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A central feature in the respecification of the price sector of the Federal Reserve's MPS model is the attempt to estimate the direct and indirect effects of external sources of domestic inflation on the U.S. economy and to include these effects systematically in the model's aggregate price-determining mechanism. The key assumptions underlying this attempt are that the U.S. economy is open to externally originating price disturbances and that the U.S. price-determining process does not occur in isolation, but rather is included in a reverberation process of increasingly interdependent world price linkages.

In their report to the Pacific Basin Central Bank Conference held in San Francisco last year, Clark and Enzler [2] presented an overview of the basic structure of the MPS model. The also indicated how a crudely modified version of this model could be used to simulate external shocks to the U.S. domestic price sector. Towards the end of that presentation they discussed future modifications and extensions of the MPS model which were proposed to systematize the international forces operating in the domestic economy. Section I of this paper will review our thinking to date on how these forces should be considered within the context of a price sector of a large domestic macroeconomic model. Section II will present the specification and preliminary estimates of the new MPS price sector. Section III will conclude with an outline of our research strategy for closing the international economic linkage process from the standpoint of the MPS model.

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*The views expressed herein are solely those of the authors and do not necessarily represent the views of the Federal Reserve System.
The price equations presented here are initial results from a reestimation of the MPS price sector undertaken as Mr. Thurman's dissertation research at the Department of Economics, George Washington University. Both authors conducted the simulations and analysis. A preliminary version of this paper was presented at the Second Pacific Basin Central Bank Conference on Econometric Modeling held on June 8-11, 1976, Seoul, Korea.

Section I

To evaluate the effects of externally originating sources of domestic inflation, let us imagine the response of the domestic economy to an increase in foreign prices or an effective depreciation of the U.S. dollar. We have divided these effects into four categories for discussion purposes.

1. Direct Balance of Payments Effects: A rise in the prices of imported goods and services will cause the real value of expenditures on imports to fall. The prices of domestic exported goods, including services, relative to foreign competing goods will fall which will induce demand for and subsequent real expenditures on exported goods to rise. Hence, the goods and services account balance will improve for the domestic economy. This improvement will eventually strengthen the value of the domestic currency in foreign exchange markets.

2. Passthrough Effects from the Foreign Sector to the Domestic Price Sector: Direct passthroughs of higher import prices by domestic retailers to domestic buyers of final goods increases the value of purchases by ultimate consumers in the short run. Lagged passthroughs of imported intermediate goods prices temporarily reduce business profit margins of domestic producers using imported production inputs. Import-competing goods producers now feel more free to raise competing goods prices. Producers of export goods will be encouraged by their new strength in markets abroad to raise the prices of the goods that they produce which are also consumed domestically. Domestic producers of close substitutes to these export goods will also feel free to increase prices. Increased profit margins in the domestically traded goods industries will eventually attract new firms to these markets, thus having a mitigating influence on price increases in these industries.

3. <u>Indirect Domestic Macroeconomic Effects</u>: A general increase in consumer prices will reduce the real net worth positions of domestic households, which has a depressing influence on consumption expenditures. Wage earners, now faced with increasing prices, will seek increased wages to maintain their standard of living. These increased wage demands shift upward the short-term Phillips curve and exert further upward pressure on the price level. The direct rise in traded goods prices, along with an induced rise in domestic sector prices will lead to an increase in the demand for nominal money balance by increasing the total value of economic transactions. If monetary aggregates are not allowed to rise in an accommodating fashion, interest rates will increase. Higher interest rates will tend to hold down real output and will also attract inflows of capital from abroad, which will lead to an appreciation of the value of the domestic currency in foreign exchange markets.

4. <u>Domestic-Foreign Price Reverberations</u>: The general rise in domestic prices, and the macroeconomic responses to the external inflationary forces, are retransmitted to the foreign domestic economies with which the United States directly and indirectly trades. These retransmissions are received by the foreign economies through increasing U.S. export (foreign import) prices, reduction in U.S. demand for imports (foreign exports), and shifts in capital flows towards the U.S. According to its own structure and degree of openness to external stimulae, each foreign economy will likewise be affected by the change in U.S. current account conditions. These foreign domestic reactions in turn will be retransmitted back to the U.S. economy.

The inflation transmission mechanisms discussed above contain simplifying assumptions, which were made for purposes of exposition. These include an implicit dynamic-statics for the domestic rest-of-world price reverberations and the assumption that the initial inflationary shock originated exogenously to the domestic price system. In reality--and this will be approximated in our final model--reverberations are dynamically interactive with, and endogenous to, the domestic system.

Section II

In early MPS model studies of external sources of domestic inflation the model presented two major deficiencies. The first source of consternation was that all impact and lagged foreign price effects were absent in the model equations and required extensive judgmental adjustment. Second, foreign inflationary distrubances, judgmentally fed into the model's sector price deflators, could not be guaranteed to be consistently applied to the production and expenditure accounts measurements such that the economy's income identities would compute consistent amounts. A "mix" problem of misallocation of sector price changes would have to be adjusted by a constant blow-up factor to insure consistency.

The restructured domestic price sector attempts to maintain the incomes account consistency by estimating a fixed weight general nonfarm business deflator as the dominant price equation in the model along with sector deflators weighted and relative to the general fixed weight deflator. Included in the specifications of the general and relative price equations are foreign exchange rate adjusted prices relative to domestic prices.

The consistency requirements for the allocation of impacts to the price sector are met by the following system.

(1) $$P = \sum_{i=1}^{m} w_i P_i, \quad \Sigma w_i = 1, \quad w_i \geq 0, \text{ for } i = 1,2, \ldots m \text{ sectors of the economy}$$

(2) $$P = \alpha + BZ + \gamma P_f$$

(3) $$\frac{w_i P_i}{P} = \alpha_i + B_i Z + \gamma_i P_f,$$

where P and p_i are the general fixed weight and sector deflators respectively. A fixed weight w_i is a constant historical ratio of the i^{th} expenditure sector to total expenditures. Z is a vector of domestic activity variables and P_f represents a vector of foreign prices. From the above system we have the properties

$$(4) \qquad \sum_{i=1}^{m} \alpha_i = 1, \quad \sum_{i=1}^{m} B_{ij} = 0, \quad \sum_{i=1}^{m} \gamma_i = 0$$

Equation (4), the "summing constraints", guarantees consistent sector price changes with respect to a constant or changing general fixed weight price deflator; for example:

$$(5) \qquad \frac{\partial P}{\partial P_f} = \sum_{i=1}^{m} w_i \left(\frac{\partial P_i}{\partial P_f} \right)$$

The above means that within the context of a large nonlinear econometric model the change in the production side of the economy (call it the source of value added), brought about by a shift in a determinant variable, will be consistent with the national income accounts expenditure side (call it the ultimate use by sector of the source of value added). This achieves a consistent set of price deflators and eliminates the "mix" problem of inconsistent allocation of impacts between the production and expenditure accounts that results in either the direct case of an impact estimated within the system (ΔZ or ΔP_f) or the indirect case of a change in some other domestic variable affecting Z.

To derive the specification of the estimated equations in the MPS framework we start by introducing a vector of value added outputs equal to a vector of final demands with "$" denoting current dollar values:

(6) $$XBNF\$ + XBF\$ + EIM\$ + YH\$ = ECND\$ + ECD\$ + EH\$ + EPD\$ + EPS\$ + EGSC\$ + EGSO\$ + EGFC\$ + EGFO\$ + EEX\$$$

where

ECND$ = expenditures on consumer nondurables

ECD$ = expenditures on consumer durables

EH$ = expenditures on residential housing

EPD$ = expenditures on producers' durable equipment

EPS$ = expenditures on producers' structures

EGSC$ = expenditures on state & local government construction

EGSO$ = expenditures on state & local government nonconstruction enterprises

EGFO$ = expenditures on federal government construction

EGFC$ = expenditures on federal government nonconsturction enterprises

EEX$ = foreign expenditures on U.S. exports

XBF$ = value of farm business output

EIM$ = domestic expenditures on imports

YH$ = household income

XBNF$ = value of nonfarm business output.

Rewriting equation (6) with the industry and final demand implicit deflators and expressing in terms of the nonfarm business sector yields

(7) $$XBNF \cdot PXBNF = ECND \cdot PCND + ECD \cdot PCD + EH \cdot PEH + EPD \cdot PPD + EGFC \cdot PEGFC + EGFO \cdot PEGFO + EEX \cdot PEEX - XBF \cdot PXBF - EIM \cdot PEIM - YH \cdot PYH$$

The fixed weight general nonfarm business deflator, PXPFW1, is calculated by weighting the right-hand side deflators with the ratio of the base year 1972 real values of the right-hand side expenditure levels to XBNF to get the w_i's in equation (1):

(8) PXPFW1 = .65107*PCND' + .11659*PCD' + .064899*PEH + .077775*PPD
+ .044529*PPS + .027618*PEGSC + .039057*PEGSO
+ .0046335*PEGFC + .049895*PEGFO + .076099*PEEX
- .03356*PXBF - .079429*PEIM - .038979*PYH

PXPFW1 differs from PXBNF as federal indirect business taxes effects were purged from PCND and PCD to reflect the fact that excise taxes add nothing to value added, although they are directly passed on to prices purchasers pay for goods.

The functional form explaining PXPFW1 is conceptually the same as the previous MPS nonfarm business deflator equation as described in De Menil and Enzler [5]:

(9) PXPFW1 = f(PL, UOS, OMH, PRFD, PWM)

PL is the domestic nonfarm wage rate representing labor costs which will be assumed to be passed on directly to prices. Consequently unitary labor costs will be forced in estimation.

UOS is the ratio of unfilled orders to a moving average of shipments of producers' durable equipment $(OUPD/(\sum_{i=0}^{3} EPD_{-i}/4))$. This variable is designed to reflect the degree of demand elasticity affecting the markup policy of the oligopolist producer. When this ratio is high, orders are backlogged and demand is strong. The net positive effect here is estimated with a current and lagged term. This variable is similar to the capacity utilization measures (XB/XBC ratio of business output to business capacity) used in other models and later to be seen in conjunction with UOS in the relative price equations below.

OMH is output per manhour in the nonfarm business sector, namely the ratio of nonfarm business output (XBNF) to total manhours (LMHT). This variable enters in estimation as a distributed lag with the rationale that technical progress is Harrod neutral over a relatively long time horizon. The lagged coefficients, together with the lagged dependent variable need to be forced to unity.

PRFD represents exchange rate adjusted foreign wholesale prices relative to domestic prices (PFXW*FPWIW/PXPFW1) where PFXW and FPWIW are the foreign effective exchange rate and foreign wholesale price indexes, respectively, weighted by averaged bilateral and multicountry import value shares. This foreign to domestic price linkage effect will be assumed to enter with a lag process.

PWM, a price of world materials, is entered to represent a transitory impact in the cost passthrough process of oligopolist pricing decisions. It is expected that the effect is initially negative because the passthroughs take time to occur before a positive impact is felt later on. The MPS variables used to proxy PWM were of the form (.7PEIM + .3PXBF).

In general, one would expect there would not be much time lag in the adjustment of the output price by a firm to a change in its costs. The aggregative price includes the prices of outputs of some firms which are inputs to others. Those firms using the intermediate goods adjust their prices slowly for the increased cost of the intermediate goods. Consequently a lagged adjustment process of the Koyck type is assumed.

The specification for the PXPFW1 equation (analogous to equation (2)) is:

Table I: Non-Farm Business Deflator Equation (PXPFW1)

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a = .12521494 (5.76)
b = .65003277 (10.79)

c_0 = -.11436513 (-5.43)
c_1 = -.03235575 (-1.50)
c_2 = .01404106 (.5429)
c_3 = .02482631 (1.28)

Σc_i = -.1078525 (2nd degree polynomial)

d_1 = .10487914 (2.41)
d_2 = -.00760412 (-.18)

f_0 = -.17954098 (-4.24)
f_1 = -.06300592 (-3.42)
f_2 = -.01177179 (-.46)
f_3 = -.00483526 (-.23)
f_4 = -.02119308 (-1.43)
f_5 = -.03984195 (-1.90)
f_6 = -.03977871 (-1.88)

Σf_i = -.35996723 (3rd degree polynomial)

g = -.00591955 (-1.18)
h = -.00737038 (-4.33)

l_0 = .01601084 (.61)
l_1 = .01973905 (.92)
l_2 = .02283675 (1.30)
l_3 = .02530392 (1.67)
l_4 = .02714058 (1.96
l_5 = .02834671 (2.09)
l_6 = .02892233 (2.09)
l_7 = .02886743 (2.02)
l_8 = .02818202 (1.93)
l_9 = .02686607 (1.84)
l_{10} = .02491962 (1.75)
l_{11} = .02234264 (1.68)
l_{12} = .01913516 (1.62
l_{13} = .01529715 (1.57)
l_{14} = .0182862 (1.52)
l_{15} = .00572957 (1.48)

Σl_i = .35046857 (2nd degree polynomial)

$\bar{R}^2$ = 0.9995 Se = 0.0028 DW = 2.057 ρ = 0.2

$$\ln(PXPFW1/PL) = a + b \ln(PXPFW1_{-1}/PL) + \sum_{i=0}^{3} c_i \Delta \ln(PWM)_{-i} \tag{10}$$
$$+ d_1 UOS + d_2 UOS_{-1} + \sum_{i=0}^{6} f_i \ln(OMH)_{-i}$$
$$+ gCONT + hDUME + \sum_{i=0}^{15} l_i \Delta \ln(PRFD)_{-i}$$

CONT is a vector of estimated price residuals entered to net out the relative impacts of the phases of the price controls period from 1971:3 to 1973:4. DUME is a dummy variable to account for missing lagged foreign exchange rate and price data prior to 1957:1.

The equation was estimated for the period 1958:1 to 1974:4 using restricted least squares with a scanned autoregressive scheme that minimized the sum of squared errors. Almon polynomial distributed lag coefficients were estimated for the lagged variables, constrained to 0 at the end of the period. The estimated coefficients are given in Table I. Figures in parentheses are t-ratios. ρ is the coefficient of the first order serial correlations.

In formulating the relative price equations it was obvious that not all of the sector prices on the right-hand side of the definition of PXPFW1 would respond to the markup over minimized cost functional form. Specifically, PEIM, PXBF and PHY were considered to respond to significantly different forces than those of the nonfarm business sector. Consequently a gross domestic sales fixed weight deflator is introduced as:

$$PXPFW2 = .56513*PCND' + .10112*PCD' + .056322*PEH + .067509*PPD \tag{11}$$
$$+ .038651*PPS + .023972*PEGSC + .033902*PEGSO$$
$$+ .0040219*PEGFC + .043309*PEGFO + .066054*PEEX$$

The right-hand side weights (call them v_i) for each p_i are calculated by the ratio of each historical real 1972 base sector expenditure level to the total of all real 1972 base expenditures. PXPFW2 and PXPFW1 are therefore related by the identity:

$$(12) \qquad PXPFW2 = PXPFW1 + \sum_{i=1}^{10} (v_i - w_i)\, p_i + \sum_{i=11}^{13} w_i p_i$$

Using a similar functional form as that of the general nonfarm business fixed weight deflator equation (10), the specification for the relative price equations for each p_i is as follows:

$$(13) \qquad \frac{v_i p_i}{PXPFW2} = a + a_1 * \frac{PEIM}{PXPFW2} + a_2 * \frac{PXBF}{PXPFW2} + a_3 * \frac{PYH}{PXPFW2} + b_1 * UOS$$
$$+ b_2 * UOS_{-1} + \sum_{i=0}^{3} c_i * (XB/XBC)_{-i} + \sum_{i=0}^{11} d_i * \ln(OMH)_{-i}$$
$$+ h * CONTR + (e + \rho e_{-1})$$

XB/XBC is a proxy for the capacity utilization rate and CONTR is a simple binary dummy variable for the price controls period (1. from 1971:3 to 1973:4, 0. otherwise).

The values for coefficients of the sector prices (PEIM, PXBF, PYH) which were not included in PXPFW2 can be derived a priori from the expression:[1/]

$$(14) \qquad a_{ki} = \frac{X_k}{T - X_k} (\alpha_{ki} - v_i) \qquad k = 1,2,3$$

where X_k is the historical real value added output of the omitted value added sector k,

T is the total of the final demand expenditure sections, the denominator in calculating the PFXFW2 weights; $T = \sum_{j=1}^{10} X_j$,

v_i is the PXPFW2 weight $v_i = X_i/T$ for the i^{th} sector, and

α_{ki} is the proportion of the k^{th} omitted value added output sector consumed in the i^{th} final demand sector.

The α_{ki} are derived from the dual of the "C" matrix used in an input-output analysis described in Preston [8]. The "C" matrix derives coefficients to express the proportion of final demand vectors that come from a vector of value added sector outputs. Here we are interested in the proportion of value added output "consumed" totally in the vectors of final demand. This concept yields the relative impacts of the omitted value added output deflators on the included final demand deflators. These impacts are weighted such that the total impact across the system sums to zero thereby preserving the system summing constraints.[2/]

The estimates for the ten relative price equations are contained in Table II. The equations were estimated using ordinary least squares with a specified autoregressive coefficient to preserve the summing constraints yet correct for the average serial correlation in the disturbances across equations. All lagged variables are Almon polynomial distributed lags. Both lag structures were 2nd degree constrained to 0. at t-n. Figures in parentheses are t-ratios. The values of a_{ki}, as mentioned above, were imposed.

As in most of these sum constrained systems the estimated coefficients are to be interpreted as impacts on the weighted relative variable. The impact upon the level of each sector deflator is not immediately apparent. Similar to equation

TABLE II: Relative Price Equations

	PCND'	PCD'	PEH	PPD	PPS	PEGSC	PEGSO	PEGFC	PEGFO	PEEX
v_i	.56513	.10112	.056332	.067509	.038651	.023972	.033902	.0040219	.043309	.066054
a_1	-.01699	.0049595	-.0020267	.0080446	-.000344	-.0014661	-.0020763	.0010068	.010766	-.0019245
a_2	.0014962	-.0027339	-.0011201	-.0012754	-.0007696	-.0004792	-.000507	-.00009067	-.0008494	.006299
a_3	.015228	-.0035409	-.0019727	-.0023541	-.001353	-.00083948	-.0011872	-.00014084	-.0015166	-.002313
b_1	.022728	-.035652	.010471	-.037040	.008031	.009983	.003483	-.001210	-.021224	.040521
	(1.49)	(-2.08)	(.99)	(-3.17)	(1.14)	(1.98)	(.73)	(-1.02)	(-2.11)	(2.16)
b_2	-.076594	-.009975	.001500	.002235	.014395	.009171	.003845	.000645	.000774	.054068
	(-4.70)	(-.75)	(.13)	(.18)	(1.91)	(1.70)	(.76)	(.51)	(.07)	(2.71)
c_0	.029210	.087434	-.035592	.052781	-.033923	-.028814	-.006637	.002343	.014095	-.081104
	(1.59)	(4.26)	(-2.80)	(3.77)	(-4.01)	(-4.76)	(-1.17)	(1.64)	(1.17)	(-3.61)
c_1	.026816	.035915	-.010765	.015147	-.017855	-.013315	-.004992	-.000519	.005935	-.036440
	(5.77)	(6.90)	(-3.33)	(4.26)	(-8.31)	(-8.66)	(-3.45)	(-1.43)	(1.93)	(-6.39)
c_2	.021150	.004170	.003443	-.006194	-.006845	-.003346	-.003337	-.001864	.000866	-.008035
	(3.17)	(.56)	(.74)	(-1.21)	(-2.22)	(-1.51)	(-1.61)	(-3.58)	(.20)	(-.98)
c_3	.012211	-.007802	.007031	-.011243	-.000893	.001092	-.001673	-.001691	-.001113	.004112
	(1.78)	(-1.01)	(1.47)	(-2.14)	(-.28)	(.48)	(-.78)	(-3.15)	(-.25)	(.49)
Σc_i	.089387	.119717	-.035883	.050491	-.059516	-.044383	-.016639	-.001730	.019783	-.121468
d_0	-.014297	-.023310	.011532	-.018997	.011839	.011911	.003817	-.000261	.001699	.016165
	(-1.11)	(-1.62)	(1.29)	(-1.94)	(1.99)	(2.80)	(.76)	(-.26)	(.20)	(1.03)
d_1	-.008888	-.018225	.008068	-.014137	.008930	.008739	.002794	-.000113	.001065	.011835
	(-1.02)	(-1.87)	(1.33)	(-2.12)	(2.22)	(3.03)	(1.03)	(-.17)	(.19)	(1.11)
d_2	-.004246	-.013712	.005060	-.009873	.006371	.005963	.001899	.000013	.000520	.008047
	(-.82)	(-2.38)	(1.41)	(-2.51)	(2.68)	(3.50)	(1.19)	(.03)	(.15)	(1.27)
d_3	-.000370	-.009770	.002507	-.006204	.004162	.003584	.001132	.000115	.000064	.004802
	(-.17)	(-4.06)	(1.70)	(-3.78)	(4.19)	(5.04)	(1.69)	(.69)	(.05)	(1.82)
d_4	.002738	-.006400	.000409	-.003131	.002301	.001601	.000493	.000195	-.000302	.002099
	(5.87)	(-12.26)	(1.26)	(-8.79)	(10.68)	(10.38)	(3.40)	(5.36)	(-.98)	(3.67)
d_5	.005080	-.003600	-.001235	-.000654	.000791	.000014	-.000018	.000251	-.000578	-.000061
	(2.24)	(-1.42)	(-.79)	(-.38)	(.76)	(.02)	(-.03)	(1.42)	(-.39)	(-.02)
d_6	.006655	-.001372	-.002423	.001227	-.000371	-.001177	-.000400	.000284	-.000764	-.001680
	(1.85)	(-.34)	(-.97)	(1.45)	(-.22)	(-.99)	(-.36)	(1.01)	(-.32)	(-.38)
d_7	.007463	.000285	-.003157	.002512	-.001183	-.001971	-.000654	.000295	-.000861	-.002756
	(1.70)	(.06)	(-1.03)	(.75)	(-.58)	(-1.36)	(-.48)	(.86)	(-.30)	(-.51)
d_8	.007504	.001370	-.003435	.003201	-.00164	-.002370	-.000780	.000282	-.000868	-.003289
	(1.68)	(.26)	(-1.07)	(.91)	(-.77)	(-1.55)	(-.54)	(.78)	(-.28)	(-.58)
d_9	.006778	.001885	-.003259	.003295	-.001758	-.002372	-.000777	.000246	-.000786	-.003280
	(1.59)	(.39)	(-1.09)	(1.00)	(-.88)	(-1.67)	(-.58)	(.73)	(-.28)	(-.62)
d_{10}	.005286	.001828	-.002628	.002792	-.00152	-.001977	-.000646	.000187	-.000613	-.002729
	(1.54)	(.48)	(-1.10)	(1.07)	(-.96)	(-1.75)	(-.61)	(.70)	(-.27)	(-.65)
d_{11}	.003026	.001199	-.001541	.001694	-.000935	-.001187	-.000387	.000105	-.000351	-.001636
	(1.52)	(.54)	(-1.11)	(1.11)	(-1.02)	(-1.80)	(-.66)	(.68)	(-.27)	(-.67)
Σd_i	.016729	-.069824	.009898	-.038275	.026981	.020759	.006473	.001599	-.001774	.027517
h	.000167	-.000669	.001149	.000057	.000920	.000369	-.000159	.000086	-.000999	-.000930
	(.20)	(-.72)	(1.99)	(.09)	(2.40)	(1.34)	(-.62)	(1.33)	(-1.83)	(-.91)
Const.	.470657	.153266	.068052	.108164	.030000	.016531	.037390	.001635	.028877	.085550
	(62.70)	(18.23)	(13.05)	(18.87)	(8.60)	(6.66)	(16.03)	(2.79)	(5.83)	(9.29)
ρ	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60
$\bar{R}^2$	.954457	.976096	.861975	.962273	.973260	.973031	.763079	.876682	.696884	.913288
S_e	.001033	.001157	.000718	.000789	.000400	.000342	.000321	.000081	.000681	.001260
D.W.	1.74	.63	.77	.57	.54	.56	1.91	1.96	1.81	.77

(14) we can derive an approximation to the implied level impact from the expression:

$$\delta_{ki} = \frac{\hat{\beta}_{ki} + v_i \hat{B}_k}{v_i} \tag{15}$$

where δ_{ki} is the approximated impact of the k^{th} right-hand side variable on the i^{th} sector deflator

$\hat{\beta}_{ki}$ is the estimated coefficient of the k^{th} right-hand side variable in the i^{th} sector equation

$\hat{B}_{ki}$ is the impact on the weighted average price, PXPFW2, derived from k^{th} variables' impact on PXPFW1 and each p_i in equation (12).

Equation (15) is a nontrivial reminder to those who would attempt to interpret the estimated (or imposed) right-hand side coefficients. The $\hat{\beta}_{ki}$ for any i^{th} sector equation may, at first glance, appear to have the "wrong sign". The impact δ_{ki} on the i^{th} equation, however, also takes into account the sector weight v_i and the total system impact $\hat{B}_k$. Therefore, the impact δ_{ki} should conform to the theoretical expectations.

Of specific interest to this conference as well as policy makers are the impacts of foreign price and exchange rate shocks on domestic prices and activities. To calculate the impact on domestic prices, we performed two sets of simulations over a three year period (1968 to 1970): the first with the price sector alone and the second with the price-wage sectors jointly. These simulations assumed a shock of a 1 percent depreciation of the weighted foreign exchange rate index (0.01 for the base year 1972=1). This shock feeds into the model through three channels: the main price equation (10), the estimated equation for the unit value index for nonfuel imports which affects PEIM, and an adjustment on farm product exports deflator affecting PXBF.

Table III presents the simulation results for the price sector alone. The numbers in the table are percent changes in the level of each deflator. For example, the one percent exchange rate depreciation increases gross domestic sales fixed weight deflator PXPFW2 by slightly more than 0.1 percent at the end of three years. On the whole, we expect the sector price deflators that have the higher direct and indirect foreign trade components, as indicated by the coefficients α_{ki} in equation (14), to show greater impacts than the weighted average, PXPFW2. This is evidenced in the impacts on PCD, PPD, and PEEX. The impacts on PCND are surprisingly less than the average. This may indicate that the pass-through effect has not been fully captured in the price system for this sector. PPS, a representative expenditure sector deflator that has a small foreign component, has correspondingly lower than the average impact multiplier. The impacts on PEIM and PXBF reflect the assumed direct influence of world market pricing and exchange rate movements.

The further inflationary pressure brought about by the wage-price interaction of the Phillips curve mechanism in the MPS model was the object of the second simulation. The results are presented in Table IV. We see here the higher value of impacts across all of the deflators resulting from the interaction of the price deflators with the wage rate, PL. This result is in line with the findings of Kwack [4]. At the end of the three year simulation period, the change of 0.29 in the wage level represents a .06 percent change in PL. The 0.06 percent increase in PL was fed into the price sector, resulting in a 0.06 percent increase in the level of PXPFW2. The multiplier effect on PXPFW2 of a one percent depreciation is slightly more than a 0.15 percent increase, which is higher than the non-wage induced increase of 0.11 percent in the first simulation. The pattern of changes in the levels of the sector deflators relative to PXPFW2 is similar to that of the first simulation, as expected.

Table III: MPS Price Sector Simulations
With a 1% Increase in the Exchange Rate Index

	PXPFW1	PXPFW2	PCND	PCD	PPD	PPS	PEEX	PEIM	PXBF
1968:1	-.03	.01	.01	.01	.03	.00	.06	.73	.57
2	-.02	.02	.02	.02	.05	.01	.07	.30	.60
3	.01	.05	.04	.05	.07	.03	.10	.33	.62
4	.03	.07	.06	.07	.10	.05	.12	.36	.66
1969:1	.04	.08	.07	.09	.11	.07	.14	.36	.67
2	.05	.09	.08	.10	.13	.07	.15	.44	.71
3	.05	.10	.08	.10	.13	.08	.16	.47	.72
4	.05	.10	.09	.11	.15	.09	.17	.52	.77
1970:1	.06	.11	.09	.12	.15	.09	.17	.54	.76
2	.06	.11	.10	.12	.16	.10	.17	.54	.73
3	.06	.11	.10	.12	.16	.10	.17	.56	.73
4	.06	.11	.09	.12	.16	.10	.16	.57	.69

1. Figures are percent changes in price deflators due to an increase of 0.01 in the exchange rate index.

2. The 1972 base year price deflators are equal to 100, whereas the 1972 base year exchange rate index is equal to 1.

Table IV: MPS Price and Wage Sector Simulations
With a 1% Increase in the Exchange Rate Index

	PXPFW1	PXPFW2	PCND	PCD	PPD	PPS	PEEX	PEIM	PXBF	PL
1968:1	-.03	.01	.01	.01	.03	.00	.06	.23	.57	.0
2	-.02	.02	.02	.02	.05	.01	.07	.30	.59	.0
3	.01	.05	.04	.05	.07	.03	.10	.33	.62	.01
4	.03	.07	.06	.08	.10	.06	.13	.36	.66	.02
1969:1	.05	.09	.08	.09	.11	.07	.14	.36	.67	.04
2	.05	.10	.09	.10	.13	.08	.16	.44	.72	.07
3	.06	.11	.09	.12	.15	.09	.17	.47	.73	.10
4	.07	.12	.11	.13	.16	.10	.19	.53	.79	.14
1970:1	.08	.13	.12	.14	.18	.12	.20	.56	.79	.17
2	.09	.14	.12	.15	.19	.13	.21	.56	.76	.21
3	.10	.15	.13	.16	.20	.14	.21	.57	.77	.25
4	.11	.15	.13	.16	.20	.14	.21	.59	.73	.29

1. Figures are percent changes in price deflators (1972=100) and the value of PL (for 1972, PL=approximately 465), due to an increase of 0.01 in the exchange rate index.

2. The 1972 base year exchange rate index is equal to 1.

FOOTNOTES

1/ This expression is derived from $\Delta p_k \left(\frac{v_i p_i}{PXPFW2}\right) / \Delta p_k \left(\frac{p_k}{PXPFW2}\right)$ where $\Delta p_k = \partial / \partial p_k$.

2/ The derived λk_i used in calculating the ak_i in vector notation for the three omitted value added sectors were EIM(.336, .168, .029, .176, .034, .0042, .0059, .0176, .1885, .0401), XBF(.615, .01, .019, .025, .013, .008, .017, .001, .015, .276), YH(1.0, 0., 0., 0., 0., 0., 0., 0., 0., 0.,). Our thanks is due to Ros Preston and Gene Guill for providing the updated C mature coefficients for the 1972 base year.

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