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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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 non-wage-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 disturbance 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) \[ \frac{Cn/N}{.5(Cn/N)_{-1}} = .3008\left[ (Y_{d}/P_{dN}) - .5(Y_{d}/P_{dN})_{-1} \right] \]
\[ - .2428[\frac{P_{nd}/P}{.5(P_{nd}/P)_{-1}}] + .2346 \]
\[ \frac{R^2}{3.44} = .960 \]
\[ DW = 1.96 \]
\[ MS2SLS \]

(2) \[ \frac{Cn/N}{.0100[\frac{1}{Z} \sum_{k=1}^{6} k^{s-1} e^{-k}(Y_{d}/P_{dN})_{-k+1}]} = .1609(\frac{P_{cd}/P}{(59.13)}) \]
\[ + .4212(Cn/N)_{-1} + .2359 \]
\[ \frac{R^2}{16.9} = .944 \]
\[ DW = 1.66 \]
\[ NLLS \]

(3) \[ \frac{Cs/N}{.0870(Y_{d}/P_{dN}) - .0179(P_{s}/P) + .7686(Cs/N)_{-1} + .0152} \]
\[ \frac{R^2}{1.73} = .984 \]
\[ DW = 1.91 \]
\[ 2SLS \]

**Investment functions**

(4) \[ \frac{I_{pa}}{.4829[\frac{1}{Z} \sum_{k=1}^{7} k^{s-1} e^{-k}V_{a,-k+1}]} + 108.0443(V_{a}/V_{a}^{*})_{-1} \]
\[ - .0605 K_{a,-1}^{u} - 336.2051 \]
\[ \frac{R^2}{3.46} = 1.39 \]
\[ 1.70 \]
\( I_{pm} = \frac{0.5359}{Z} \sum_{k=1}^{7} \frac{1}{Z} k^{s-1} e^{-k} v_{m,-k+1} \)
\( + 0.1122 \left[ \frac{1}{Z} \sum_{k=1}^{7} k^{s-1} e^{-k(D_1/P_k)-k+1} \right] \)
\( + 1993.9756(v_m/v^*)_{m-1} - 0.2487K^u_{m-1} - 2655.5776 \)
\( s = 2.0106 \)
\( (1.17) \)
\( \frac{\overline{R}^2}{R} = 0.851 \)
\( DW = 1.23 \)
\( NLLS \)

\( I_{pc} = \frac{0.2018}{Z} \sum_{k=1}^{7} \frac{1}{Z} k^{s-1} e^{-k} v_{c,-k+1} \)
\( - 14.6544 \left[ \frac{1}{Z} \sum_{k=1}^{7} k^{s-1} e^{-k} i_{L,-k+1} \right] \)
\( - 1.134 K^u_{c,-1} - 18.1747 \)
\( s = 1.9688 \)
\( (1.90) \)
\( \frac{\overline{R}^2}{R} = 0.533 \)
\( DW = 1.22 \)
\( NLLS \)

\( I_{psg} - G_I/P_k = \frac{0.3382}{Z} \sum_{k=1}^{7} \frac{1}{Z} k^{s-1} e^{-k} v_{s,-k+1} \)
\( + 1.7683 \left[ \frac{1}{Z} \sum_{k=1}^{7} k^{s-1} e^{-k(D_1/P_k)-k+1} \right] \)
\( - 0.1447(K^u_{sg,-1} - K^u_{g,-1}) - 893.0647 \)
\( s = 2.5795 \)
\( (2.04) \)
\[ I_h = 8.2225 \left[ \frac{1}{Z} \sum_{k=1}^{6} k^{s-1} e^{-k} I_{h,-k+1} \right] + 377.2559 \] (13.05) 
\[ I_h^s = 0.0532 \left[ \frac{1}{Z} \sum_{k=1}^{6} k^{s-1} e^{-k} (MTG/P_h)^{-k+1} \right] + 75.0933 \] (8.83) 
\[ \overline{R^2} = 0.896 \] 
\[ DW = 1.13 \] 
\[ s = 0.7399 \] (1.19) 
\[ \overline{R^2} = 0.724 \] 
\[ DW = 1.54 \] 
\[ s = 2.4947 \] (2.56) 
\[ \text{Export and import functions} \]

\[ \Delta I_{in}/P_k = 0.45(\Delta I_{in}/P_k)_{-1} \] (4.90) 
\[ = 0.1720[GNP/P - 0.45(GNP/P)_{-1}] \] 
\[ - 0.7699[I_{in,-1} - 0.45 I_{in,-2}] - 1376.9768 \] (4.81) 
\[ \overline{R^2} = 0.575 \] 
\[ DW = 2.04 \] 
\[ \text{MS2SLS} \] 
\[ s = 3.500 \] (0.75) 
\[ \overline{R^2} = 0.716 \] 
\[ DW = 0.124 \] 
\[ \text{NLLS} \] 
\[ s = 0.3 \] (0.44) 
\[ \overline{R^2} = 0.848 \] 
\[ DW = 2.24 \] 
\[ \text{OLS} \] 

\[ X_a = 2.5194 Y^w + 0.1813 X_{a,-1} + 182.2718 \] (4.01) 
\[ (0.84) \] 
\[ s = 14.41 \] 
\[ \overline{R^2} = 0.848 \] 
\[ DW = 2.24 \] 
\[ \text{OLS} \]
(13) \[ X_m - 0.2X_{m,-1} = 21.1321[Y^w - 0.2 Y^w] \]
\[ (8.70) \]
\[ -7222.7031[\frac{P_m}{P_m^w} - 0.2(\frac{P_m}{P_m^w})_{-1}] + 4123.0938 \]
\[ (1.61) \]
\[ R^2 = 0.852 \]
\[ DW = 1.27 \]
\[ MS2SLS \]

(14) \[ F_m = 0.1690 \left( \frac{Y_d}{P_d} \right) + 8246.0273 \left( \frac{P_m}{P_m^F} \right) \]
\[ (4.12) \]
\[ (2.27) \]
\[ + 0.5573 F_{m,-1} - 9863.2656 \]
\[ (3.35) \]
\[ (3.12) \]
\[ R^2 = 0.961 \]
\[ DW = 1.58 \]
\[ 2SLS \]

(15) \[ F_s = 0.0805 \left( \frac{Y_d}{P_d} \right) + 1754.2883 \left( \frac{P_s}{P_s^F} \right) - 958.4468 \]
\[ (6.73) \]
\[ (2.83) \]
\[ R^2 = 0.960 \]
\[ DW = 1.86 \]
\[ 2SLS \]

(16) \[ F'_{L} - 0.65 F'_{L,-1} = 0.0084 \left\{ \sum_{i=0}^{5} (D_i + PI)_k \right\}_{1L} \]
\[ (2.68) \]
\[ \sum_{i=1}^{6} (D_i + PI)_{kL,-1} \]
\[ + 131.1133 \]
\[ (3.57) \]
\[ R^2 = 0.850 \]
\[ DW = 1.54 \]
\[ MS2SLS \]
Wage equations

(17) \[ w_a = 0.35 w_{a,-1} - 2.0727[un - 0.35un_{-1}] \]
\[ + 0.0187[p_d - 0.35p_{d,-1}] \]
\[ + 0.0604[v_a/l_a - 0.35(v_a/l_{a,-1})] - 0.3827 \]

(18) \[ w_m = 0.7w_{m,-1} = -2.3744[un - 0.7un_{-1}] \]
\[ + 0.2853[v_m/l_m - 0.7(v_m/l_{m,-1})] + 0.4558[w_m^US - 0.7w_{m,-1}^US] \]
\[ - 0.0377 \]

(19) \[ w_c = 0.95 w_{c,-1} = -3.6575[un - 0.95un_{-1}] \]
\[ + 0.5599[v_c/l_c - 0.95(v_c/l_{c,-1})] + 1.2405[w_c^US - 0.95w_{c,-1}^US] \]
\[ - 0.3664 \]

(20) \[ w_s = 0.55 w_{s,-1} = 0.0536[v_s/l_s - 0.55(v_s/l_{s,-1})] \]
\[ + 0.6324[w_s^US - 0.55w_{s,-1}^US] - 0.0901 \]
Price equations

\( P_a - .25 P_{a,-1} = 1.8356[\omega_{a}\ell_a / V_a - .35(\omega_{a}\ell_a / V_a)_{-1}] \)
\( (3.84) \)
\( + .4699[V_a/V_a^* - .35(V_a/V_a^*)_{-1}] + .1080 \)
\( (4.19) \)
\( (\omega_{a}\ell_a / V_a)_{-1} \)
\( (\omega_{a}\ell_a / V_a^*)_{-1} \)
\[ R^2 = .615 \]
\[ DW = 1.30 \]
\[ MS2SLS \]

\( P_m - .45 P_{m,-1} = .7307[\omega_{m}\ell_m / V_m - .45(\omega_{m}\ell_m / V_m)_{-1}] \)
\( (2.85) \)
\( + .1386[V_m/V_m^* - .45(V_m/V_m^*)_{-1}] \)
\( (1.47) \)
\( (\omega_{m}\ell_m / V_m)_{-1} \)
\( (\omega_{m}\ell_m / V_m^*)_{-1} \)
\( + .6463[P^{US}_{m,-1} - .45P^{US}_{m,-1}] - .1189 \)
\( (2.82) \)
\( (1.46) \)
\[ R^2 = .868 \]
\[ DW = 1.75 \]
\[ MS2SLS \]

\( P_c - .95 P_{c,-1} = .5104[\omega_{c}\ell_c / V_c - .95(\omega_{c}\ell_c / V_c)_{-1}] \)
\( (6.39) \)
\( + .1451[P_m - .95 P_{m,-1}] \)
\( (1.77) \)
\( + .0544[V_c/V_c^* - .95(V_c/V_c^*)_{-1}] + .0408 \)
\( (1.62) \)
\( (6.48) \)
\[ R^2 = .829 \]
\[ DW = 1.41 \]
\[ MS2SLS \]

\( P_s - .85 P_{s,-1} = .4230[\omega_{s}\ell_s / V_s - .85(\omega_{s}\ell_s / V_s)_{-1}] \)
\( (1.89) \)
\( + .1003[V_s/V_s^* - .85(V_s/V_s^*)_{-1}] \)
\( (.80) \)
\( + .6827[P^{US}_{s,-1} - .85P^{US}_{s,-1}] - .0021 \)
\( (3.79) \)
\( (1.10) \)
\[ R^2 = .907 \]
\[ DW = 2.00 \]
\[ MS2SLS \]
(25) \[ P_{nd} - 0.35P_{nd,-1} = 0.6453[(wgt_1 P_s + wgt_2 P_m) - 0.35(wgt_1 P_s + wgt_2 P_m,-1)] + 0.2417 \]
\[ (14.14) \]
\[ wgt_1 = c_s/(c_{nd} + c_s) \]
\[ wgt_2 = 1 - wgt_1 \]
\[ R^2 = 0.913 \]
\[ DW = 1.25 \]
\[ MS2SLS \]

(26) \[ P_{cd} - 0.45 P_{cd,-1} = 0.3984[P_m - 0.45 P_{m,-1}] + 0.3272 \]
\[ (1.74) \]
\[ R^2 = 0.477 \]
\[ DW = 2.04 \]
\[ MS2SLS \]

(27) \[ P_h - 0.95 P_{h,-1} = 1.1705[P_c - 0.95 P_{c,-1}] - 0.0170 \]
\[ (15.76) \]
\[ R^2 = 0.930 \]
\[ DW = 1.84 \]
\[ MS2SLS \]

(28)* \[ P_k - 0.95 P_{k,-1} = 0.6354[(0.4697 P_m + 0.5303 P_c) - 0.95(0.3697 P_m + 0.5303 P_c,-1)] + 0.0334 \]
\[ (9.66) \]
\[ R^2 = 0.837 \]
\[ DW = 1.15 \]
\[ MS2SLS \]

*Labor force participation and shares of available labor

(29) \[ L_{sup}/N = 1.810(Y_d/P_d N) - 0.0684(w/P_d) + 0.3106 \]
\[ (7.84) \]
\[ (8.28) \]
\[ R^2 = 0.779 \]
\[ DW = 1.35 \]
\[ 2SLS \]

*The weight of .4697 is the ratio of new machinery and equipment investment in the National Income Accounts to Ip in 1967.
\[ L_m^A/L_A = -0.5(L_m^A/L_A)_{-1} = 0.1533[V_m/V - 0.5(V_m/V)_{-1}] \]
\[ -0.0174[w_m/w - 0.5(w_m/w)_{-1}] + 0.1214 \]
\[ \bar{R}^2 = 0.811 \]
\[ DW = 1.46 \]
\[ MS2SLS \]

\[ L_c^A/L_A = -0.8(L_c^A/L_A)_{-1} = 0.2683[V_c/V - 0.8(V_c/V)_{-1}] \]
\[ -0.0193[w_c/w - 0.8(w_c/w)_{-1}] + 0.0156 \]
\[ \bar{R}^2 = 0.873 \]
\[ DW = 1.19 \]
\[ MS2SLS \]

\[ L_s^A/L_A = -0.35(L_s^A/L_A)_{-1} = 1.6924[V_s/V - 0.35(V_s/V)_{-1}] \]
\[ -0.7225[w_s/w - 0.35(w_s/w)_{-1}] + 0.2300 \]
\[ \bar{R}^2 = 0.777 \]
\[ DW = 1.33 \]
\[ MS2SLS \]

Production functions

\[ \ln(V_a/L_a) - 0.55 \ln(V_a/L_a)_{-1} = 0.8758[\ln(K_a^U/L_a)_{-1}] \]
\[ -0.55 \ln(K_a^U/L_a)_{-1}] - 0.1792 \]
\[ \bar{R}^2 = 0.861 \]
\[ DW = 2.11 \]
\[ MS2SLS \]

\[ \ln V_m - 0.6 \ln V_{m,-1} = 0.4379[\ln L_m - 0.6 \ln L_{m,-1}] \]
\[ + 0.6956[\ln K_m^U - 0.6 \ln K_{m,-1}^U] - 0.2000 \]
\[ \bar{R}^2 = 0.888 \]
\[ DW = 1.54 \]
\[ MS2SLS \]
(35) \[ \ln V_C = .55 \ln V_{C,-1} = .5417[\ln L_C - .55 \ln L_{C,-1}] + .5119[\ln K_C - .55 \ln K_{C,-1}] + .3201 (.47) \]

(36) \[ \ln V_s = .05 \ln V_{s,-1} = 1.1052[\ln L_s - .05 \ln L_{s,-1}] + .0714[\ln K_{sg} - .05 \ln K_{sg,-1}] + .1030 (.59) \]

\[ R^2 = .904 \]
\[ DW = 1.55 \]
MS2SLS

**Capacity production functions**

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

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

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

**Short- and long-term interest rate equations**

(41) \[ i_s = .8805 i_D + 13.7536[\frac{TRB + DTL}{TCA}] - 1.0180 \]

\[ R^2 = .951 \]
\[ DW = 2.15 \]
OLS
\[ (42) \quad i_L = .0937 \cdot i_s + .8855 \cdot i_L, -1 + .5406 \]
\[ (.44) \quad (2.75) \quad (.49) \]
\[ \frac{R^2}{R} = .815 \]
\[ DW = 1.90 \]
\[ 2SLS \]

**Sectoral domestic product equations**

\[ (43) \quad v_a^d = .95 v_a^d, -1 = .0336 [\text{GNP/P} - .95(\text{GNP/P})_1] \]
\[ (1.19) \]
\[ -.4164[v_a^d, -1 - .95 v_a^d, -2] - .3673[\text{WETH} - .95 \text{WETH}_{-1}] \]
\[ (1.85) \quad (4.11) \]
\[ + .3143[(\Delta I_{ia}/P_a)_{-1} - .95(\Delta I_{ia}/P_a)_{-2}] - 43.0294 \]
\[ (1.97) \]
\[ \frac{R^2}{R} = .607 \]
\[ DW = 1.92 \]
\[ MS2SLS \]

\[ (44) \quad v_m^d = .5 v_m^d, -1 = .0447 [(C_d + C_{nd} + I_p + G_i/P_k) \]
\[ (1.18) \]
\[ -.5(C_d + C_{nd} + I_p + G_i/P_k)_{-1}] + 1271.3252 \]
\[ (3.19) \]
\[ \frac{R^2}{R} = .646 \]
\[ DW = 1.16 \]
\[ MS2SLS \]

\[ (45) \quad v_c = .45 v_c, -1 = .1669 [(I_p + I_h + G_i/P_k) \]
\[ (10.71) \]
\[ -.45(I_p + I_h + G_i/P_k)_{-1}] + 174.8186 \]
\[ (2.35) \]
\[ \frac{R^2}{R} = .858 \]
\[ DW = 1.68 \]
\[ MS2SLS \]

\[ (46) \quad v_s = .6435(Y_d/P_d) + .1917(G_s/P_s) + 732.8945 \]
\[ (27.68) \quad (1.67) \]
\[ \frac{R^2}{R} = .998 \]
\[ DW = 2.39 \]
\[ 2SLS \]
Depreciation, corporate savings and interest payment equations

\[ (47) \quad D = 0.95 D_{-1} + 0.1457[P_{k}I - 0.95(P_{kI})_{-1}] + 213.9404 \]
\[ (4.17) \]
\[ (7.53) \]
\[ \frac{R}{\hat{R}} = 0.995 \]
\[ DW = 2.35 \]
\[ MS2SLS \]

\[ (48) \quad S_{C} = 0.15 S_{C, -1} + 0.1427[(P_{m}^{V}m + P_{C}^{V}c + P_{S}^{V}v)_{-1}] \]
\[ (29.58) \]
\[ -.15(P_{m}^{V}m + P_{C}^{V}c + P_{S}^{V}v)_{-1} + 72.5772 \]
\[ (5.59) \]
\[ \frac{R}{\hat{R}} = 0.844 \]
\[ DW = 2.08 \]
\[ MS2SLS \]

\[ (49) \quad IPD = 172.5668 i_{l} + 0.1876 B_{g} - 2596.3789 \]
\[ (6.62) \]
\[ (10.61) \]
\[ (14.00) \]
\[ \frac{R}{\hat{R}} = 0.966 \]
\[ DW = 1.51 \]
\[ MS2SLS \]

Taxes and transfer payment equations

\[ (50) \quad T_{P} = -0.79 T_{P, -1} = 0.2198[W - 0.79 W_{-1}] - 326.8604 \]
\[ (4.87) \]
\[ (4.54) \]
\[ \frac{R}{\hat{R}} = 0.921 \]
\[ DW = 1.88 \]
\[ MS2SLS \]

\[ (51) \quad T_{I} = -0.65 T_{I, -1} = 0.1558[GNP - 0.65 GNP_{-1}] - 367.7986 \]
\[ (38.55) \]
\[ (6.28) \]
\[ \frac{R}{\hat{R}} = 0.987 \]
\[ DW = 2.49 \]
\[ MS2SLS \]
\( T_r = 0.8 \, T_r, -1 = 164.57.0977[\text{un} - 0.8 \, \text{un} - 1] \)
\( (3.39) \)
\( -113.4885[\Delta GNP/GNP - 0.8(\Delta GNP/GNP) - 1] \)
\( (0.96) \)
\( + 1.314[\text{GNP} - 0.8 \, \text{GNP} - 1] - 539.6538 \)
\( (12.14) \)
\( (4.38) \)

\[ \hat{R}^2 = 0.887 \]
\[ DW = 1.99 \]
\[ MS2SLS \]

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) \( K_a = K_a^u \frac{L_a}{L_a} \)

(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) \[ K_{sg} = k^u \frac{L^A_{s}}{L_s} \]

(64) \[ P_x = (P_a X_a + P_m X_m) / X \]

(65) \[ C = C_{nd} + C_d + C_s \]

(66) \[ I_p = I_{pa} + I_{pm} + I_{pc} + (I_{pgs} - G_L / P_k) \]

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

(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) \[ u_m = U / L_{sup} \]

(79) \[ V = V_a + V_m + V_c + V_s \]

(80) \[ \text{GNP} = P_{nd} C_{nd} + P_{cd} C_d + P_s C_s + P_k I_p + P_h I_h + \Delta I_i \]

\[ + P_x X - P_F F + G + S_e \]
(81) \[ Y_d = NI - T_p + T_r + IPD - S_c \]

(82) \[ NI = GNP - T_I - D - S_e \]

(83) \[ P_d = (P_{nd}C_{nd} + P_{cd}C_d + P_{s}C_s)/C \]

(84) \[ P = GNP/(GNP/P) \]

(85) \[ V_a = V_a^d + X_a \]

(86) \[ V_m = V_m^d + X_m \]

**List of Variables**

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
\[ G = \text{total government expenditures, millions of current dollars} \]
\[ G_{\text{const}} = \text{total government expenditures, millions of 1957 dollars} \]
\[ G_I = \text{government investment expenditures, millions of current dollars} \]
\[ *G_{\text{NP}} = \text{gross national product, millions of 1957 dollars} \]
\[ G_s = \text{government expenditures on services, millions of current dollars} \]
\[ *I = \text{total gross investment, millions of 1957 dollars} \]
\[ *I_h = \text{new residential construction, millions of 1957 dollars} \]
\[ *I_h^s = \text{housing starts, thousands of units} \]
\[ *I_p = \text{new nonresidential construction, new machinery and equipment investment in all sectors, millions of 1957 dollars} \]
\[ *I_{pa} = \text{plant, machinery and equipment in agriculture, fishing and forestry, millions of 1957 dollars} \]
\[ *I_{pc} = \text{plant, machinery and equipment investment in construction, millions of 1957 dollars} \]
\[ *I_{PD} = \text{interest on the public debt, millions of current dollars} \]
\[ *I_{pm} = \text{plant, machinery and equipment investment in mining and manufacturing, millions of 1957 dollars} \]
\[ *I_{psg} = \text{plant, machinery and equipment investment in services including government capital formation, millions of 1957 dollars} \]
\[ I_{VA} = \text{inventory value adjustment, millions of current dollars} \]
\[ i_D = \text{discount rate, percentage} \]
\[ *i_L = \text{long-term interest rate, percentage} \]
\[ *i_s = \text{short-term interest rate, percentage} \]
\[ *\Delta I_1 = \text{changes in total inventories, millions of current dollars} \]
\[ *\Delta I_{ia} = \text{changes in farm inventories, millions of current dollars} \]
\[ *\Delta I_{in} = \text{changes in nonfarm business inventories, millions of current dollars} \]
\*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

\*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_{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
*um = 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_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_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

\( w_{US}^C \) = wage rate in United States construction, thousands of current U.S. dollars

\( w_{US}^m \) = wage rate in United States mining and manufacturing, thousands of current U.S. dollars

\( w_{US}^s \) = 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

\[
\frac{1}{2} k^{s-1} e^{-k} \quad s = 1.9912
\]

<table>
<thead>
<tr>
<th>lagged periods</th>
<th>coefficients</th>
</tr>
</thead>
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<tr>
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<td>.0160</td>
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<td>6</td>
<td>.0069</td>
</tr>
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</table>

**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

\[
IN = \lambda (K^* - K_{-1}) + \gamma C_{p,-1}
\]

where \(\lambda\), \(K^*\), \(K_{-1}\) 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 $\delta$,

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

Substituting (88) into (87), we obtain

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

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

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

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:

$$ p_{-j} = j^{-s} \cdot e^{-j}. $$

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

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

Equation (91) is used to estimate investment of the four
sectors. The mining and manufacturing, and service sectors use
net direct foreign investment, $D_T/P_K$, 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>
<thead>
<tr>
<th>lagged periods</th>
<th>$I_{pa}$</th>
<th>$I_{pm}$</th>
<th>$I_{pc}$</th>
<th>$I_{psg}^{G_{I}/P_{k}}$</th>
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<td>.1597</td>
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<td>.0028</td>
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</tr>
<tr>
<td>8</td>
<td>.0006</td>
<td>.0012</td>
<td>.0012</td>
<td>.0029</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>lagged periods</th>
<th>$I_{h}$</th>
<th>$I_{h}^{S}$</th>
<th>MTG/P_{h}</th>
</tr>
</thead>
<tbody>
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<td>.1106</td>
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<td>.2301</td>
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<td>.0696</td>
<td>.1990</td>
<td>.2333</td>
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</tr>
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<td>.0082</td>
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</tr>
<tr>
<td>7</td>
<td>.0003</td>
<td>.0058</td>
<td>.0183</td>
</tr>
</tbody>
</table>
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.

Exports and imports: 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 $X_{a,t-1}$. 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, \( P_m/P^W_m \), 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, \( \sum_{i=0}^{5} (D_i + P_i)' \), 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]:

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

where $uf$ and $un$ are the frictional 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, $L^A_i/L^A$ ($i = c, m, \text{and} s$) 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 $i$, $L^A_i/L^A$, is formulated as

$$\left(93\right) \quad \frac{L^A_i}{L^A} = d_o + d_1 \frac{V_i}{V} + d_2 \frac{w_i}{w},$$

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

\[
(96) \quad K_i^u = \sum_{k=0}^{9} (.934)^k I_{pi,-k}
\]

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

In estimating the production function for agriculture, fishing and forestry we \emph{a priori} 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, \textit{Fixed Capital Flows and Stocks Manufacturing Canada, 1926-1960}, Ottawa, 1968, p.Al. .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:

\[
\frac{K_i^u}{K_i} = \frac{L_i}{L_i^A}
\]

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

\[
K_i = K_i^u \frac{L_i^A}{L_i}
\]

**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, \( \Delta L_a/P_a \), 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 $\delta K_{-1}$, where $\delta$ 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, $B_g$.

3. 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-Farity 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 exert 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
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Table 4: Forecast, 1969-1975: Nonfarm-Paternity
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. \(^{(2)}\)

Let us now turn to wage-parity simulations. 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

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

where \( P \) = price of output
\( w \) = wage rate
\( L \) = employment
\( V \) = output
\( \alpha \) = the exponential coefficient of labor
\[ e = \text{the elasticity of demand.} \]

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

\[ (98) \quad P = \frac{1}{\alpha(1+r)} \left( \frac{wL}{V} \right) \left( \frac{e}{e+1} \right) \]

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 synchronization 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

\[ (99) \quad P_m = .45 P_{m,-1} = .6501 \left[ w_m L_m / V_m - .45 (w_m L_m / V_m)_{-1} \right] \]

\[ + .1386 \left[ V_m / V_m^* - .45 (V_m / V_m^*)_{-1} \right] \]

\[ + .6463 \left[ P_m^{US} - .45 P_{m,-1}^{US} \right] = .1189 \]

\[ (100) \quad P_s = .85 P_{s,-1} = .3653 \left[ w_s L_s / V_s - .85 (w_s L_s / V_s)_{-1} \right] \]

\[ + .1003 \left[ V_s / V_s^* - .85 (V_s / V_s^*)_{-1} \right] \]

\[ + .6827 \left[ P_s^{US} - .85 P_{s,-1}^{US} \right] = .0021 \]

The simulation results using equations (99) and (100)
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**Unemployment Rate**
- Trade Services
- Construction
- wholesale and manucturing
- Forestry
- agriculture, forestry and fishing
- III. Employment

**Wages**
- Services
- Construction
- wholesale and manucturing
- IV. Wages

**Percentage of Growth of GNP**
- Cross National Expenditure

**Imports of Goods and Services**
- new residential construction
- Plant, machinery and equipment
- Business Gross Investment
- Personal Consumption

*Table 6 The Step-wise Increase in Wages to Attain Full Parity*
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**Table 5.** The wage-party, 100% effective in 1969.
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Table 7: The Stepwise Increase in Wages to Attain Full
Lower Price Mark-up Rates
Parity in 1970 and after, Compensated by the
1. GNE Account
2. Expenditure
3. Imports of Goods and Services
4. Exports of Goods and Services
5. New Residential Construction
6. Personal Consumption
7. Business Investment
8. Government Consumption
9. Government Gross Investment
10. Plant, Machinery and Equipment
11. Construction
12. Services
13. Business Services
14. Personal Services
15. Government Services
16. Retail Sales
17. Wholesale Sales
18. Consumer Prices
19. GNP
20. Percentage Growth of GNP
21. Gross National Expenditure

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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

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

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

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

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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.

Queen's University
References


5. Faddeeva, V.N., Computational Methods of Linear Algebra, Dover, New York, 1959


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

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**Notes:**
1. Actual values are used for 1968
2. Average values between 1958 and 1967
3. Variables other than $\Delta I_{ia}$, WETH, and $s_e$ are time trend estimates based on 1958 to 1967.