SIMULATING INDEXATION

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As the number of theoretical articles on the macroeconomic impact of indexation continues to grow, there has been little parallel empirical investigation. The reasons for this asymmetry appear to be both the inappropriateness of existing models for the systematic handling of indexation, and the theoretical uncertainties as to the appropriate questions or likely outcomes. The present study attempts to redress this asymmetry by investigating, through simulation, the likely impacts of indexation. The present analysis will build upon the theoretical work in the area, however. This is evidenced by the method of indexation considered, and the focal questions addressed.

In terms of the method of indexation examined, the work of Gultekin and Santomero (1976A) indicates that an economy with any indexation of prices to wage movements or input costs is inherently less stable than the non-indexed regime. On the other hand, wage movements that are linked to price variability render the economy more stable. Accordingly, the present study will limit its investigation to wage indexation only, with some consideration given to interest rate adjustments as well.

On the theoretical priors regarding the effect of indexation, the current literature is much less certain. On the unemployment side, the works of Fischer (1976) and Gray (1976A, 1976B) indicate that full indexation will successfully dampen labor market disequilibrium for monetary disturbances while exacerbating real disturbances. The work of Gultekin and Santomero (1976B), however, suggests that indexation reduces labor market disturbances for both real and monetary shocks. It, therefore, suggests that the indexed regime should do uniformly better than a non-indexed economy subjected to the same disturbance vector. On the inflation front, the work of Heller (1974) and Gultekin and Santomero (1976B) suggest that indexed regimes exhibit greater price movement. The current study investigates the inflationary tendency alleged by these researchers.

In addition to these more obvious questions, the present study also investigates three related issues. The first is the suggestion by Friedman (1974) and indeed much of the literature on price dynamics,[1] that indicates the economy will approach de facto indexation of wages to prices by the formation of expectations of price inflation as a motive force in wage dynamics. It has been shown in Gultekin and Santomero (1976A) that indexation is the limiting case of the adjustment of wage movements to expected inflation. In this limit, then, the two regimes are identical. It is of considerable interest to the policymaker whether the economy is converging to this equivalency given the experiences of the last decade. The second issue investigated here is the impact that the timing of indexation will have in the time series behavior of relevant variables. If the use of indexation proves desirable, the question of the optimal timing within a business cycle to institute this one-time change will be considered. The concern here is whether or not the economy will react differently to the implementation of indexation during the trough or the peak of a business cycle. Finally, the policy response of indexed and non-indexed regimes is explored.

The results obtained from the analysis of these questions may be summarized as follows. First, wage indexation improves social

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[1]See Fischer (1972), Barro (1972) and Stein (1971), as well as the natural rate literature on the equivalent subject area.

welfare by reducing the quantity of unemployment in the sample period. However, this is accomplished only at the expense of higher inflation rates. Second, a very simple form of wage indexation proves quite adequate to obtain these desired results. Third, the economy of the last decade does, indeed, appear to be similar to the indexed regime. A reestimation of the model used shows an increase in the importance of observed inflation on nominal wage contracts in recent years. Fourth, the results indicate that whether it is instituted in expansionary or contractionary periods depends on whether policymakers weigh the unemployment rate or the inflation rate more heavily. Fifth and finally, from a policy point of view, an economy with wages indexed by prices tends to exhibit relatively more stable employment levels but more inflation variability. As a matter of fact, if policymakers are more interested in lowering the rate of unemployment than fighting the rate of inflation, their task may be easier in an indexed environment.

I. THE PINDYCK MODEL

One of the reasons that has been offered for the lack of research on the impact of indexation using econometric models is the difficulty in obtaining a model appropriate to the task. The problem requires a model that estimates both nominal wages and prices, and is sufficiently small to capture the essence of the impact of indexation without being lost in detail. Also needed is a model that can be simulated for sufficient out-of-sample periods. While larger models[2] generally derive quarterly estimates of nominal wages and prices, their size often precludes exact isolation of cause and effect, for which reason these models were felt

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[2]For example, the reader is referred to the Wharton Model, the MPS model, etc.

inappropriate for the present study. On the other hand, the smaller models[3] generally use annual data and often derive only real variables, rather than the nominal values of interest here.

A second problem in selecting a model relates to the period over which it was estimated. It will be recalled that the exercise requires that a model with no incorporation of expected inflation be analyzed in order to investigate the impact of such a change, through general indexation. If the model had been estimated beyond, say, the mid 1960's, one would anticipate that all estimated regressions would incorporate some recognition of the then still moderate inflation rate. This is not to imply that a post 1960 model is inappropriate, however. Rather, our ability to extract the exact portion of price expectations from the model, so that full indexation may be considered, is very limited. Therefore, one would have greater confidence in the results if the sample period omitted periods of substantial inflation. Doing so would yield a model of the "real" economy on which indexation can be explicitly imposed. Of course, such a choice is not without cost. If the structure of the economy has changed significantly, a model estimated over a more distant period may be suspect.

The model that appeared to balance these criteria for selection, and which was employed in the analysis below is the small quarterly model of the U. S. economy developed by Pindyck (1973). This model is highly aggregated, completely linear and contains nine behavioral equations together with a tax relation and an income indentity. The model was estimated over the period 1955I to 1966IV.

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[3]For example, the reader is referred to Klein-Goldberger, Moroney-Mason, etc.

Table 1

Original Model Specification
and
Data Source and Definition

I. Estimated Equations

(1) $$C = \underset{(8.25)}{0.4152YD} - \underset{(-4.80)}{0.2819YD_{-1}} + \underset{(1.73)}{8.1743W_{-1}} - \underset{(-2.29)}{2.3676\Delta P} + \underset{(10.34)}{0.7596C_{-1}} + \underset{(2.17)}{5.2988}$$

$R^2 = 0.9991$, SER = 1.594, F = 10,280. DW = 1.95, $\rho = -0.400$

(2) $$\Delta INR = \underset{(7.08)}{0.1569\Delta YD} + \underset{(1.97)}{0.0443\Delta YD_{-3}} - \underset{(-1.57)}{1.3563\Delta RL_{-5}} + \underset{(3.73)}{0.3397\Delta INR_{-1}} - \underset{(-2.44)}{0.0042(INR_{-1} + INR_{-2})}$$

$R^2 = 0.178$, SER = 0.744, F = 29.3, DW = 1.98, $\rho = -0.335$

(3) $$IR = \underset{(5.49)}{0.0127YD} - \underset{(-6.22)}{0.550(R_{-2} + R_{-3})} - \underset{(12.83)}{0.603IR_{-1}} + \underset{(5.84)}{6.65}$$

$R^2 = 0.992$, SER - 0.582, F = 184.9, DW = 1.64, $\rho = 0.700$

(4) $$IIN = \underset{(2.08)}{0.0113YD} + \underset{(5.95)}{0.4647\Delta_2 YD} - \underset{(-3.72)}{0.6002\Delta_2 C} + \underset{(4.60)}{0.4219IIN_{-1}} - 2.4615$$

$R^2 = 0.740$, SER = 2.228, F = 33.5, DW = 2.28, $\rho = 0.400$.

(5) $$R = \underset{(3.66)}{0.0071YD} + \underset{(3.13)}{0.0344\Delta YD} - \underset{(-2.26)}{0.1648\Delta M} + \underset{(2.48)}{0.4791\Delta P} + \underset{(3.19)}{0.3745R_{-1}} - \underset{(-2.74)}{1.4734}$$

$R^2 = 0.883$, SER = 0.336, F = 68.2, DW = 1.90, $\rho = 0.400$

Table 1 cont.

(6) $RL = \underset{(1.43)}{0.0598R} + \underset{(2.05)}{0.0055\Delta_2 YD} + \underset{(12.38)}{0.8715RL_{-1}} + \underset{(1.62)}{0.3126}$

$R^2 = 0.941$, SER = 0.1358, F = 292, DW = 1.97, $\rho = 0.250$

(7) $P = \underset{(7.71)}{6.281W_{-1}} + \underset{(4.37)}{0.0195(YD_{-1} - YDP_{-1})} - \underset{(-3.50)}{0.0328IIN_{-2}} - \underset{(-3.09)}{0.0156YD}$

$+ \underset{(10.20)}{0.8040P_{-1}} + \underset{(6.54)}{14.552}$

$R^2 = 0.984$, SER = 0.195, F = 710.3, DW = 2.47, $\rho = 0.500$

(8) $UR = - \underset{(-4.94)}{0.00043\Delta YD} - \underset{(-4.02)}{0.00032\Delta YD_{-1}} + \underset{(2.56)}{0.0024W_{-1}} - \underset{(-2.04)}{0.00014(YD_{-1} - YDP_{-1})}$

$+ \underset{(8.88)}{0.8047UR_{-1}} + \underset{(1.58)}{0.0065}$

$R^2 = 0.953$, SER = 0.0023, F = 185.5, DW = 1.11, $\rho = 0.050$

(9) $W = \underset{(3.37)}{0.0105P_{-3}} + \underset{(3.73)}{0.0011YD_{-1}} + \underset{(2.98)}{0.00012\Delta YD} - \underset{(-3.39)}{0.8277UR_{-4}}$

$+ \underset{(5.92)}{0.6269W_{-1}} - \underset{(-3.35)}{0.6850}$

$R^2 = 0.9992$, SER = 0.0117, F = 11.940, DW = 1.87, $\rho = 0.0200$

II. Relations

(10) GNP = C + INR + IR + IIN + G

(11) YD = GNP - T

Table 1 cont.

III. Definitions and Data Sources

C$	Total personal consumption expenditures, billions of current dollars.
INR$	Gross private domestic investment in non-residential structures and producers durable equipment, billions of current dollars.
IR$	Value of new additions and alterations to private non-farm residential buildings, billions of current dollars.
IIN$	Change in business inventories, total, billions of current dollars.
G$	Government purchases of goods and services, total, billions of current dollars.
PC	Implicit price deflator, personal consumptions expenditures 1958 = 100.
PNR	Implicit price deflator, non-residential fixed investment 1958 = 100.
PR	Implicit price deflator, non-farm residential structures 1958 = 100.
PG	Implicit price deflator, government purchases of goods and services 1958 = 100.
P	Implicit price deflator, GNP 1958 = 100.
C	100.C$/PC
INR	100.INR$/PNR
IR	100.IR$/PR
IIN	100.IIN$/P
G	100.G$/PG
I	INR + IR + IIN
Y	C + I + G
FR	Federal Government receipts, billions of current dollars.
FTR	Total Federal transfer payments, billions of current dollars.
T	FR - FTR
t	T = tY. Estimated value of t = 0.15
YD	(1-t)Y.
MC	Currency outside the treasury, the Federal Reserve System, and the vaults of all commercial banks. Billions of current dollars, seasonally adjusted average during quarter. Source: Federal Reserve Bulletin.
MD	Demand deposits at all commercial banks, other than those due to domestic commercial banks and the U.S. Government. Billions of current dollars, seasonally adjusted average during quarter. Source: Federal Reserve Bulletin.
M	MC + MD
R	Average market yield (bank discount rate) on U.S. Government 3-month bills. Percent per annum, average during quarter. Source: Federal Reserve Bulletin.
RL	Yield on long-term U.S. Government bonds (maturing or callable in 10 or more years). Percent per annum, average during quarter. Source: Federal Reserve Bulletin.
WS	Wages and salaries (component of national income), billions of current dollars.

Table 1 cont.

H	Quarterly man-hours (all persons) in the total private economy, seasonally adjusted at annual rates, millions of persons.
W	1000.WS/H (hourly money-wage rate)
U	Total unemployment, millions of persons, seasonally adjusted, averaging during quarter. Source: Employment and Earnings.
LF	Civilian labor force, millions of persons, seasonally adjusted, average during quarter. Source: Employment and Earnings.
UR	U/LF (unemployment rate)

The estimated equations are contained in Table 1.[4] In sample simulations of the model, as reported by Pindyck, are quite good. Its out-of-sample behavior will, of course, not be as accurate. However, given the presence of substantial inflation in the post sample decade, one should not expect it to forecast well. Essentially, if the underlying structure of the economy has been altered by the acceptance of a substantial inflation rate, the model will, in effect, be invalid for post sample prediction. This, however, should not concern us here, since what we require for the simulation of indexation is a model that performs well during a period of stable prices, not rising inflation. The behavior of the model over the period 1966IV to 1975IV, therefore, should be viewed as a control simulation characterizing the behavior of the economy without adjustments due to expected inflation. In other words, such a simulation can be interpreted as a rough approximation of the behavior of the "real" economy during this time period. Out-of-sample simulation results for the three variables of interest, inflation, unemployment and the short-term interest rate are presented in Figures 1, 2, and 3. It will be immediately obvious that the behavior of the economy is markedly different from the control simulation. This is, to a large degree, traceable to the absence of inflationary adjustment in the model. Notice that prices predicted by the model rise very slowly. Examining the estimated equation indicates the reason for the discrepancy. In equation (7) of Table 1, note that prices do not move according to any inflationary expectations. Rather, prices move downward in

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[4] A reestimation of the model using currently available data for the 1955 to 1966 period results in a nearly identical set of coefficients.

PINDYCK MODEL

RANGE 3.40 TO 8.40

ACTUAL R*	SOLUTION R*	RESIDUALS	
5.100	4.724	0.376	1968 1
5.500	4.484	1.016	1968 2
5.200	4.283	0.917	1968 3
5.600	4.414	1.186	1968 4
6.100	4.579	1.521	1969 1
6.200	4.845	1.355	1969 2
7.000	5.086	1.914	1969 3
7.300	5.150	2.150	1969 4
7.300	4.834	2.466	1970 1
6.800	4.341	2.459	1970 2
6.400	4.298	2.102	1970 3
5.400	4.476	0.924	1970 4
3.900	4.448	-0.548	1971 1
4.200	4.021	0.179	1971 2
5.100	4.275	0.825	1971 3
4.200	4.958	-0.758	1971 4
3.400	4.736	-1.336	1972 1
3.700	4.282	-0.582	1972 2
4.200	3.914	0.286	1972 3
4.900	4.157	0.743	1972 4
5.600	4.676	0.924	1973 1
6.600	4.792	1.808	1973 2
8.400	4.640	3.760	1973 3
7.500	4.648	2.852	1973 4
7.600	4.546	3.054	1974 1
8.300	4.444	3.856	1974 2
8.300	4.475	3.825	1974 3
7.300	4.492	2.808	1974 4
5.900	5.030	0.870	1975 1
5.400	4.479	0.921	1975 2
6.300	4.135	2.165	1975 3
5.700	4.489	1.211	1975 4

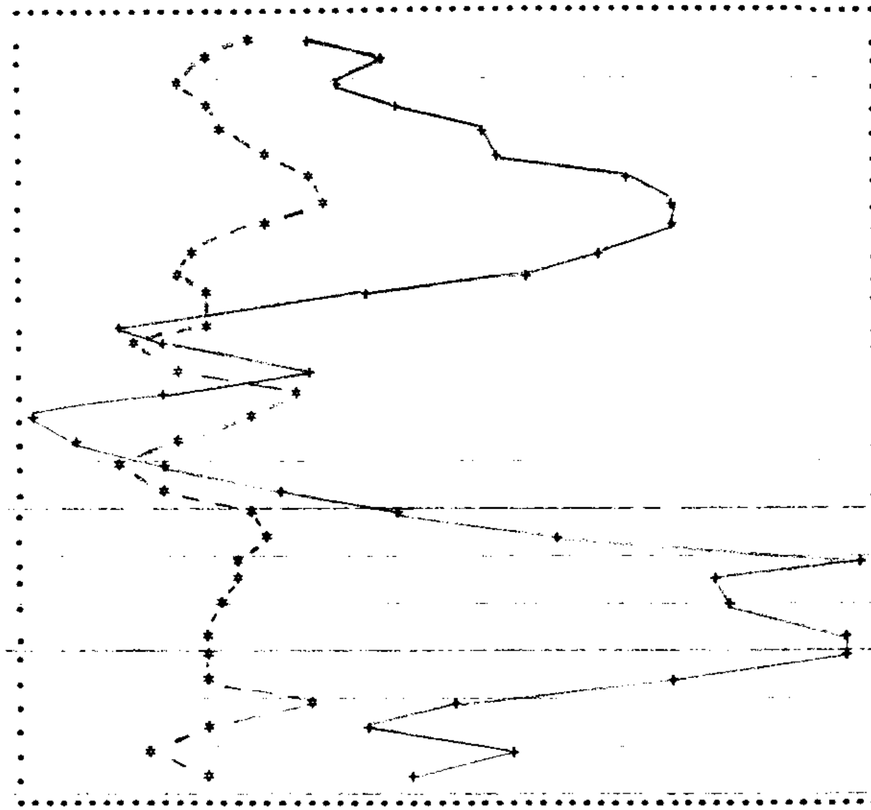

Figure 1

Out of Sample Simulation of the Short Term Interest Rate

PINDYCK MODEL

RANGE 3.40 TO 11.82

ACTUAL UR+	SOLUTION JP*	RESIDUALS	
3.700	3.871	-0.171	1968 1
3.600	3.621	-0.021	1968 2
3.500	3.685	-0.185	1968 3
3.400	3.896	-0.496	1968 4
3.400	4.069	-0.669	1969 1
3.400	4.369	-0.969	1969 2
3.600	4.693	-1.093	1969 3
3.600	5.022	-1.422	1969 4
4.200	5.608	-1.408	1970 1
4.700	6.627	-1.927	1970 2
5.200	7.477	-2.277	1970 3
5.900	7.687	-1.787	1970 4
5.900	7.559	-1.659	1971 1
5.900	7.566	-1.666	1971 2
6.000	7.494	-1.494	1971 3
6.000	7.069	-1.069	1971 4
5.800	6.679	-0.879	1972 1
5.600	6.935	-1.335	1972 2
5.600	7.710	-2.110	1972 3
5.400	8.042	-2.642	1972 4
4.900	7.631	-2.731	1973 1
4.800	7.396	-2.596	1973 2
4.800	7.816	-3.016	1973 3
4.800	8.390	-3.590	1973 4
5.000	8.821	-3.821	1974 1
5.100	9.390	-4.290	1974 2
5.600	10.109	-4.509	1974 3
6.700	10.768	-4.068	1974 4
8.100	11.090	-2.990	1975 1
8.700	11.161	-2.461	1975 2
8.600	11.395	-2.795	1975 3
8.400	11.823	-3.423	1975 4

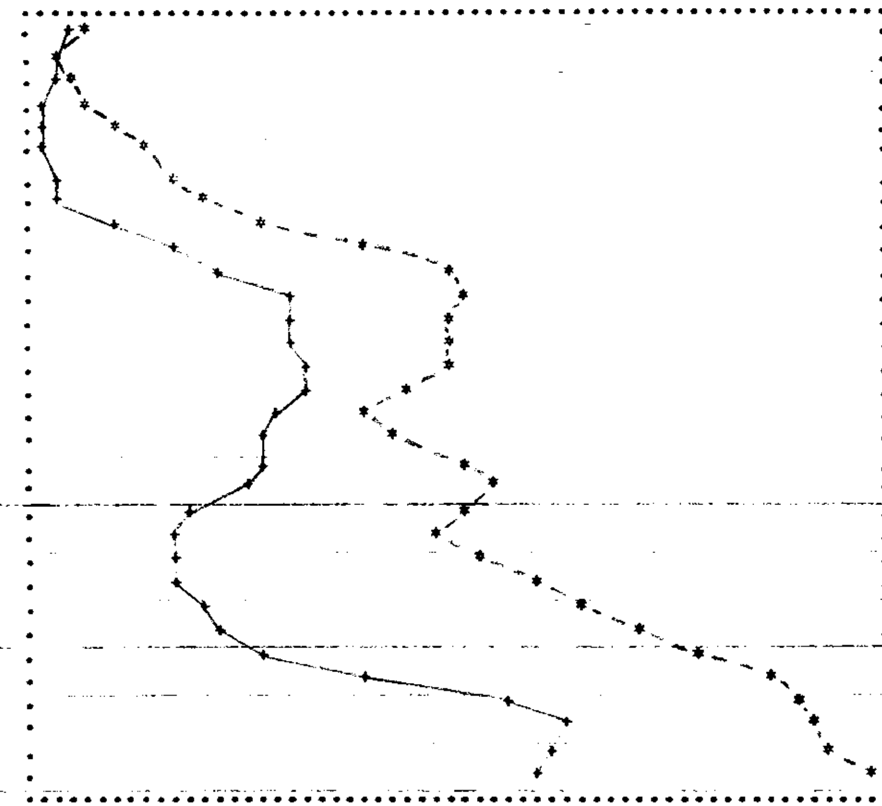

Figure 2

Out of Sample Simulation of the Unemployment Rate

PINDYCK MODEL

ACTUAL P*	SOLUTION P*	RESIDUALS	
120.400	119.851	0.549	1968 1
121.600	120.248	1.352	1968 2
122.900	120.947	1.953	1968 3
124.300	121.814	2.486	1968 4
125.600	122.840	2.760	1969 1
127.200	123.878	3.322	1969 2
129.100	124.841	4.259	1969 3
130.900	125.739	5.161	1969 4
132.900	126.675	6.225	1970 1
134.400	127.589	6.811	1970 2
135.800	128.237	7.563	1970 3
137.900	128.680	9.220	1970 4
139.500	129.049	10.451	1971 1
141.100	129.344	11.756	1971 2
142.000	129.435	12.565	1971 3
142.700	129.425	13.275	1971 4
144.600	129.545	15.055	1972 1
145.300	129.854	15.446	1972 2
146.500	130.177	16.323	1972 3
148.000	130.240	17.760	1972 4
150.000	130.280	19.720	1973 1
152.600	130.501	22.099	1973 2
155.700	130.744	24.956	1973 3
158.900	130.812	28.088	1973 4
163.600	130.867	32.733	1974 1
167.300	130.971	36.329	1974 2
172.100	131.011	41.089	1974 3
178.000	130.910	47.090	1974 4
181.600	130.602	50.997	1975 1
183.900	130.191	53.709	1975 2
186.000	129.761	56.239	1975 3
189.200	129.217	59.983	1975 4

RANGE 119.85 TO 189.20

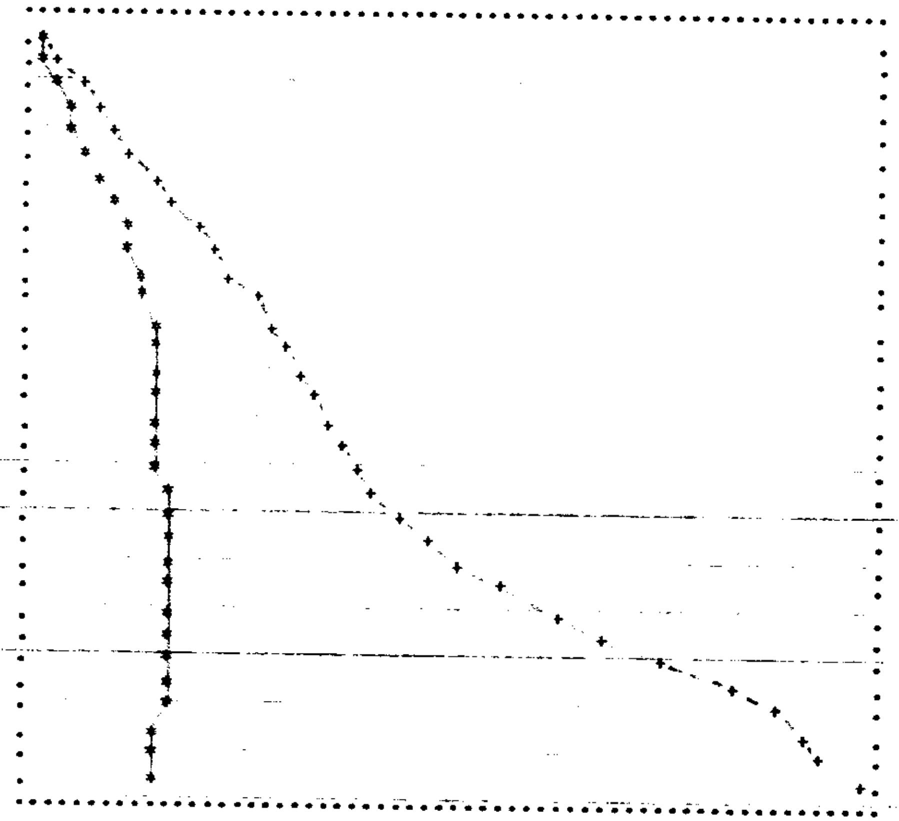

Figure 3

Out of Sample Simulation of the Price Level absolute terms when faced with excess potential supply. In a period of stable prices, where expected inflation is zero, this seems appropriate. In a period of rising prices, however, one may expect such movement around a general non-zero inflation trend. The predicted interest rates also move slowly relative to actual values and can be viewed as an approximation to real interest rates. In any case the out-of-sample behavior of the model will serve as a valid control upon which to impose various indexation schemes. Changes in the actual values of the three key variables are considered further in Section III.

II. SIMULATING INDEXATION

As noted in the introduction, indexation may take many forms. Following the theoretical work, however, we will limit the regimes considered here to only a small subset. The indexation scheme must be potentially constructive and administratively manageable. Nominal wages will be indexed by the rate of change in prices with the indexation of interest rate considered as an additional investigative area.

Indexation of wages will take the form,

$$(1) \qquad {}_{I}W = W(1 + \frac{\Delta P}{P}) \equiv W(1 + \pi)$$

with interest rate indexation of the form

$$(2) \qquad {}_{I}R = R + \frac{\Delta P}{P} \equiv R + \pi.$$

Since the model was estimated over a period of low inflation rates R can be viewed as being akin to the real short-term rate. Furthermore, it is this rate that enters the residential structures (IR) equation and the long-term rate equation (RL). Therefore, in order to preserve the internal consistency of the model, when R is indexed, it is R and not R+π that feeds back on the rest of the model. The analysis will consider wage indexation separately and jointly with interest rate adjustment. These two are segmented because they are effectively separable issues. The desirability of indexation, in general, is its ability to circumvent the frictions of the market. If these frictions exist to a much smaller extent in the capital market, the use of indexation in interest rates may prove of little service. This will be investigated below.

Using indexation in the forms specified in equations (1) and (2) requires consideration of the mechanics of its implementation. Essentially, time dimensions must be specified, and the lag with which wages and interest rates are to adjust to prices must be made explicit. For the purposes of the present simulations, several alternative inflation adjustment periods were examined. The results reported here assumed that wage and interest rates are adjusted quarterly by an index which is, alternatively, a quarter lag, a two quarter lag, and a one year lag of actual inflation.

Two methods of simulation were employed to analyze the impact of indexation. First, the basic model was simulated out-of-sample from 1968I to 1975IV without being indexed. This was taken as the control experiment. Next, the various forms of indexation were imposed upon the model in identical simulations over the full out-of-sample period. These results were then compared to the control simulation. A second method of simulation was also employed, however. In this form, the simulation period was divided into four separate eight quarter subperiods for shorter simulations. At the start of each subperiod, the model was reinitialized so as to reduce the error build-up that generally occurs in longer run simulations.

For each method, ex-post predicted time series on all variables were obtained. These were then compared using a weighting of three endogenously determined variables, price inflation, unemployment, and interest rates. Specifically, the form of the weighting scheme used included inflation and unemployment as arguments, and experimented with the inclusion of both nominal and *ex post* real rates. The general form was

$$(3) \qquad Q = \sum_{t=1}^{32} (\alpha_i \pi_t + \beta_i U_t + \gamma_i R_t)$$

where the weighting values varied from zero to ten. The polar extremes of these weights, and the resultant Q values are presented in Table 2. Table 2A compares results of indexation, relative to the control, using a single 32 quarter simulation, while Table 2B reports the results of four non-overlapping eight-quarter simulations. The Q weights for each column of Table 2B were obtained by summing the Q weights of the four relevant simulations. The relative ranking of an indexation scheme in terms of its Q values, which can be thought of as crude forms of a welfare index, are used to compare the behavior of the various indexation schemes.

Interestingly enough, in Table 2A, virtually all the comparisons by Q weights suggest that wage and interest rate indexation using the past period's rate of inflation is the most successful in keeping down both the rate of inflation and the unemployment rate. The simple wage indexation scheme dominates (in the sense that it has lower Q weights) the control simulation for the Q indexes that give heavier weights to the unemployment rate, or both unemployment and the

TABLE 2A

WEIGHTING OUTCOME OF INDEXATION SIMULATIONS

Method 1

Indexation by:

	Control	$\frac{P - P_{t-1}}{P_{t-1}}$	$\frac{P_{t-1} - P_{t-2}}{P_{t-2}}$	$\frac{P_{t-4} - P_{t-5}}{P_{t-5}}$	
$Q_1 = \Sigma(\pi + U)$	261.82	270.21	271.8	274.74	Wage Indexation
$Q_2 = \Sigma(10\pi + U)$	533.73	638.81	658.99	695.12	
$Q_3 = \Sigma(\pi + 10U)$	2346.3	2333.5	2330.8	2327.1	
$Q_4 = \Sigma(\pi + U + R)$	402.25	414.49	416.74	420.88	
$Q_5 = \Sigma(\pi + U + 10R)$	1666.1	1713	1721.2	1736.1	
$Q_6 = \Sigma(\pi + 10U + R)$	2486.7	2477.7	2475.8	2473.2	
$Q_7 = \Sigma(10\pi + U + R)$	674.16	738.09	803.93	841.25	
$Q_8 = \Sigma(10\pi + 10U + R)$	2758.6	2846.4	2862.9	2893.6	
$Q_9 = \Sigma(10\pi + U + 10R)$	1938	2081.6	2108.4	2156.5	
$Q_{10} = \Sigma(\pi + 10U + 10R)$	3750.6	3776.2	3780.3	3788.4	
$Q_{11} = \Sigma(\pi + U + (R + \pi))$	432.46	455.45	459.76	467.56	Wage and Interest Rate Indexation
$Q_{12} = \Sigma(\pi + U + 10(R + \pi))$	1968.2	2122.6	2151.4	2203.2	
$Q_{13} = \Sigma(\pi + 10U + (R + \pi))$	2516.9	2518.7	2518.8	2519.9	
$Q_{14} = \Sigma(10\pi + U + (R + \pi))$	704.37	824.05	846.95	887.97	
$Q_{15} = \Sigma(10\pi + 10U + (R + \pi))$	2788.8	2887.3	2906	2940.2	
$Q_{16} = \Sigma(10\pi + U + 10(R + \pi))$	2240.2	2491.2	2538.6	2623.6	
$Q_{17} = \Sigma(P + 10U + 10(R + \pi))$	4052.7	4185.9	4210.4	4255.5	

TABLE 2B

WEIGHTING OUTCOME OF INDEXATION SIMULATIONS

Method 2

Indexation by:

	Control	$\frac{P - P_{t-1}}{P_{t-1}}$	$\frac{P_{t-1} - P_{t-2}}{P_{t-2}}$	$\frac{P_{t-4} - P_{t-5}}{P_{t-5}}$	
Q_1	194.18	199.95	205.43	219.7	Wage Indexation
Q_2	377.04	430.39	473.73	593.3	
Q_3	1758.9	1758.9	1769.1	1786	
Q_4	328.8	335.32	342.04	358.96	
Q_5	1540.3	1553.7	1571.5	1612.3	
Q_6	1893.6	1904.5	1922.6	1962.7	
Q_7	511.66	565.76	610.34	732.55	
Q_8	2076.4	2134.9	2190.9	2336.3	
Q_9	1723.2	1784.1	1839.8	1985.9	
Q_{10}	3105.1	3122.8	3152.1	3216	
Q_{11}	349.12	360.92	371.85	400.47	Wage and Interest Rate Indexation
Q_{12}	1743.6	1809.7	1869.6	2027.4	
Q_{13}	1913.9	1930	1952.4	2004.2	
Q_{14}	531.98	591.36	640.15	774.07	
Q_{15}	2096.7	2160.5	2220.7	2377.8	
Q_{16}	1926.4	2040.1	2137.9	2401	
Q_{17}	3308.3	3378.8	3450.2	3631.1	

ex post real rate of interest, as in (Q3, Q6), but is dominated by the control for other weighting schemes. This Table suggests that the net effect of indexation is an increase in inflation, and a slight reduction in unemployment, relative to the control simulation. In weighing its desireability the key determinant becomes the relative importance placed on U and π in the social welfare function. Weighing each of the arguments in the Q indexes equally results in small differences between indexed and non-indexed regimes as lower U is being attained at the cost of higher π in the index scenario (Q1, Q4, Q11). The Q values for regimes that index both wages and interest rates compare less favorably than regimes that only index wages.

In Table 2B the indexed model does not dominate the control simulation. However, for these same weighting schemes (i.e. Q3, Q6, Q13,), the results of the control and indexed simulations are very close. Thus, for these simulations, as in those presented in Table 2A, the losses on the inflation front due to indexation are dominated and here are not offset by lowering the unemployment rate.

The difference between Tables 2A and 2B, especially the lower Q values of the latter, can be explained in the context of the model performance relative to what actually happen from 1968 to 1975. The model generally underestimates the rate of inflation and overestimates the unemployment rate. The reinitializations of the model needed to obtain Table 2B values generally lowered the ex post unemployment forecasts of the model more than they raised the ex post inflation forecasts. Consequently, on the margin, it shifts the Q rankings against the indexed regime.

In all, the results obtained suggest there is a tradeoff associated with moving towards a fully indexed economy. Only if the policy maker weighs unemployment quite highly do the results suggest indexation is desireable.

TABLE 3

COMPARING THE OPTIMAL INDEXATION SCHEMES
WITH THE HISTORICAL TIME SERIES

Weights*	Indexation Method 1	Actual	Indexation Method 2
Q1	270.21	310.33	199.95
Q2	638.81	1742.5	430.39
Q3	2333.5	1671.1	1758.9
Q4	414.49	318.2	335.32
Q5	1713	389.02	1553.7
Q6	2477.7	1679	1904.5
Q7	738.09	1750.4	565.76
Q8	2846.4	3111.2	2134.9
Q9	2081.6	1821.2	1784.1
Q10	3776.2	1749.8	3122.8
Q11	455.45	477.33	360.92
Q12	2122.6	1980.3	1809.7
Q13	2518.7	1838.1	1930
Q14	824.05	1909.5	591.36
Q15	2887.3	3270.3	2160.5
Q16	2491.2	3412.5	2040.1
Q17	4185.9	3341.1	3378.8

*The Q Weights are defined in Table 2A.

However greater employment is only accomplished at the cost of higher inflation.

III. IMPLIED INDEXATION AND RE-ESTIMATION

Thus far, the comparison of results has used the control simulation as a point of reference. As noted above, this was done to isolate the impact of inflation from the structure of the economy. However, the behavior of the historical time series in the Q welfare indexes is of some interest in itself. In order to calculate the Q values for the historical series ex post real interest rates were used for Q4 through Q10 and nominal interest rates were used for Q11 through Q17. Table 3 compares the historical time series with the optimal indexation regimes of Tables 2A and 2B. The results are somewhat mixed. The indexed regimes are generally more optimal (in the sense that they have lowered Q values) than the actual data when the rate of inflation and the unemployment rate are given equal weights or the former is given a higher weight (Q1, Q2, Q7, Q8, Q11, Q14, Q15, Q16). The opposite is true when the rate of unemployment and the ex post real interest rate are given larger weights (Q3, Q6, Q13, Q17). These results can also be attributed to the propensity of the model both in its control and indexed form to underestimate the rate of inflation and overestimate the unemployment rate during this period. If this tendency of the model is considered when a comparison of the Q values is made, the index simulation is quite comparable into total Q over the sample.

A stronger case emerges by comparing Tables 2A, 2B, and 3. The indexed regimes for both the long- and short-run simulations are closer to history than the control simulations for the majority of the Q rankings Yet in each case this is the result of higher inflation in the actual time series, and lower unemployment.

There are a number of reasons that may be offered to explain this relationship between the historical series and the indexed regimes. First, the economy may have at least partially indexed itself through the incorporation of expectations on inflation into nominal contracts. If this is the case, this would explain why total Q values are closer to the simulation totals than the control experiment. In addition, expectation of inflation in the economy of the 1968-1975 period may be proved biased and led to sub-optimal work-leisure and consumption savings decisions.[5] This would explain the lower unemployment rate and higher inflation rates in the actual time series relative to the indexation simulation. If this is the case, however, the implied cost of such sub-optimal behavior must be added to the aggregate Q index to obtain a fuller picture of economic well being. As this is far from the present area of interest, the relative ranking of the actual time series relative to the optimal index regime in this broader welfare index will not be attempted. It will remain, however, of considerable interest to anyone trying to assess the welfare level associated with this period in U.S. history, and an important unknown to be added to any comparison of an indexed economy relative to one using expectations alone.

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[5] See, for example, Tobin and Ross (1971).

TABLE 4

RE-ESTIMATION OF THE BASIC MODEL

1955 I to 1975 IV

(1) $0.330741YD - 0.0993297YD - 14.9515W_{-1} - 3.19880\Delta P + 0.628825C_{-1} - 8.41457$

(4.23531) (-4.32547) (4.32547) (-4.40348) (6.48822) (-3.93794)

$R^2 = 0.9993$ SER = 2.63577 DW = 1.9765 = -0.16329

(2) $\Delta INR = 0.121939\Delta YD + 0.0416897\Delta YD_{-3} + 0.00369547\Delta RL_{-5} + 0.462852\Delta INR_{-1} - 0.00278383(INR_{-1} + INR_{-2})$

(6.56567) (1.97527) (0.00528022) (5.87767) (-2.52585)

$R^2 = 0.6358$ SER = 1.16761 DW = 2.0961 $\rho = -0.32105$

(3) $IR = 0.0210752YD - 0.534530(R_{-2} + R_{-3}) + 0.513819IR_{-1} + 4.71798$

(4.07303) (-4.77114) (6.15837) (1.87440)

$R^2 = 0.9607$ SER = 0.813424 DW = 2.0394 $\rho = .8193$

(4) $IIN = 0.00292994YD + 0.277048\Delta_2 YD - 0.22602\Delta_2 C + 0.697808IIN_{-1} - 0.604952$

(1.22807) (5.11950) (-2.29378) (11.8826) (-0.514875)

$R^2 = 0.6632$ SER = 3.18110 DW = 2.1059 $\rho = -.40761$

(5) $R = -0.0195304\Delta YD + 0.0048968YD + 0.0213498\Delta P + 0.0707445\Delta M + 0.548620R_{-1} - 0.716370$

(-1.00560) (2.18689) (0.098443) (0.756514) (4.04281) (-0.947987)

$R^2 = .9121$ SER = 0.538082 DW = 1.7354 $\rho = .47813$

(6) $RL = 0.0832774R + 0.00227643\Delta_2 YD + 0.895294RL_{-1} + 0.179144$

(3.18086) (1.22226) (25.2589) (1.96428)

$R^2 = 0.9802$ SER = 0.180619 DW = 1.9912 $\rho = 0.01293$

TABLE 4 (CONTINUED)

RE-ESTIMATION OF THE BASIC MODEL

1955 I to 1975 IV

(7) $$P = \underset{(0.111548)}{0.274522W_{-1}} + \underset{(5.7637)}{0.045117(YD - YDP)_{-1}} - \underset{(-0.871389)}{0.011091IIN_{-2}} - \underset{(-2.26883)}{0.0114584YD} + \underset{(17.4828)}{1.14121P_{-1}} - \underset{(-2.05751)}{5.04830}$$

$R^2 = .9997$ SER = 0.421624 DW = 2.0074 $\rho = 0.52855$

(8) $$UR = \underset{(-3.53010)}{-0.0199677\Delta YD} - \underset{(-1.45426)}{0.00772512\Delta YD_{-1}} - \underset{(-2.85142)}{0.617171W_{-1}} - \underset{(3.54674)}{0.0193234(YD - YDP)_{-1}} + \underset{(6.4839)}{0.635462UR_{-1}} + \underset{(3.30195)}{1.44680}$$

$R^2 = .9693$ SER = .22707 DW = 1.8046 $\rho = .57628$

(9) $$W = \underset{(0.121058)}{0.000182538P_{-3}} + \underset{(2.84112)}{0.00115535\Delta YD} - \underset{(-0.59472)}{.000081795YD_{-1}} - \underset{(-2.09821)}{0.004977UR_{-4}} + \underset{(16.4435)}{1.02933W_{-1}} - \underset{(-0.100797)}{0.00722354}$$

$R^2 = 0.9996$ SER = 0.0170163 DW = 2.0339 $\rho = -0.05663$

In any case, the behavior of the economy when faced with substantial inflation, relative to the stable price time period, is of considerable interest. The fact that this inflation may have incorporated inefficiently into decision variables only re-enforces the need to obtain fuller information as to its impact in a non-indexed economy. With this in mind, the model was reestimated, using two stage least squares, the method originally employed by Pindyck, to see if including this subperiod significantly effects the coefficients. The results for the larger sample period are contained in Table 4. The re-estimation, using the same model structure, updates the structural coefficients of the model somewhat; however, the results are quite similar. Of course, the in-sample prediction of the second half of the period (1968–1975) now performs much closer to the observed values. However, this is of secondary importance in the current analysis.

Of interest are the wage and interest rate equations obtained in the model re-estimation, equations (5) and (9) of Table 4.[6] Comparing these two equations with alternate estimations of these equations, which include de facto implicit indexation, may offer some evidence as to whether the economy itself did incorporate inflation into wage and interest rate setting agreements. With this in mind, the wage and interest rate equations were re-estimated using specification that was consistent with the imposition of indexation of the original model.

[6] It should be noted in passing that given the high inflation rates of recent years, equations of Table 4 can no longer be said to explain the real short-term rate but a rate that is somewhere between the real and nominal rates.

This form of the estimated equation begins with the basic index schemes represented by equations (1) and (2) of the previous section, repeated here for convenience,

(1) $\quad {}_{I}W = W(1 + \pi)$,

(2) $\quad {}_{I}R = R + \pi$.

Wages and the short-term interest rate are assumed to be determined by the general form suggested by Pindyck,

(3) $\quad W = W(P, YD, \Delta YD, UR)$

(4) $\quad R = R(YD, \Delta YD, \Delta M, \Delta P)$.

Assuming that equations (3) and (4) are linear, and that $W_t \approx W_{t-1}$ and $R_t \approx R_{t-1}$ the indexed specifications are[7]

(5) $\quad {}_{I}W = \alpha_0 + \alpha_1 YD_{-1} + \alpha_2 \Delta YD_t + \alpha_3 UR + \alpha_4 W_{-1} + \alpha_5 (W_{-1}\pi) + \alpha_6 P_{-3}$

for the wage equation, and

(6) $\quad {}_{I}R = \beta_0 + \beta_1 YD + \beta_2 \Delta YD + \beta_3 \Delta M + \beta_4 R_{-1} + \beta_5 \pi$

for the corresponding interest rate equation.[8] Using this implied indexation specification and selecting a lagged inflation index

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[7]The assumptions of $W_t \approx W_{t-1}$ and $R_t \approx R_{t-1}$ simplify the constraints on the equation. These equations like the others were estimated using two-stage least squares.

[8]The multicolinearity between ΔP and the indexation scheme itself precluded using both in the interest rate equation.

that gave the highest explanatory power resulted in the following estimated equations.

$$(7)\quad W = \underset{(0.928254)}{0.00135652P_{-3}} + \underset{(3.4749)}{0.00184745\Delta YD} + \underset{(0.379108)}{0.0000520172YD_{-1}}$$

$$\underset{(-1.31774)}{-0.00318902UR_{-4}} + \underset{(15.3746)}{0.964775W_{-1}} + \underset{(1.99223)}{0.379299W_{-1}}\left(\frac{P-P_{-1}}{P_{-1}}\right)$$

$$\underset{(-0.798997)}{-0.0545431}$$

$R^2 = 0.9996$ SER = 0.0166916 DW = 2.0143 $\rho = -0.03682$

$$(8)\quad R = \underset{(-1.11887)}{-0.0171239\Delta YD} + \underset{(2.10983)}{0.00474939YD} + \underset{(0.914429)}{0.0750023\Delta M}$$

$$+ \underset{(4.67285)}{0.546552R_{-1}} + \underset{(0.393898)}{7.22943}\left(\frac{P_{-1}-P_{-2}}{P_{-2}}\right) \underset{(-0.924417)}{-0.684737}$$

$R^2 = 0.9134$ SER = 0.534152 DW = 1.7289 $\rho = 0.48728$

The results of the wage equation are slightly better than the estimated form in Table 4, equation (9). However, the wage indexation term is insignificant. This may be due to the multicollinearity between the lagged wage and the indexation terms. Re-estimating equation (8) without the lagged wage term, equation (9), marginally reduces the explanatory power of the equation but increases the significance of the indexation term. The increased

$$(9)\quad W = \underset{(21.8307)}{0.0216015P_{-3}} + \underset{(4.71651)}{0.00185504\Delta YD} + \underset{(9.35384)}{0.00246070YD_{-1}}$$

$$\underset{(-0.661683)}{-0.421607UR_{-4}} + \underset{(3.94151)}{0.602149W_{-1}}\left(\frac{P-P_{-1}}{P_{-1}}\right) \underset{(-6.69059)}{-0.948607}$$

$R^2 = .9995$ SER = 0.174556 DW = 2.1146 $\rho = .94046$

significance of the lagged price level term, however, suggests that some relationship between wages and prices remains even after indexation. It is possible that a more complex indexation scheme, perhaps in the form of a distributed lag, can better explain wage increases in the past decade. In the interest of brevity this issue will not be explored further. Suffice it to say that some form of implicit indexation seems to have taken place in recent years.

The results for interest rate adjustment, however, are not as supportive. The overall fit of the equation is better than the non-indexed form presented in Table 4, equation (5). In addition, the coefficient on the additive inflation premium is insignificant at any reasonable level. One explanation of this result is that the incorporation of inflation into nominal interest rates is considerably more complex than a simple additive term. This has been suggested by Siegel and Shiller (1976), and is accepted here. Effectively, the determinnants of the interest rate are themselves affected by inflation, and the net addition of a single inflation premium term becomes redundant.

One may conclude, then, that there have been some structural changes in the economic environment since the estimation of the model used here. These changes suggest that the economy itself has adjusted to inflation by some implicit indexation of wages. Interest rates, however, do not show such incorporation.

IV. THE TIMING OF INDEXATION

A further issue to be investigated using the present model is the optimal timing of instituting an indexed regime. It has been shown above that a preferred time path of the more important macro varibles may be obtained by a simple indexation of wages on price movements. Further, the previous section suggested that such indexation is occurring implicitly in the private economy even without national directives fostering its use. If this method of labor pricing is desirable in a social sense and acceptable to the private market, it would appear that official support is warranted. Accordingly, a one-time shift from nominal wage to real wage contracting would appear socially desirable. The present section investigates whether there is an optimal time within a business cycle to make this once-and-for-all shift. Clearly, the short-term movement of wages differs from peak to trough and again to peak. Will the implementation of indexation at one point in the cycle cause additional short run disequilibrium? This is the essence of the present investigation.

To explore this issue, the business cycle from 1969IV to 1973IV is considered. Both these quarters were defined as peaks by the NBER, with the trough occurring in the fourth quarter of 1970. The model is simulated from 1969IV to 1973IV using the control simulation up to the point of indexation. Indexation of wages on the rate of inflation in the previous quarter is initiated in a different quarter for each simulation starting from 1969IV. For each simulation, a series of Q welfare indices is calculated where Q is defined as

$$(9) \qquad Q_i = \sum_{1969IV}^{1973II} (\alpha_i \pi + \beta_i U + \gamma_i R) .$$

TABLE 5

THE OPTIMAL TIMING OF IMPLEMENTING INDEXATION

Weights*	1969 IV	1970 I	1970 II	1970 III	1970 IV	1971 I	1971 II
Q1	185.49	184.57	184.28	183.6	183.15	183.54	182.87
Q2	579.59	566.83	555.95	543.22	522.66	525.43	518.73
Q3	1460.8	1463.4	1471.1	1476.4	1481	1493.5	1492.8
Q4	292.71	291.87	290.56	289.57	288.86	287.94	287.81
Q5	1257.7	1257.6	1247.2	1243.4	1240.3	1227.6	1232.3
Q6	1568	1570.7	1577.4	1582.3	1586.7	1597.9	1597.8
Q7	686.81	674.13	662.24	649.2	639.37	629.84	623.67
Q8	1962.1	1953	1949	1942	1937.2	1939.8	1933.7
Q9	1651.8	1639.9	1618.8	1603	1590.8	1569.5	1568.2
Q10	2533	2536.5	2534	2536.1	2538.1	2537.6	2542.3
Q11	336.49	334.34	331.86	329.53	326.58	325.93	325.13
Q12	1695.5	1682.3	1660	1642.9	1617.5	1607.4	1605.4
Q13	1611.8	1613.2	1618.7	1622.3	1635.4	1635.9	1635.1
Q14	730.59	716.6	703.53	689.1	666.09	667.82	660.99
Q15	2005.9	1995.5	1990.6	1981.9	1974.9	1977.8	1971
Q16	2089.6	2064.6	2031.7	2002.5	1957	1949.3	1941.3
Q17	2970.8	2961.2	2946.9	2935.7	2926.3	2917.4	2915.4

	1970 III	1971 IV	1972 I	1972 II	1972 III	1972 IV	1973 I
Q1	182.99	182.8	182.86	182.89	182.63	182.41	182.27
Q2	513.23	510.51	509.97	508.81	504.6	501.6	500.9
Q3	1499.6	1500.3	1501.5	1502.9	1504.4	1504.9	1504
Q4	287.21	287.23	287.26	287.05	286.78	286.72	286.65
Q5	1225.2	1227.1	1226.8	1224.6	1224.1	1225.5	1226.1
Q6	1603.8	1604.7	1605.9	1607.1	1608.5	1609.2	1608.4
Q7	617.45	614.94	614.37	612.98	608.74	605.9	605.28
Q8	1934.1	1932.4	1933	1933	1930.5	1928.4	1927.1
Q9	1555.5	1554.8	1553.9	1550.5	1546	1544.7	1544.7
Q10	2541.9	2544.6	2545.5	2544.6	2545.8	2548	2547.8
Q11	323.9	323.64	323.61	323.26	322.55	322.19	322.05
Q12	1592.1	1591.2	1590.3	158.6	1581.9	1580.2	1580.1
Q13	1640.6	1641.1	1642.2	1643.4	1644.3	1644.7	1643.9
Q14	654.14	651.35	650.72	649.18	644.52	641.38	640.68
Q15	1970.8	1968.8	1969.3	1969.3	1966.2	1963.9	1962.5
Q16	1922.4	1918.9	1917.4	1912.5	1903.8	1899.4	1898.7
Q17	2908.8	2908.7	2908.9	2906.7	2903.6	2902.7	2901.9

TABLE 5 (CONTINUED)

THE OPTIMAL TIMING OF IMPLEMENTING INDEXATION

Weights*	1973 II	1973 III	1973 IV
Q1	182.4	182.08	182.04
Q2	500.71	498.51	497.42
Q3	1503.9	1504.4	1505
Q4	286.63	286.49	286.41
Q5	1226.1	1226.2	1225.8
Q6	1608.3	1608.8	1609.4
Q7	605.1	602.92	601.8
Q8	1926.8	1925.2	1924.7
Q9	1544.6	1542.6	1541.2
Q10	2547.8	2548.5	2548.8
Q11	322	321.65	321.45
Q12	1578.4	1577.8	1576.2
Q13	1645.3	1643.9	1644.4
Q14	640.31	638.08	636.86
Q15	1963.6	1960.4	1959.8
Q16	1896.7	1894.2	1891.5
Q17	2901.7	2900.1	2899.1

*The Q weights are defined in Table 2A.

For the period before indexation, the elements of Q are those obtained from the control, while the indexed regime values are used after the one time shift occurs. The results of this experiment are contained in Table 5. These numbers indicate that the behavior of the welfare index varies in a consistent fashion according to when the indexation is implemented. If a greater weight is placed on the rate of inflation (Q2, Q7, Q14), the optimal timing of indexation is during the latter half of the expansionary period. If a greater weight is placed on the unemployment rate (Q3, Q6, Q13), the optimal time to index is at the beginning of the contractionary period. If the inflation rate and the unemployment rate are given equal weights (Q1) the timing issue is more ambiguous. Using indexed interest rates ($R + \pi$) rather than real interest rates (R) does not alter the above conclusions. Similar results hold when one considers a trough-to-trough period.

These results are quite consistent with the previously reported data. Given that indexation increases inflationary pressure while reducing unemployment, implementing it at the peak of a cycle tends to exacerbate inflation, and reduces the unemployment rate to some extent. If employment levels are more highly prized in the welfare index, immediate indexation significantly aids the economies performance. If inflation

TABLE 6A

MODEL RESPONSE TO POLICY CHANGES

Weights*	No Policy Change	One Year Increase in Government Spending	Sustained Increase in Government Spending	One Year Increase in M_1	Sustained Increase in M_1
Q1	261.82	242.79	234.15	261.82	261.81
Q2	533.73	750.5	872.33	534.03	533.97
Q3	2346.3	1920.1	1703.3	2345.9	2345.9
Q4	402.25	398.84	398.62	402.08	402.05
Q5	1666.1	1803.3	1878.8	1664.5	1664.2
Q6	2486.7	2076.2	1867.8	2486.2	2486.2
Q7	674.16	906.55	1036.8	674.3	674.21
Q8	2758.6	2583.9	2506	2758.4	2758.3
Q9	1938	2311	2517	1936.7	1936.4
Q10	3750.6	3480.6	3348	3748.6	3748.4
Q11	432.46	455.25	469.53	432.33	432.29
Q12	1968.2	2367.4	2587.9	1966.9	1966.6
Q13	2516.9	2132.7	1938.7	2516.5	2516.4
Q14	704.37	962.96	1107.7	704.54	704.45
Q15	2788.8	2640.4	2576.9	2788.7	2788.6
Q16	2240.2	2875.1	3226.1	2239.1	2238.8
Q17	4052.7	4044.8	4057.1	4051	4050.7

*The Q weights are defined in Table 2A.

TABLE 6B

INDEXED MODEL RESPONSE TO POLICY CHANGES

Weights*	No Policy Change	One Year Increase in Government Spending	Sustained Increase in Government Spending	One Year Increase in M_1	Sustained Increase in M_1
Q1	270.21	252.86	256.01	270.22	270.21
Q2	638.81	1111.8	932.93	639.21	639.14
Q3	2333.5	1669.6	1883.2	2333.2	2333.2
Q4	414.49	426.64	419.33	414.33	414.3
Q5	1713	1990.7	1889.2	1711.4	1711.1
Q6	2477.7	1843.4	2046.5	2477.3	2477.3
Q7	783.09	1285.6	1096.2	783.32	783.24
Q8	2846.4	2702.3	2723.5	2846.3	2846.2
Q9	2081.6	2849.7	2566.1	2080.4	2080.1
Q10	3776.2	3407.5	3516.4	3774.3	3774.1
Q11	455.45	522.08	494.54	455.33	455.29
Q12	2122.6	2945	2641.3	2121.3	2121
Q13	2518.7	1938.9	2121.7	2518.3	2518.3
Q14	824.05	1381	1171.5	824.32	824.22
Q15	2887.3	2797.8	2798.6	2887.3	2887.2
Q16	2491.2	3804	3318.3	2490.3	2490
Q17	4185.9	4361.8	4268.5	4184.3	4184

*The Q weights are defined in Table 2A.

is of major concern, such a timing decision is clearly suboptimal, and starting indexation in a period of the cycle with relatively lower inflationary pressures would be the preferred alternative.

V. POLICY RESPONSE OF THE INDEXED AND THE NON-INDEXED MODEL

One of the important issues in considering indexed versus non-indexed economies is the response to policy changes. Of crucial importance is the stability of the indexed regime in response to expansionary policy. With this in mind, the indexed and non-indexed versions of the Pindyck model simulated for the following four scenarios: (1) a one-year increase on government spending of 50 percent; (2) a sustained increase in government spending of 10 percent; (3) a one-year increase in M1 of 4 percent; (4) a sustained increase in M1 of 1 percent. All the policy changes were initiated in 1970IV. As in the previous section the form of the indexation consists of wages indexed on the previous rate of price inflation.

Tables 6A and 6B compare the control and the policy simulations for the two models. Both models are stable in response to policy changes. The indexed model will typically have a higher equilibrium rate of inflation and a lower rate of unemployment compared to the non-indexed model, in response to a more stimulative policy. These results are consistent with the results of the previous sections and with the theoretical results of Gultekin and Santomero (1976).

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