

AGGREGATE PRICE DYNAMICS

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I. Introduction

Does demand have an influence on the short run movements of prices above and beyond its effect as a determinant of wages? Much empirical study has been devoted to this question, with varying results. Neild's claim (Neild [1963]) that "the relationship between trends in costs and prices of manufactures (in the United Kingdom)... is not sensitive to cyclical... variations in the pressure of demand" has been contested by Rushdy and Lund [1967] and McCallum [1970]. In Canada, Courchene [1969] has found conditions of excess demand to be "important determinants of short-run price fluctuations" whereas Bodkin, Bond, Reuber, and Robinson [1966] suggest that they are "of decidedly secondary importance." In the United States, the studies of Kuh [1959], Schultze and Tryon [1965], Fromm and Taubman [1969], Perry [1966], Klein and Evans [1967], Solow [1968], Eckstein and Fromm [1968], and Gordon [1970, 1971] have all featured both cost and demand variables but with great diversity of specification.¹

¹Since it is generally agreed that at least in the short run, the rate of change of money wages and thus of labor costs is a function of demand pressure in the labor market, the question is not whether or not demand has any influence on prices, but whether, given wages, demand has an additional influence on prices.

The cost versus demand controversy is well covered in the excellent surveys by Nordhaus [1970] and Silbertson [1970].

The issue does not come up at all in the estimation of the type of price equation used in some macro models which bypass structural relations between prices and wages, and feature instead a partial reduced form equation between price changes and demand variables. See Fair [1970a, 1970b].

The differences in results have, in part, reflected differences in underlying theoretical models. Some investigators who have emphasized the role of disequilibrium factors have taken the Walrasian model as their point of departure,

$$\frac{\Delta P}{P} = f\left(\frac{D-S}{S}\right)$$

(P is price and D and S are quantity demanded and quantity supplied), and have argued that excess demand is the primary determinant of price movements. The question for them has then been whether or not to add cost variables (including the rate of change of wages) to the right hand side.²

Others, emphasizing equilibrium forces, have worked with different versions of a markup model,

$$P = \pi \left[\frac{C}{X} \right]$$

($\left[\frac{C}{X} \right]$ is some measure of unit cost and π is the markup), and have put the primary emphasis on unit costs. In these models, the role of demand has been, if anything, that of causing changes in the markup factor π . But, even in this context, there has been disagreement over whether the association is between demand pressure and the level of price or demand pressure and the rate of change of price, the first view being related to the argument that π is a function of the current level of excess demand, and the second view that it is a function of cumulated past rates of excess demand.³

²See Courchene, op.cit., and Eckstein and Fromm, op.cit., 1159-64.

³Neild, op.cit., 20, argues that demand variables should be added to markup equations in cumulative form. His interpretation is contested by Rushdy and Lund, op.cit., but approved by McCallum, op.cit..

theory.⁵ Consequently particular attention has been paid to the development of a precise pricing model as a basis for estimation in this paper. The model presents the representative firm as a seller with some monopoly power who acts in such a way as to maximize his short-run profits.

This approach is somewhat novel, or rather is so old as to be new again.⁶ In particular it represents a departure from the more established appeal in econometric studies of price determination to the hypothesis that firms set price through the application of a relatively rigid markup to full cost. It was decided to base the model on the notion of short-run profit maximization under imperfect competition for two reasons. First, the theory associated with this notion is more fully developed and richer than the theory of full-cost pricing. Second, it appears, on face value, to be applicable to a broader spectrum of market structures than full-cost theory, which has received its greatest support in applications to oligopolistic industries.⁷ This being said, the difference between short-run profit maximization and full-cost theory should not be overemphasized, because in fact, very similar propositions can be derived from both types of theory,

⁵ See Nordhaus, op.cit., p.24 .

⁶ The same basic approach has been taken recently by Klein [1969], Klein and Evans [1967] and Evans [1969]. It harks back to the models of imperfect competition of the 1930's.

⁷ See for instance, the full-cost theory of pricing based on entry prevention of Modigliani [1958], who synthesizes the work of Bain and Sylos-Labini.

materials, and that the supplies of both are infinitely elastic at the going hourly wage rate W and unit price M .

The technology of production will be treated in a simplified manner. Assume that capital is putty-clay and that technical change is primary-factor augmenting and partly embodied, partly disembodied. Then, at any given time, the representative firm can produce output on different old machines with a variety of input requirements. The distribution of old machines depends on the firm's past history of investment and of technical change. To every distribution of old machines there will correspond an aggregate production function for the firm relating total input of variable factors to local output. Likewise, there will be a marginal cost function for the firm relating marginal cost to factor prices and output.

We can state some of the qualitative characteristics of this marginal cost function: (1) Marginal cost will rise as output rises. (2) Marginal cost will be homogenous of degree one in all factor prices.¹⁰ (3) The prices of variable factors will be complementary in their influence on marginal cost. An increase in the price of materials will result in a greater increase in marginal cost the higher the price of labor.¹¹ (4) The marginal cost function will shift downwards with time as both embodied and disembodied technical change raise the efficiency of all machines. (5) The

¹⁰An equal percentage increase in all factor prices will leave relative factor prices, and thus the distribution of output over machines of different intensities, unchanged.

¹¹The reason is that the increase in the price of materials induces a substitution of labor for materials. (Output is shifted from materials intensive to labor intensive machines.)

Equation (2) describes marginal cost. However, given the complexity of production and the variety of machines operated by each firm, management will not know its marginal cost with certainty. It has data on average labor cost and average materials cost, but not on marginal cost. It is well known that measured unit labor cost varies to a considerable extent inversely with average utilization rates. If a firm does estimate its marginal cost from average cost figures, it will suffer from what could be called a "cost illusion," and accordingly, it will be assumed here that the representative firm systematically underestimates its short-run marginal cost when average labor productivity is above its trend and conversely when it is below its trend.

Let X_0/N_0 be labor productivity in the base period. Assume that trend labor productivity grows exponentially and is equal to $X_0/N_0 e^{rt}$. The "cost illusion" hypothesis is that equation (1) is replaced by

$$(1') \quad P^* = \frac{1}{1-\tau} e^{\frac{\eta}{1+\eta}} \frac{\partial C}{\partial X} \cdot \left(\frac{X/N}{e^{rt} X_0/N_0} \right)^{-\mu}$$

where $\frac{\partial C}{\partial X} \left(\frac{X/N}{e^{rt} X_0/N_0} \right)^{-\mu}$ is the firm's estimate of marginal cost.

5. Demand Factors

The markup of price over marginal cost depends on the elasticity of demand facing the representative firm. Harrod [1936] argued long ago that the elasticity of demand facing a firm in

Because X and B move together in the short run, the cyclical movements of their ratio are more damped than would be the movements of the ratio of unfilled orders to a measure of productive capacity. It was felt that buyers are likely to base their anticipations of delay times less on the recent level of suppliers' sales than on estimates of their productivity capacity, and therefore $\frac{B}{X}$ was replaced in (3) with the ratio of unfilled orders to capacity output, B/\bar{X} . The measure of B/\bar{X} which was used was corrected for trend.¹⁵

¹⁵The basic measure for B/X was the ratio of unfilled orders to shipments in manufacturing industries multiplied by the Wharton capacity utilization index for manufacturing. (There is no data on orders outside of manufacturing.) A plot of this constructed ratio of unfilled orders to capacity revealed a downward trend from a 1956.3 peak of .74 to a 1966.4 peak of .58. (Wharton manufacturing utilization indices for the same quarters were 89.9 and 97.2). At least at the two-digit level, the trend does not reflect a change in the mix of industries with unfilled orders.

Most of the manufacturing industries with unfilled orders are durables industries. Within durables, the industry with the largest share of unfilled orders is transportation equipment. In that industry, particularly in airplane and boat production, expected waiting times are several multiples of what they are in manufacturing on the average. The share of durables in total manufacturing shipments was very stable over the period, going from an average of .53 in 1956 to .52 in 1966. The share of transportation equipment in total shipments of durables rose slightly, going from .24 in 1956 to .25 in 1966. The decline appears to have occurred within the individual industries. In the transportation equipment industry, for instance, the ratio of unfilled orders to quarterly shipments fell from an average of 2.40 in 1956 to an average of 1.76 in 1966.

All of this suggests that the trend is due either to a technological shortening of gestation lags or to measurement error. Consequently, the measure of B/\bar{X} actually used was trend adjusted. The method of trend adjustment, the sources for the figures quoted in this footnote, and the method of construction of all data series used in the study are reported in the data appendix.

7. Alternative Models and Aggregation

In order to highlight which characteristics, if any, of (6) are due to the short-run profit maximization assumption and thus intrinsic to this model, it is useful to compare that equation with a similar equation derived from one version of the "full cost" model. The version is Modigliani's [1958] oligopoly pricing model, on which the aggregate price equation in the FRB-MIT-Penn econometric model is based.¹⁶

The model describes oligopolies in which existing firms coordinate their actions in such a way as to discourage new entrants. Modigliani's hypothesis, which is a synthesis of the theories of Bain and Sylos-Labini, is that existing firms set output, and therefore prices, at such a level that the sales of one additional firm would lower price below the average total cost of that firm. In other words, they fix the price by marking up average total cost on new equipment at standard rates of operation. The markup depends on the volume of production with which a new firm would be likely to enter the market and the shape of the industry demand curve. Bain, Sylos-Labini and Modigliani assume that there are economies of scale and that the minimum size of a plant is large relative to industry output.

In symbols,

$$P^* = \pi \left[\frac{C}{X} \right]^*$$

where $\left[\frac{C}{X} \right]^*$ is minimum average total cost on new machines. If one adds the hypothesis that the effective markup varies with demand because of fluctuations in the discipline with which oligopolists stick to their

¹⁶See de Menil and Enzler [1970].

TABLE 1: REGRESSION ESTIMATES

Equations for Δp , First Difference of the Logarithm
of a constructed Index of the Price of Gross Output--
in the Private, Business, Nonfarm Sector 1954.3 through
1968.2, 56 observations.

	P_{-1}^{-w}	t	B/\bar{X}	A	x-n	$\frac{\ln \frac{1}{.97-X/\bar{X}}}{.97-X/\bar{X}}$	m-w	d	R^2 SEE
I	-.325 (-8.53)	-.00217 (-8.39)						1.60	.613 .00217
II	-.181 (-2.61)	-.00121 (-2.59)	.0169 (2.44)					1.86	.655 .00207
III	-.214 (-3.17)	-.00143 (-3.16)	.0327 (3.55)	.00193 (2.46)				2.05	.694 .00197
IV	-.277 (-4.58)	-.00132 (-3.27)	.0226 (1.98)	.00130 (1.71)	-.0788 (3.54)	.000522 (.609)		2.39	.778 .00171
V	-.307 (-4.60)	-.00139 (3.55)	.0271 (3.37)	.00177 (2.40)	-.0807 (-4.07)		.0107 (1.01)	2.38	.781 .00170
	$P_{-1}^{-w} + \ln(1-\tau^e)$								
VI	-.303 (-4.75)	-.00128 (-3.55)	.0261 (3.25)	.00124 (1.75)	.0814 (-4.15)		.0147 (1.36)	2.36	.786 .00168
	B_{-1}/\bar{X}_{-1}								
VII	-.236 (-4.02)	-.00155 (-3.98)	.0333 (3.68)	.00178 (2.25)				2.23	.709 .00192

Note: The numbers in parentheses under the coefficient estimates are t-statistics. R^2 is not adjusted for degrees of freedom. A constant term and dummy variables equal to 1 in the first, second, and third quarters were included in all equations.

correlated. The level of utilization, the logarithm of utilization, and the nonlinear function presented in the table were all tried. Equation (6) calls for the level. Neither the FRB-MIT-Penn nor the Wharton utilization rates had significant explanatory power in any form though results were slightly better with the Wharton rate than with the other. The Wharton rate was used for equation IV in the table. Utilization was dropped from subsequent equations.

These results underline the difficulty of distinguishing between a short-run profit maximization model such as this one and long-run "full cost" models. This short-run model calls for the average age of machines and capacity utilization both to have significant effects, whereas, in the results, only the age variable is significant. Further study of the differences between the two models is needed.

Introduction of the materials price index and the average federal excise tax rate has only a marginal effect on the standard error. When $\ln(1-\tau_t^e)$ was added unconstrained, its free coefficient barely missed significance, and differed from the coefficient of the lagged dependent variable by less than one standard error. In equation VI its coefficient is constrained to be equal to that of the lagged dependent variable.

When added to VI, the guidepost dummy had a positive, insignificant coefficient, suggesting that the guideposts did not have any effect on prices over and above whatever effect they had on wages.

TABLE 2: COMPARISON OF SELECTED AGGREGATE PRICE EQUATIONS

Equation	Dependent Variable	Period of Fit	Standard Error of Estimate	Durbin Watson
VI	Price of Gross Output, Private Nonfarm Business (excluding household sector) ^a	54.3- 68.2	.00168	2.38
Gordon (1970) ^b	Private Nonfarm Deflator	54.2- 69.4	.0019	2.26
DHL-III(1970) ^c	Private Nonfarm Deflator	54.1- 68.4	.0026	2.15
OBE (1970) ^d	Deflator, Gross Private Output Except Housing Services	53.3- 68.1	.0023	0.62
Eckstein and Fromm (1968) ^e	Wholesale Price Index, Manufactures	54.3- 65.4	.0022	1.64

- a. The dependent variable is the natural logarithm of the deflator. Errors in this variable are approximately equal to errors in the deflator.
- b. See Gordon (1970b), Equation (2), p. 456. The dependent variable is the quarterly growth rate of the deflator. Since the deflator is equal to 1.0 in 1958, errors in the growth rate are approximately equal to errors in the deflator.
- c. This is taken from the 1970 version of the Michigan model, DHL-III. See Hymans (1970), Appendix.
- d. This is taken from the Department of Commerce, OBE model. See Hirsch (1970) Appendix A, Equation A.2.
- e. See Eckstein and Fromm (1968), Table 2, Equation 2-(4). The dependent variable is the wholesale price index for manufactured goods. This price is considerably different from the broader GNP deflators used in the studies above.

level, not the rate of change of prices. In other words, in the long run, the rate of change of prices is eventually a function only of the rate of change, not the level of excess demand.²²

This being said, the influence of our demand variable, the ratio of unfilled orders to capacity, is substantial in the short and medium term. From VI, the long-run annual rate of price change can be seen to be

$$\Delta p^* = k + .34 \Delta\left(\frac{B}{\bar{X}}\right) ,$$

where k is a constant representing the effect of all other variables. The range of $\Delta\left(\frac{B}{\bar{X}}\right)$ in the sample period is from $-.058$ to $.040$, therefore this implies that a rising B/\bar{X} can add as much as 3.4 percent per year to the rate of inflation. Demand does have a large impact on the rate of change of prices in the short and medium run, even though in the long run it dies out.²³

²²Our model implies that in the long run, the price level, P , is a function of the ratio of unfilled orders to capacity B/\bar{X} . It can easily be shown that in the long run, if the flow rate of excess demand is constant, B/\bar{X} will also be constant. Thus in the long run, only the level, not the rate of change, of price is a function of demand.

Let the rate of additions to unfilled orders (new orders minus sales) be $\Delta B = I$. I/X is the flow rate of excess demand. Let $I/X = \theta$, a constant. Let X grow at a constant rate, $X_t = X_0 e^{gt}$.

Then

$$B_t = \theta \int_{-\infty}^t X_t .$$

$$\frac{B_t}{X_t} = \frac{\theta \int_{-\infty}^t X_0 e^{gt}}{X_t} = \frac{\theta}{g} .$$

If, moreover $X/\bar{X} = \xi$, a constant, then $B/\bar{X} = \xi \frac{\theta}{g}$, a constant.

²³The difference between short-run and long-run effects was ignored in the Neild, Rushdy and Lund, McCallum controversy over the effect of excess demand on prices referred to at the beginning of this paper.

b) Raising the rate of capital accumulation will increase also the rate of growth of capacity, which, other things being equal, will ease the pressure of demand.

In short, this study strengthens the arguments in favor of increasing the share of investment in total aggregate demand as one desirable action in a broad anti-inflation policy mix.

REFERENCES

- Abramovitz, Moses. "Monopolistic Selling in a Changing Economy," Quarterly Journal of Economics, Vol. LII, No. 2 (February, 1938), 191-214.
- Anderson, L.C. and K.M. Carlson, "An Econometric Analysis of the Relation of Monetary Variables to the Behavior of Prices and Unemployment." Paper presented to the SSRC Conference on Econometrics of Price Determination, Washington, D.C., Oct. 30, 1970.
- Bodkin, R.G., E.P. Bond, Grant L. Reuber, and T. Russell Robinson, Price Stability and High Employment, The Options for Canadian Economic Policy, Queen's Printer: Ontario, 1966.
- Courchene, T.J., "An Analysis of the Price-Inventory Nexus with Empirical Application to the Canadian Manufacturing Sector," International Economic Review, Vol. 10, No. 3, Oct., 1969, pp. 315-336.
- Eckstein, Otto, and Gary Fromm, "The Price Equation," American Economic Review, Vol. LVIII, No. 5, Part 1 (December, 1968), 1159-1183.
- Evans, M.K., Macroeconomic Activity, Harper and Row, New York (1969).
- Evans, M.K. and L.R. Klein, The Wharton Econometric Forecasting Model, Economics Research Unit, Wharton School of Finance and Commerce, University of Pennsylvania (1967).
- Fair, R., "Aggregate Price Changes and Price Expectations," Federal Reserve Bank of St. Louis Review, Vol. 52, No. 11, Nov., 1970.
- _____, A Short-Run Forecasting Model of the United States Economy, Lexington: C.D. Heath and Company, 1971.

- McCallum, B.T., "The Effect of Demand on Prices in British Manufacturing: Another View," Review of Economic Studies Vol. 37, No. 109, Jan. 1970, pp. 147-156.
- de Menil, George and Jared J. Enzler, "Prices and Wages in the F.R.B. M.I.T.-Penn, Econometric Model," Paper presented to the Conference on the Econometrics of Price Determination, October, 1970, Washington, D.C..
- Modigliani, Franco, "New Developments on the Oligopoly Front," Journal of Political Economy, 1958.
- Murphy, Michael A., "U.S. International Trade Data Appendix," Princeton, revised February 2, 1968 (mimeo).
- Neild, R.R., Pricing and Employment in the Trade Cycle, A Study of British Manufacturing Industry, 1950-61, Cambridge, England: University Press, 1963.
- Nevin, E., "The Cost Structure of British Manufacturing, 1948-61," The Economic Journal, Vol. 73, No. 292, Dec. 1963, pp. 642-664.
- Nordhaus, W.D., "Recent Developments in Price Dynamics," Cowles Foundation Discussion Paper No. 296, August 13, 1970.
- Perry, George L., Unemployment, Money Wage Rates, and Inflation, Cambridge, Massachusetts: MIT Press, 1966.
- Phipps, A.J., "The Roles of Labour Productivity and Demand in the Pricing Process: An Inter-Industry Study Using Time-Series Data," Bulletin of the Oxford University Institute of Economics and Statistics, Vol. 31, No. 4, Nov., 1969, pp. 285-302.
- Pitchford, J.D., "An Analysis of Price Movements in Australia," Australian Economic Papers, (December, 1968), 111-135.
- Rushdy, F. and P.J. Lund, "The Effect of Demand on Prices in British Manufacturing Industry," Review of Economics and Statistics (October, 1967), 361-73.
- Sato, K., "Aggregate Production Functions under Constantly Growing Investment and Technology." Mimeo, M.I.T., 1969.
- _____, "Micro and Macro Constant-Elasticity-of-Substitution Production Functions in a Multifirm Industry," Journal of Economic Theory, Vol. 1, No. 4, Dec., 1969, pp. 438-453.
- Schilling, T.D., "A Demand Approach to Quarterly Estimation of Price Change," M.I.T., Spring, 1966 (mimeo).

V = Implicit price deflator for the private business nonfarm sector, 1958 = 1.0. Computed by dividing quarterly figures for current dollar GNP of the private business nonfarm sector (NIPA, 1.7, line 4 and SCB, July, 1968, p. S-3 and May, 1969, p. S-3) by constant dollar GNP (1958 prices) of that sector (NIPA, 1.8, line 4, and SCB, July, 1968, p. S-3 and May, 1969, p. S-3).

M^X = Price index of world exports of primary commodities, 1957-9 = 1.0. We wish to thank Mr. Abraham Aidenoff, Acting Director of the United Nations Statistical Office for providing three overlapping series using different weights which were then corrected for a common base. The combined series was then seasonally adjusted.

M^f = Wholesale price index of farm products, 1957-9 = 1.0. Quarterly average of monthly figures. Source: BUS and SCB, May, 1969, p. S-8. Seasonally adjusted.

M = Materials price index. Computed as a weighted average of the price index of world exports (M^X) and the wholesale price index of farm products (M^f). The moving weights were computed in the following manner. Annual figures for the total value (in millions of U.S. dollars) of U.S. imports of farm and primary commodities were the sum of food, beverages and tobacco, crude materials except fuels, mineral fuels, and animal and vegetable fats collected from the Yearbook of International Trade Statistics, United Nations. These annual figures were interpolated to form a quarterly series (EM). From the National Food Situation, Economic Research Service, U.S. Department of Agriculture (August, 1967, Table 9; May, 1968, Table 8; and May, 1969, Table 2) annual series for net production (supply), domestic utilization, and net imports of farm food commodities, all as percentages of total annual net utilization, were collected. A series of the share of domestically produced farm products used domestically was generated in the following manner: Domestic utilization less net imports was divided by net production. Again this series was interpolated to form a quarterly series (FS). Another series of GNP originating on farms in 1958 dollars (XF) was collected (NIPA, 1.8, line 5, and SCB May, 1969, p. S-3). M^X was weighted by the real value of U.S. imports of primary commodities (EM/M^X) divided by this real value of imports plus the share of U.S. farm commodities used domestically times GNP originating in farms. M^f was weighted by the share of farm commodities used domestically times farm GNP divided by this product plus the real value of imports. Algebraically,

$$M = \frac{(EM/M^X)}{(EM/M^X) + (FS \cdot XF)} M^X + \frac{(FS \cdot XF)}{(EM/M^X) + (FS \cdot XF)} M^f$$

P = Price of gross output. Computed as a weighted average of the private sector of GNP price index (V) and the materials price index (M). Let F = (EM/M^X) + (FS · XF). Then

$\frac{B}{\bar{X}}$ = Ratio of unfilled orders to capacity in manufacturing, adjusted for trend as follows:

$$\frac{B}{\bar{X}} = \frac{B^m}{X^m} \cdot \frac{X^m}{\bar{X}^m} \cdot e^{.00601463(t-80)}$$

The number .00601463 was the geometric growth trend between the peaks of $(\frac{B^m}{X^m} \cdot \frac{X^m}{\bar{X}^m})$ in 1956.3 and 1966.4.

t = time, in quarters.

$$t = 1 \text{ in } 1947.1$$

⋮

$$t = 89 \text{ in } 1969.1$$

τ^e = Effective indirect business tax rate, constructed as:

$$\tau^e = \frac{TF}{YB} ,$$

where TF = Federal government indirect business tax and non-tax accruals, seasonally adjusted at annual rates, in billions of current dollars. Source: NIPA, 3.2, line 4, and SCB, May, 1969, p.S-6,

and YB = GNP of the private business sector, excluding households and institutions, seasonally adjusted at annual rates, in billions of current dollars. Source: NIPA, 1.7, line 3, and SCB, May, 1969, p.S-3.

A = Mean age of nonfarm equipment. Annual series was interpolated linearly to form a quarterly series by assuming the yearly figure represents the value at the end of the 2nd quarter, and multiplied by 4 to put the age in quarters. Source: SCB, February, 1969, p.27. We estimated the annual figure for 1969 as 24 quarters, or 6.0 years.

$\frac{X}{\bar{X}}$ = Wharton index of capacity utilization. Source: Wharton Quarterly Spring, 1969, pp.20-21 (I). We estimated the 1969.1 value as 94.6. We also experimented with the Bischoff utilization index, taken from the data bank of the FED-MIT-Penn econometric model.