = .944$
DW =1.66
NLLS

(3) $$Cs/N = \underset{(1.73)}{.0870}(Y_d/P_dN) - \underset{(.35)}{.0179}(P_s/P) + \underset{(4.09)}{.7686}(Cs/N)_{-1} + \underset{(.47)}{.0152}$$

$\bar{R}^2 = .984$
DW = 1.91
2SLS

Investment functions

(4) $$I_{pa} = \underset{(3.46)}{.4829}[\frac{1}{Z} \sum_{k=1}^{7} k^{s-1}e^{-k}V_{a,-k+1}] + \underset{(.39)}{108.0443}(V_a/V_a^*)_{-1}$$

$$- \underset{(1.39)}{.0605} K^u_{a,-1} - \underset{(1.70)}{336.2051}$$

$$s=\underset{(2.02)}{1.5574} \qquad \bar{R}^2 = .631 \quad DW=.80 \quad NLLS$$

(5) $$I_{pm} = \underset{(1.55)}{.5359}\left[\frac{1}{Z}\sum_{k=1}^{7} k^{s-1}e^{-k}\, V_{m,-k+1}\right]$$

$$+ \underset{(.15)}{.1122}\left[\frac{1}{Z}\sum_{k=1}^{7} k^{s-1}e^{-k}(D_I/P_k)_{-k+1}\right]$$

$$+\underset{(1.06)}{1993.9756}(V_m/V_m^*)_{-1} - \underset{(.76)}{.2487}K^u_{m,-1} \underset{(1.63)}{-2655.5776}$$

$$s=\underset{(1.17)}{2.0106} \qquad \bar{R}^2 = .851 \quad DW = 1.23 \quad NLLS$$

(6) $$I_{pc} = \underset{(2.08)}{.2018}\left[\frac{1}{Z}\sum_{k=1}^{7} k^{s-1}e^{-k}\, V_{c,-k+1}\right]$$

$$\underset{(.47)}{-14.6544}\left[\frac{1}{Z}\sum_{k=1}^{7} k^{s-1}e^{-k}\, i_{L,-k+1}\right]$$

$$\underset{(.89)}{-.1134}\, K^u_{c,-1} \quad \underset{(.31)}{-18.1747}$$

$$s=\underset{(1.90)}{1.9688} \qquad \bar{R}^2 = .533 \quad DW = 1.22 \quad NLLS$$

(7) $$I_{psg} - G_I/P_k = \underset{(1.47)}{.3382}\left[\frac{1}{Z}\sum_{k=1}^{7} k^{s-1}e^{-k}\, V_{s,-k+1}\right]$$

$$+\underset{(1.23)}{1.7683}\left[\frac{1}{Z}\sum_{k=1}^{7} k^{s-1}e^{-k}(D_I/P_k)_{-k+1}\right]$$

$$- \underset{(1.15)}{.1447}(K^u_{sg,-1} - K^u_{g,-1}) \underset{(1.43)}{-893.0647}$$

$$s=\underset{(2.04)}{2.5795} \qquad \bar{R}^2 = .846 \quad DW = .70 \quad NLLS$$

(8) $$I_h = \underset{(13.05)}{8.2225}\left[\frac{1}{Z}\sum_{k=1}^{6} k^{s-1}e^{-k}\, I^s_{h,-k+1}\right] + \underset{(4.94)}{377.2559}$$

$s= \underset{(1.19)}{.7399}$

$\bar{R}^2 = .896$
DW =1.13
NLLS

(9) $$I^s_h = \underset{(1.33)}{.0532}\left[\frac{1}{Z}\sum_{k=1}^{6} k^{s-1}e^{-k}(MTG/P_h)_{-k+1}\right] + \underset{(8.83)}{75.0933}$$

$\bar{R}^2 = .724$
DW =1.54
NLLS

$s= \underset{(2.56)}{2.4947}$

(10) $$MTG/P_h = \underset{(2.00)}{.1482}\left[\frac{1}{Z}\sum_{k=1}^{6} k^{s-1}e^{-k}(Y_d/P_d)_{-k+1}\right]$$

$$-\underset{(1.96)}{313.7134}\, i_L - \underset{(.44)}{210.2276}$$

$\bar{R}^2 = .716$
DW = .124
NLLS

$s= \underset{(.75)}{3.500}$

(11) $$\Delta I_{in}/P_k - .45(\Delta I_{in}/P_k)_{-1} = \underset{(4.90)}{.1720}[GNP/P - .45(GNP/P)_{-1}]$$

$$- \underset{(4.81)}{.7699}[I_{in,-1} - .45\, I_{in,-2}] - \underset{(4.09)}{1376.9768}$$

$\bar{R}^2 = .575$
DW = 2.04
MS2SLS

__Export and import functions__

(12) $$X_a = \underset{(4.01)}{2.5194}\, Y^W + \underset{(.84)}{.1813}\, X_{a,-1} + \underset{(14.41)}{182.2718}$$

$\bar{R}^2 = .848$
DW = 2.24
OLS

(13) $$X_m - .2X_{m,-1} = \underset{(8.70)}{21.1321}[Y^W - .2\ Y^W_{-1}]$$

$$-\underset{(1.61)}{7222.7031}[P_m/P^W_m - .2(P_m/P^W_m)_{-1}] + \underset{(1.03)}{4123.0938}$$

$\bar{R}^2 = .852$
DW =1.27
MS2SLS

(14) $$F_m = \underset{(4.12)}{.1690}\ (Y_d/P_d) + \underset{(2.27)}{8246.0273}(P_m/P^F_m\ )$$

$$+ \underset{(3.35)}{.5573}\ F_{m,-1} - \underset{(3.12)}{9863.2656}$$

$\bar{R}^2 = .961$
DW =1.58
2SLS

(15) $$F_s = \underset{(6.73)}{.0805}\ (Y_d/P_d) + \underset{(2.83)}{1754.2883}\ (P_s/P^F_s) - \underset{(2.61)}{958.4468}$$

$\bar{R}^2 = .960$
DW =1.86
2SLS

(16) $$F'_I - .65\ F'_{I,-1} = \underset{(2.68)}{.0084}\Big\{[\sum_{i=0}^{5}(D_I + PI)_{-k}]i_L]$$

$$-.65[\sum_{i=1}^{6}(D_I + PI)_{-k}]i_{L,-1}\Big\} + \underset{(3.97)}{131.1133}$$

$\bar{R}^2 = .850$
DW =1.54
MS2SLS

<u>Wage equations</u>

(17)
$$w_a - .35\, w_{a,-1} = \underset{(2.15)}{-2.0727}[un - .35un_{-1}]$$
$$+ \underset{(6.51)}{.0187}[P_d - .35P_{d,-1}]$$
$$+ \underset{(2.02)}{.0604}[V_a/L_a - .35(V_a/L_a)_{-1}] \underset{(6,64)}{-.8273}$$

$\bar{R}^2 = .946$
DW = 1.31
MS2SLS

(18)
$$w_m - .7w_{m,-1} = \underset{(\ .89)}{-2.3744}[un - .7un_{-1}]$$
$$+ \underset{(2.33)}{.2853}[V_m/L_m - .7(V_m/L_m)_{-1}] + \underset{(4.30)}{.4558}[w_m^{US} - .7w_{m,-1}^{US}]$$
$$- \underset{(.24)}{.0377}$$

$\bar{R}^2 = .818$
DW =1.19
MS2SLS

(19)
$$w_c - .95\, w_{c,-1} = \underset{(1.50)}{-3.6575}[un - .95un_{-1}]$$
$$+ \underset{(7.79)}{.5599}[V_c/L_c - .95(V_c/L_c)_{-1}] + \underset{(6.40)}{1.2405}[w_c^{US}$$
$$- .95\, w_{c,-1}^{US}] - \underset{(3.96)}{.3664}$$

$\bar{R}^2 = .882$
DW =1.24
MS2SLS

(20)
$$w_s - .55\, w_{s,-1} = \underset{(.27)}{.0536}[V_s/L_s - .55(V_s/L_s)_{-1}]$$
$$+ \underset{(15.29)}{.6324}[w_s^{US} - .55w_{s,-1}^{US}] - \underset{(.22)}{.0901}$$

$\bar{R}^2 = .974$
DW =1.97
MS2SLS

Price equations

(21) $$P_a - .25\,P_{a,-1} = \underset{(3.84)}{1.8356}[w_aL_a/V_a - .35(w_aL_a/V_a)_{-1}] + \underset{(4.19)}{.4699}[V_a/V_a^* - .35(V_a/V_a^*)_{-1}] + \underset{(.83)}{.1080}$$

$\bar{R}^2 = .615$
DW =1.30
MS2SLS

(22) $$P_m - .45\,P_{m,-1} = \underset{(2.85)}{.7307}[w_mL_m/V_m - .45(w_mL_m/V_m)_{-1}] + \underset{(1.47)}{.1386}[V_m/V_m^* - .45(V_m/V_m^*)_{-1}] + \underset{(2.82)}{.6463}[P_m^{US} - .45P_{m,-1}^{US}] - \underset{(1.46)}{.1189}$$

$\bar{R}^2 = .868$
DW =1.75
MS2SLS

(23) $$P_c - .95P_{c,-1} = \underset{(6.39)}{.5104}[w_cL_c/V_c - .95(w_cL_c/V_c)_{-1}] + \underset{(1.77)}{.1451}[P_m - .95\,P_{m,-1}] + \underset{(1.62)}{.0544}[V_c/V_c^* - .95(V_c/V_c^*)_{-1}] + \underset{(6.48)}{.0408}$$

$\bar{R}^2 = .829$
DW =1.41
MS2SLS

(24) $$P_s - .85P_{s,-1} = \underset{(1.89)}{.4230}[w_sL_s/V_s - .85(w_sL_s/V_s)_{-1}] + \underset{(.80)}{.1003}[V_s/V_s^* - .85(V_s/V_s^*)_{-1}] + \underset{(3.79)}{.6827}[P_s^{US} - .85P_{s,-1}^{US}] - \underset{(.10)}{.0021}$$

$\bar{R}^2 = .907$
DW =2.00
MS2SLS

(25) $$P_{nd} - .35P_{nd,-1} = \underset{(14.14)}{.6453}[(wgt_1P_s + wgt_2P_m) - .35(wgt_1P_s + wgt_2P_m)_{-1}] \underset{(8.01)}{+.2417}$$

$wgt_1 = C_s/(C_{nd}+C_s)$

$wgt_2 = 1 - wgt_1$

$\bar{R}^2 = .913$
DW =1.25
MS2SLS

(26) $$P_{cd} - .45\,P_{cd,-1} = \underset{(1.74)}{.3984}[P_m - .45P_{m,-1}] \underset{(2.53)}{+.3272}$$

$\bar{R}^2 = .477$
DW =2.04
MS2SLS

(27) $$P_h - .95\,P_{h,-1} = \underset{(15.76)}{1.1705}[P_c - .95\,Pc_{,-1}] \underset{(1.67)}{-.0170}$$

$\bar{R}^2 = .930$
DW =1.84
MS2SLS

(28)* $$P_k - .95\,P_{k,-1} = \underset{(9.66)}{.6354}[(.4697P_m + .5303P_c) - .95(.3697P_m + .5303P_c)_{-1}] \underset{(5.84)}{+.0334}$$

$\bar{R}^2 = .837$
DW =1.15
MS2SLS

<u>Labor force participation and shares of available labor</u>

(29) $$Lsup/N = \underset{(7.84)}{.1810}(Y_d/P_dN) - \underset{(8.28)}{.0684}(w/P_d) + \underset{(32.22)}{.3106}$$

$\bar{R}^2 = .779$
DW =1.35
2SLS

*The weight of .4697 is the ratio of new machinery and equipment investment in the National Income Accounts to I_p in 1967.

(30) $$L^A_m/L^A - .5(L^A_m/L^A)_{-1} = \underset{(1.57)}{.1533}[V_m/V - .5(V_m/V)_{-1}] \underset{(1.40)}{-.0174}[w_m/w - .5(w_m/w)_{-1}] \underset{(6.08)}{+.1214}$$

$\bar{R}^2 = .811$
DW =1.46
MS2SLS

(31) $$L^A_c/L^A - .8(L^A_c/L^A)_{-1} = \underset{(2.25)}{.2683}[V_c/V - .8(V_c/V)_{-1}] \underset{(2.72)}{-.0193}[w_c/w - .8(w_c/w)_{-1}] + \underset{(10.57)}{.0156}$$

$\bar{R}^2 = .873$
DW= 1.19
MS2SLS

(32) $$L^A_s/L^A - .35(L^A_s/L^A)_{-1} = \underset{(5.26)}{1.6924}[V_s/V - .35(V_s/V)_{-1}] \underset{(6.98)}{-.7225}[w_s/w - .35(w_s/w)_{-1}] + \underset{(1.81)}{.2300}$$

$\bar{R}^2 = .777$
DW =1.33
MS2SLS

<u>Production functions</u>

(33) $$\ln(V_a/L_a) - .55 \ln(V_a/L_a)_{-1} = \underset{(5.30)}{.8758}[\ln(K^u_a/L_a) - .55 \ln(K^u_a/L_a)_{-1}] \underset{(1.38)}{-.1792}$$

$\bar{R}^2 = .861$
DW = 2.11
MS2SLS

(34) $$\ln V_m - .6 \ln V_{m,-1} = \underset{(1.16)}{.4379}[\ln L_m - .6 \ln L_{m,-1}] + \underset{(3.76)}{.6956}[\ln K^u_m - .6 \ln K^u_{m,-1}] - \underset{(.36)}{.2000}$$

$\bar{R}^2 = .888$
DW =1.54
MS2SLS

(35) $$\ln V_c - .55 \ln V_{c,-1} = \underset{(1.71)}{.5417}[\ln L_c - .55 \ln L_{c,-1}] + \underset{(3.41)}{.5119}[\ln K^u_c - .55 \ln K^u_{c,-1}] + \underset{(.47)}{.3201}$$

$\bar{R}^2 = .904$
DW =1.55
MS2SLS

(36) $$\ln V_s - .05 \ln V_{s,-1} = \underset{(22.52)}{1.1052}[\ln L_s - .05 \ln L_{s,-1}] + \underset{(2.92)}{.0714}[\ln K^u_{sg} - .05 \ln K^u_{sg,-1}] + \underset{(.59)}{.1030}$$

$\bar{R}^2 = .996$
DW =1.60
MS2SLS

<u>Capacity production functions</u>

(37) $$\ln(V^*_a/L^A_a) = .8758[\ln(K_a/L^A_a) - .55 \ln(K_a/L^A_a)_{-1}] - .1792 + .55 \ln(V^*_a/L^A_a)_{-1}$$

(38) $$\ln V^*_m = .4379[\ln L^A_m - .6 \ln L^A_{m,-1}] + .6956[\ln K_m - .6 \ln K_{m,-1}] - .2000 + .6 \ln V^*_{m,-1}$$

(39) $$\ln V^*_c = .5417[\ln L^A_c - .55 \ln L^A_{c,-1}] + .5119[\ln K_c - .55 \ln K_{c,-1}] + .3201 + .55 \ln V^*_{c,-1}$$

(40) $$\ln V^*_s = 1.1052[\ln L^A_s - .05 \ln L^A_{s,-1}] + .0714[\ln K_{sg} - .05 \ln K_{sg,-1}] + .1030 + .05 \ln V^*_{s,-1}$$

<u>Short- and long-term interest rate equations</u>

(41) $$i_s = \underset{(8.30)}{.8805}\, i_D + \underset{(3.01)}{13.7536}\left[\frac{TRB + DTDL}{TCA}\right] - \underset{(5.50)}{1.0180}$$

$\bar{R}^2 = .951$
DW =2.15
OLS

(42) $$i_L = \underset{(.44)}{.0937}\, i_s + \underset{(2.75)}{.8855}\, i_{L,-1} + \underset{(.49)}{.5406}$$

$\bar{R}^2 = .815$
DW = 1.90
2SLS

<u>Sectoral domestic product equations</u>

(43) $$V_a^d - .95\, V_{a,-1}^d = \underset{(1.19)}{.0336}[GNP/P - .95(GNP/P)_{-1}]$$

$$- \underset{(1.85)}{.4164}[V_{a,-1}^d - .95\, V_{a,-2}^d] - \underset{(4.11)}{.3673}[WETH - .95\, WETH_{-1}]$$

$$+ \underset{(1.97)}{.3143}[(\Delta I_{ia}/P_a)_{-1} - .95(\Delta I_{ia}/P_a)_{-2}] - \underset{(.48)}{43.0294}$$

$\bar{R}^2 = .607$
DW =1.92
MS2SLS

(44) $$V_m^d - .5\, V_{m,-1}^d = \underset{(1.18)}{.0447}[(C_d + C_{nd} + I_p + G_I/P_k)$$

$$- .5(C_d + C_{nd} + I_p + G_I/P_k)_{-1}] + \underset{(3.19)}{1271.3252}$$

$\bar{R}^2 = .646$
DW =1.16
MS2SLS

(45) $$V_c - .45\, V_{c,-1} = \underset{(10.71)}{.1669}[(I_p + I_h + G_I/P_k)$$

$$- .45(I_p + I_h + G_I/P_k)_{-1}] + \underset{(2.35)}{174.8186}$$

$\bar{R}^2 = .858$
DW =1.68
MS2SLS

(46) $$V_s = \underset{(27.68)}{.6435}(Y_d/P_d) + \underset{(1.67)}{.1917}(G_s/P_s) + \underset{(4.60)}{732.8945}$$

$\bar{R}^2 = .998$
DW =2.39
2SLS

<u>Depreciation, corporate savings and interest payment eauations</u>

(47) $$D - .95\,D_{-1} = \underset{(4.17)}{.1457}[P_k I - .95(P_k I)_{-1}] + \underset{(7.53)}{213.9404}$$

$\bar{R}^2 = .996$
DW =2.35
MS2SLS

(48) $$S_c - .15\,S_{c,-1} = \underset{(29.58)}{.1427}[(P_m V_m + P_c V_c + P_s V_s)$$

$$-.15(P_m V_m + P_c V_c + P_s V_s)_{-1}] + \underset{(.59)}{72.5772}$$

$\bar{R}^2 = .844$
DW =2.08
MS2SLS

(49) $$IPD = \underset{(6.62)}{172.5668}\,i_L + \underset{(10.61)}{.1876}\,B_g - \underset{(14.00)}{2596.3789}$$

$\bar{R}^2 = .966$
DW =1.51
MS2SLS

<u>Taxes and transfer payment equations</u>

(50) $$T_p - .79\,T_{p,-1} = \underset{(14.87)}{.2198}[W - .79\,W_{-1}] - \underset{(4.54)}{326.8604}$$

$\bar{R}^2 = .921$
DW =1.88
MS2SLS

(51) $$T_I - .65\,T_{I,-1} = \underset{(38.55)}{.1558}[GNP - .65\,GNP_{-1}] - \underset{(6.28)}{367.7986}$$

$\bar{R}^2 = .987$
DW=2.49
MS2SLS

(52) $$T_r - .8\,T_{r,-1} = \underset{(3.39)}{16457.0977}[un - .8\,un_{-1}]$$

$$-\underset{(.96)}{1136.4885}[\Delta GNP/GNP - .8(\Delta GNP/GNP)_{-1}]$$

$$+\underset{(12.14)}{.1314}[GNP - .8\,GNP_{-1}] - \underset{(4.38)}{539.6538}$$

$\bar{R}^2 = .887$
DW =1.99
MS2SLS

Identities

(53) $$L^A = L\,\frac{1 - uf}{1 - un}$$

(54) $$L_a^A/L^A = 1 - (L_m^A + L_c^A + L_s^A)/L^A$$

(55) $$K_a^u = \sum_{j=0}^{9}(.934)^j I_{pa,-j}$$

(56) $$K_m^u = \sum_{j=0}^{9}(.934)^j I_{pm,-j}$$

(57) $$K_c^u = \sum_{j=0}^{9}(.934)^j I_{pc,-j}$$

(58) $$K_{sg}^u = \sum_{j=0}^{9}(.934)^j I_{psg,-j}$$

(59) $$K_g^u = \sum_{j=0}^{9}(.934)^j (G_I/P_k)_{-j}$$

(60) $$K_a = K_a^u\,\frac{L_a^A}{L_a}$$

(61) $$K_m = K_m^u\,\frac{L_m^A}{L_m}$$

(62) $$K_c = K_c^u\,\frac{L_c^A}{L_c}$$

(63) $$K_{sg} = K^{u}_{sg} \frac{L^{A}_{s}}{L_s}$$

(64) $$P_x = (P_a X_a + P_m X_m)/X$$

(65) $$C = C_{nd} + C_d + C_s$$

(66) $$I_p = I_{pa} + I_{pm} + I_{pc} + (I_{pgs} - G_I/P_k)$$

(67) $$P_k I = P_k I_p + P_h I_h$$

(68) $$\Delta I_i = \Delta I_{in} + \Delta I_{ia}$$

(69) $$I_{in} = I_{in,-1} + \Delta I_{in}/P_k$$

(70) $$X = X_a + X_m$$

(71) $$F = F_m + F_s + F_i'/P_F$$

(72) $$GNP/P = C + I + \Delta I_{in}/P_k + \Delta I_{ia}/P_a + X - F + G_{const} + S_e/P$$

(73) $$I = I_p + I_h$$

(74) $$W = w_a L_a + w_m L_m + w_c L_c + w_s L_s$$

(75) $$w = W/L$$

(76) $$L = L_a + L_m + L_c + L_s$$

(77) $$U = L_{sup} - L$$

(78) $$un = U/L_{sup}$$

(79) $$V = V_a + V_m + V_c + V_s$$

(80) $$GNP = P_{nd} C_{nd} + P_{cd} C_d + P_s C_s + P_k I_p + P_h I_h + \Delta I_i + P_x X - P_F F + G + S_e$$

(81) $Y_d = NI - T_p + T_r + IPD - S_c$

(82) $NI = GNP - T_I - D - S_e$

(83) $P_d = (P_{nd}C_{nd} + P_{cd}C_d + P_sC_s)/C$

(84) $P = GNP/(GNP/P)$

(85) $V_a = V_a^d + X_a$

(86) $V_m = V_m^d + X_m$

<u>List of Variables</u>

A variable with an asterisk on the upper left hand side is endogenous to the system.

B_g = unamortized government bonds, millions of current dollars

*C = total consumption, millions of 1957 dollars

*C_d = durable consumption, millions of 1957 dollars

*C_{nd} = nondurable consumption, millions of 1957 dollars

*C_s = consumption of services, millions of 1957 dollars

*D = depreciation, millions of current dollars

D_I = net direct foreign investment, millions of current dollars

DTDL = day-to-day loans, millions of current dollars

* F = total imports, millions of 1957 dollars

*F_i' = interest and dividend payments to the foreigners, millions of current dollars

*F_m = imports of mining and manufacturing goods, millions of 1957 dollars

*F_s = imports of other goods and services, millions of 1957 dollars

G = total government expenditures, millions of current dollars

G_{const} = total government expenditures, millions of 1957 dollars

G_I = government investment expenditures, millions of current dollars

*GNP = gross national product, millions of 1957 dollars

G_s = government expenditures on services, millions of current dollars

*I = total gross investment, millions of 1957 dollars

*I_h = new residential construction, millions of 1957 dollars

*I_h^s = housing starts, thousands of units

*I_p = new nonresidential oncstruction, new machinery and equipment investment in all sectors, millions of 1957 dollars

*I_{pa} = plant, machinery and equipment in agriculture, fishing and forestry, millions of 1957 dollars

*I_{pc} = plant, machinery and equipment investment in construction, millions of 1957 dollars

*IPD = interest on the public debt, millions of current dollars

*I_{pm} = plant, machinery and equipment investment in mining and manufacturing, millions of 1957 dollars

*I_{psg} = plant, machinery and equipment investment in services including government capital formation, millions of 1957 dollars

IVA = inventory value adjustment, millions of current dollars

i_D = discount rate, percentage

*i_L = long-term interest rate, percentage

*i_s = short-term interest rate, percentage

*ΔI_i = changes in total inventories, millions of current dollars

*ΔI_{ia} = changes in farm inventories, millions of current dollars

*ΔI_{in} = changes in nonfarm business inventories, millions of current dollars

$*K_a$ = net capital stock in agriculture, fishing and forestry, millions of 1957 dollars

$*K_c$ = net capital stock in construction, millions of 1957 dollars

$*K_m$ = net capital stock in mining and manufacturing, millions of 1957 dollars

$*K_{sg}$ = net capital stock in services, millions of 1957 dollars

$*K^u_a$ = net capital stock utilized in agriculture, fishing and forestry, millions of 1957 dollars

$*K^u_c$ = net capital stock utilized in construction, millions of 1957 dollars

$*K^u_g$ = net government capital stock utilized, millions of 1957 dollars

$*K^u_m$ = net capital stock utilized in mining and manufacturing, millions of 1957 dollars

$*K^u_{sg}$ = net capital stock utilized in services (including government capital formation), millions of 1957 dollars

$*L$ = total employment, 1000 of persons

$*L_a$ = employment in agriculture, fishing and forestry, 1000 of persons

$*L_c$ = employment in construction, 1000 of persons

$*L_m$ = employment in mining and manufacturing, 1000 of persons

$*L_s$ = employment in services, 1000 of persons

$*L^A$ = total available labor force, 1000 of persons

$*L^A_a$ = available labor in agriculture, fishing and forestry, 1000 of persons

$*L^A_c$ = available labor in construction, 1000 of persons

$*L^A_m$ = available labor in mining and manufacturing, 1000 of persons

$*L_s^A$ = available labor in services, 1000 of persons

*MTG = all housing mortgage loans approved by lending institutions, millions of current dollars

N = Canadian population, thousands of persons

*NI = net national income, millions of current dollars

*P = price index of gross national product, 1957=1.0

$*P_a$ = price index of agriculture, fishing and forestry,1957=1.0

$*P_c$ = price index of construction, 1957=1.0

$*P_{cd}$ = price index of durable goods, 1957=1.0

$*P_d$ = price index of personal expenditures on consumer goods, 1957=1.0

P_F = price index of total imports, 1957=1.0

$*P_h$ = price index of residential construction, 1957=1.0

PI = net long-term portfolio investment, millions of current dollars

$*P_k$ = price index of investment, 1957=1.0

$*P_m$ = price index of mining and manufacturing, 1957=1.0

P_m^F = import price index of mining and manufacturing goods, 1957=1.0

P_m^W = world price index of mining and manufacturing goods, 1957=1.0

$*P_{nd}$ = price index of nondurable goods, 1957=1.0

$*P_s$ = price index of services, 1957=1.0

P_s^F = import price index of services, 1957=1.0

P_s^{US} = price index of services in the United States,1957=1.0

P_m^{US} = price index of mining and manufacturing in the United States, 1957=1.0

$*P_x$ = price index of total exports, 1957=1.0

$*S_c$ = earnings not paid out to persons, millions of current dollars

S_e = residual error of estimate, millions of current dollars

TCA = total Canadian and net foreign assets in Canadian chartered banks, millions of current dollars

$*T_I$ = indirect taxes, millions of current dollars

$*T_p$ = personal direct taxes, millions of current dollars

$*T_r$ = transfer payments, millions of current dollars

TRB = treasury bills, millions of current dollars

uf = frictional unemployment rate, percentage

*un = unemployment rate, percentage

*V = gross domestic product, millions of 1957 dollars

$*V_a$ = gross domestic product originating in agriculture, fishing and forestry, millions of 1957 dollars

$*V_a^d$ = domestic demand for gross domestic product originating in agriculture, fishing and forestry, millions of 1957 dollars

$*V_c$ = gross domestic product originating in construction, millions of 1957 dollars

$*V_m$ = gross domestic product originating in mining and manufacturing, millions of 1957 dollars

$*V_m^d$ = domestic demand for gross domestic product, originating in mining and manufacturing, millions of 1957 dollars

$*V_s$ = gross domestic product originating in services, millions of 1957 dollars

$*V_a^*$ = capacity production of agriculture, fishing and forestry, millions of 1957 dollars

$*V_c^*$ = capacity production of construction, millions of 1957 dollars

$*V_m^*$ = capacity production of mining and manufacturing, millions of 1957 dollars

$*V_s^*$ = capacity production of services, millions of 1957 dollars

*W = wages, salaries and supplementary labor income, millions of current dollars

*w = aggregate wage rate, thousands of current dollars

$*w_a$ = wage rate in agriculture, fishing and forestry, thousands of current dollars

$*w_c$ = wage rate in construction, thousands of current dollars

WETH = weather adjustment for agricultural output, millions of 1949 dollars

$*w_m$ = wage rate in mining and manufacturing, thousands of current dollars

$*w_s$ = wage rate in services, thousands of current dollars

w_c^{US} = wage rate in United States construction, thousands of current U.S. dollars

w_m^{US} = wage rate in United States mining and manufacturing, thousands of current U.S. dollars

w_s^{US} = wage rate in United States services, thousands of current U.S. dollars

$*X$ = total exports, millions of 1957 dollars

$*X_a$ = exports of agriculture, fishing and forestry, millions of 1957 dollars

$*X_m$ = exports of mining and manufacturing goods, millions of 1957 dollars

$*Y_d$ = disposable income, millions of current dollars

Y^W = weighted national income of the United States, United Kingdom and Japan: weights being the ratios of Canadian exports to these countries to the total Canadian exports, billions of 1958 dollars.

III Discussion of the Equations

Consumption: The consumption sector follows the national account classification of nondurable, durable, and services, and per capita consumption is estimated for each category. The per capita consumption functions are simply based on the real per capita income and on the relative prices. Since the model is based on annual data it may be plausible to say that current real income is the major determinant of consumption except for durable goods. In this case consumption is likely to be influenced by the current as well as past income in some weighted fashion. To determine the weights of the lags on the part of income, we introduced gamma distributed lags proposed in [9], and the estimated time form of lags is presented in Table 1.

Table 1 The Distributed Lag Coefficients of the Durable Consumption Equation

$\frac{1}{Z} k^{s-1} e^{-k}$ s= 1.9912

lagged periods	coefficients
0	.4017
1	.2938
2	.1615
3	.0790
4	.0363
5	.0160
6	.0069

Investment functions: "Business gross fixed capital formation" in the national income accounts are divided into residential construction, I_h, and plant (i.e. nonresidential construction), machinery and equipment, I_p. The latter is further broken down to four sectors. If we denote net investment by IN, and if we introduce an overall stock adjustment of the form such as in [4: p.25], then IN will be given as

$$(87) \qquad IN = \lambda(K^* - K_{-1}) + \gamma C_{p,-1}$$

where λ, K^*, K_{-1} and $C_{p,-1}$ are respectively, an adjustment coefficient, desired capital stock, lagged capital stock and lagged capacity utilization rate. Gross investment, IG, is related to net investment, IN, by the following identity if we assume a depreciation rate of δ,

(88) $$IG = IN + \delta K_{-1}$$

Substituting (88) into (87), we obtain

(89) $$IG = \lambda K^{*} - (\lambda - \delta)K_{-1} + \gamma C_{p,-1}.$$

We make a hypothesis that desired capital stock, K^{*}, is determined by

(90) $$K^{*} = \sum_{j=1}^{m} p_{-j}(\alpha V_{-j+1} + \beta F_{-j+1})$$

where V and F are output and a financial variable respectively, and the distributed lag coefficients $\{p_j\}$ is given by the gamma distributed lags:

$$p_j = j^{s-1}e^{-j}.$$

Substitution of (90) into (89) gives rise to

(91) $$IG = \alpha\lambda\sum_{j=1}^{m} p_{-j}V_{-j+1} + \beta\lambda\sum_{j=1}^{m} p_{-j}F_{-j+1} + \gamma C_{p,-1} - (\lambda - \delta)K_{-1}.$$

Equation (91) is used to estimate investment of the four sectors. The mining and manufacturing, and service sectors use net direct foreign investment, D_I/P_k, as a financial variable, while the construction sector uses the long-term interest rate, i_L. The agricultural, fishing and forestry sector and mining and manufacturing sector retain the capacity utilization variables which are not statistically significant but have the right sign.

The estimated time forms of the gamma distributed lags for the investment function of each sector are presented in Table 2.

Table 2. Gamma Distributed Lag Coefficients: Investment

lagged periods	I_{pa}	I_{pm}	I_{pc}	$I_{psg}-G_I/P_k$
0	.5065	.3970	.4071	.2663
1	.2742	.2943	.2931	.2928
2	.1265	.1631	.1597	.2044
3	.0546	.0802	.0778	.1184
4	.0228	.0370	.0355	.0620
5	.0093	.0164	.0156	.0304
6	.0037	.0070	.0067	.0143
7	.0015	.0030	.0028	.0065
8	.0006	.0012	.0012	.0029

Except for the service sector, $I_{psg}-G_I/P_k$, the distributed lag coefficients decline like a Koyck lag.

Residential construction, I_h, housing starts, I_h^s, and housing mortgages form a triangular block: mortgages are determined by the distributed lags of disposable income and by the long-term interest rate, and the distributed lags of housing mortgages determine housing starts. In turn the distributed lags of the housing starts determine residential construction. The distributed lag structures are presented in Table 3.

Table 3. Gamma Distributed Lag Coefficients: Residential Construction, Housing Starts, and Mortgages

lagged periods	I_h	I_h^s	MTG/P_h
0	.6839	.2846	.1106
1	.2101	.2950	.2301
2	.0696	.1990	.2333
3	.0237	.1125	.1762
4	.0082	.0578	.1132
5	.0029	.0279	.0657
6	.0010	.0129	.0355
7	.0003	.0058	.0183

As expected the distributed lags of housing starts to determine residential construction are short: roughly 70% of the current housing starts determine the residential construction. The distributed lags of mortgages to determine housing starts and those of disposable income to determine mortgages are longer: the peak of the former lags is in the first lagged period while that of the latter lags is in the second lagged period. The high interest rate tends to discourage the demand for housing mortgages.

A change in nonfarm inventories is explained by the real gross national product, and the stock of inventories in the previous period. The stock of inventories has an arbitrary origin of zero in 1947.

<u>Exports and imports</u>: Exports are divided into two groups--exports of agricultural, fishing and forestry products, X_a, and exports of mining and manufacturing products, X_m. The former is determined by the world real income, Y^w, and the lagged dependent variable $X_{a,-1}$. Attempts to introduce relative prices were not successful. The omission of the relative prices cannot catch the recent development in the international wheat market.

The world income, Y^w, is the weighted average of national income of United States, United Kingdom and Japan, weights being the portions of total Canadian exports going to these countries. The world price of mining and manufacturing goods is constructed by the weighted average of price indexes of the three countries above and the weights are the same the ones used for Y^w. The relative price variable, P_m/P_m^w, is retained in the equation for exports of mining and manufacturing goods.

Imports are divided into three categories: imports of mining and manufacturing goods, F_m, imports of services, F_s, and interest and dividend payments to the foreigners, F_i'. The first two groups, i.e. F_m and F_s, are explained by real income and relative prices, while the last group, F_i', is explained by a stock of net direct and portfolio investments and the long-term interest rate. The stock of net direct and portfolio investments is constructed by taking a moving sum of six years, $\sum_{i=0}^{5} (D_I + P_I)_{-i}$ in view of the fact no data on stock of foreign investment are available.

Wages and prices: The wage rate in each sector is defined as the annual wages and supplementary income divided by the total number of employment in that sector. The wage rate functions are based on the general formulation of the Phillips curve and of the average labor productivity, and they are modified by the wage rates of the United States. Most of the Canadian labor unions are in close contact with their counterparts in the United States and their wage demand may be influenced by how much the U.S. workers may get.

The price equations of the four sectors are the basis of all price equations of the model, since once the sectoral prices are determined, they in turn determine other prices. The four sectoral prices, i.e. P_a, P_m, P_c, and P_s are determined basically by mark-up equations, modified by the rates of capacity utilization and by the "price syncronization" between the United States and Canada, because in sectors other than the agriculture large Canadian corporations tend to be U.S. subsidiaries and their pricing policies may closely coordinate with those of their parent companies.

Labor force participation and shares of available labor: The aggregate labor participation rate, L_{sup}/N, is determined by real per capita disposable income, Y_d/P_dN, and the real wage rate, w/P_d. The negative coefficients of the real wage rate may indicate a trade-off between work and leisure. However, this aggregate participation rate does not catch any changes in the supply of labor due to changes in age composition of population or due to a change in women's participation rate.

To explain the equations to determine the shares of available labor, L_i^A/L^A (i=a,m,c, and s) we shall start with the total available labor, L^A. The determination of L^A follows the formulation of Klein and Preston [6]:

$$(92) \qquad L^A = L\,\frac{1-uf}{1-un}$$

where uf and un are the fricitional rate and the national rate of unemployment respectively. L is the total employment. The frictional unemployment rate may be regarded as the rate which determines the effective full employment, and it will change according to the institutional arrangements and statistical definitions of the unemployment rate. In our model it is set at 2%, the minimum actual unemployment rate reached in the sample period.

Once L^A is computed by equation (92), the problem is how to distribute it among the industrial sectors. Over the long-run the sectoral distribution of labor follows a trend, and hence this trend may be used to distribute the aggregate available labor L^A.

In the model, the trend of each sectoral share, L_i^A/L^A (i=c,m, and s) was constructed by fitting linear segments between the share of labor in each sector at peak points of aggregate labor demand rather than at peak points of sectoral labor demand. This is because when the aggregate labor demand reaches a peak, the unemployment rate, un, will tend towards the frictional unemployment rate, uf, and thus the aggregate available labor force L^A will be close to the actual employment. The peaks of the aggregate employment were at 1947, 1953, 1957, 1959, 1962, 1966 and 1967.

Assuming that each sector experiences the same type of technological change of the similar magnitude, we may say that in the long-run, the labor share of a sector may depend on the share of production in that sector. However, if the wage rate of the sector is high relative to the wage rate of the other sectors, demand for labor in the sector under consideration may be discouraged. Based on this argument the share of available labor in sector i, L_i^A/L^A, is formulated as

$$(93) \qquad \frac{L_i^A}{L^A} = \alpha_0 + \alpha_1 \frac{V_i}{V} + \alpha_2 \frac{w_i}{w} ,$$

where V_i/V, w_i, and w are respectively the share of output, wage rate in sector i and the aggregate wage rate.

<u>Production functions</u>: The production functions in the model follow the general Cobb-Douglas form. Since we do not have reasonable data on capital stock which are consistent with the investment series of the national accounts, we created utilized capital stock for sector i, K_i^u, by

$$(94) \qquad K_i^u = \sum_{k=0}^{9} (.934)^k I_{pi,-k}$$

where I_{pi} is gross investment in sector i, and the depreciation rate .934 is taken from the estimate of the depreciation rate in the manufacturing industries.(1)

In estimating the production function for agriculture, fishing and forestry we <u>a priori</u> restricted it to the constant returns to scale. This is because the estimated coefficient of labor in the unrestricted production function tended to be negative and insignificant. Employment in this sector has been declining over years and thus it has a negative correlation with output. For the other sectors the coefficients are not restricted, but their estimates tend to indicate constant returns to scale in these sectors.

Now we turn to the capacity production functions which follow the Klein and Preston formulation [6]. The parameters of the capacity production are the same as those for actual production function but available labor, L_i^A, and capital stock, K_i, are now used to compute the capacity output, V_i^*.

(1) Dominion Bureau of Statistics, <u>Fixed Capital Flows and Stocks Manufacturing Canada, 1926-1960</u>, Ottawa, 1966, p.A1. .934 is the average depreciation between 1947 and 1967. The utilized capital stock series may underestimate real capital stocks, but in the absence of capacity utilization and capital stock data any other attempt will also be subject to this criticism.

We assumed the following relationship between utilized capital and labor:

$$(95) \qquad \frac{K_i^u}{K_i} = \frac{L_i}{L_i^A}$$

which states that the capital utilization rate is the same as the labor utilization rate. Then we will have

$$(96) \qquad K_i = K_i^u \frac{L_i^A}{L_i} \quad .$$

Short- and long-term interest rates: The short-term interest rate is determined by the discount rate, i_D, and the proportion that the treasury bills and day-to-day loans take up in the total assets of the chartered banks. The inclusion of the latter variable is due to the fact that the 1967 Bank Act instituted the secondary reserve ratio which may be imposed by the Bank of Canada. The secondary reserves consist of bank cash, Canadian treasury bills issued for a term of one year or less and day loans to money-market dealers. Hence, it will be reasonable to expect that as the money situation becomes tight the banks tend to switch more to these assets from much longer commitments. The long-term interest rate is determined by the short-term interest rate and by the lagged long-term interest rate.

Sectoral domestic products: The sectoral domestic products are determined in the model by such demand variables as consumption, investment, and government expenditures. Once the domestic products are determined then the production functions are used to find labor requirements to produce the levels of output which meet the demand.

We had difficulties in estimating domestic demand for agricultural, fishing and forestry products, V_a^d, and for mining and manufacturing products, V_m^d. This is mainly because V_a^d and V_m^d are residually defined as $V_a^d = V_a - X_a$, and $V_m^d = V_m - X_m$ and because the sources of statistics for X_a and X_m are not consistent with those of V_a and V_m.

The determination of V_a^d is done in a synthetic fashion because it has changes in farm inventories, $\Delta I_{ia}/P_a$, and the adjustment for weather condition, WETH. If data on changes in inventories which are consistent with data on domestic product, V_a, are available, then it is desirable to explain inventory changes and supply separately: then demand will be determined from the identity demand = supply - changes in inventories.

The domestic demand for mining and manufacturing is determined by the sum of consumer durables, C_d, nondurables, C_{nd}, plant and equipment investment, I_p, and government investment, G_I/P_k, while the demand for gross domestic product originating in construction, V_c, is determined by the sum of plant and equipment investment, I_p, residential construction, I_h, and government investment, G_I/P_k. The demand for gross domestic product originating in services is determined by disposable income, Y_d/P_d, and government expenditures on services, G_s/P_s.

Depreciation, corporate savings and interest on the public debt: Depreciation allowances will be determined by the level of net capital stock existing in the society at the beginning of the period, K_{-1}: If we have an estimate of K_{-1}, then the real depreciation investment is given by δK_{-1}, where δ is the depreciation rate. However, depreciation allowances, D, in the model include value adjustments due to price fluctuations and furthermore the net capital stock of Canada, K_{-1} is not available. Rather than getting a proxy for K_{-1} and determining real depreciation investment, and then adjusting it for price fluctuations, we simply made the current value of depreciation, D, determined by the current value of gross investment, $P_k I$.

Earnings not paid out to persons, S_c, is determined by gross domestic product of all sectors except that originating in agriculture, fishing and forestry, while interest on the public debt, IPD, is determined by the long-term interest rate, i_L, and the level of unamortized government bonds, B_g.

Taxes and transfer payments: In the model the taxes consist of personal direct taxes, T_p, and indirect taxes, T_I. The former is determined by the total wage bills, W, while the latter is determined by gross national product, GNP.

The transfer payments, T_r, will increase as the unemployment rate, un, increases while the gross national product, GNP, indicates economy's capacity to pay the transfer payments.

IV. Wage-Parity Simulations

The model includes nonlinear equations such as production functions, price and wage equations, and the shares of available labor equations among others. Hence, the entire system was solved by a modified Seidel method. As a set of initial values for iteration, the solution of the previous period was used.

Using a set of exogenous variables most of which are based on the time trend estimates, we made first the forecast of the Canadian economy from 1969 to 1975 based on the nonwage-parity assumption. The values of exogenous variables used for the forecast are presented in Table A1 in Appendix.

The forecast values of GNE account, wages, employment, unemployment rate, and prices are presented in Table 4. With the set of exogenous variables given in appendix Table A1, we find that the real economic growth tends to slow down from 1971 to 1974, since the growth rates decline from 4.30% in 1970 to 3.47% in 1971 and then they stay between 3% and 2.5% from 1972 to 1974.

One of the reasons of this pattern of growth seems to lie on the government expenditures, which are exogenous to the model. As clear from Table A1 in Appendix, in 1969 the government expenditures in 1957 dollars stay the same level as in 1968, and from 1970 to 1974 the growth rate in government spendings is between one and two percents. This slow-down in the government spendings in 1969 seems to excert an impact on the economy in 1970 and 1971, hence with almost one to two year lags; the growth rate slows down in 1971 to 3.47% from 4.30% in 1970, while the price rises slacken in 1970. In 1975, however, the government expenditures increase by 5.1% and this seems to be a major reason in the gain in the growth rate from 2.49% in 1974 to 3.22% in 1975.

We note here that the reaction lag between the government spending and economic growth is not symmetric: a spending-cut seems to have a longer reaction time until its effects are felt in the growth rate, whereas a spending-increase has a

Table 4 Forecast, 1969-1975: Nonwage-Parity

	1969	1970	1971	1972	1973	1974	1975
I. GNE account							
Personal consumption	33585	34793	35846	36795	37642	38489	39378
Government expenditure*	8794	8960	9116	9216	9411	9544	10028
Business gross investment	10636	10980	11212	11420	11591	11755	11986
plant, machinery and equipment	8621	8874	9024	9152	9251	9352	9527
new residential construction	2015	2106	2188	2268	2340	2403	2459
Exports of goods and services	13327	13968	14631	15266	15881	16445	16984
Imports of goods and services	13677	13864	13986	14096	14176	14366	14647
Gross National Expenditure	53176	55465	57387	58978	60566	62065	64062
Percentage growth of GNE	4.03	4.30	3.27	2.77	2.68	2.49	3.22
II. Wages							
Mining and manufacturing	5.52	5.60	5.74	5.88	6.03	6.17	6.29
Construction	6.37	6.59	6.87	7.18	7.49	7.77	8.02
Services	4.87	4.94	5.04	5.16	5.29	5.42	5.56
III. Employment							
Agriculture, fishing and forestry	743	649	644	625	641	676	725
Mining and manufacturing	2133	2122	2111	2110	2109	2129	2167
Construction	569	560	560	551	546	550	565
Services	4504	4666	4775	4864	4936	5021	5123
Unemployment	.035	.056	.061	.065	.065	.061	.056
IV. Prices							
Agriculture, fishing and forestry	1.17	1.05	1.02	.99	1.00	1.02	1.07
Mining and manufacturing	1.20	1.17	1.16	1.16	1.16	1.16	1.17
Construction	1.61	1.62	1.63	1.65	1.67	1.70	1.74
Services	1.42	1.43	1.45	1.48	1.51	1.57	1.60
Plant, machinery and equipment	1.42	1.42	1.43	1.44	1.45	1.47	1.49
New residential construction	1.70	1.70	1.71	1.73	1.75	1.78	1.83
Gross National Product	1.34	1.33	1.33	1.34	1.35	1.37	1.39

* exogenous to the model.

quicker reaction.

The tightening of the government expenditures seems to slow down the price rises, but if it persists long, then it may dampen the economic growth which is not too desirable. Moreover, in this nonwage-parity simulation the wage and price determination is assumed to follow its sample period behavior pattern. Consequently if the economy were to observe stepped-up price fixing activities in the product as well as in the labor markets, then the government policy to cut down its expenditure may only lead to a low economic growth with higher price levels.

The pattern of price rises is different depending on the types of goods and services: a noticable rise is observed in construction and services, and the rise in construction wage seems to be the fastest in all sectors.

Let us now turn to wage-parity simulations.(2) First we define the wage-parity that the Canadian worker receives annually the same amount of money which his U.S. counterpart receives, without allowing for the exchange rate differential. Under this definition the Canadian wage in sector i, w_i, becomes

$$w_i = w_i^{US}$$

where w_i^{US} is the United States wage rate in sector i.

Now let us suppose that the wage-parity is enforced in the

(2) For wage-parity simulations we use the same exogenous variables as those used for nonwage-parity simulation.

two sectors: mining and manufacturing and services, starting from 1969. The impacts of the wage-parity on the economic growth, prices and employment will depend largely on the way the wage-parity is introduced. In our experiments we set up two different ways: (1) the wage-parity is to be 100% effective in 1969 and after, and (2) the full wage-parity is to reach in 1971 and after with step-wise wage increases in 1969 and 1970. In order to achieve 100% wage-parity in 1971 and after, the wage rate in mining and manufacturing has to increase by 12.4% per annum in 1969 and 1970, whereas in services the annual increase of 15.8% in 1969 and 1970 will bring the full wage-parity in 1971 and after.

The simulation results for these two cases are presented in Table 5 and 6. We note that the enforcement of 100% parity in 1969 tends to bring slower economic growth and higher prices and unemployment rate than the stepwise wage increases to attain full parity in 1970.

Given the above result one may wonder if the labor productivity is increased to compensate for the wage increase, will price increases be halted ? If firms maximize short-run profits and if the production functions are Cobb-Douglas, then as shown in [4], we have

(97) $$P = \frac{1}{\alpha}\left(\frac{wL}{V}\right)\left(\frac{e}{e + 1}\right)$$

where P = price of output

w = wage rate

L = employment

V = output

α = the exponential coefficient of labor e = the elasticity of demand.

If the average productivity increases by the same percentage as the wage increase, then equation (98) becomes

$$(98) \qquad P = \frac{1}{\alpha(1+r)}\left(\frac{wL}{V}\right)\left(\frac{e}{e+1}\right)$$

where r is the rate of wage increase.

In our model the wage equation is based on equation (98) modified by the capacity utilization and price syncronization between Canada and the United States. For the mining and manufacturing the estimated coefficient of wL/V is .7307 and for services .4230. If we take these coefficients to represent $\frac{1}{\alpha}\left(\frac{e}{e+1}\right)$ in equation (97), then given the wage increase of 12.4% per annum for mining and manufacturing and 15.8% per annum for services, the coefficients after the productivity increase $\frac{1}{\alpha(1+r)}\left(\frac{e}{e+1}\right)$ in equation (98) becomes, assuming that the elasticity of demand, e, remains the same, .6501 for mining and manufacturing and .3653 for services. Hence the new price equations become

$$(99) \qquad P_m - .45\, P_{m,-1} = .6501\,[w_m L_m/V_m - .45(w_m L_m/V_m)_{-1}] + .1386[V_m/V_m^* - .45(V_m/V_m^*)_{-1}] + .6463[P_m^{US} - .45P_{m,-1}^{US}] - .1189$$

$$(100) \qquad P_s - .85\, P_{s,-1} = .3653[w_s L_s/V_s - .85(w_s L_s/V_s)_{-1}] + .1003[V_s/V_s^* - .85(Vs/V_s^*)_{-1}] + .6827[P_s^{US} - .85\, P_{s,-1}^{US}] - .0021\,.$$

The simulation results using equations (99) and (100)

Table 6 The Step-wise Increase in Wages to Attain Full Parity in 1970 and After

	1969	1970	1971	1972	1973	1974	1975
I. GNE account							
Personal consumption	33046	33388	33327	33366	33622	33640	34422
Business gross investment	10522	10592	10330	10259	10276	10254	10473
plant, machinery and equipment	8508	8496	8274	8072	8063	8048	8265
new residential construction	2014	2096	2156	2197	2213	2216	2208
Exports of goods and services	13191	13538	13921	14572	15147	15656	16187
Imports of goods and services	13549	13636	13616	13401	13350	13341	13641
Gross National Expenditure	52319	52995	53049	53791	55092	55915	57469
Percentage growth of GNE	2.56	1.29	.10	.91	2.42	1.49	2.78
II. Wages							
Mining and manufacturing	5.78	6.50	7.30	7.49	7.68	7.88	8.07
Construction	6.44	6.76	7.09	7.43	7.72	7.95	8.13
Services	5.33	6.18	7.16	7.37	7.57	7.78	7.99
III. Employment							
Agriculture, fishing and forestry	696	573	555	549	608	625	758
Mining and manufacturing	2091	1997	1924	1951	1962	1976	2030
Construction	562	542	516	490	484	488	510
Services	4379	4358	4274	4266	4315	4351	4492
Unemployment rate	.060	.110	.139	.139	.122	.115	.079
IV. Prices							
Agriculture,fishing and forestry	1.11	.98	.95	.94	1.00	1.02	1.17
Mining and manufacturing	1.23	1.25	1.28	1.28	1.29	1.29	1.32
Construction	1.62	1.64	1.66	1.67	1.69	1.72	1.77
Services	1.46	1.55	1.65	1.71	1.76	1.81	1.85
Plant, machinery and equipment	1.43	1.45	1.47	1.48	1.50	1.52	1.55
New residential construction	1.70	1.72	1.74	1.76	1.78	1.81	1.87
Gross National Product	1.36	1.40	1.45	1.47	1.49	1.50	1.55

Table 5 The Wage-Parity, 100% Effective in 1969

	1969	1970	1971	1972	1973	1974	1975
I. GNE account							
Personal consumption	32172	32297	32476	32919	33025	33482	33629
Business gross investment	10252	10096	10080	10125	10134	10255	10385
plant, machinery and equipment	8242	8015	7956	7976	7975	8096	8223
New residential construction	2010	2081	2124	2149	2159	2159	2162
Exports of goods and services	12718	13253	13895	14489	15065	15647	16158
Imports of goods and services	13614	13542	13378	13439	13364	13412	13442
Gross National Expenditure	50306	50579	52125	53721	54593	55861	56236
Percentage growth of GNE	-1.39	.54	3.05	3.06	1.62	2.32	.67
II. Wages							
Mining and manufacturing	6.91	7.10	7.30	7.49	7.68	7.88	8.07
Construction	6.47	6.78	7.09	7.41	7.67	7.90	8.11
Services	6.74	6.95	7.16	7.37	7.57	7.78	7.99
III. Employment							
Agriculture, fishing and forestry	574	523	566	597	610	702	720
Mining and manufacturing	1954	1930	1947	1959	1957	2003	2037
Construction	541	511	498	489	483	494	508
Services	4148	4139	4172	4265	4288	4368	4401
Unemployment rate	.122	.154	.149	.132	.126	.099	.094
IV. Prices							
Agriculture, fishing and forestry	1.01	.94	.96	.99	1.01	1.11	1.13
Mining and manufacturing	1.31	1.29	1.29	1.30	1.29	1.31	1.32
Construction	1.62	1.63	1.65	1.67	1.70	1.74	1.78
Services	1.58	1.62	1.67	1.72	1.77	1.82	1.86
Plant, machinery and equipment	1.46	1.46	1.48	1.49	1.50	1.53	1.54
New residential construction	1.71	1.72	1.74	1.76	1.79	1.83	1.86
Gross National Product	1.43	1.45	1.46	1.48	1.49	1.52	1.54

Table 7 The Stepwise Increase in Wages to Attain Full Parity in 1970 and After, Compensated by the Lower Price Mark-up Rates

	1969	1970	1971	1972	1973	1974	1975
I. GNE account							
Personal consumption	33109	33615	33686	33854	34155	34217	35101
Business gross investment	10577	10756	10668	10545	10568	10551	10767
plant, machinery and equipment	8563	8659	8506	8337	8335	8307	8523
new residential construnction	2014	2097	2162	2208	2233	2244	2244
Exports of goods and services	13353	13806	14263	14934	15542	16054	16612
Imports of goods and services	13382	13342	13202	12916	12778	12719	13006
Gross National Expenditure	52892	54164	54608	55370	56787	57664	59514
Percentage growth of GNE	3.69	2.40	.82	1.39	2.56	1.54	3.21
II. Wages							
Mining and manufacturing	5.78	6.50	7.30	7.49	7.68	7.88	8.07
Construction	6.43	6.74	7.07	7.41	7.71	7.95	8.14
Services	5.33	6.18	7.16	7.37	7.57	7.78	7.99
III. Employment							
Agriculture, fishing and forestry	734	613	593	572	632	641	783
Mining and manufacturing	2139	2058	1986	1999	2004	2008	2062
Construction	566	552	530	504	496	499	520
Services	4399	4415	4350	4348	4498	4428	4588
Unemployment rate	.047	.089	.116	.119	.103	.098	.060
IV. Prices							
Agriculture, fishing and forestry	1.12	.98	.95	.93	.99	1.00	1.15
Mining and manufacturing	1.20	1.21	1.22	1.22	1.22	1.22	1.24
Construction	1.62	1.64	1.65	1.66	1.68	1.71	1.76
Services	1.44	1.52	1.61	1.65	1.70	1.74	1.79
Plant, machinery and equipment	1.42	1.44	1.46	1.46	1.48	1.49	1,52
New residential construction	1.70	1.72	1.74	1.75	1.77	1.80	1.85
Gross National Product	1.34	1.37	1.41	1.42	1.44	1.45	1.49

are given in Table 7. We compare in Table 8 the patterns of growth rate, price rise and unemployment among the four different sets of simulation: (1) nonwage-parity, (2) 100% wage-parity in 1969 and after, (3) stepwise increase in wages to attain full parity in 1971 and after, and (4) stepwise increase in wages to attain full parity in 1971 and after with the compensated price mark-up coefficients.

Table 8 Comparison of Four Simulation Sets
Percentage

(1) Nonwage-parity

	1969	1970	1971	1972	1973	1974	1975	average
Growth Rate of GNP	4.03	4.30	3.47	2.77	2.68	2.49	3.22	3.28
Price Rise GNP Deflator	1.51	-.75	0.0	.75	.75	1.48	1.46	.74
Unemployment Rate	3.5	5.6	6.1	6.5	6.5	6.1	5.6	5.7

(2) 100% Wage-parity in 1969 and after

	1969	1970	1971	1972	1973	1974	1975	average
Growth Rate of GNP	-1.39	.54	3.05	3.06	1.62	2.32	.67	1.41
Price Rise GNP Deflator	9.40	.76	.62	1.44	1.35	1.20	2.10	2.41
Unemployment Rate	12.2	15.4	14.9	13.2	12.6	9.9	9.4	12.5

(3) Stepwise Increase in Wages to Attain Full Parity in 1971 and after

	1969	1970	1971	1972	1973	1974	1975	average
Growth Rate of GNP	2.56	1.29	.10	.91	2.42	1.49	2.78	1.85
Price Rise GNP Deflator	2.81	3.24	3.86	.82	1.64	.94	3.19	2.36
Unemployment Rate	6.0	11.0	13.9	13.9	12.2	11.5	7.9	10.9

Table 8 Continued

(4) Stepwise Increase in Wages to Attain Full Parity in 1971 and after with the Compensated Price Mark-up

	1969	1970	1971	1972	1973	1974	1975	average
Growth Rate of GNP	3.69	2.40	.82	1.39	2.56	1.54	3.21	2.23
Price Rise GNP Deflator	1.44	2.32	3.07	.85	1.19	.83	2.89	1.80
Unemployment Rate	4.7	8.9	11.6	11.9	10.3	9.8	6.0	9.0

The average percentage figures between 1969 and 1975 indicate that the worst situation is the case (2) i.e. 100% wage-parity in 1969 and after, and that the compensated price mark-up [case(4)] is not sufficient to halt impacts of wage-parity on the growth rate of the economy and on price rises.

In our wage-parity experiments above we assumed the par-value exchange rate. If the wage-parity arrangement were to allow for the exchange rate differential, then the effects on economic growth, prices and employment will be severer than our experiments indicate.

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Appendix Table A1 The Values of the Exogenous Variables Used for the Simulation Experiments

	1968 (1)	1969	1970	1971	1972	1973	1974	1975
G_I	2925	3016	3165	3313	3461	3610	3758	3906
G	13329	13357	14013	14668	15324	15980	16635	17291
G_{const}	8792	8794	8960	9116	9216	9411	9544	10028
ΔI_{ia}(2)	531	25	25	25	25	25	25	25
Y^W	579	596	618	639	660	682	703	725
w_m^{US}	6.72	6.91	7.10	7.30	7.49	7.68	7.88	8.07
w_c^{US}	7.20	7.31	7.55	7.78	8.01	8.24	8.54	8.69
w_s^{US}	6.53	6.74	6.95	7.16	7.37	7.57	7.78	7.99
DTDL	193	377	397	418	438	458	479	499
TRB	2124	1843	1925	2006	2087	2168	2249	2331
TCA	29321	27473	28753	30033	31313	32593	33874	35154
WETH(2)	77	-23	-23	-23	-23	-23	-23	-23
S_e	-41	0	0	0	0	0	0	0
P_F	1.21	1.25	1.28	1.30	1.32	1.34	1.36	1.38
P_s^F	1.16	1.18	1.20	1.21	1.22	1.23	1.24	1.26
P_m^F	1.25	1.28	1.31	1.33	1.35	1.38	1.40	1.43
P_m^W	1.22	1.22	1.23	1.25	1.27	1.29	1.31	1.33
P_s^{US}	1.16	1.38	1.41	1.44	1.47	1.50	1.53	1.56
P_m^{US}	1.13	1.10	1.11	1.12	1.13	1.13	1.14	1.15
B_g	18493	19188	19652	20116	20580	21044	21508	21972
i_D	6.84	5.39	5.58	5.78	5.98	6.17	6.37	6.57
N	20954	21266	21581	21882	22155	22392	22597	22770
D_I/P_k	451	460	484	502	515	524	530	536
P_I	929	972	1033	1041	1036	1029	1023	1018

Notes: (1) Actual values are used for 1968
(2) Average values between 1958 and 1967
Variables other than ΔI_{ia}, WETH, and S_e are time trend estimates based on 1958 to 1967.