FORECASTING PRICES IN AN INPUT-OUTPUT FRAMEWORK

by
David Gilmartin

Dissertation submitted to the Faculty of the Graduate School
of the University of Maryland in partial fulfillment
of the requirements of the degree of
Doctor of Philosophy
1976

ABSTRACT

Title of Dissertation: Forecasting Prices in an Input-Output Framework

David Gilmartin, Doctor of Philosophy, 1976

Dissertation directed by: Clopper Almon, Jr.
Professor
Department of Economics

A model of industrial prices for the United States is presented. A *ceteris paribus* test of the long-term effect of the 1973-74 price increases for crude materials (live animals, grains, non-ferrous ores, and oil) demonstrates the model's significance, power, and quirks.

The model incorporates the input-output relationships and its main feature is that it explicitly simulates the transformation of commodity price changes into changes in the costs of production of the various industries. 185 industries are recognized. The simulations are monthly.

Price equations are estimated independently for 137 industries. The specification says that price is the sum of two distributed lags, one of twelve months on unit cost, the other of twenty-four months on output. Almon lags of the second degree are used throughout. Tests of different lag lengths and degrees are touched on. Ordinary-least-squares estimation is given a chance to produce lags of the desired shapes and sizes, but quadratic programming is usually invoked in order to constrain the results. The lag sums are interpreted as elasticities of price with respect to cost

and output, and taken as the answer to two questions: to what extent does this industry pass through cost increases; is this industry subject to long-run rising or declining costs.

For the purpose of the analysis, consistent historical series were compiled, by industry, for price, non-seasonalized output, seasonally adjusted output, total employment, the number, hours, and weekly pay of production workers, and the unit cost of production. These data cover the months from January, 1954, to June, 1974.

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

1. Prices for INFORUM

Forecasting industrial prices and the general price level in a general equilibrium model is the goal of this study. The model presented here is the price side of the Interindustry Forecasting Model of the University of Maryland (INFORUM)[1]. It is intended to provide medium-term forecasts of absolute prices for 185 industries, monthly from 1971 to 1985. A further purpose is simulation, either of alternative prospective events or for *ceteris paribus* testing of historical effects.

Price is the central concept of economics and the knowledge that relative price determines behavior is the open secret of economists. The study of price has been largely concerned with hypothetical supply and demand, and deductions from them. However, price as a statistical observation has been studied with heightened intensity since 1950. The creation of national accounts and the methodical collection of measures of aggregate prices provided the foundation which made these studies possible. When Bronfenbrenner and Holzman [7] surveyed this literature in 1962, most of the work was discursive rather than econometric, and used statistics mainly by way of example to buttress theoretical conclusions. A decade later Earl [11] found forty-three studies which reported econometric estimates of price equations. A dozen of these placed price determination in the context of a larger model and half a dozen reported price equations for individual industries, but only one - the Brookings model [31] - combined these two characteristics in one study. It is just this combination with which we are particularly concerned.

In this context an input-output analysis of prices offers three special advantages. First, it deals explicitly with the transmission of price changes from industry to industry. A rise in the price of steel increases the costs of production of many other commodities, each according to its input coefficient for steel. At any time many such effects are at work. Through the input-output technique, they can be controlled for in the historical data and reproduced in the simulations. The second advantage concerns the effect on price of the cost of labor. An increase in the general level of wages has a greater significance for labor-intensive industries and for those with little growth in productivity. These differences will be captured by performing the analysis at the industry level. The third advantage arises because the real variables (consumption, output, employment, etc.) are influenced by relative prices. If oil prices are up, but nevertheless lower in relation to the price of natural gas than formerly, oil can be expected to replace gas and show an increase in output. The price of coal could move between them. An aggregate price equation is no help in modeling the substitution of coal for oil or steel for energy. By modelling industrial prices in an input-output framework, we will be able to attend to the shifts in relative prices calculated from the absolute prices which are the immediate subject of our equations.

Our task falls into two parts, estimation of price equations for 185 industries and construction of a model which applies the equations to forecast prices, carries the prices into the production, demand, and wage calculations of INFORUM, and returns with a consistent stimulus for the next period of price determination.

For estimation, a single specification will be fitted for every industry. This short-cut suggests itself quite naturally to the person who will perform the work. The estimated coefficients will be examined in the light of general knowledge about which industries are competitive or concentrated, which have flat, falling, or rising lon-run average costs. In individual cases, the specification could be improved, but the refinements lie in the future. Accepting the limitations, we pursue the question of how well can an input-output model of prices perform.

2. Specification of an Equation

2.1. An Equation

Our equation has not been derived by strict deduction from a mathematical description of the behaviour of firms. It is proposed instead as a mathematical form which can be applied to the limited data available in order to learn some of the behavioural differences among industries which are relevant to the determination of prices. This discussion will proceed by first presenting the equation itself and then considering the meaning of each variable and of the way it enters the equation. The features of the equation which go beyond the individual variables will be described. It will be seen that the equation is largely concerned with the characteristics of the supply. To simulate demand effects, we must join the whole set of price equations together and cause them to interact with the "real" variables of INFORUM. It is this more complete model which is offered as a technique for forecasting and simulating price effects in the American economy.

Our equation makes price the sum of two distributed lags, on unit cost and on output. For the j-th commodity, it looks like this:

$$(1) \qquad P_{jt} = S + \sum_{k=1}^{m} v_{jk}\, UC_{j,t-k} + \sum_{k=1}^{n} w_{jk}\, Q_{j,t-k}$$

where

P_{jt} = the price index of the j-th commodity, month t

S = an intercept or seasonal

$UC_{j,t-k}$ = the unit production cost of the j-th commodity k months earlier

v_{jk} = the lag weight corresponding to $UC_{j,t-k}$

$Q_{j,t-k}$ = the seasonally adjusted output of the j-th commodity, k months earlier, and

w_{jk} = the output's lag weight

Each observation of unit cost is the sum of unit material cost (UMC) and unit labor cost (ULC):

$$UC_{j,t-k} = UMC_{j,t-k} + ULC_{j,t-k}$$

Each unit material cost is constructed using a 185 order input- output matrix (A):

$$(2) \quad UMC_{j,t-k} = \sum_{i=1}^{185} P_{i,t-k} A_{ij}$$

The general idea is that the industry is subject to uncontrollable forces from two directions. Internally, the structure of its production makes it vulnerable in a characteristic way to fluctuations in its factor prices. Externally it meets demand for its output as this changes with incomes, tastes, and the prices of other goods. The industry lives in the middle by choosing its price. We will make the cost variable bear the burden of representing the "internal" forces and leave to the output variable the "external" forces.

2.2. Cost

In choosing to represent cost by material-plus-labor cost per unit of output, we have implicitly answered several significant questions. First, as we shall see, we have chosen unit cost over an average of factor prices. Second, we use average rather than marginal cost, and this average has some element of fixed cost in it while it omits an important element of variable cost. The choice was partly on principle, partly of necessity. We will first explain the choice and then discuss its significance in measuring technological change, factor price changes, and inflation.

The choice between factor price and unit cost concerns the treatment of productivity. A 5% increase in wage rates creates higher costs of production if labor's productivity has risen less than 5%, but it represents lower costs of production if productivity rose, say, 8%. Two distinct possibilities exist. The owners of a factor use the knowledge that the productivity of what they sell has risen to bargain for a higher factor price; this is a common case for labor. On the other hand, the firm may respond to a higher factor price by adjusting the production technique so that the factor's productivity rises at the margin; this applies generally to the price of material inputs and to wage bargains in excess of productivity gains. Changes in factor prices and productivity are equally relevant to the level of the cost of production. One possibility would be to use them as separate explanatory variables, letting the productivity enter as a reciprocal. Since we are distinguishing a large number of inputs, this approach would require either an inordinate number of variables - 30 or 40 for factor prices and an equal number for the productivities - or two variables which were each judicious averages, one of the factor prices and the other of the productivities. The advantage of the latter formulation would be to test for a different response to the two causes of change in production costs, arising perhaps from differing expectations about the permanence of changes. Separating unit cost into two variables, however, introduces the possibility that the estimated coefficients will not reflect the algebraic relationship between them, that the factor share is the ratio of the factor payment to the factor's productivity. In simulating over several years, the factor shares would change radically, could turn negative, and would not sum to unity. We avoid these possibilities by combining all factor prices and productivities into a single variable, unit cost. In this way we also give the correct relative weights to each of the material inputs and to labor.

Having made this choice, we must point out that labor is the only factor for which we have any measures of productivity change. To observe productivity change of material inputs, we need input-output tables on a comparable basis for more than one year. Reimbold [29] has laid a basis for such estimates, but the work of incorporating them into this study has not been done. Consequently, all production materials are treated like government workers — as if they have the same impact on final product year after year.

The unit cost variable is essentially a measure of average material and labor cost. If it reflected marginal cost, then we would expect price to equal cost. (An exception is that immediately after a shift in demand, the observed point may be off the supply curve because suppliers are collecting the rent on the existing inventory.) But the input-output relationships are estimated as annual averages and do not indicate how the intensity of use of individual materials changes with the rate of capacity utilization. Three classes of inputs could be distinguished if input-output techniques were used to study marginal cost. First are those which are consumed according to fixed coefficients; input rises in proportion to output. Second come "overhead" materials, such as lumber for maintenance of the buildings; in periods of extra production the "overhead" coefficients would be falling. The third category consists of inputs which could be used more intensively to speed up production, like pre-fabricated parts and air freight. If our time series were founded on even this much detail, then movements along the marginal cost curve could be observed. With only one input-output matrix, we must assume that all inputs belong to the first class. Applying the fixed cost structure to all levels of output would produce a flat average cost curve. It is more likely that this level of cost holds only at a point or over a small range. As the factor prices change, the weighted average of equation (2) (page 5) yields a new value for the unit materials cost. The new value is the level of another average cost curve, so that factor price changes shift the curve vertically.

Two elements of fixed cost are included in the unit cost variable, but the main piece of it, the capital cost, is missing. The "overhead" materials have an aspect of fixed cost to them. More importantly, non-production workers' payroll is included in figuring unit labor cost. Capital costs were omitted because of the difficulty of measuring them in sufficient industrial detail. If a measure of the capital stock were available annually, it could be multiplied by the sum of a depreciation rate and the (monthly) interest rate to produce a measure of capital cost consonant with the material and labor cost described above. This refinement lies in the future, but it belongs in our concept of cost as the representative of all the uncontrollable forces arising from the supply side of the industry.

An industry's costs can change in three ways, technological change, change in the prices of factors (in the absence of a change in the general price level), and inflation. Our measure of cost will not capture the three with equal success. The first two shift the cost curves up and down while the third can be expected to shift the demand curve as well.

Figure 1 illustrates a change in technology which reduces the marginal cost at every level of output. Demand is represented by D. The marginal cost is S, the supply curve as well, and the corresponding average cost curve is AC. The industry is in long-run equilibrium at output q. As a result of innovation, the marginal cost curve shifts down to S'; AC' shows that at output q', which achieves a short-run equilibrium, an abnormal profit is being earned. In the long-run, a greater scale could be expected to push the cost curves to the right, as shown in AC'' and s'', so that output reaches q''.

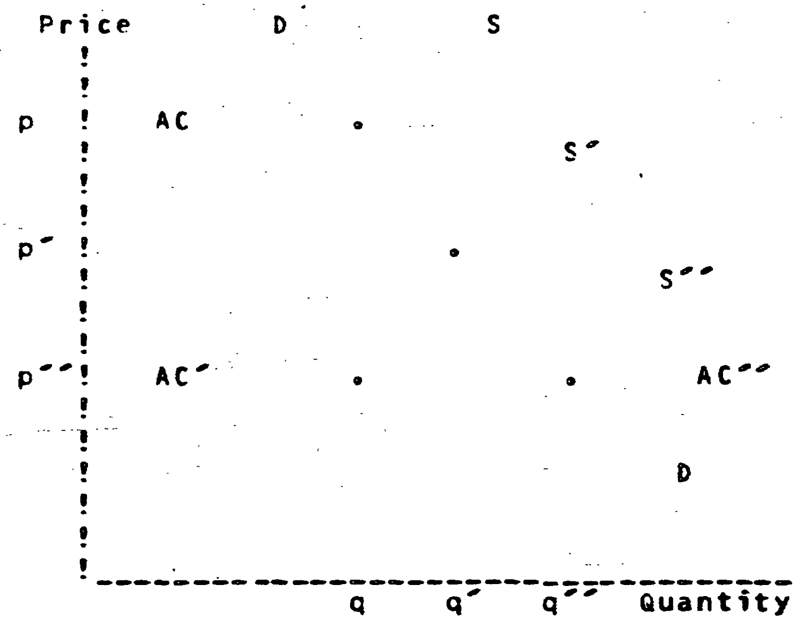


FIGURE 1. Technological Change.

Now the question arises, how much of this can be revealed through the measure of cost which is described above? As for the initial shift, if the saving is brought about by reducing the input of labor, we will capture it.

If the reduction comes in physical inputs, we will miss it, since we rely on a single input-output matrix. The size of the drop in cost will overstate the drop from p to p′, for we measure the full drop from AC to AC′ immediately. The fact that price will drop successively to p′ and then to p″ calls for a distributed lag. The second shift of the average cost curve could lead to slightly higher or lower observed cost, if long-run costs do not exhibit constant returns to scale. Again, we will capture the difference only to the extent that the labor input is affected, but this difference is much less significant than the original shift.

Figure 1 illustrates a change in factor prices, also. The market equilibrium would undergo the same adjustment from q to q″ through q′. The difference is that our measure of cost completely records the relevant changes. The shift in the average cost curve will be fully reflected in the unit cost as constructed. Whereas in the case of technological change, the decline in price is likely to appear excessive compared to the measured drop in cost, here the two will go together, and give a reliable indication of the pattern of the lagged response.

The case of inflation is illustrated in Figure 2. The shift from S to S′ differs from that of the previous case only in that we now assume factor prices have risen instead of fallen.

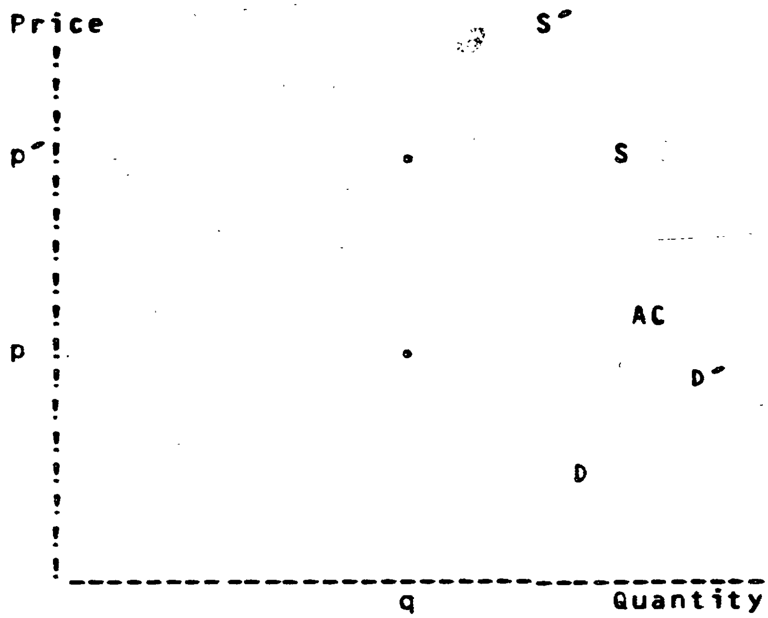


FIGURE 2. Inflation.

The new feature is that demanders can be expected to pay the higher prices because all prices tend upward in an inflation. (To the extent that the industry´s output price rises at a different pace from its input prices, the problem is the one just discussed.) But if demand shifts up roughly in step with supply, equilibrium output is little affected while price rises the same amount as average cost. This shift in cost, brought about by changes in factor prices, is just the kind that we capture in our measure of unit cost. Only the missing capital cost clouds the analysis. Instances like that in Figure 2 should be helpful in estimating the lag on unit cost.

2.3. Output

The second explanatory variable is output. It is expected to correlate with the variance between cost and price, and to represent all the "external" forces.

To illustrate the usefulness of this variable, we consider a period surrounding a shift in demand when factor price changes just offset productivity gains so that average costs are constant. Figure 3 (on page 14) depicts the industry's adjustment. The original average cost curve (AC) and the marginal cost curve (S) yield a long-run equilibrium under the first demand curve (D) at the point (P,Q). The equilibrium is established at (p,q) once demand shifts to D′, but since marginal cost exceeds average cost, there is an incentive to expand capacity. We consider that the expansion does not appear all at once but that an intermediate point is reached when production will be higher and abnormal profits reduced. The point is represented by average cost AC′ and marginal cost S′, yielding a short-run equilibrium at (p′,q′). Additions to capacity should not push the average cost curve beyond AC″, for profits then turn to losses. The final equilibrium is at (p″,q″).

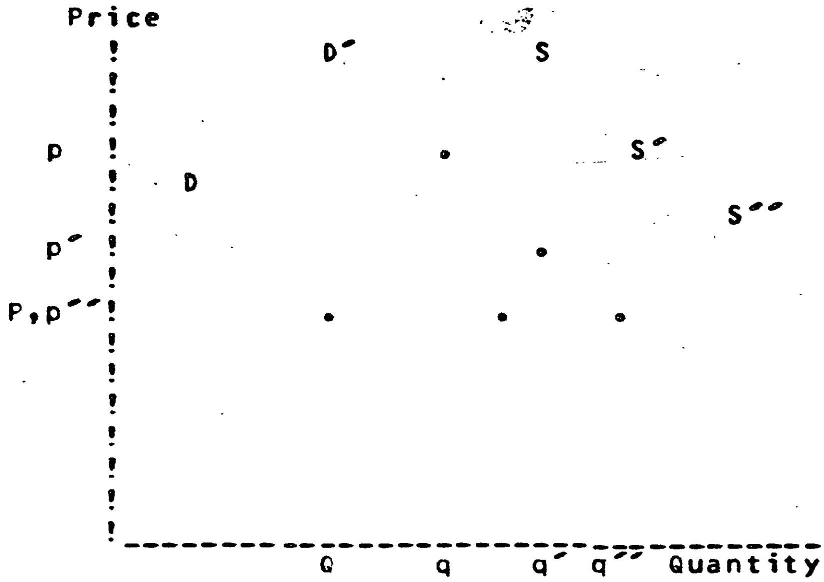


FIGURE 3. Demand Shifts Out.

Whether an increase in output is associated with rising or falling price depends on the time elapsed since the change in output. The increase from Q to q is accompanied by an increase in price, while the two successive increases in output co-incide with falling price. By introducing output into the equation as a distributed lag, we make price dependent on the output of several past periods. If our second variable were demand rather than output, then the data corresponding to Figure 3 would show a single increase equivalent to the gap between Q and q´´. Matching this, the expected shape of the distributed response by price would be an initial rise and then a succession of decreases. But our variable is output. Output does not rise all at once in the fashion of demand. If demand is inelastic, then the first change in output is large, compared to the later ones. In this case, the lag on output will tend to look very much like the theoretical lag on demand. It will depart from the theoretical lag, the more elastic is demand. We will see in the statistical analysis that many of the lags conform to our expectation.

Variables which are indicative of short-run disequilibria would be preferable to output. Capacity utilization, inventory change, and backlogged orders are of this type. The data on backlogs cover only the industries manufacturing durable goods, mostly machinery. When special attention can be given to some industries, this variable deserves attention. Measures of inventory change also lack the coverage needed for this study. Capacity utilization is measured quarterly for broad industrial aggregates. With the guidance of these published data, it would be possible to construct industry-specific measures by "trending the peaks" of our output data. Such artificial data is conceptually better than output, but it consists only of the very same data, reworked. Leaving the testing of more complicated constructions for the future, we take output as the choice which supports our determination to estimate equations monthly for the detailed industries currently recognized by INFORUM.

The returns to scale characteristic of the industry's cost functions determine whether the price at the final equilibrium, p'' in Figure 3, exceeds, equals or falls below the initial price, P. We will be watching the statistical estimates of the lags to see how many industries experience a net effect less than zero when price responds to an increase in output. There should be cases of increasing returns to scale, of decreasing costs. Presumably the electric utilities will show this result, and maybe a few others, but we expect to find that most lags sum to very near zero, that is, that most industries are operating on the flat portion of their long-run average cost curves.

Both Figures 2 and 3 illustrate cases of a shift in demand. The shift in Figure 2 is brought about by inflation, which affects both supply and demand; the effects are assumed to be equal for conceptual neatness. Since the output is unaffected by the adjustment, we would not expect these instances to influence the estimation of the lag on output. Only cases in which demand shifts up or down relative to the cost curves will play a role. Whether the shift is due to changing income, the prices of substitutes and complements, or fashions and tastes will have no bearing; Figure 3 illustrates any of these causes. In every case, including that of Figure 2, the estimates will be clean only to the extent that our measure of cost truly represents the movements of the average cost curve.

2.4. Other Features of the Equations

Several features of the equation remain to be considered. First, although the discussion has been concerned largely with the nature of changes in the variables, the equation is estimated in levels rather than first differences. Aside from the problem that first differences of the published price series would suffer badly from rounding error, this choice has been governed by the need to forecast levels. It is levels which will be needed to simulate unit material costs and relative prices. The forecasting will be more reliable if the equation has been fitted by minimizing the variance around the identical variable. Since we want to forecast levels, we shall estimate the eouation for levels. The estimates will undoubtably exhibit auto-correlation in this form.

The effects of the two variables are added together. Quite likely this leads to some distortion. For the sake of simplicity we assume that this linear approximation to the theoretical curves is close enough. Further it should be noted that the equation is not log-linear. Such a formulation would impose the assumption of constant elasticities for each variable over the entire range of values. This assumption is not obviously inferior; it is another variant which awaits future attention. Meanwhile, the elasticities are very much of interest. To reveal them directly, all variables are transformed to indicies centering arounc unity in 1967. The sums of the two lags in any case bear the interpretation of the long-run effect on price of a unit change in the variables. Once cost, output, and price are indexed, these effects become the percentage change in price given a one per cent change in the variables (on the average over the historical period). The lag sums are then the arc-elasticities.

The lags in all cases exclude the current period. In this way we avoid the assumption that price-setters have perfect knowledge of what all other price-setters are deciding at the same moment. The price model is thereby made strictly recursive.

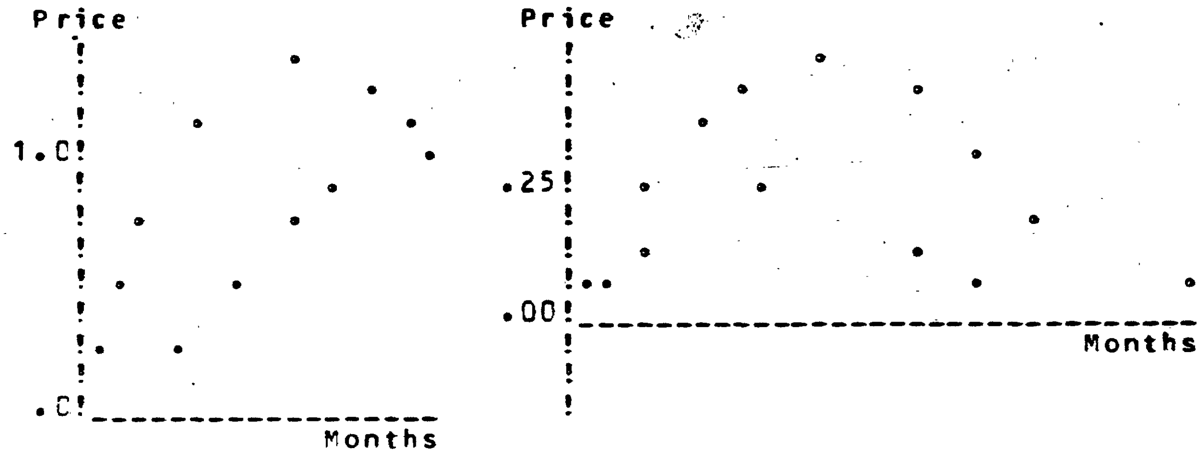
Only output is adjusted for seasonal variation. Unit cost and price enter the computations in their unadjusted form. The seasonality of the cost should largely explain the seasonality in the price; a rise in cost is no less a reason for raising price simply because it occurs every year at the same time. A change in output, on the other hand, is presumed to affect price only to the extent that it is a permanent change; therefore output is de-seasonalized. It could be argued in a manner parallel to the statement about cost that seasonal increases in output still push the industry up its short-run marginal cost curve and justify seasonal increases in price. If so, then the seasonal dummies represented by S in equation (1) should turn out to be significant, and their significance should evaporate on substituting unadjusted for seasonally adjusted output. This test has not actually been performed in a systematic way. We have assumed that prices are set in anticipation of seasonal fluctuations in output. All equations are estimated with the seasonally adjusted outputs.

A final comment on the equation concerns the role of money. However much the supply of money may be said to influence prices, no price-setter bases his decision on this variable. The normal working of monetary policy, which seeks its effect by manipulating the excess reserves of the banking system, will have its initial impact on the nominal interest rate. In the second round of effects, investment will be stimulated, and consumption, too, through both a real-balance effect and the reduced cost of borrowing. The prices in individual industries will then respond to the changes in output. Therefore we look to the larger model to establish the connection between monetary policy and prices; the price equation cannot see beyond its own output variable. Patinkin [24,p. 241], discussing an economy of only one commodity-producing industry, gave this description; it is all the more true when we consider many industries. Keynes [19] touched on the very question and answered it directly: "In a single industry its particular price-level depends partly on the rate of remuneration of the factors of production which enter into its marginal cost and partly on the scale of output."

2.5. Constraints

In the analysis to be presented in Chapter 4, two techniques are employed, ordinary least-squares regression analysis (OLS) and a constrained estimation achieved by quadratic programming. The goodness-of-fit is of necessity better with OLS, which is always given first chance. If the OLS estimates of the distributed lags do not satisfy our theoretical expectations, we then apply three successively tighter sets of constraints. Although the fit must worsen, we hope thereby to produce an equation which can be used to forecast the industry's price level in a meaningful way. The rules which determine whether to constrain the estimates are based on the discussions above of the cost and output, but a clearly arbitrary element enters as well.

We expect price to rise roughly point for point with cost. If the lag sums to unity, the equation will then pass through all cost changes to the price, without either mark-up or a holding back. In log-linear form, a sum of unity would mean a mark-up; a rise in cost of 1% would lead to a rise in price of 1% and imply a 1% increase in the elements that fill the gap between cost and price, primarily profits. Since our equation is not log-linear, a rising share for profits will take the form of a cost lag which sums to more than unity. If the industry fails, on the other hand, to pass through its costs, so that in the long sweep it has been taking a smaller and smaller share in profits, we expect to see a lag sum of less than unity. The curves in Figure 4a trace the integral of the lag, not the monthly effects. The higher one represents an industry which regularly over-reacts to a cost change. Both come to rest at about unity, meaning an eventual elasticity of 1.



4a. COST 4b. OUTPUT

FIGURE 4. Cumulative Percentage Effect on Price n Months after a 1% Increase in the Independent Variable.

The output lag will take on positive values in the early months if output acts like a demand variable. The net effect should be near zero. If the industry's average costs are flat over a wide range which encompasses the levels of output experienced during the last twenty years, then the shifts in demand during that period did not necessitate any price increases. We therefore look to the sum of the lag on output to indicate whether long-run costs are declining or rising. Negative values mean that rising outputs have been associated with decreases in the price and we will interpret that as increasing returns to scale. Correspondingly, a positive sum for the output lag will be taken to mean that the industry has been expanding in a range of decreasing returns to scale. The other half of the figure illustrates the output lag. The upper curve in Figure 4b represents a price which is more sensitive in the short-run, although the lower curve generates the same net effect in the long-run.

All the curves in Figure 4 illustrate the cumulative effects, not the lag weights themselves but their integral from the time of the change in the independent variable until the n-th month after. If these polynomials are to be free to flatten out in the final months to reflect a smooth conclusion to the adjustment, they must be of the third degree or higher. As will be learned in Chapter 4, the third degree already allows wiggles in the estimated lags for which we have no behavioral interpretation. Thus we dare not choose a higher degree polynomial, and so we settle for the third degree as the one best fitting the cumulative structure of the lags; therefore the lags themselves are estimated as quadratic functions. As for the lengths of the lags, the guiding thoughts were primitive. Although in special cases the adjustment of price is immediate, it may be incomplete even then and dribble on for several months. The standard case is presumably slower, due to uncertainty about the changes in cost and demand, or existing contracts, inventories outside the industry of origin, or simply a bunching-up of small changes. In the case of the adjustment for changes in output, it may consist of additional investment. For this reason we think the output lag must be notably longer than the cost lag. From a likely range of three months to three years, we have chosen to run all equations with a cost lag of twelve months and an output lag of twenty-four months. A short word on the effect of varying lag lengths will be found in Chapter 4, on page 49.

The ordinary least-squares estimates will be used if they satisfy three conditions:

1. The cost lag sums to 1.0±.25 and the output lag to 0.±.25.

2. The cost lag rises no higher than 2.

3. The output lag maintains positive values for the first half of its length.

If one of these conditions fails, then we constrain the estimates in an attempt to satisfy it. The unconstrained estimation takes the mathematical form of minimizing a quadratic function of the coefficients, and if the contraint were one of equality, say, that the cost elasticity be unity,, then with the use of Lagrangian multipliers, the calculus would still suffice to solve the problem. But our constraints are inequalities, so that the problem is transformed into a programming problem, one of searching many satisfactory programs for the optimal one. Because the objective still includes the minimization of the sum of squared residuals, it is a quadratic programming problem and the technique for its solution is found in Dantzig [8]. The four possible estimates go by cryptic names in the tables of Chapter 4; their names and the conditions under which they will be estimated are:

BASIC - The basic estimate is an ordinary least squares estimate, without any constraints, of a twelve-month quadratic lag on cost and a twenty-four month quadratic lag on output. The tails of the lags were not tied to zero.

BASIQ - Quadratic programming is used to force the cost lag's sum into the range between .75 and 1.25, and the output lag's sum between -.25 and .25. The lag lengths and degrees of the polynomials are the same as BASIC and the lag tails are free. All interpolation points except the final one of the output lag are kept from going negative.

RISING - Rising long-run average costs are not consistent with a negative sum for the lag on output. This sum is restricted to the range .0 to .25 whenever either BASIC or BASIQ indicates that it is less than -.1; otherwise the estimation is identical to BASIQ. The final month's effect in the output lag is still allowed to be negative to allow for the inverted U shape, but the accumulated effect of the entire lag is kept non-negative.

SLIM - Slimmer ranges are the only difference; the cost lag's sum is fixed between .9 and 1.1, the output lag's sum between -.1 and .1.

2.6. Literature

There are now twenty years of active experimentation with the statistical correlates of price. Earl [11] surveyed the literature as of 1972 and found that 75 distinct variables had proved useful. Except for five variables, all of them represent either production costs or demand. The five extras are price of substitutes, expectation of price change, age of the stock of equipment, corporate profits tax rate, and the supply of money - these in addition to lagged prices, dummies of various kinds, and time.

These two classes of variables are, in general, both represented in each study. In no case is a specification derived directly from a behavioral model of equilibrium and adjustments to equilibrium. Instead, each type of variable is justified separately. In his paper of 1970, Nordhaus [23] presents six long-run price equations derived from a log-linear demand equation and six different production functions; these neo-classical price equations corroborate the use of both a cost and a demand variable, with the caveat that the scale of output disappears from the expression under constant returns to scale. Nordhaus obaserves, "Most of the specifications and interpretations have proceeded without the benefit of formal theory."

For all the agreement over the types of regressors, there is little agreement about the precise variables and the forms in which they should enter. For the cost variable, the main questions addressed in the literature are:

1. mark-up over labor cost or explicit inclusion of material and/or capital cost;

2. factor cost or unit cost (marginal or average);

3. whether productivity and output should be adjusted for cyclical or short-lived variations; and

4. short-run versus long-run.

It would be nice if some evidence from past studies could say which of each pair above best explains prices, but it is not so. The questions arise only in comparing models; no one has tested them by alternately fitting an equation using each choice. Even in the monumental re-estimations of many equations by Earl, the desired answers are not found.

The first two questions can be considered together. We have discussed the matter above and chosen a comprehensive measure of unit cost. Several studies have reported estimates with the components entered as separate variables. The combined effect of wage and productivity variables still must reproduce the factor share. Their success in getting statistical estimates which do so was not great. Schultze and Tryon [31], Gordon [17], Eckstein and Fromm [14], and Fromm and Taubman [16] get very high estimates of the shares, while Solow [32] gets a very low one (see Nordhaus [23], p.38). In using equations embodying such estimates for forecasting, the effect is to produce factor shares very different from those observed historically, whereas the most reasonable assumption is that the shares are stable. None of the studies has incorporated a measure of the cost of capital. If the implied share for labor and material is excessive, then the omitted share will waste away to nothing in a forecast.

The third question, concerning adjustments to productivity, touches the same issue. A feature of the available data is that variations in labor productivity are measured monthly, but changes in the productivity of total materials cannot be measured directly more frequently than once a year, and it is less often for individual materials and capital. Therefore, unit materials and capital costs are automatically "normalized", but unit labor costs as measured are heavily influenced by cyclical fluctuations in the recorded labor productivity. This adjustment should be made for two reasons: first it makes the three unit factor costs consistent with one another; and second, as Eckstein [12] remarked, after hoarding of labor in the trough, the productivity growth which arises from any growth in output will appear to be positively correlated with price unless the adjustment is made.

The fourth and final question on the cost variable concerns how to capture both short-run and long-run responses. Earl regards observed unit materials and labor cost as short-run variables while the same variables formed out of normalized output (the long-term trend in output) and the normalized unit capital cost are considered the lon-run variables. Schultze and Tryon [31] use the deviation of un-normalized from normalized cost to represent the short-run effect. This is the phenomenon which we aim to record by a distributed lag, as previously described.

We turn now to the second class of variables, demand variables. Eckstein and Fromm [14] argue that the rate of adjustment of price disequilibrium is proportional to the gap between supply and demand at the current price. They consider that the gap consists of three parts: inventory reductions below the desired level, cancellation of orders, and unfilled orders. Allowing for the limited coverage of this kind of data and its irrelevance where adjustments occur rapidly, they add operating rates (capacity utilization) as a possible demand variable. After testing equations of a number of forms using three demand variables, they conclude that operating rates are more effective a regressor than order backlogs and that the measure for inventory disequilibrium drops out of the results as insignificant. Schultze and Tryon had the opposite experience with inventory and backlog variables at the aggregated level and in their industry equations (for which these variables are not available) they relied on various forms of operating rates. Solow [32], Eckstein and Wyss [15], and Klein [20] also employed this variable and Perry [25] used its reciprocal. Gordon used the rate of change in the ratio of new orders to sales. All of these studies worked with aggregated industries

The work of Schultze and Tryon and of Eckstein and Wyss both deal with a selection of industries mainly at the SIC 2-digit level. Two studies have gone significantly beyond that, Heien and Popkin [18] and Earl [11]. All four of these studies include equations for two industries which are strictly comparable to those in our study, Autos and Tobacco. Each of the latter pair in addition estimates ten other sectors which match ours. All except for Eckstein and Wyss include simulations. However, neither the Schultze-Tryon nor the Heien-Popkin paper incorporates a measure of the cost of materials which is specific to each industry. As a result the simulations do not generate a set of prices which are consistent between industries for either the current or subsequent periods. Eckstein and Wyss constructed input prices on the input-output concept and used them in their estimations, but did not report simulations with the set of equations. Earl used the input prices of Eckstein and Wyss for estimation of industry price equations, but for his simulations he also explicitly explained input prices by aggregate measures of wages and capacity utilization. Nine sectors are covered by these simulations. Of course, they fail to guarantee any consistency within the whole set of industry prices.

3. Data

Estimation of the specification discussed above consists of regressing a monthly series of the commodity's price against a monthly series of the unit production cost of the commodity and a seasonally adjusted monthly series of its output. These series are needed for each of the 185 sectors (commodities) in the input-output scheme. In the cases of prices and outputs, the problem is to match the commodity detail in which these data are published to the commodity groups for which the input-output sectors are defined. The unit cost variable must be computed. This computation for each sector uses the price of the sector, the prices of all materials used by the sector, its output unadjusted for seasonal variation, and a series of the sector's monthly payroll. Thus, the basic data can be thought of as four matrices of price, payroll, seasonally adjusted output, and output not seasonally adjusted. Since many of the payroll series were first estimated and published for January, 1954, the whole analysis begins with that date. The last observation is June, 1974, making 246 in all. The four matrices are therefore of dimensions 185 sectors by 246 months.

3.1. Price

Two programs of the U.S. Department of Labor's Bureau of Labor Statistics(BLS) collect price data, the Wholesale Price Index(WPI) and the Consumer Price Index(CPI) programs. The aim of each is to create a single index. In the process, each program collects data on a large number of commodities in many localities. The detailed series, nonetheless, fail to cover the whole range of commodities and services, and furthermore they generally fail to cover all of the products that fall within a single input-output sector.

The rumor is widespread that the measured prices are not real, that they are list prices and err in all cases of volume discounts, pre-paid transportation, or simply below-list sales. The questionnaire on which the data are collected, however, specifically asks for prices actually paid. Stigler and Kindall [33] at great expense, studied this question for a limited number of commodities by asking the buyers rather than the sellers. They found significant cases that substantiate the rumor as well as many that belie it. They illuminate the many weaknesses of this data.

A weakness of the data which appears only from the technique used in the current analysis arises from the input-output concept of cost. The price data contains one series per sector. But the price of steel sheet purchased by the stamping industry differs from the price of steel tubing used in fencing or of the alloys used in instruments. A rectangular input-output table, with more rows than columns, could be the basis for incorporating the additional price detail which is available. Lacking such a table, the analysis treats all steel as "average" steel.

A third major short-coming of the price data, already mentioned, is the failure to cover all commodities within a sector, or to assign them proper importance in the sector's average price. Table 8 , starting on page 359, shows which WPI products were included in each I/O sector. As an example, Sector 55, Industrial Chemicals, is priced in as much detail as any sector of the economy. Priced commodities represented a large portion of the total value of production, but several significant commodities were ommitted, including chrome colors, chlorine, and gaseous oxygen. The only possibility is to assume that the prices of excluded items move in the same identical pattern as does the average of the priced items.

Where a sector's price is defined by more than one series, the weighted average is formed with the weights used in the BLS indices and scaled so as again to average unity for 1967. The BLS weights are derived from the 1963 economic censuses. They involve an element of judgment and further investigation, since the annual output of the precise items priced is, in many cases, not reported separately. No attempt has been made to improve upon the weights assigned by the BLS.

If a series begins in the middle of the period, it has to be spliced into the sector-level series. For series inaugurated after January, 1967, the whole series is scaled so that in the first month it has the same value as the average of all other series in the sector. For many series taken from the Consumer Price Index program, the early years' observations were quarterly or less often. These series are not volatile, so the intervening months' prices were assumed to lie along a straight line connecting successive observations. A few series which are supposedly a part of the WPI program were not found on the magnetic tape which carried the data. In a few other cases series with the appropriate codes were found, but all the values were zero. The two groups are marked 'Not on Tape' and 'Data Missing', respectively, in the columns of Table 8 which otherwise carry the beginning and ending dates of the series.

3.2. Outputs from the FED

The Board of Governors of the Federal Reserve System constructs the Industrial Production Index monthly. The data were all refurbished and published as a complete set in the August, 1971, issue of the <u>Federal Reserve Bulletin</u>. The industry series come both seasonally adjusted and unadjusted. They cover mining, manufacturing, and utilities, but not agriculture, transport, comminications, finance, or services.

Table 9, starting on page 374, shows which WPI products were included in each sector's monthly output. Where more than one series was called for, they were averaged together, using for weights the 1967 value of shipments from the Census of Manufactures.

3.3. Outputs by Interpolation

The gaps in the data on outputs were filled in by the mass production of monthly interpolations of annual outputs. Such a technique cannot in any way reveal seasonal variations; for these sectors only the seasonally adjusted output is available. To avoid breaks in the series between December and January, the outputs were cumulated, so that the series became "total output of the sector since January 1, 1954". Each set of three years, with four end-of-year points, defines a unique cubic, from which can be read the monthly increments at evenly spaced intervals. The monthly outputs determined in this fashion have three nice properties. They sum to the true annual output. They suffer no end-of-year discontinuity. And they are influenced by the outputs of the surrounding years. They are, of course, third-rate data. In many cases, better series are available from other sources, but they have not been pulled together yet.

3.4. Payroll

The Bureau of Labor Statistics is also the source of the payroll data. The reporting system behind the monthly publication, Employment & Earnings, collects seven basic series for a nearly complete set of 4-digit SIC industries in mining, construction, manufacturing, transport, utilities, trade, finance, and services, in short, in all areas except agriculture. Table 10, starting on page 381, shows the correspondence between the industries used in the employment data and the sectors of the price analysis.

The concept of payroll can be described simply. It is the number of employees of the industry in a given month times the average weekly earnings of production workers in the industry that month, times 4.333 (to scale weekly up to monthly pay). This measure of payroll should be quite comprehensive. Average weekly earnings of production workers includes incentive pay, overtime pay, and occasional payments. It covers all pay which is owned by the worker, but only for production workers. The pay of non-production workers is not reported in the same program. Since the payroll is used as the numerator of the unit labor cost, which is added to the unit material cost, it must be of the proper magnitude. If the payroll data of the Census of Manufactures were monthly or if the data from the Unemployment Insurance program had been in a machine-readable form, one of them could have filled this gap. Instead the expedient solution was to assume that non-production workers have the same average earnings as production workers, that wages for clerical and custodial workers balance the wages of supervisory, professional, and sales personnel. In this way, the magnitude is made approximately right, but the first differences in the series are incorrect; whenever the average earnings of non-production workers changes at a different rate from production workers' earnings, the variance as measured is misleading.

3.5. Unit Cost

Unit cost is the sum of unit material cost and unit labor cost. Unit material cost is computed for each month for each sector by first forming the weighted average of all sectoral prices. The weights are specific to the sector, being the input coefficients. Thus the price of a commodity that is not used in a certain sector's production has no effect on that sector's unit material cost. The coefficients are the purified input-output table for 1963, as described by Almon, et al. [1]. It is possible to use several years' tables and thereby capture shifts in the techniques of production, but we have not yet done so. The diagonal coefficient is always treated as zero, since a large part of the consumption which it represents is inter-plant transfers within a company, which are not subject to an external price. In the period for which the prices are unity (1967), the weighted average input-price for a sector should be the sum of the input coefficients. However, it will fall short if the price of a consumed commodity is missing from our base of data. To adjust for the missing prices, we compute the mean for the twelve months of 1967 of the weighted average described above. If that mean is .45 but the sum of the input coefficients is .55, then the whole time-series is scaled up by the ratio 55/45. To this unit material cost is added the unit labor cost, computed as the ratio of payroll to output, month by month. Both series are in current dollars and the output is used without adjustment for seasonal variation.

4. The Analysis

4.1. Results: The Case of Plastics Resins

The results for each industry are presented in a set of graphs starting on page 125. Since the graphs are not immediately understandable, one set will be described in detail as an example.

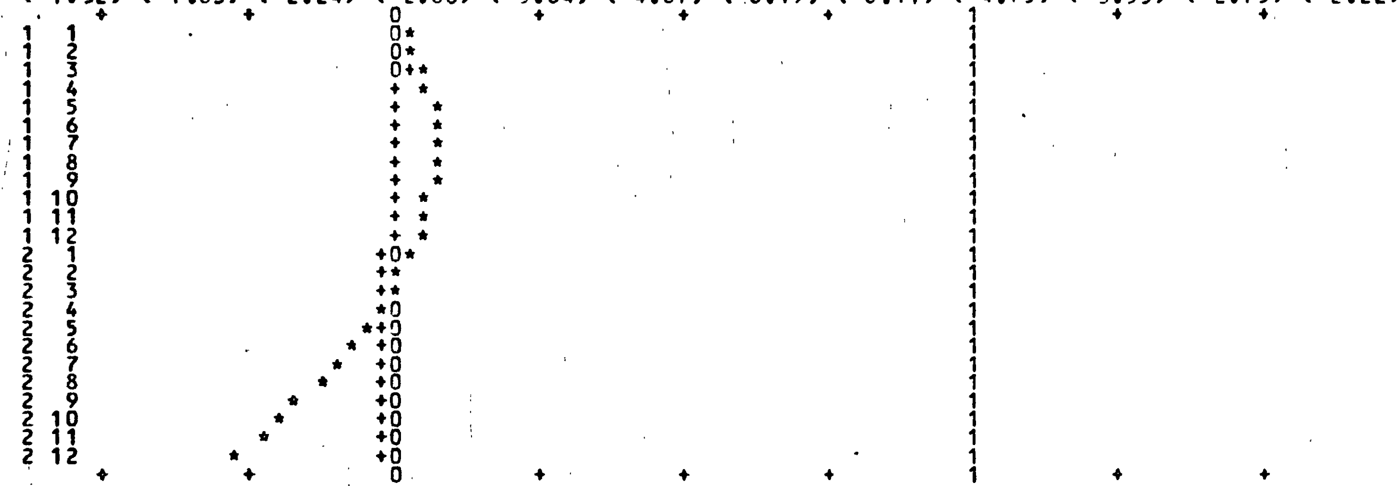
Industry 62, Plastics Materials and Resins, illustrates several features of the anaysis and provides a good place to begin. The equation is fitted to data covering the period January, 1956, to June, 1974. The distributed lag on unit cost was estimated by introducing three transformations of unit cost as three independent variabes. Each observation of the transformed variables was a weighted sum of the twelve months' unit costs immediately preceeding the month of the observation but not including that month; the Appendix to this chapter explains the transformations (page 100). The cost lag is then interpolated between the three points estimated as coefficients of these transformed variables. In this manner the cost lag is forced to lie on a quadratic and to be twelve months long. The ouptut lag is also a quadratic and is made twenty-four months long.

Three measures of the overall performance of the equation have been computed. The RBARSQ (the coefficient of

multiple correlation, adjusted for degrees of freedom [34])
of .806 says,

```
*****************************************************
Industry  62   Plastic Materials + Resins           * BASIC
*****************************************************
RBARSQ =     .806   RTSQ =     .534     Intercept =    -.088       Durbin-Watson =    .25

  1 Unit Cost                      SUM = 1.276    T STATISTIC = 10.50              HIGH POINT =     3.36
 1.4761* 2.4851* 3.0924* 3.3634* 3.3636  3.1584* 2.8131* 2.3933* 1.9643* 1.5915* 1.3405* 1.2765
(12.25) (14.29) (13.10) ( 5.20) (   .00) ( 2.83) ( 4.90) ( 6.96) ( 8.96) ( 6.95) ( 2.78) (   .43)
```

```
  2 Cutput Level                   SUM = -.267    T STATISTIC =-21.89              HIGH POINT =      .07
  .0185    .0340    .0466    .0564    .0633    .0675    .0690    .0678    .0640    .0577    .0489    .0376
( 1.07) ( 1.17) ( 1.30) ( 1.47) ( 1.60) ( 1.24) (   .36) (   .22) (   .57) (   .82) ( 1.04) ( 1.27)
  .0240    .0081* -.0101* -.0305* -.0531* -.0778* -.1045* -.1332* -.1639* -.1965* -.2309* -.2670*
( 1.52) ( 1.83) ( 2.24) ( 2.80) ( 3.64) ( 4.87) ( 6.19) ( 6.11) ( 4.75) ( 3.55) ( 2.75) ( 2.22)
```



```
**************************************************************
Industry  62   Plastic Materials + Resins            *  BASIQ
**************************************************************
RBARSQ =     .726   RTSQ =     .343    Intercept =    -.080       Durbin-Watson =   .12

   1 Unit Cost                          SUM = 1.250                              HIGH POINT =    1.65
   .6250  1.0795  1.3864  1.5682  1.6477  1.6477  1.5909  1.5000  1.3977  1.3068  1.2500  1.2500
       +         +         0         +         +         +         1         +         +
 1  1                      0                        *              1
 1  2                      0                 +                     1  *
 1  3                      0           +                           1            *
 1  4                      0      +                                1                    *
 1  5                      0  +                                    1                       *
 1  6                      +                                       1                       *
 1  7                    + 0                                       1                     *
 1  8                  +   0                                       1                   *
 1  9                  +   0                                       1               *
 1 10                  +   0                                       1           *
 1 11                    + 0                                       1         *
 1 12                      +                                       1         *
       +         +         0         +         +         +         1         +         +

   2 Output Level                       SUM = -.230                              HIGH POINT =     .04
   .0000   .0018   .0051   .0095   .0146   .0200   .0255   .0307   .0351   .0384   .0403   .0404
   .0384   .0338   .0263   .0156   .0013  -.0170  -.0396  -.0669  -.0993  -.1371  -.1807  -.2304
       +         +         0         +         +         +         1         +         +
 1  1                      *                                       1
 1  2                      *                                       1
 1  3                      *                                       1
 1  4                      *                                       1
 1  5                      +*                                      1
 1  6                      +*                                      1
 1  7                      +*                                      1
 1  8                      +*                                      1
 1  9                      +*                                      1
 1 10                      + *                                     1
 1 11                      + *                                     1
 1 12                      + *                                     1
 2  1                      + *                                     1
 2  2                      +*                                      1
 2  3                      +*                                      1
 2  4                      +*                                      1
 2  5                     +*                                       1
 2  6                     *0                                       1
 2  7                    *+0                                       1
 2  8                   * +0                                       1
 2  9                  *  +0                                       1
 2 10                 *  + 0                                       1
 2 11               *    + 0                                       1
 2 12             *      + 0                                       1
       +         +         0         +         +         +         1         +         +
```

```
***************************************************************
Industry 62   Plastic Materials + Resins                      *  RISING
***************************************************************
RBARSQ =    -.182   RTSQ =  -1.837     Intercept =     .253       Durbin-Watson =   .03

   1 Unit Cost                            SUM =  .750                                      HIGH POINT =      .75
  .1198    .1954    .2368    .2543    .2579    .2579    .2644    .2876    .3376    .4245    .5586    .7500
        +            +           0           +           +            +           1           +            +
  1  1                           0     *                                          1
  1  2                           0   +     *                                      1
  1  3                           0 +        *                                     1
  1  4                           0+          *                                    1
  1  5                           +           *                                    1
  1  6                           +           *                                    1
  1  7                           +            *                                   1
  1  8                           0+             *                                 1
  1  9                           0 +              *                               1
  1 10                           0   +                *                           1
  1 11                           0     +                    *                     1
  1 12                           0         +                          *           1
        +            +           0           +           +            +           1           +            +

   2 Output Level                         SUM =   .000                                     HIGH POINT =      .00
  .0000   -.0000   -.0000   -.0000   -.0000   -.0000   -.0000   -.0000   -.0000   -.0000   -.0000   -.0000
 -.0000   -.0000   -.0000   -.0000    .0000    .0000    .0000    .0000    .0000    .0001    .0001    .0001
        +            +           0           +           +            +           1           +            +
  1  1                           *                                                1
  1  2                           *                                                1
  1  3                           *                                                1
  1  4                           *                                                1
  1  5                           *                                                1
  1  6                           *                                                1
  1  7                           *                                                1
  1  8                           *                                                1
  1  9                           *                                                1
  1 10                           *                                                1
  1 11                           *                                                1
  1 12                           *                                                1
  2  1                           *                                                1
  2  2                           *                                                1
  2  3                           *                                                1
  2  4                           *                                                1
  2  5                           *                                                1
  2  6                           *                                                1
  2  7                           *                                                1
  2  8                           *                                                1
  2  9                           *                                                1
  2 10                           *                                                1
  2 11                           *                                                1
  2 12                           *                                                1
        +            +           0           +           +            +           1           +            +
```

of course, that the variance between the equation's predictions and the actual price index is 19.4% of the variance of the actuals around their means. But since there is a time trend in both the independent variables and the dependent variable, it is possible to construct a set of predicted values with the same overall time trend as the price index. Since this last trend is markedly differnet from zero, the RBARSQ is high.

An additional measure of the fit arises from comparing the variance of the estimated equation to the variance of the time trend. For the price of Plastics Materials and Resins, the sum of squared deviations from the mean over the 222 observatins used in the regression analysis is 1.896. The residual variance of the equation is 0.358, 19% of the original variance. But the time trend leaves a residual variance of 0.769. Our equation's residual variance is .466 times as great. RTSQ will express the fit relative to the variance of the time trend and in analogy to an RBARSQ, it is equal to 1 minus .466, or .534. Even if the time trend fit better than the equation, it would not offer any opportunity for modelling inflation; it is used only for a basis of comparison.

The autocorrelation of the regression's residuals is the third measure of overall performance. The Durbin-Watson statistic of .25 implies an autocorrelation coefficient for the residual between predicted and actual price of .875 and says that instead of fluctuating randomly, the residuals tend to maintain a constant value. Two factors contribute to the autocorrelation. The published price series is steplike; it holds at 1.327 for six months, then drops to 1.325 for three months. It drops to 1.313 for six more months and then to 1.215 for three months. By contrast, the distributed lags are a form of moving average; they are slower to attain a new level. The predicted values move along below the actual immediately after an increase in the actual; then if the predictions over-shoot, they will remain above for a period. The fit is good, but the Durbin-Watson statistic is very low. No correction has been made.

We turn now from the overall performance of the equation to the two distributed lags. Each lag is presented in a graph with two plotted series. The series marked by plus signs is the distributed lag. (These plus signs should not be confused with the other plusses used to mark every tenth increment on the vertical axis.) The other series, plotted by asterisks, is the cumulative form of the same lag. The last asterisk indicates, therefore, the sum of the lag. Since the cumulative series rises above 1.75, A's mark the points which lie off the page. The places on the vertical axis of 0.0 and 1.0 are marked by a string of zeros and a string of ones across the graph. For Plastics and Resins, the asterisks show that the cumulative effect on price of a one-index-point increase in unit cost rises during the first five months to more than three points; it then falls, so that the final effect is 1.27 points. The values to which the asterisks correspond can be read sideways just to the left of the plot. Under each is the Student's t statistic for the unaccumulated lag weight for the same month. (The actual weights do not appear but can be deduced by subtraction.) Where the t statistic exceeds 1.68 (the 10% confidence level), an asterisk is placed beside the value.

This distributed lag on unit cost says that the price makes an immediate response greater than the change in cost which stimulated it; the asterisk for the first month marks both the one-month effect and the accumulated, and lies at 1.4761. The falling line of plusses says that no later month experiences so large an effect and that the monthly increments remain positive for only four months. The peak of the accumulated effect cannot be seen, but it obviously lies at the fourth and fifth months, and its value is 3.36, meaning a triple increment in price. But the lag continues down and goes negative, pulling the accumulated effect down during months six to twelve. The final effect of a one-point increase in cost is an increase in price of 1.27 points.

The sum of the lag, 1.27, is the elasticity of price with respect to cost and is in the neighborhood of unity as expected. But the distribution of the response indicates that price-setters regularly overshoot the equilibrium in the first six months by a factor of 2.6 (3.36 instead of 1.27) and must then adjust prices down. The general inflation of prices tends to increase each industry's unit cost. It is not reasonable that every such rise in cost evokes so excessive a response, although the final effect is acceptable.

The lagged response to output has the desired shape, that is, price first rises, then falls. indicated elasticity of price with respect to output is -.267. Although this is a bit low, it comes very close to the pre-determined range, -.25 to +.25.

In order to reduce or eliminate the hump in the lag on cost, we constrain the elasticities to ranges of .25 on either side of the desired values of unity and zero. Since the unconstrained elasticities are already very close to the ranges, these constraints would make little difference. However, the interpolation points are months one, six, and twelve for the cost lag, and months one, twelve, and twenty-four for the output lag. It can be seen from the plusses that the sixth and twelfth months of the cost lag have negative weights, as does the twelfth month of the output lag. The constraints can therefore be expected to have a ponderable effect.

The second page of plots for industry 62 is denoted BASIQ rather than BASIC to indicate the use of quadratic programming. The constraints were quite successful. The exaggerated hump in the cost lag was cut in half and the enormous first-month effect was also, but the intercept and the two elasticities were hardly affected. The residual variance rose by 50%, from 19.4% of the original variance (RBARSQ = .806) to 27.4% of it (RBARSQ = .724). This loss in explanatory power is compensated by the improved structure of the lag on cost. The constraints on the cost lag are clearly binding. The sum is up against its ceiling and the sixth and twelfth interpolation points are both zero. By contrast, the output lag is just inside its constraints. It can also be seen that although the cost lag's interpolation points are all non-positive, the interpolated lag dips negative and creates an overshoot in the accumulated distribution.

A third page of plots presents the results of changing one constraint, the lower limit of the range for the output elasticity from -.25 up to zero. This is a way of testing the strength of the negative elasticity. The quadratic programming guarantees that the constraints will be satisfied. Both lagged distributions are completely changed in the process. But the residual variance is greater that the original variance so the RBARSQ goes negative. The loss in fit says that the negative elasticity with respect to output is necessary to explain the historical price movements.

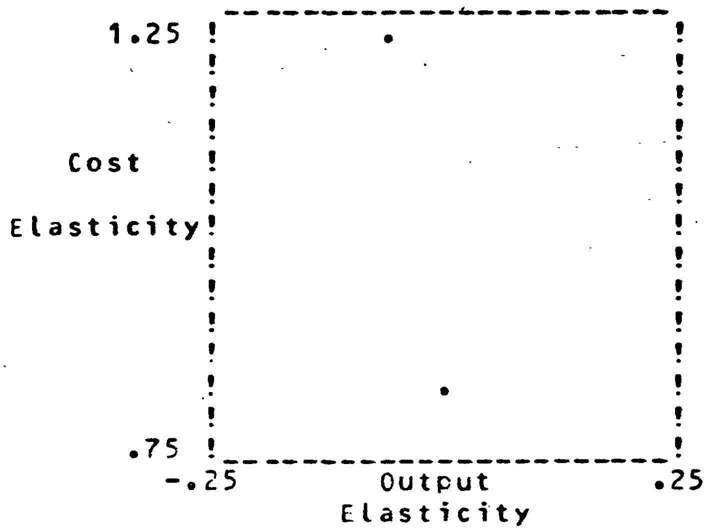


Figure 5. Plot of Equation Based on the End-points of the Data for Plastics Materials and Resins.

The elasticities hold approximately to a relationswhip determined by the end-points of the time series. From the beginning observation to the last one, the unit cost, output and price indices increase as shown:

Table 1. End-Points of Data for Plastics Materials and Resins.

	January 1956	June 1974	Increase
Unit cost	.990	1.279	.289
Output	.345	2.208	1.863
Price	1.153	1.396	.243

The three increases form the equation $.289C + 1.863Q = .243$, where C represents the sum of the cost lag and Q the sum of the output lag. Figure 5 shows the combinations of lag sums which satisfy this equation based on end-points, and the box within which the sums were required to lie by the constrained estimation.

The best choice for Plastics Materials and Resins is the constrained version with the wider range. The fit is fair. The loss of fit as compared with the unconstrained regression is more than compensated by the less wild cost lag. The cost elasticity of price must be constrained. The output elasticity of price is definitely negative, corresponding to the introduction of new products and processes and the economies of scale reaped by a relatively young industry. The attempt to constrain the output elasticity to be positive assures the strength of its sign.

The Plastics Materials and Resins industry has been discussed in great detail so as to introduce all the notions which are here being used to analyze the historical experience and estimate price equations. Although we have not made exhaustive test of differing lengths for the two lags, the equation for the Engines and Turbines industry was estimated sixteen times with various combinations to see what happens to the fit, the intercepts and the elasticities.

Table 2. Various Lengths of Lags Tested for Industry 102, Engines and Turbines

Fit (RBARSQ)		Length of Lag on Unit Cost			
		6	12	18	24
Length of	6	.973	.975	.981	.985
Lag on	12	.975	.976	.982	.986
Output	18	.979	.979	.981	.985
	24	.983	.983	.983	.986

Elasticity of Price with respect to Unit cost					
Length of	6	.821	.787	.738	.700
Lag on	12	.795	.787	.734	.693
Output	18	.751	.752	.739	.694
	24	.712	.711	.719	.712
Elasticity of Price with respect to Output					
Length of	6	.128	.130	.132	.129
Lag on	12	.131	.130	.135	.135
Output	18	.135	.135	.132	.134
	24	.137	.137	.132	.127
Intercept					
Length of	6	.060	.094	.142	.181
Lag on	12	.086	.094	.145	.186
Output	18	.130	.129	.141	.184
	24	.170	.171	.163	.169

The table shows a strong uniformity. The fit, as measured by RBARSQ, varies between .972 and .983; the elasticity on output, between .217 and .227; the cost elasticity shows more response, varying from .69 to .84, but it never comes close to unity. There is a pattern to the results that can be seen in the table of cost elasticities, especially. Increasing the assumed length of either lag generally reduces the estimate of the cost elasticity. This phenomenon is evident on the diagonal of the table, for the cases of equal lag lengths. Similarly small effects can be found in cases where the fit is not so good. For the rest of the industries, the results will be presented in groups, with tables and plots, accoring to two schemes: 1) the measure of forcing required to get acceptable characteristics; and 2) the characteristics of the price equations.

4.2. Broad Brush: How Much Forcing?

Of the 185 industries in the model, there are forty-eight for which no price equation was estimated. Eleven of these are industries to which the idea simply does not apply, such as imports of commodities not available in the United States. The other thirty-seven are cases of missing data. Price equations were estimated for 137 industries. The four types of estimates described on page 23 were applied according to the rules laid down. The results of this selective process are summarized as follows:

Table 3. Frequency of Choice of Each Type of Estimate

RBARSQ:	Less than 80%	50% to 80%	Less than 50%	Total
BASIC	16	2	0	18
BASIQ	67	12	17	96
SLIM	7	4	2	13
RISING	4	3	3	10
Total	94	21	22	137
Equation not estimated				48
			TOTAL	185

It is obvious from Table 3 that BASIQ is the mainstay of our equations. In eighteen cases the unconstrained BASIC form produced as acceptable a result as the other three. In thirteen more, SLIM constraints improved the shpaes of the lags without great loss of fit. And in ten cases, the sum of the output lag could be forced from negative values up to zero without great loss.

The long Table 5, which begins on page 78, summarizes the results of the search for each industry. For each successive estimation that was tested for an industry, the goodness of the fit, the intercept, and the two elasticities are displayed. The best choice for each industry is preceded by an asterisk. Table 4 is the index to this longer table, listing the numbers of the industries according to the frequencies of Table 3.

Table 4. Best Choices

BASIC	16, 25, 59, 66, 68, 79, 83, 92, 93, 95, 97, 100, 103, 105, 109, 110, 113, 167
RISING	2, 5, 13, 33, 42, 47, 51, 75, 81, 94
BASIQ,RBARSQ>.8	21, 23, 24, 26, 27, 28, 29, 31, 32, 34, 35, 36, 38, 39, 40, 43, 44, 45, 46, 48, 52, 61, 67, 69, 71, 73, 76, 77, 78, 80, 82, 84, 85, 90, 96, 98, 99, 101, 102, 104, 108, 112, 115, 117, 121, 124, 130, 131, 133, 138, 139, 145, 146, 147, 148, 150, 151, 155, 158, 160, 166, 168, 170, 171, 173, 175
BASIQ,.8>RBARSQ>.5	5, 14, 22, 37, 41, 62, 64, 65, 74, 116, 120, 122, 123
BASIQ,.5>RBARSQ>.0	4, 17, 55, 63, 72, 86, 87, 111, 119, 125, 126, 149
BASIQ,.0>RBARSQ	50, 114, 128, 152, 162
SLIM	1, 3, 7, 11, 15, 49, 60, 98, 129, 161, 165, 174
Missing Data	6, 8, 10, 12, 19, 20, 53, 54, 56, 57, 58, 70, 89, 106, 107, 127 132, 134, 135, 136, 137, 140, 141, 142, 143, 144, 153, 154, 156, 157, 159, 163, 164, 169, 172, 176
Concept Inapplicable	9, 18, 177, 178, 180, 181, 182, 183, 184, 185

The equation for industry 25, Canned and Frozen Food, illustrates the BASIC equation. The fit is good; the cost lag rises smoothly to a final value of 1.06; the output lag reaches its maximum value in five months, then dips and rises eventually to .07. The dip prior to the end is not suggested by any theoretical consideratons (see page 13); on the other hand, it seems to indicate that the lag is not really twenty-four months long.

Industry 5, Grain Farming, has nearly as good a fit under the restrictions of a RISING cost curve as in the BASIQ estimation of the equation. Under this form, the output lag completely disappears.

Industry 24, Dairy Products, has a good fit to the BASIC assumptions and the sums of the lags are within the required ranges. However, the strongly negative response of price for two years after an increase in output raises a question. The constrained estimation (BASIQ) almost totally eliminates the negative values and the fit is hardly affected. Here the constraints are merely to change the shape of the lags.

The more common need of the BASIQ estimation is exemplified by industry 35, Fabric. Unconstrained, the cost lag rises to 1.71, but constraining it to 1.25 causes only a modest drop in the RBARSQ, from .95 to .93. The adjustment in the intercept, from -.94 to -.43 protects the fit.

Finally there are several cases that strongly support the narrower constraints (SLIM), industry 161, Natural Gas Utilities, for instance. Unconstrained, the lags sum to a very low .28 for cost and a high .35 for output. Constraining them by BASIQ drives the RBARSQ down from .93 to .90. However, the output lag goes negative during the early months. Since it rises to .18 at the end, a value outside the SLIM range, narrowing the range will lead to a different result. In fact, SLIM inverts the shape of this lag; the RBARSQ then falls to .88. SLIM is the best choice.

4.3. Characteristics of Price Responses

Table 6, found on page 94, groups the 137 equations which were selected into classes based on the estimated elasticities. Each elasticity is assigned to one of five categories;

1.) constrained at the lower limit;

2.) unconstrained, but below the immediate neighborhood of the desired value;

3.) in the immediate neighborhood of the desired values - 1±.05 for cost and 0±.05 for output;

4.) above the immediate neighborhood, but not against the upper constraint; and

5.) constrained at the upper limit.

The combinations for the two elasticities yield twenty-five classes. The discussion will follow the order of the classes, and refer on the one hand to Table 5, which begins on page 78 and summarizes the several estimations for each industry, and on the other hand, it will refer to the plot of the best choice. We will name the principle product or service covered by the equation rather than stick to the often stilted names which are necessary to be most precise. The first mention of an industry will include in parentheses the number that the industry bears in all the tables, plus two page references, one to the summary of the regression results and the other to the plot.

Class 1 (page 94) includes four industries whose elasticities tend to be lower than we allow. A cost elasticity of .75 says that the ratio of price to cost has been steadily eroded during the historical period, while the output elasticity indicates a decreasing cost industry. Alcohol, bearings, appliances, and TV's make a motley collection and only alcohol achieves a good fit. None is an obvious guess for a decreasing cost industry. The BASIC estimate for alcohol (#30: 80,161) would have passed through only 50% of costs, but shows a weaker degree of decreasing costs in that the output elasticity was -.09. Foreign competition is the likely explanation for the implied decline in profits per unit of output. We have constrained the cost elasticity up to 75% so as not to grind the profit margin down to nothing in the long-term simulations; however, we have to accept the unlikely output elasticity as the compensation. The equation for appliances (#123: 90,301) has a reasonable fit, considering the fact that the price has no time trend. (The lack of a time trend is evident from the small difference between RBARSQ and RTSQ.) The much better fit of the BASIC estimate is tempting, especially in light of the small difference between the elasticities and the intercepts. The RISING-cost estimate costs us so much in fit as to convince us that the data indicates decreasing costs for the manufacture of appliances. The equation for TV's (#125: 90,305) has a poor fit and the strongly negative output elasticity cannot be raised close to zero without a much poorer fit. The BASIC estimate achieves a good fit by saying that costs do not affect price, that for 1967, when the output index stood at 1.00, price was .95 (the intercept minus the output elasticity) and that for every three-point increase in the output index, price falls one point. But the time trend of the historical price gives a much better fit. At any rate, we will not accept an equation which leaves the ratio of price to cost adrift. The BASIQ equation is suspect, both for the nature of the unconstrained estimates and the indication of decreasing costs. The poorest fit in the class is the equation for bearings (#111: 88,281). A good fit to the BASIC estimate had to be sacrificed to pull the output elasticity out of the pit (-.62). Another such sacrifice would have been required to obliterate the simulation of decreasing costs, and so we cut our losses. In summary, the data for bearings and TV's is suspect. Alcohol manufacturers are definitely having trouble passing along cost increases, and appliances give strong evidence of a falling cost curve.

The next class, Class 2 (page 94) contains only the equation for Industry 99, Miscellaneous Fabricated Wire Products (#99: 87,264). The price of this industry has tended to fall relative to costs during the historical period. And the output elasticity indicates decreasing costs, though this seems strange. The choice of BASIQ over the other two is not obvious. It was preferred over the unconstrained version simply to hold the line on the output elasticity, though the difference between -.31 and -.25 is not great, and it was preferred over RISING because of the effect on the cost elasticity, though RISING seems about equally desirable.

The two equations in Class 4 (page 94) also are estimated as decreasing cost industries. Like all of the preceding cases, the output lag rises ever so slightly positive during the first year before it takes the plunge. This behavior is the necessary result of the interaction of two facts: that the lag weights for months one and twelve are restricted to non-negative values, and the lag sum obviously is negative. Both the equation for refineries (#69: 84,221) and that for generators (#120: 89,297) say that more than 100% of costs have been passed through to price. In each, the unconstrained estimates produced an unacceptably high cost elasticity coupled with an unacceptably low output elasticity. The relationship between the elasticities (see page 48) then allows us to correct both by applying the BASIG constraints. In these two cases, it is the cost elasticity which satisfies the constraints first, so to speak, so that when the output elasticity has been forced within range, the cost elasticity is not against its limit. The cost lag for refineries rises up to 1.52 in the first five months before falling back to its final level. The apparent meaning is that the industry always over-reacts to an increase in costs, and then adjusts downward. If the price were measured at retail, then we could accept this as the behavior of gasoline stations, but since it is the wholesale price which is the dependent variable, we must observe that the step-like movement of price as measured has created a statistical illusion of over-shooting. The cost in terms of fit of forcing the output elasticity up to zero is modest. However, RISING turns upside down the conclusion about passing through of costs. We choose to accept the indication that refineries operate on the decreasing portion of their industry-wide average cost curve, and pass through 115% of cost increases. The over-shooting is not a feature of the equation for generators (#120: 89,297). RISING suffers such a loss in fit, compared to BASIQ, that the decreasing costs must be considered a feature of the industry; for generators it is not unbelievable.

Two classes out of a possible of five with the output elasticity constrained at its lower limit are empty. They are the one with roughly 100% pass-through of costs and the one with pass-throughs larger than we allow. This second empty class might gain a member if the BASIC estimate produced too high a cost elasticity and too low an output elasticity. Generators appeared to be such a case, but the constraints, when applied, were not both binding. Industry 5, Grains, also could have been, had not the RISING-cost version produced a good fit. At any rate, the first three classes include the equations with the most negative output elasticities. Steady economic growth in the forecasts will work through these equations to hold prices down. Alcohol and refineries are large industries which have heavy weights in the computation of consumer and wholesale prices.

The next five classes also contain equations with negative output elasticities, though not so strongly negative as the ones just discussed. The first of them, Class 6 (page 94), includes a baker's dozen cases of minimum cost pass-through. Rugs, or "Floor Coverings" as we call it (#36: 81,172), had an even smaller cost elasticity according to the unconstrained estimate. With a small loss in fit and a miniscule change in the output elasticity, the cost elasticity was brought up to .75. The attempt to force the output elasticity positive drove the RBARSQ negative; BASIQ is the best choice. The same description applies to knitting mills (#38: 81,176), nylon (#65: 84,213), and the manufacturers of air conditioners and commercial appliances (#116: 89,290). The equation for air conditioners exhibits the over-shooting discussed in connection with refineries, and we speculate the same explanation. The other equations just mentioned all have cost lags in which the upward movement in temporarily arrested; we offer no particular interpretation of this quirk. Basic chemicals (#55: 83,201), rubber (#63: 84,209), and transformers (#119: 89,295) have a very similar pattern, also. They differ in that the loss of fit is not so small as with the others, and the output elasticity requires more of a fall to offset the increase in the cost elasticity. Autos (#133: 90,315) and watches (#146: 91,322) differ only because the output elasticity was greater than -.10, so that RISING was never tested.

In this class only four equations differed from the pattern of that for rugs. Computers do not fit our equation at all, and we had to accept a highly negative RBARSQ in order to produce an equation with which to simulate and forecast; the result happened to fall within this class. Pencils (#149: 91,328) and real estate (#168: 93,348) each call for a positive response to output according to the unconstrained estimate, but the constraints flip the sign negative; the latter has a special problem of its own, that the early months of the cost lag see a negative response in price. Finally we have the electric utilities, which gets a cost elasticity lower than is acceptable until we constrain it. The decline in the output elasticity just about equals the rise in the cost elasticity. RISING produces a good fit, but in light of the commonly accepted notion that the utilities operate in the range of declining costs, we have retained the BASIQ form of the equation.

Several of the industries in this group are quite large, knitting mills, chemicals, computers, air conditioners, and of course autos, utilities, and real estate. Their role in a period of both inflation and industrial growth will be to counteract the rise in prices, according to the equations which we have deemed "best choice".

Class 7 (page 95) is also characterized by less than full pass-through of cost and negative output elasticities. Iron ore (#11: 78,135) especially, and also primary aluminum (#87: 86,248) both fail to turn up a good fit. The equation for iron ore is completely wacky until it is constrained; it has a negative elasticity with respect to cost. Even when constrained, the cost lag still dips negative at the beginning. Aluminum, by contrast, has offsetting errors in the unconstrained version, and though the fit is weak, it is not harmed much by lowering the cost elasticity and raising the output elasticity. The equation for crates and boxes (#44: 82,186) is excellent. Fertilizers (#59: 83,204) will use the unconstrained estimates. It is also the first case we have come to in which the output variable performs according to the expectation. The hump up to a high point of .39 corresponds to the movement up S in figure 3, on page 14. The cost lag is a "high flyer", rising off the top of the page to a momentary height of 1.90 before falling to .76. Drugs (#66: 84,216) also uses an unconstrained equation. Because the output elasticity was so low, we tried to force a RISING cost curve, but the fit evaporated. The final member of this class is electric meters (#118: 89,293). It is the first use of the SLIM constraints, which were accepted in place of the unconstrained form because it moved the elasticities closer to the values of one and zero with little loss in fit; the BASIC equation is clearly a good alternative.

Our first example of a cost elasticity in the immediate vicinity of one is the equation for welding equipment (#122: 89,300). The output elasticity is strongly negative. Although the telephone company (#158: 92,337) fell over the border into the next class, its elasticities are remarkably similiar. Both these industries will simulate so as to reduce the inflationary pressures of an expansion in output, and they will neither add to nor detract from the price hikes in their inputs.

Three good equations constitute Class 10 (page 95), the last class for which the output elasticities are well below zero. Fats and oils (#32: 80,166), plastics (#62: 83,208), and asphalt (#71: 84,223) all tend to raise price more than the stimulating increase in cost. Especially with asphalt, the BASIC form yielded a very high cost elasticity, with an unacceptably low output elasticity to match it. This group of equations will work against itself in a period marked by both inflation and growth. Inflation will work through the cost lag to drive prices higher, while growth in output will work through the output lag to depress prices.

The next five classes in the order of Table 6 all meet our expectations concerning the elasticity with respect to output. In one third of these industries, the chosen form was that in which we forced RISING costs. Since all of the RISING-cost equations are cases in which the output elasticity would otherwise have been less than -.1, the constraint was binding and the output elasticity becomes zero. It happens in several cases that the forcing of the sum of the output lag drives the whole distribution to zero, so that the final form is effectively a relationship between price and cost.

For fourteen industries, the cost elasticity is against its lower constraint of .75 (Class 11, on page 95). The BASIC equation for the chicken was most unacceptable, passing through only 36% of cost increases and reducing price 55% of a point for every one point increase in output. The price of both broilers and eggs moves sharply in response to production, as firms move in and out of the industry, and the equation has recorded that. Furthermore, the ability to pass along increases in cost will be good when prices are rising after an exodus of firms, and poor when prices are falling because of excess capacity. But the lag sums, which confirm this behavior, will be used in forecasting as long-term elasticities. In that context the cost lag signifies a rapidly declining rate of profit, and the output lag terrific economies of scale. The form given by RISING still indicates a difficulty in passing along costs, and the output lag's sum of zero agrees with the view that there are no economies of scale to the industry as a whole; chicken farming is one industry in which the expected shape of the output lag (shown in Figure 3 on page 14) should have been borne out. The price of non-ferrous ores other than copper (#13: 79,137) should cover aluminum, lead, zinc, tin, and the precious metals; actually it is based only on mercury. Therefore it is not used in the simulations and will not be given any more attention here. Felts, tire cord, embroideries, rope and similar products (#37: 81,174) all come from an industry whose equation exhibits our ideal lag on output. Even unconstrained, the output elasticity was estimated to be zero. The constraints swapped the intercept for the cost elasticity with no sacrifice in fit. Very much the same is true for rayon (#64: 84,211) and soaps (#67: 84,217), while the equation for cameras and film (#145: 91,320) requires a greater adjustment in the estimate of the output elasticity but also produces similar characteristics; the negative weights in the cost lags for soaps and cameras could not be cured by any of the four estimates which we are using. The only other equation yielding an output lag with a camel's hump is that of plywood (#42: 82,182). In this case, the output elasticity was estimated at -.37, unconstrained. To bring it up to the bottom of the allowable range caused the cost lag to drop from 19% excessive pass-through to the level of a straight-forward pass-through of costs. But the RISING-cost form moved the output elasticity the rest of the way to zero, giving the pleasing shape and requiring only a modest loss in fit; it also flipped the cost lag, which now implies a falling margin for profit.

The remaining equations in this class (11) all remove the output variable from the regression by making the entire distribution flat. While this agrees with our expectation for the long-run, it says that there is neither any short-run response. Paper (#48: 82,194), mobile homes (#139: 91,318), toys (#148: 91,326), and buttons and brushes (#150: 91,330) all achieve good fits with acceptable cost lags. Converted paper products, labelled "Wall and Building Paper" (#50: 83,197) but consisting largely of paper bags and wrapping paper, has an equation which looses all its explanatory power as soon as we lift the rate of pass-through of cost from 10% to 75%. The equation for tires has a very modest fit. The final equation is for luggage (#77: 85,232), the good fit of which is marred by the negative values in the cost lag for the initial seven months.

The eleven industries in Class 12 (page 96) also have output elasticities of zero, and less than complete pass-through of costs, though the cost lag's sum is not constrained. Six of them achieve the expected output elasticity only because they are forced to by the RISING-cost form of the estimation. Of these six equations, that for peanut butter (and other processed foods) (#33: 81,167) exhibits a healthy short-run response to output changes. The same could be said for boxes (#51: 83,199) and oncrete (#81: 86,238), which both have good fits, but it is less true for industrial controls (#121: 89,298) with its cantancerous cost lag. Both wood pulp (#47: 82,192) and plumbing and heating equipment (#94: 87,256) lose their output variables because of the RISING-cost constraints, but the loss of fit thereby is small. In two cases, batteries (#129: 90,311) and banking (#165: 92,344), the SLIM constraints have been adopted; the cost elasticities lay further from the SLIM range than the output elasticity in each case, so that to bring the cost lag up drove the output lag to zero., with little loss in RBARSQ. (The dependent variable in the case of banking rests mistakenly on the index on mortgage interest rates, although it also includes the service charges for checking accounts, both taken from the Consumer Price Index program. Our equation is irrelevant to the explanation of an interest rate.) The last three equations in this class all were fitted in their BASIC form, and it can be claimed that they all exhibit, besides excellent fits which are not attributable to time trends, the desired short-run and long-run properties of the output lag. The camel's hump has turned snake-like in the equation for metal barrels (#93: 87,255); the cost lag for pre-fabricated metal structures (#95: 87,258) is a "high flyer"; and as could be expected, the equation for "owner-occupied dwellings" (#167: 93,347) is wild.

Class 13 (page 96) is the one which fulfills our expectations of full pass-through for costs and an output lags which generates constant returns to scale. Unfortunately, only two equations fell into it. Both have excellent explanatory power. The equation for pipe fabricators (#100: 87,266) is used without constraints. Its cost lag rides a roller coaster, for which we have no interpretation, and its output variable gets only the weakest response. The equation for the manufacturers of x-ray equipment (#131: 90,314) has better characteristics. BASIQ produces only a small over-shoot in the cost lag and the output lag rises to a modest height, though it takes sixteen months to reach the turning point. Both these equations will simulate prices so that nothing is added to the existing stimulus to inflation. Costs will be transmitted but not augmented while the growth in output will add to price temporarily, but the effect will be gone by the end of two years.

The five equations in Class 14 (page 96) pass through more than 100% of any increase in cost. That for ammunition (#21: 79,147) is quite close to the equations in the classs just discussed. The constraints were applied in order to force positive the first few weights in the cost lag of the BASIC estimates, which are not shown but which were negative. The constraints had little other effect. The only one of the five which failed to do better than a simple time-trend was the equation for pesticides (#60: 83,205). Like ammunition, the output variable tends to be inconsequential. The SLIM constraints greatly reduced the estimated cost elasticity with only a modest loss in the fit. Unconstrained, each of the two lags was too active. The equation for abrasives and other mineral products (#82: 86,240) produced a good fit for the BASIC form, but the output variable's lag was negative from the first month. BASIQ yielded almost the same elasticity, but forced the lag to be positive. Lead (#85: 86,245) gives the most satisfying result of the class. Its output lag is a camel's hump and its fit is excellent. Its cost lag starts off immediately with a value nearly half of its final level;it over-shoots. The equation for copper wire (#90: 86,251) is quite similar, down to the way the BASIC estimation of the output lag begins with negative values. All five of these equations will aggravate any simulated inflation.

The last class with output elasticities near zero, Class 15 (page 96), contains two equations, both using the RISING estimates, and both with cost elasticities constrained by the upper limit. In the case of grain (#5: 78,133), the output plays no role whatsoever. This is hardly surprising, since the data are interpolated annual series which could not yield any information about the short-run behavior. In fact, the output of grain is an annual phenomenon, while the fluctuation in its price is observed in the markets for wheat, corn, and soy futures. The missing hump is to be expected. The sum of zero tells us that grain is grown according to constant returns to scale. The tanning industry (#75: 85,230), on the other hand, responds strongly in the short run to rising output. Unconstrained, the estimates are wild. The BASIQ constraints flip the output elasticity from .62 to -.21 while reducing the RBARSQ only four points. RISING trims another four points from the fit to give us an equation with no long-run effect due to output.

The eight industries in Class 16 (page 97), like all of the rest, will be simulated with equations having output elasticities greater than .05 and therefore implying increasing costs and decreasing returns to scale. The equation for sulphur and potash mines (#17: 79,145) yields a comparatively high RBARSQ when unconstrained, but the negative elasticity on cost is unacceptable. The constraints drive the RBARSQ from .71 to .19, but achieves reasonable elasticities. It is obvious that the feature of the data leading to the negative cost elasticity is still active in the negative weights during the first four months. SLIMer constraints could not cure this dip, and the BASIQ form was adopted; the output lag has a tall camel's hump. The equation for soft drinks (#31: 80,163) fits the data well, and although the BASIQ constraints will be used, they make little difference to the results. There is less-than-full pass-through of costs, a strong short-run response to output, and long-run decreasing returns to scale. The millwork equation (#43: 82,184) shows a very quick response to changes in output which is complete after eight months. The constraints have effected a trade-off between the long-run impact of the two variables with little change in the fit, which is excellent. The equation for household furniture gives a good fit. The output lag insists on mildly negative values in the first year, but they are best thought of as zero, so that the lag says the response does not arise until a full year after the change in output; then it accumulates quickly to a rather high figure of .23. The cost lag rises steadily to the lower constraint. The thousands of plastics products (#74: 85,227) present the same problem as Industry 17, just mentioned. The constraints are required in order to get a reasonable elasticity on cost, but the cost lag dips negative and SLIM will not cure it. The output lag traces a modest hump, with a final figure almost the same as soap (#67: 84,217), luggage (#77: 85,232), and toys (#148: 91,326). Engines (#102: 87,268) is a heavily capitalized industry which would not likely operate at constant returns to scale. Our equation for it says also that costs are not fully passed through. The constraints are applied to lift the cost elasticity from .71 to .75, with little effect on the other characteristics of the equation. Typewriters (#115: 89,288) is another case with a negative dip in the cost lag which SLIM does not cure. The constraints lift the cost elasticity notably, and the output elasticity, little affected, is high; the fit appears to be excellent, but the RTSQ shows that it is partly due to a time trend in the price. Our equation draws reasonable elasticities from the consumer price index for passenger rail fares (#151: 91,332) without constraints, although BASIQ is the estimate we will use. The SLIMer range costs us so little in fit as to suggest that both elasticities may be closer to their "ideal" values than we assume. The output lag is slow to begin, like that for furniture; that railroads appear to operate in a range of rising costs is not surprising, once we recall that the large cost fixed in track is excluded from the cost variable and that the industry's labor, the cost of which is included, is highly unionized.

The dozen industries of Class 17 (page 97), like the previous eight, exhibit rising costs and less-than-full pass-through of cost increases, and they include six of the largest industries in the stuoy. The RBARSQ's are generally quite high, though only half get their good fits without the help of a time trend. A characteristic feature is a dragging lag on output, such as in the equation for raw milk (#1: 78,126). Here the RTSQ is .19 when the equation is fit without constraints, but the output elasticity is very strange. The plot is not included to be seen by the reader, but it takes a strongly negative course down to -1.3 in the eighth month, and then rises back up to zero and finishes, as can be seen in Table 5, at +.40. The BASIQ estimate controls this lag without requiring a notably different lag on cost, and with only a modest loss in the RBARSQ. But the output lag still dips negative. SLIM constraints makes only a modest improvement and was adopted because it moved the elasticities closer to our ideal values without a loss in explanatory power. Six other equations share most of these characteristics with that for raw milk: livestock (#3: 78,130), crude oil (#15: 79,141), meat (#23: 79,150), cigarettes (#34: 81,169), office furniture (#46: 82,190), and hardware (#98: 87,262). Together, they include a third of all cases in which SLIM constraints were preferred. All suffer from output lags that want to make output a measure of supply, that is, with a negative direction. The fit for three is good, for cigarettes it is modest; for livestock, nearly non-existent; and for oil, abysmal. Gas utilities are also in the same category, differing only in that the SLIM estimation flips the output lag over, so that it acts like a measure of demand. Judging by the small reduction in RBARSQ, the unconstrained version might just as well have said the same thing. Clay mines (#16: 79,144) and bricks (#79: 85,236) are both found in this class. Their snake-like lags on output differ in that the one for the mines takes on negative values while the other does not. The final values are close, as are the fits and the shape of the cost lags. Only two out of the twelve have output lags with camel-humps. Lights (#124: 90,303) turned up negative values in the early months of the output lag, but the BASIQ constraints fixed it. Flour (#26: 80,156) offers the prettiest picture of the lot. Milk, livestock, oil, meat, flour, cigarettes, and gas are all large industries. Our simulations will incorporate the lesson learned by regression analysis from the history, that these industries fail to pass along cost increases but that their prices rise with output.

Four of the six equations in Class 18 (page 97) were estimated by BASIC, our unconstrained form. All of them have excellent RBARSQ's, strongly rising costs, and 100% pass-through. Airlines' equation belongs to the group of supply-oriented output lags like raw milk; the constraints cannot fix it. Sheets and towels (#40: 81,179), cans (#92: 86,253), stampings (#97: 87,261), elevators (#105: 88,274), and pumps (#110: 88,280) have output lags which move quickly toward their final levels. In only two of the six does the cost lag over-shoot its long-run elasticity.

Class 19 (page 98) contains three more industries in which SLIM estimates were chosen. Converted paper (#49: 83,196) belongs with raw milk, but the equation for movies (#174: 93,355) suffers from the opposite problem. The output elasticity rises to 2.99, unconstrained. If the RBARSQ had not indicated that the SLIM version is just as explanatory and the BASIQ one, we would have taken the output elasticity to be .25; instead, this is the only service industry for which that is not true. Fruits and vegetables (#7: 78,134) has a true camel's hump with or without the constraints, but the elasticities are not within bounds to begin with; again, the SLIM fit is almost as good as the BASIQ fit. Canned food (#25: 80,155), bread (#27: 80,157) and steel (#83: 86,242), besides being all very large industries, have cost lags that rise like arrows to generate more than 100% pass-through of costs, and creeping, crawling output lags with modestly rising costs; their fits are good. Finally, in the case of springs (#101: 87,267), the elasticities are impervious to our constraints, and so is the negative wrinkle at the beginning of the cost lag.

Class 20 (page 98) is the last one in which the output elasticity is not constrained; the cost elasticity is against its upper limit. Which are they? Mostly a set of staples, sugar (#28: 80,158), fabric (#35: 81,171), turpentine (#61: 83,206), molded and foam rubber products (#73: 85,226), glass (#78: 85,234), pottery (#80: 85,237), and locomotives (#138: 91,317). Only rubber presents a slight problem with negative values. Sugar and fabric are real camels. The other four have sedate output lags, while all except locomotives have kinky cost lags. None has an RBARSQ below 80%, but sugar and turpentine have RTSQ's in the neighborhood of 65%. The whole set will contribute to any inflationary tendancies.

Class 21 (page 98) is a truly ridiculous one. These equations are brought together by their steeply rising costs and falling profit margins. But of the eqight equations, only one performs better than a time trend. That is candy (#29: 80,159), whose slight dip negative is the remnant of the gorge that was filled in by the constraints. The case of electronic components is clearly special. The equation gives a good fit with an output elasticity of near zero and a cost lag which passes along only 19% of increases in cost. For the simulations we want a decent pass-through, so we force the cost lag to sum to .75. Strange to say, that forces the output elasticity against its <u>upper</u> limit. The constraints work on the two elasticities of the equation for busses (#152: 92,334) in a similar way. The remaining equations can all be characterized as follows: unconstrained, the cost elasticity is too low and the output elasticity is too high; the constraints trade the one for the other. For small arms (#22: 79,148) and tools and dies (#108: 88,275), the trade-off did not affect the fit very much; for zinc (#86: 86,246), records (#126: 90,307) and water utilities (#162: 92,342), the fits grew much worse.

Two equations achieve good fits with unconstrianed cost lags, and constitute Class 22 (page 98). In the case of milk and ice cream (#24: 80,152), the lag on output has a negative portion which our constraints will not reverse. Farm machinery (#103: 88,271) uses an equation fit altogether without constraint, even though the output lag sums to .26; this is the one exception to our rules. Both these industries are characterized by their equations as operating on the rising portions of their long-run average cost curves and suffering a declining profit share since cost increases have not been passed through to price.

Five industries, Class 23 (page 99), have full-cost pricing, among these five classes with the high output elasticities. The lags in the equation for cotton (#4: 78,131) have a reasonable shape, once the BASIQ constraints are applied; the fit is quite poor. The unconstrained equation for apparel (#39: 81,178) produces an estimate of the output elasticity of .35. The BASIQ version dips negative, and again, the SLIMer limits do not help; a good measure of the excellent RBARSQ is attributable to the time trend. Paints (#68: 84,220) will be simulated with the BASIC, unconstrained estimates. The equation for tin, titanium, the precious metals, et cetera (#88: 86,250) has a modest fit and a kinky cost lag, but its output lag exhibits the strong short-run response followed by a smaller long-run elasticity. Construction machinery ends up with an equation embodying a smaller output elasticity than that of the unconstrained estimate, but the fit is hardly affected. For the strange haitus in the rise of the cost lag is we have no explanation.

Class 24 (page 99) with four industries consists of those have regularly been able to mark up price more than the increase in costs, and add to the margin of profit per unit of output. Shoes (#76: 85,231) has an equation which tends toward a very high cost elasticity. Once constrained, it crawls along at zero like a crab for the first year; the good RBARSQ includes a modicum of help from a time trend. The measures of fit are even better for special-industry machinery (#109: 88,278), which makes machinery for food processing, textiles, paper, printing, and many other industries. The cost lag starts slowly, and the monthly increments die out; but the same can unfortunately be said for the output lag, which is therefore missing its camel's hump. The output lag for clutches (#112: 88,283) is quite similar, but the cost lag is rising more sharply at the end than at the beginning, due to our forcing the equation to yield a higher cost elasticity as a compensation for a lower output elasticity. The RTSQ is not nearly so good as the RBARSQ, indicating a significant time trend. The goodness-of-fit measures for spark plugs and distributors (#130: 90,313) is the same as for clutches, and so is the necessity to force the cost elasticity up. The resulting lag on output has the opposite curvature.

The last of our twenty-five classes contains a baker's dozen of equations which will all intensify any simulations of inflation; they all mark up price 125% of the increase in costs and they all raise price in response to growth in output. The fits are quite good as measured by the RBARSQ, but every price series has a marked time trend, so that the RTSQ's are much lower. Five of the thirteen have camel-hump lags on output: lumber (#41: 82,181), insurance (#166: 92,345), business services (#171: 93,353), auto repair (#173: 93,354), and medical services (#175: 93,357). Three have output lags with upside-down shapes: industrial patterns (#113: 88,285), machine shops (#117: 89,292), and laundries (#170: 93,351). The remaining five equations turn up pedestrian lags on both cost and output. It is true of all equations in the class that the response in the early months of the cost lag is the largest of all, so that the lags are quite short in practice; these industries are most significant in the economy, coal (#14: 79,140), newspapers (#52: 83,200), and copper (#84: 86,244), also nuts and bolts

(#96: 87,259) and jewelry (#147: 91,325).

Table 5. Summary of Regression Results

Ind	Best	RPARSQ	RTSQ	Intercept	Cost	Output
1 Dairy Farm Products	BASIC	.75	.19	-.33	.86	.40
	BASIQ	.67	-.05	-.12	.82	.25
	* SLIM	.66	-.08	-.06	.90	.10
2 Poultry and Eggs	BASIC	.63	.64	1.30	.36	-.55
	BASIQ	.40	.41	.60	.76	-.25
	* RISING	.33	.34	.40	.75	.00
3 Meat Animals, Oth Livestk	BASIC	.87	.75	-.25	.71	.73
	BASIQ	.65	.30	.01	.81	.25
	* SLIM	.59	.19	.04	.90	.10
4 Cotton	BASIC	.48	.48	-1.49	1.03	1.15
	* BASIQ	.20	.20	-.02	.95	.25
5 Grains	BASIC	.75	.73	.15	2.86	-2.16
	BASIQ	.43	.40	.05	1.25	-.25
	* RISING	.40	.36	-.17	1.25	.00
7 Fruit,Vegetables,Oth Crops	BASIC	.83	.72	-.20	1.46	-.37
	BASIQ	.76	.60	-.35	1.25	.13
	* SLIM	.73	.54	-.17	1.10	.10
11 Iron Ores	BASIC	.09	-.24	1.18	-.12	-.03
	BASIQ	-.99	-.99	.54	.75	-.25
	* SLIM	-.99	-.99	.24	.90	-.10

Table 5. Summary of Regression Results (continued)

Ind	Best		RBARSQ	RTSQ	Intercept	Cost	Output
13 Other Non-ferrous Ores		BASIC	.15	.02	1.51	-1.48	.43
		BASIQ	-.09	-.26	.11	.75	-.20
	*	RISING	-.11	-.29	-.09	.75	.00
14 Coal Mining		BASIC	.92	.81	-2.07	3.09	.05
	*	BASIQ	.61	.11	-.32	1.25	.25
15 Crude Petroleum, Nat. Gas		BASIC	.60	.32	.32	.05	.75
		BASIQ	-.99	-.99	-.21	.75	.25
	*	SLIM	-.99	-.99	-.28	.90	.10
16 Stone and Clay Mining	*	BASIC	.99	.96	.11	.79	.12
		BASIQ	.99	.96	.11	.80	.12
		SLIM	.99	.93	.05	.90	.07
17 Chemical Fertilizer Mining		BASIC	.71	.54	.56	-.30	.70
	*	BASIQ	.19	-.30	.05	.75	.09
		SLIM	.03	-.55	-.02	.90	-.01
21 Ammunition		BASIC	.96	.78	-.01	1.05	.01
	*	BASIQ	.96	.73	-.02	1.07	.01
22 Other Ordnance		BASIC	.92	-.02	.04	.58	.47
	*	BASIQ	.77	-.99	-.01	.75	.25
23 Meat Products		BASIC	.95	.89	.01	.86	.14
	*	BASIQ	.95	.89	.02	.84	.15

Table 5. Summary of Regression Results (continued)

Ind	Best	RBARSQ	RTSQ	Intercept	Cost	Output
24 Dairy Products	BASIC	.99	.93	-.05	.88	.18
	* BASIQ	.99	.92	-.13	.89	.25
	SLIM	.98	.89	-.04	.95	.10
25 Canned and Frozen Foods	* BASIC	.99	.94	-.12	1.06	.07
26 Grain Mill Products	BASIC	.95	.91	.06	.66	.22
	* BASIQ	.95	.90	-.07	.80	.20
27 Bakery Products	BASIC	.99	.94	-.23	1.14	.09
	* BASIQ	.99	.94	-.24	1.15	.10
28 Sugar	BASIC	.85	.74	-.82	1.87	-.13
	* BASIQ	.80	.66	-.45	1.25	.19
29 Confectionery Products	BASIC	.90	.68	.08	.76	.25
	* BASIQ	.89	.63	.07	.75	.25
	SLIM	.88	.61	.04	.90	.10
30 Alcoholic Beverages	BASIC	.99	.96	.59	.50	-.09
	* BASIQ	.97	.88	.49	.75	-.25
	RISING	.37	-.99	.27	.75	.00
31 Soft Drinks and Flavorings	BASIC	.95	-.21	.07	.72	.12
	* BASIQ	.95	-.21	.05	.75	.11
	SLIM	.95	-.22	-.05	.90	.05
32 Fats and Oils	BASIC	.88	.81	-.11	1.21	-.10
	* BASIQ	.87	.80	-.17	1.25	-.09

Table 5. Summary of Regression Results (continued)

Ind	Best		RBARSQ	RTSQ	Intercept	Cost	Output
33 Misc Food Products		BASIC	.78	.59	.12	1.16	-.27
		BASIQ	.77	.58	.14	1.12	-.25
	*	RISING	.76	.55	.25	.79	.00
34 Tobacco Products		BASIC	.97	.70	.06	.90	.05
	*	BASIQ	.96	.64	.02	.85	.14
		SLIM	.96	.63	.01	.90	.10
35 Broad and Narrow Fabrics		BASIC	.95	.93	-.94	1.71	.23
	*	BASIQ	.93	.91	-.43	1.25	.19
36 Floor Coverings		BASIC	.90	.63	.60	.56	-.16
	*	BASIQ	.86	.47	.40	.75	-.18
		RISING	-.43	-.99	.27	.75	.00
37 Misc Textiles		BASIC	.53	.37	.44	.51	.00
	*	BASIQ	.52	.35	.18	.75	.00
38 Knitting		BASIC	.87	.66	.68	.54	-.23
	*	BASIQ	.83	.57	.46	.75	-.23
		RISING	-.30	-.99	.26	.75	.00
39 Apparel		BASIC	.94	.69	-.40	1.07	.35
	*	BASIQ	.91	.51	-.29	1.05	.25
		SLIM	.83	.12	-.22	1.10	.10
40 Household Textiles		BASIC	.91	.81	-.17	.98	.18
	*	BASIQ	.91	.81	-.20	1.01	.18

Table 5. Summary of Regression Results (continued)

Ind	Best	RBARSQ	RTSQ	Intercept	Cost	Output
41 Lumber and Wood Products	BASIC	.67	.69	-1.42	2.46	.02
	* BASIQ	.71	.32	-.41	1.25	.25
	SLIM	.63	.13	-.11	1.10	.10
42 Veneer and Plywood	BASIC	.72	.65	.19	1.19	-.37
	BASIQ	.70	.63	.28	1.01	-.25
	* RISING	.61	.51	.34	.75	.00
43 Millwork and Wood Products	BASIC	.99	.95	.22	.58	.22
	* BASIQ	.98	.92	.13	.75	.12
44 Wooden Containers	BASIC	.98	.84	.53	.68	-.15
	* BASIQ	.97	.77	.31	.79	-.06
45 Household Furniture	BASIC	.99	.91	.10	.64	.28
	* BASIQ	.99	.89	.04	.75	.23
	SLIM	.97	.78	.00	.90	.10
46 Other Furniture	BASIC	.99	.96	-.05	.95	.11
	* BASIQ	.99	.94	-.04	.92	.13
47 Pulp Mills	BASIC	.76	.68	.04	1.20	-.24
	BASIQ	.73	.64	.06	1.14	-.25
	* RISING	.68	.57	.19	.83	.00
48 Paper and Paperboard Mills	BASIC	.98	.94	.33	.60	.07
	* BASIQ	.97	.91	.22	.75	.02

Table 5. Summary of Regression Results (continued)

Ind		Best	RBARSQ	RTSQ	Intercept	Cost	Output
49	Paper Proucts, Nec	BASIC	.98	.91	-.26	1.21	.08
		BASIQ	.97	.89	-.27	1.21	.09
		* SLIM	.97	.88	-.18	1.10	.10
50	Wall and Building Paper	BASIC	.91	.84	.36	.09	.51
		* BASIQ	-.99	-.99	.36	.75	-.03
51	Paperboard Containers	BASIC	.97	.92	-.09	1.26	-.19
		BASIQ	.97	.92	-.08	1.25	-.19
		* RISING	.94	.85	.12	.89	.00
52	Newspapers	BASIC	.99	.77	-.76	.91	.90
		* BASIQ	.93	-.49	-.55	1.25	.25
55	Industrial Chemicals	BASIC	.78	.77	.78	.27	-.10
		* BASIQ	.34	.32	.38	.75	-.21
		RISING	-.99	-.99	.25	.75	.00
59	Fertilizers	* BASIC	.71	.63	.22	.76	-.09
60	Pesticides + Agric. Chem.	BASIC	.70	-.04	.47	1.84	-1.37
		BASIQ	.61	-.35	-.19	1.25	-.09
		* SLIM	.60	-.38	-.08	1.10	-.04
61	Misc Chemical Products	BASIC	.92	.67	-.79	1.68	.10
		* BASIQ	.92	.64	-.38	1.25	.15
62	Plastic Matls. + Resins	BASIC	.81	.53	-.09	1.28	-.27
		* BASIQ	.73	.34	-.08	1.25	-.23
		RISING	-.18	-.99	.25	.75	.00

Table 5. Summary of Regression Results (continued)

Ind	Best		RBARSQ	RTSQ	Intercept	Cost	Output
63 Synthetic Rubber		BASIC	.57	.57	.80	.31	-.11
	*	BASIQ	.31	.32	.42	.75	-.18
		RISING	-.99	-.99	.27	.75	.00
64 Cellulosic Fibers		BASIC	.70	.66	.46	.53	.01
	*	BASIQ	.66	.62	.24	.75	.00
65 Non-cellulosic Fibers		BASIC	.68	-.52	.57	.59	-.14
	*	BASIQ	.68	-.53	.42	.75	-.15
		RISING	-.15	-.99	.30	.75	.00
66 Drugs	*	BASIC	.79	.75	.30	.88	-.23
		RISING	-.99	-.99	.28	.75	.00
67 Cleaning + Toilet Prod.		BASIC	.98	.81	.57	.32	.12
	*	BASIQ	.93	.19	.27	.75	-.04
		SLIM	.88	-.36	.17	.90	-.10
68 Paints	*	BASIC	.98	.84	-.26	1.05	.25
		BASIQ	.98	.84	-.28	1.07	.25
69 Petroleum Refining		BASIC	.91	.89	.14	1.25	-.44
	*	BASIQ	.87	.84	.06	1.15	-.25
		RISING	.77	.73	.07	.93	.00
71 Paving and Asphalt		BASIC	.92	.89	-.25	1.71	-.42
	*	BASIQ	.82	.76	-.05	1.25	-.17
		RISING	.80	.73	-.19	1.25	.00

Table 5. Summary of Regression Results (continued)

Ind	Best	RBARSQ	RTSQ	Intercept	Cost	Output
72 Tires and Inner Tubes	BASIC	.53	.44	.17	.97	-.10
	* BASIQ	.46	.36	.31	.75	-.03
73 Rubber Products	BASIC	.97	.92	-.46	1.43	.03
	* BASIQ	.97	.90	-.30	1.25	.07
	SLIM	.96	.88	-.17	1.10	.09
74 Misc Plastic Products	BASIC	.85	.40	1.18	-.33	.11
	* BASIQ	.66	-.33	.14	.75	.07
	SLIM	.61	-.52	.00	.90	.06
75 Leather + Ind Lthr Prod	BASIC	.90	.72	-2.80	3.25	.62
	BASIQ	.86	.60	.06	1.25	-.21
	* RISING	.82	.50	-.19	1.25	.00
76 Footwear(exc. Rubber)	BASIC	.98	.84	-.86	1.28	.55
	* BASIQ	.98	.81	-.49	1.20	.25
77 Other Leather Products	BASIC	.97	.73	.24	.60	.15
	* BASIQ	.96	.63	.20	.75	.05
	SLIM	.92	.25	.15	.90	-.07
78 Glass	BASIC	.96	.86	-.42	1.40	.06
	* BASIQ	.96	.84	-.36	1.25	.17
79 Structural Clay Products	* BASIC	.98	.90	.02	.90	.09
80 Pottery	BASIC	.98	.91	-.43	1.36	.08
	* BASIQ	.98	.90	-.38	1.25	.14

Table 5. Summary of Regression Results (continued)

Ind		Best	RBARSQ	RTSQ	Intercept	Cost	Output
81	Cement, Concrete, Gypsum	BASIC	.99	.96	.17	1.03	-.20
		BASIQ	.99	.96	.18	1.02	-.19
		* RISING	.98	.93	.18	.83	.00
82	Other Stone + Clay Prod.	BASIC	.99	.96	-.10	1.21	-.08
		* BASIQ	.99	.95	-.08	1.16	-.05
83	Steel	* BASIC	.98	.93	-.18	1.14	.06
84	Copper	BASIC	.87	.60	-.70	1.64	.11
		* BASIQ	.84	.52	-.49	1.25	.25
85	Lead	BASIC	.81	.67	-.11	1.27	-.08
		* BASIQ	.81	.66	-.10	1.23	-.05
86	Zinc	BASIC	.52	.18	.42	-.54	1.07
		* BASIQ	.08	-.59	.24	.75	.25
87	Aluminum	BASIC	.42	.31	.15	1.33	-.44
		* BASIQ	.36	.23	.48	.78	-.23
		RISING	-.30	-.55	.34	.75	.00
88	Oth Prim Non-fer Metals	BASIC	.74	.15	.23	-.49	1.28
		* BASIQ	.41	-.93	-.10	1.03	.25
90	Non-ferrous Wire Drawing	BASIC	.97	.90	-.20	1.18	-.02
		* BASIQ	.96	.89	-.20	1.19	-.02
92	Metal Cans	* BASIC	.98	.89	-.16	1.00	.15

Table 5. Summary of Regression Results (continued)

Ind	Best	RBARSQ	RTSQ	Intercept	Cost	Output
93 Metal Barrels and Drums	* BASIC	.98	.90	.04	.90	.05
94 Plumbing + Heating Equip.	BASIC	.99	.96	.12	1.00	-.11
	BASIQ	.99	.96	.12	.98	-.11
	* RISING	.98	.94	.21	.81	.00
95 Structural Metal Products	* BASIC	.98	.95	.12	.89	-.03
96 Screw Machine Products	BASIC	.98	.73	-.67	1.26	.45
	* BASIQ	.97	.52	-.50	1.25	.25
97 Metal Stampings	* BASIC	.99	.94	-.16	1.00	.17
98 Cutlery,Hand Tools,Hardwr	BASIC	1.00	.96	.04	.83	.15
	BASIQ	1.00	.96	.06	.80	.16
	* SLIM	.99	.95	.01	.90	.10
99 Misc Fabricated Wire Products	BASIC	.93	.89	.43	.84	-.31
	* BASIQ	.87	.79	.31	.93	-.25
	RISING	.80	.69	.29	.75	.00
100 Pipes, Valves, Fittings	* BASIC	.98	.89	-.05	1.04	.01
101 Oth Fabricated Metal Prod.	BASIC	.98	.78	-.11	1.05	.10
	* BASIQ	.98	.77	-.11	1.06	.09
	SLIM	.98	.77	-.11	1.06	.09
102 Engines and Turbines	BASIC	.98	.92	.17	.71	.14
	* BASIQ	.98	.92	.14	.75	.13

Table 5. Summary of Regression Results (continued)

Ind	Rest	RBARSQ	RTSQ	Intercept	Cost	Output
103 Farm Machinery	* BASIC	.99	.80	-.02	.79	.26
	BASIQ	.99	.80	-.03	.80	.25
104 Constr,Mine,Oilfield Mach	BASIC	.99	.86	-.22	.92	.33
	* BASIQ	.99	.82	-.23	1.00	.25
105 Materials Handling Mach.	* BASIC	.99	.95	-.07	.95	.15
108 Other Metal Working Mach	BASIC	.93	-.89	.05	.68	.32
	* BASIQ	.93	-.99	.03	.75	.25
109 Special Industrial Mach	* BASIC	.99	.89	-.34	1.10	.26
	BASIQ	.99	.89	-.34	1.12	.25
110 Pumps,Compressors,Blowers	* BASIC	.99	.93	-.21	1.05	.18
111 Ball and Roller Bearings	BASIC	.78	.78	.79	.74	-.62
	* BASIQ	.10	.11	.54	.75	-.25
	RISING	-.85	-.83	.37	.75	.00
112 Power Transmission Equip	BASIC	.99	.83	-.38	1.01	.41
	* BASIQ	.98	.64	-.44	1.18	.25
113 Industrial Patterns	* BASIC	.99	.82	-.48	1.26	.26
	BASIQ	.99	.82	-.47	1.25	.25
114 Computers + Related Mach.	BASIC	.28	.21	.83	.18	-.03
	* BASIQ	-.99	-.99	.36	.75	-.18
	RISING	-.99	-.99	.24	.75	.00

Table 5. Summary of Regression Results (continued)

Ind	Best		RBARSQ	RTSQ	Intercept	Cost	Output
115 Other Office Machinery		BASIC	.98	.73	.21	.60	.22
	*	BASIQ	.98	.68	.07	.75	.19
		SLIM	.94	.10	-.10	.98	.10
116 Service Industry Machinery		BASIC	.79	.78	.62	.48	-.13
	*	BASIQ	.59	.56	.38	.75	-.18
		RISING	-.14	-.21	.28	.75	.00
117 Machine Shop Products		BASIC	.99	.69	-.53	1.17	.43
	*	BASIQ	.99	.65	-.43	1.25	.25
118 Electrical Measuring Instruments		BASIC	.95	.41	.14	.80	.08
		BASIQ	.93	.15	.24	.75	.04
	*	SLIM	.92	-.03	.21	.90	-.10
119 Transformers + Switchgear		BASIC	.48	.46	.64	.39	-.05
	*	BASIQ	.30	.27	.36	.75	-.16
		RISING	-.05	-.10	.24	.75	.00
120 Motors and Generators		BASIC	.79	.80	-.37	1.91	-.59
	*	BASIQ	.58	.59	.14	1.13	-.25
		RISING	.34	.34	.34	.75	.00
121 Industrial Controls		BASIC	.89	.49	-.10	1.26	-.21
		BASIQ	.89	.48	-.07	1.22	-.20
	*	RISING	.86	.36	.15	.84	.00
122 Welding App, Graphite Prod		BASIC	.81	.77	.16	1.05	-.24
	*	BASIQ	.77	.72	.14	1.05	-.22
		RISING	.67	.61	.28	.75	.00

Table 5. Summary of Regression Results (continued)

Ind	Best		RBARSQ	RTSQ	Intercept	Cost	Output
123 Household Appliances		BASIC	.82	.81	.49	.79	-.29
	*	BASIQ	.65	.63	.50	.75	-.25
		RISING	-.99	-.99	.30	.75	.00
124 Elec Lighting + Wiring Eq.		BASIC	.94	.68	-.04	.97	.10
	*	BASIQ	.94	.66	-.02	.94	.10
125 Radio and TV Receiving		BASIC	.93	-.66	1.27	.00	-.32
	*	BASIQ	.34	-.99	.48	.75	-.25
		SLIM	-.67	-.99	.24	.90	-.10
126 Phonograph Records		BASIC	.90	.27	.51	.22	.30
	*	BASIQ	.17	-.99	.04	.75	.25
128 Electronic Components		BASIC	.87	.47	.78	.19	.02
	*	BASIQ	-.99	-.99	-.06	.75	.25
		SLIM	-.99	-.99	-.08	.90	.10
129 Batteries		BASIC	.92	.63	.29	.63	.10
		BASIQ	.91	.59	.20	.75	.07
	*	SLIM	.89	.51	.09	.90	.02
130 Engine Electrical Equip.		BASIC	.99	.76	-.28	.96	.38
	*	BASIQ	.98	.55	-.34	1.12	.25
131 X-ray, Elec Equip,nec		BASIC	.98	.94	-.05	1.06	.00
	*	BASIQ	.98	.94	-.04	1.04	.00
133 Motor Vehicles		BASIC	.99	.96	.38	.71	-.07
	*	BASIQ	.97	.90	.33	.75	-.06

Table 5. Summary of Regression Results (continued)

Ind	Best	RBARSQ	RTSQ	Intercept	Cost	Output
138 Railroad Equipment	BASIC	.96	.80	-.48	1.32	.18
	* BASIQ	.96	.79	-.41	1.25	.18
139 Cycles, Trans Equip Nec	BASIC	.92	.84	.30	.72	.00
	* BASIQ	.92	.83	.27	.75	-.01
145 Photographic Equipment	BASIC	.93	-.51	.54	.36	.12
	* BASIQ	.81	-.99	.23	.75	-.02
	SLIM	.73	-.99	.11	.90	-.06
146 Watches and Clocks	BASIC	.89	.76	.52	.50	-.04
	* BASIQ	.84	.65	.32	.75	-.10
147 Jewelry and Silverware	BASIC	.97	.79	-.42	.95	.50
	* BASIQ	.96	.74	-.48	1.25	.25
148 Toys,Sport,Musical Instr.	BASIC	.99	.97	.20	.76	.05
	* BASIQ	.99	.96	.21	.75	.04
149 Office Supplies	BASIC	.71	.30	.72	.19	.10
	* BASIQ	.47	-.28	.32	.75	-.12
	RISING	.11	-.99	.23	.75	.00
150 Misc Manufacturing, Nec	BASIC	.98	.92	.29	.69	.05
	* BASIQ	.98	.92	.24	.75	.02
151 Railroads	BASIC	.91	.63	.17	.74	.13
	* BASIQ	.91	.61	.16	.75	.13
	SLIM	.88	.50	.10	.90	.03

Table 5. Summary of Regression Results (continued)

Ind	Best	REARSQ	RTSQ	Intercept	Cost	Output
152 Busses	BASIC	.18	-.99	4.79	-1.10	-2.65
	* BASIQ	-.39	-.99	-.15	.75	.25
	SLIM	-.56	-.99	-.20	.90	.10
155 Airlines	BASIC	.95	.34	-.20	1.21	.09
	* BASIQ	.94	.23	-.10	1.05	.15
	SLIM	.93	.18	-.10	1.10	.10
158 Telephone and Telegraph	BASIC	.92	.80	.15	.99	-.10
	* BASIQ	.91	.78	.10	1.06	-.18
	RISING	.74	.39	.27	.75	.00
160 Electric Utilities	BASIC	.97	.95	.45	.66	-.07
	* BASIQ	.95	.91	.41	.75	-.20
	RISING	.84	.70	.27	.75	.00
161 Natural Gas	BASIC	.93	.60	.51	.28	.35
	BASIQ	.90	.48	.12	.75	.18
	* SLIM	.88	.38	.03	.90	.10
162 Water and Sewer Services	BASIC	.82	-.99	-1.21	.12	2.24
	* BASIQ	-.99	-.99	-.14	.75	.25
165 Banks,Credit Agen.,Brokers	BASIC	.90	.60	.46	.20	.44
	BASIQ	.84	.34	.15	.75	.11
	* SLIM	.82	.27	.07	.90	.01
166 Insurance	BASIC	.94	.14	-.51	.96	.48
	* BASIQ	.94	.10	-.58	1.25	.25

Table 5. Summary of Regression Results (continued)

Ind	Best		REARSG	RTSQ	Intercept	Cost	Output
167 Owner-occupied Dwellings	*	BASIC	1.00	.98	.02	.94	.00
		BASIQ	1.00	.98	.00	.95	-.02
		SLIM	1.00	.98	.00	.95	-.02
168 Real Estate		BASIC	1.00	.99	.46	.40	.15
	*	BASIQ	.95	.50	.35	.75	-.12
		SLIM	.82	-.66	.19	.90	-.10
170 Personal + Repair Services		BASIC	1.00	.98	-.62	1.12	.53
	*	BASIQ	.98	.63	-.51	1.25	.25
		SLIM	.91	-.80	-.23	1.10	.10
171 Business Services		BASIC	1.00	.94	-1.28	2.21	.08
	*	BASIQ	.89	-.99	-.45	1.25	.25
173 Auto Repair		BASIC	.95	.62	-.58	.90	.68
	*	BASIQ	.93	.48	-.53	1.25	.25
		SLIM	.87	.05	-.24	1.10	.10
174 Movies + Amusements		BASIC	1.00	.65	-2.21	.31	2.99
		BASIQ	.96	-.99	-.28	1.05	.25
	*	SLIM	.96	-.99	-.18	1.09	.10
175 Medical Services		BASIC	.99	.93	-.28	.51	.85
	*	BASIQ	.96	.48	-.65	1.25	.25
		SLIM	.91	-.28	-.47	1.10	.10

Table 6. Industries Grouped According to
Cost and Output Elasticities

Class 1. Cost:at Lower Limit Output:at Lower Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.97	.88	.49	.75	-.25	30	Alcoholic Beverages
BASIQ	.10	.11	.54	.75	-.25	111	Ball and Roller Bearings
BASIQ	.65	.63	.50	.75	-.25	123	Household Appliances
BASIQ	.34	-.99	.48	.75	-.25	125	Radio and TV Receiving

Class 2. Cost:less than .95 Output:at Lower Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.87	.79	.31	.93	-.25	99	Misc Fabricated Wire Prod.

Class 4. Cost:greater than 1.05 Output:at Lower Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.87	.84	.06	1.15	-.25	69	Petroleum Refining
BASIQ	.58	.59	.14	1.13	-.25	120	Motors and Generators

Class 6. Cost:at Lower Limit Output:less than -.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.86	.47	.40	.75	-.18	36	Floor Coverings
BASIQ	.83	.57	.46	.75	-.23	38	Knitting
BASIQ	.34	.32	.38	.75	-.21	55	Industrial Chemicals
BASIQ	.31	.32	.42	.75	-.18	63	Synthetic Rubber
BASIQ	.68	-.53	.42	.75	-.15	65	Non-cellulosic Fibers
BASIQ	-.99	-.99	.36	.75	-.18	114	Computers + Related Mach.
BASIQ	.59	.56	.38	.75	-.18	116	Service Industry Machinery
BASIQ	.30	.27	.36	.75	-.16	119	Transformers + Switchgear
BASIQ	.97	.90	.33	.75	-.06	133	Motor Vehicles
BASIQ	.84	.65	.32	.75	-.10	146	Watches and Clocks
BASIQ	.47	-.28	.32	.75	-.12	149	Office Supplies
BASIQ	.95	.91	.41	.75	-.20	160	Electric Utilities
BASIQ	.95	.50	.35	.75	-.12	168	Real Estate

Table 6. Industries Grouped According to Cost and Output Elasticities (continued)

Class 7. Cost:less than .95 Output:less than -.05

	RBARSQ	RTSQ	Interc	Cost	Output		
SLIM	-.99	-.99	.24	.90	-.10	11	Iron Ores
BASIQ	.97	.77	.31	.79	-.06	44	Wooden Containers
BASIC	.71	.63	.22	.76	-.09	59	Fertilizers
BASIC	.79	.75	.30	.88	-.23	66	Drugs
BASIQ	.36	.23	.48	.78	-.23	87	Aluminum
SLIM	.92	-.03	.21	.90	-.10	118	Elect. Measuring Instruments

Class 8. Cost: .95 to 1.05 Output:less than -.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.77	.72	.14	1.05	-.22	122	Welding App, Graphite Prod

Class 9. Cost:greater than 1.05 Output:less than -.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.91	.78	.10	1.06	-.18	158	Telephone and Telegraph

Class 10. Cost:at Upper Limit Output:less than -.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.87	.80	-.17	1.25	-.09	32	Fats and Oils
BASIQ	.73	.34	-.08	1.25	-.23	62	Plastic Materials + Resins
BASIQ	.82	.76	-.05	1.25	-.17	71	Paving and Asphalt

Class 11. Cost:at Lower Limit Output:-.05 to +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
RISING	.33	.34	.40	.75	.00	2	Poultry and Eggs
RISING	-.11	-.29	-.09	.75	.00	13	Other Non-ferrous Ores
BASIQ	.52	.35	.18	.75	.00	37	Misc Textiles
RISING	.61	.51	.34	.75	.00	42	Veneer and Plywood
BASIQ	.97	.91	.22	.75	.02	48	Paper and Paperboard Mills
BASIQ	-.99	-.99	.36	.75	-.03	50	Wall and Building Paper
BASIQ	.66	.62	.24	.75	.00	64	Cellulosic Fibers
BASIQ	.93	.19	.27	.75	-.04	67	Cleaning + toilet Prod.
BASIQ	.46	.36	.31	.75	-.03	72	Tires and Inner Tubes
BASIQ	.96	.63	.20	.75	.05	77	Other Leather Products
BASIQ	.92	.83	.27	.75	-.01	139	Cycles, Trans Equip Nec
BASIQ	.81	-.99	.23	.75	-.02	145	Photographic Equipment
BASIQ	.99	.96	.21	.75	.04	146	toys,Sport,Musical Instr.
BASIQ	.98	.92	.24	.75	.02	150	Misc Manufacturing, Nec

Table 6. Industries Grouped According to Cost and Output Elasticities (continued)

Class 12. Cost:less than .95 Output:-.05 to +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
RISING	.76	.55	.25	.79	.00	33	Misc Food Products
RISING	.68	.57	.19	.83	.00	47	Pulp Mills
RISING	.94	.85	.12	.89	.00	51	Paperboard Containers
RISING	.98	.93	.18	.83	.00	81	Cement, Concrete, Gypsum
BASIC	.98	.90	.04	.90	.05	93	Metal Barrels and Drums
RISING	.98	.94	.21	.81	.00	94	Plumbing + Heating Equip.
BASIC	.98	.95	.12	.89	-.03	95	Structural Metal Products
RISING	.86	.36	.15	.84	.00	121	Industrial Controls
SLIM	.89	.51	.09	.90	.02	129	Batteries
SLIM	.82	.27	.07	.90	.01	165	Banks,Credit Agen.,Brokers
BASIC	1.00	.98	.02	.94	.00	167	Owner-occupied Dwellings

Class 13. Cost: .95 to 1.05 Output:-.05 to +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIC	.98	.89	-.05	1.04	.01	100	Pipes, Valves, Fittings
BASIQ	.98	.94	-.04	1.04	.00	131	X-ray, Elec Equip,nec

Class 14. Cost:greater than 1.05 Output:-.05 to +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.96	.73	-.02	1.07	.01	21	Ammunition
SLIM	.60	-.38	-.08	1.10	-.04	60	Pesticides + Agric. Chem.
BASIQ	.99	.95	-.08	1.16	-.05	82	Other Stone + Clay Prod.
BASIQ	.81	.66	-.10	1.23	-.05	85	Lead
BASIQ	.96	.89	-.20	1.19	-.02	90	Non-ferrous Wire Drawing

Class 15. Cost:at Upper Limit Output:-.05 to +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
RISING	.40	.36	-.17	1.25	.00	5	Grains
RISING	.82	.50	-.19	1.25	.00	75	Leather + Ind Lthr Prod

Table 6. Industries Grouped According to Cost and Output Elasticities (continued)

Class 16. Cost:at Lower Limit Output:greater than +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.19	-.30	.05	.75	.09	17	Chemical Fertilizer Mining
BASIQ	.95	-.21	.05	.75	.11	31	Soft Drinks and Flavorings
BASIQ	.98	.92	.13	.75	.12	43	Millwork and Wood Products
BASIQ	.99	.89	.04	.75	.23	45	Household Furniture
BASIQ	.66	-.33	.14	.75	.07	74	Misc Plastic Products
BASIQ	.98	.92	.14	.75	.13	102	Engines and Turbines
BASIQ	.98	.68	.07	.75	.19	115	Other Office Machinery
BASIQ	.91	.61	.16	.75	.13	151	Railroads

Class 17. Cost:less than .95 Output:greater than +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
SLIM	.66	-.08	-.06	.90	.10	1	Dairy Farm Products
SLIM	.59	.19	.04	.90	.10	3	Meat Animals, Oth Livestk
SLIM	-.99	-.99	-.28	.90	.10	15	Crude Petroleum, Nat. Gas
BASIC	.99	.96	.11	.79	.12	16	Stone and Clay Mining
BASIQ	.95	.89	.02	.84	.15	23	Meat Products
BASIQ	.95	.90	-.07	.80	.20	26	Grain Mill Products
BASIQ	.96	.64	.02	.85	.14	34	Tobacco Products
BASIQ	.99	.94	-.04	.92	.13	46	Other Furniture
BASIC	.98	.90	.02	.90	.09	79	Structural Clay Products
SLIM	.99	.95	.01	.90	.10	96	Cutlery,Hand Tools,Hardwr
BASIQ	.94	.66	-.02	.94	.10	124	Elec Lighting + Wiring Eq.
SLIM	.88	.38	.03	.90	.10	161	Natural Gas

Class 18. Cost: .95 to 1.05 Output:greater than +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.91	.81	-.20	1.01	.18	40	Household Textiles
BASIC	.98	.89	-.16	1.00	.15	92	Metal Cans
BASIC	.99	.94	-.16	1.00	.17	97	Metal Stampings
BASIC	.99	.95	-.07	.95	.15	105	Materials Handling Mach.
BASIC	.99	.93	-.21	1.05	.18	110	Pumps,Compressors,Blowers
BASIQ	.94	.23	-.10	1.05	.15	155	Airlines

Table 6. Industries Grouped According to
Cost and Output Elasticities (continued)

Class 19. Cost:greater than 1.05 Output:greater than +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
SLIM	.73	.54	-.17	1.10	.10	7	Fruit,Vegetables,Oth Crops
BASIC	.99	.94	-.12	1.06	.07	25	Canned and Frozen Foods
BASIQ	.99	.94	-.24	1.15	.10	27	Bakery Products
SLIM	.97	.88	-.18	1.10	.10	49	Paper Products, Nec
BASIC	.98	.93	-.18	1.14	.06	83	Steel
BASIQ	.98	.77	-.11	1.06	.09	101	Oth Fabricated Metal Prod.
SLIM	.96	-.99	-.18	1.09	.10	174	Movies + Amusements

Class 20. Cost:at Upper Limit Output:greater than +.05

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.80	.66	-.45	1.25	.19	28	Sugar
BASIQ	.93	.91	-.43	1.25	.19	35	Broad and Narrow Fabrics
BASIQ	.92	.64	-.38	1.25	.15	61	Misc Chemical Products
BASIQ	.97	.90	-.30	1.25	.07	73	Rubber Products
BASIQ	.96	.84	-.36	1.25	.17	78	Glass
BASIQ	.98	.90	-.38	1.25	.14	80	Pottery
BASIQ	.96	.79	-.41	1.25	.18	138	Railroad Equipment

Class 21. Cost:at Lower Limit Output:at Upper Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.77	-.99	-.01	.75	.25	22	Other Ordnance
BASIQ	.89	.63	.07	.75	.25	29	Confectionery Products
BASIQ	.08	-.59	.24	.75	.25	86	Zinc
BASIQ	.93	-.99	.03	.75	.25	108	Other Metal Working Mach
BASIQ	.17	-.99	.04	.75	.25	126	Phonograph Records
BASIQ	-.99	-.99	-.06	.75	.25	128	Electronic Components
BASIQ	-.39	-.99	-.15	.75	.25	152	Busses
BASIQ	-.99	-.99	-.14	.75	.25	162	Water and Sewer Services

Class 22. Cost:less than .95 Output:at Upper Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.99	.92	-.13	.89	.25	24	Dairy Products
BASIC	.99	.80	-.02	.79	.26	103	Farm Machinery

Table 6. Industries Grouped According to
Cost and Output Elasticities (continued)

Class 23. Cost: .95 to 1.05 Output:at Upper Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.20	.20	-.02	.95	.25	4	Cotton
BASIQ	.91	.51	-.29	1.05	.25	39	Apparel
BASIC	.98	.84	-.26	1.05	.25	68	Paints
BASIQ	.41	-.93	-.10	1.03	.25	88	Oth Prim Non-fer Metals
BASIQ	.99	.82	-.23	1.00	.25	104	Constr,Mine,Oilfield Mach

Class 24. Cost:greater than 1.05 Output:at Upper Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.98	.81	-.49	1.20	.25	76	Footwear(exc. Rubber)
BASIC	.99	.89	-.34	1.10	.26	109	Special Industrial Mach
BASIQ	.98	.64	-.44	1.18	.25	112	Power Transmission Equip
BASIQ	.98	.55	-.34	1.12	.25	130	Engine Electrical Equip.

Class 25. Cost:at Upper Limit Output:at Upper Limit

	RBARSQ	RTSQ	Interc	Cost	Output		
BASIQ	.61	.11	-.32	1.25	.25	14	Coal Mining
BASIQ	.71	.32	-.41	1.25	.25	41	Lumber and Wood Products
BASIQ	.93	-.49	-.55	1.25	.25	52	Newspapers
BASIQ	.84	.52	-.49	1.25	.25	84	Copper
BASIQ	.97	.52	-.50	1.25	.25	96	Screw Machine Products
BASIC	.99	.82	-.48	1.26	.26	113	Industrial Patterns
BASIQ	.99	.65	-.43	1.25	.25	117	Machine Shop Products
BASIQ	.96	.74	-.48	1.25	.25	147	Jewelry and Silverware
BASIQ	.94	.10	-.58	1.25	.25	166	Insurance
BASIQ	.98	.63	-.51	1.25	.25	170	Personal + Repair Services
BASIQ	.89	-.99	-.45	1.25	.25	171	Business Services
BASIQ	.93	.48	-.53	1.25	.25	173	Auto Repair
BASIQ	.96	.48	-.65	1.25	.25	175	Medical Services

Appendix to Chapter 4. Polynomial Lags

The trick is to represent the lag weights as Lagrangian polynomials. These polynomials have the pleasant feature that the ordinate of any point can be expressed as a weighted sum of the ordinates of M points (M is 1 greater than the degree of the polynomial) and that the weight can be calculated from only the abscissae of those M points and the point in question; furthermore, the M points can be chosen arbitrarily (Almon, [2]).

$$P_{jt} = S_{jt} + \sum_{k=1}^{m} v_{jk}\, UC_{j,t-k} + \sum_{k=1}^{n} w_{jk}\, Q_{j,t-k}$$

$$= S_{jt} + \sum_{k=1}^{m} \left(\sum_{l=1}^{M} F_{kl1}\, b_{jl1}\right) UC_{j,t-k} + \sum_{k=1}^{n} \left(\sum_{l=1}^{N} F_{kl2}\, b_{jl2}\right) Q_{j,t-k}$$

$$= S_{jt} + \sum_{l=1}^{M} b_{jl1} \left(\sum_{k=1}^{m} F_{kl1}\, UC_{j,t-k}\right) + \sum_{l=1}^{N} b_{jl2} \left(\sum_{k=1}^{n} F_{kl2}\, Q_{j,t-k}\right)$$

To take the lag on unit cost as an example, if the v's lie on a polynomial of degree two, then M is three. For the k-th weight, v_{jk}, we have

$$v_{jk} = F_{k11}\, b_{j11} + F_{k21}\, b_{j21} + F_{k31}\, b_{j31}$$

The three weights are functions of time such that if k is one of the M points of interpolation, the weight equals the interpolation ordinate. Thus, if k co-incides with the middle interpolation point,

$F_{k11} = 0$, $F_{k21} = 1$, $F_{k31} = 0$, and $v_{jk} = b_{j21}$

Note that the following formula satisfies the conditions. Letting the abscissae of the M interpolation points be X_l, omitting the third subscript of F (which distinguishes between cost and output), and using TT to mean the product,

$$F_{kl} = \prod_{\substack{i=1 \\ i \neq l}}^{M} \frac{k - X_i}{X_i - X_l}$$

The two matrices F so computed are then used to make M transformations of cost (UC) and N transformations of output (Q). These transformed variables are the regressors for analysis.

5. Simulations

Simulating the recent history of prices and forecasting inflation for the next decade are the purpose and ultimate test of the analysis. The discussion will cover first the computations, with special reference to the promises made in the introduction and to the dependence on the INFORUM model, and second an application to the recent American experience with food and fuel.

5.1. Computations

The simulation begins with January, 1971. To evaluate an equation for that month requires the industry's unit cost between January and December, 1970, and its output between January, 1969, and December, 1970. The data needed to work out all equations form two matrices, with a row for each industry and a column for each month in the lags. The cost matrix is 185 x 12 and the output matrix 185 x 24. Evaluating all equations then produces a vector of 185 industrial prices as of January, 1971.

This description applies only to the first month of the simulation. The first month is unique in that all the data is historical and observed. February, 1971, is simulated by first constructing the January, 1971, unit cost and output of each industry, since these are now needed for evaluating the distributed lags. Eleven of the twelve columns of the cost matrix are still relevant, but the earliest one drops out and is to be replaced by the unit costs of all industries for January, 1971. Each is constructed as the unit material cost plus the unit labor cost. The j-th industry's unit material cost is calculated according to equation (2) (on page 5). Each P<i> is the January, 1971, price just computed from the equations. The A matrix is the 1971 input-output matrix estimated for the INFORUM model. The unit labor cost, also for January, 1971, is calculated as the ratio of average earnings per worker to productivity. The productivity by industry is estimated and forecast annually by INFORUM for a more aggregated set of ninety groups of industries. Each industry is assumed to experience the same growth in productivity as the group of which it is a part. The month-to-month movement is assumed to lie on a straight line created by assigning the annual productivity to July 1st and connecting successive years. The cyclical movements will be incorporated to the extent that the annual simulations reflect them, but nothing has been done to add a more truly cyclical fluctuation to the estimated productivity.

Average earnings per worker in each industry are the subject of a regression analysis of their own. The agricultural industries were excluded because they are not covered by Employment and Earnings. David Belzer [4] has described these equations. Each equation explains the level of average earnings by four distributed lags of twelve months each. Three of these lags are on national aggregates: the level of consumer prices (CPI), the unemployment rate, and national productivity (exluding the government sector); the fourth is the lag on the level of the industry's employment. To evaluate these equations for January, 1971, requires a matrix 185 x 12 of industrial employment for the twelve months of 1970 plus three vectors holding the CPI, unemployment rate, and aggregate productivity for the same twelve months. In this way average earnings are simulated for all sectors in January, 1971. The average earnings are divided by productivity to form a unit labor cost. Summing unit labor to material cost yields the unit cost vector for January, 1971.

Output is the other variable which must be extended to January, 1971, before February, 1971, prices can be simulated. Annual outputs by industry are forecast by INFORUM. Monthly outputs were interpolated using the same technique of accumulating outputs year after year as was applied to creating output series (see page 34).

February, 1971, prices can now be calculated from the price equations, and from the industry prices come the aggregates for the same month. Also from the prices, and in preparation for the March calculations, the February unit material cost for each industry is formed using the same matrix A, which is assumed to hold constant throughout the year. February's unit labor cost requires the linear interpolation of annual productivity to provide the denominator of the fraction. Each industry's output for February comes from the same cubic used to get the January estimate.

The equations of average earnings cannot be evaluated for February until the matrix of employment levels and the three vectors of national wage indicators have been updated by dropping the earliest month and adding January, 1971. The Consumer Price Index for January is simulated by moving forward the December, 1970, index in proportion to the simulated value of the deflator for Personal Consumption Expenditure; this deflator is one of the fifteen aggregates formed as weighted averages of the industrial prices after each month's computation is complete. The unemployment rate is interpolated on a straight line between the annual rates simulated by INFORUM. The aggregate productivity is the weighted average of the productivities used as the denominators of the unit labor costs; the weights are the outputs. Finally, the employment in each industry is moved forward from December to January in proportion to the increase in the industry's output and inversely to the increase in productivity of the group to which the industry belongs. With the January values of all the independent variables, the equations yield February average earnings, and the unit cost variable can be completed.

Each month is simulated in this fashion. Using the lagged values of unit cost and output, we calculate prices and then price aggregates. Then we prepare for the next month by forming unit material costs from prices, interpolating productivities, evaluating average earnings from their equations and then forming unit cost, and by interpolating outputs. We further prepare the next month by calculating the CPI and aggregate productivity, interpolating the unemployment rate and scaling all employments for increased output and productivity.

The dependence on INFORUM consists of the four elements for each year of the simulation: the updated input-output matrix, the output vector, the productivity vector and the unemployment rate. A simulation by INFORUM of these elements for the decade through 1980 makes possible a forecast of industry prices and price aggregates through 1980. Each alternate INFORUM simulation is the basis for another simulation of prices.

5.2. Two Tests

Three simulations of prices for the period 1971 to 1978 will now be contrasted in order to answer two questions. The first question concerns the extent to which crude food and fuel commodities can be blamed for the rapid inflation since 1973. The second question is whether all the regressions yield a set of equations which can track the Wholesale Price Index (WPI) better than a "naive" model.

The base of the comparison is a simulation in which the equations for all crude materials are removed. These industries are:

	Weight in WPI		Weight in WP
1 Dairy Farm Products	2.05	16 Stone & Clay Mining	.31
2 Poultry & Eggs	1.10	70 Fuel Oil	.00
3 Meat Animals	3.59	84 Copper	.74
5 Grains	1.02	85 Lead	.10
7 Fruits, Vegetables	1.81	86 Zinc	.10
11 Iron Ore	.04	87 Aluminum	.75
14 Coal	.49	88 Other Non-Ferrous	.22
15 Crude Petroleum	1.24		

Instead of deriving prices from the equations for these industries, we peg these prices at their actual values, month by month through June, 1974. Each month these actual prices enter the computation of the unit material cost of all other industries; and, of course, they are used for computing the aggregate prices. June, 1974, is the last month for which a complete set of historical prices has been assembled. Therefore, for the months beyond, the prices of crude materials are neutralized by making them move proportionately to the WPI. If the WPI rises 1% in July, all prices for crude materials rise 1% in August. In this fashion the forecast is run through December, 1978.

As a first alternative, the simulation and forecast are re-run with one set of changes: the prices of crude materials follow the trend of the WPI from November, 1972, forward. The large price increase experienced by this group between the end of 1972 and mid-1974 is thus missing from the second simulation as a spur to a rising price level.

The unit cost of all other industries will now appear lower, as will their prices. The aggregate prices will be lower and the wages will respond to them. In the months following November, 1972, unit costs will be lower for three reasons: lower wages, lower computed prices, as well as the lower prices of crude materials.

Outputs, employment levels, and technological relationships between industries are not adjusted in this second simulation. INFORUM uses the vector of prices as one of its initial assumptions and uses the relative prices computed from it to adjust per capita consumption levels and some input-output coefficients. However, the entire path requires making at least one additional simulation with INFORUM and one additional simulation with the price equations, and these extra steps have been omitted.

The second alternative requires a third simulation-forecast. Like the first two, it covers the ninety-six months from January, 1971, through December, 1978. It differs from the base forecast by a single group of changes: the replacement of all the estimated distributed lags by a standardized cost lag and a standardized output lag. The cost lag rises smoothly from 0 to 1 in twelve months and passes through all costs without any additional mark-up. The output lag rises to .6 in sixteen months and then falls back to zero by the twenty-fourth month, implying long-run constant returns to scale. The intercepts for each equation are then chosen so that the standardized lags predict the actual price for January, 1971. As in the base simulation, the prices of crude materials are pegged at their actual values through June, 1974, and thereafter they tag along after the Wholesale Price Index.

Table 7, starting on page 117, summarizes the results of the three simulations and forecasts. For June, 1974, the last month of complete historical prices, the actual price index and the price index from the base simulation are shown, and the percentage of error appears in the third column. The WPI is estimated exactly, but this average accuracy hides large underestimates and large overestimates in individual industries. Let us consider the largest errors and then the errors for the largest industries.

The errors of a first group stem from aggregation problems. Industry 28, Sugar, is estimated 25% low and Industry 32, Fats and Oils, is 11% high. Both consume the products of industry 7, Fruits, Vegetables, Other Crops, as a major input, and the price for Fruits and Vegetables is pegged at the actual. The direct way to correct this kind of error is to enlarge the number of Industries in the input-output framework. Another alternative, ad hoc, is to peg the prices at the second stage instead of the first. This alternative was chosen in the case of non-ferrous metals. Industries 85 to 88, Lead, Zinc, Aluminum, and Other Non-ferrous Primary Refining, all purchase their major input from Industry 13, Other Non-ferrous Ores. Since the measured price for Industry 13 is solely that of liquid vector dominated by the minor inputs. In 1973 the general inflation of 15% operated through these to augment the leather industry's unit cost as simulated by 9%, and the mark-up equation then created a yet larger divergence between predicted price and actual. Footwear receives the same influence one stage later in the process of production.

These cases represent the largest errors. Let us turn to the largest industries. Two of the largest industries, Dairy Farms(1) and Meat Animals(3), are pegged. Industry 23, Meat Products, appears to have a large error. In fact, the price is responding to a steep decline in the cost of live animals during the first half of 1974. The predicted price for Meat Products does not reach the same low level until September. A similar problem explains the smaller error for Industry 24, Dairy Products. The actual price fell 7% between April and June, leaving the equation 6% high at the moment the snapshot was taken. And a slightly different story applies to Industry 25, Grain Mill Products. The equations rise steadily from January to June, whereas the actual price lingered at one value for three months and then in July, 1974, achieved a value almost identical to the prediction. Industry 35, Fabric, is the opposite case; the prediction runs 2% higher than the actuals for several months until June, when the actual price leaped to meet the prediction. In all of these cases, the error is just a matter of timing; the prediction moved here faster, there slower than did the actual.

Industry 39, Apparel, presents a problem of a different sort. The error for June, 1974, 8.6%, comes from a discrepancy in the data on output. If the simulation creates a unit cost identical to the actual unit cost faced by the industry and if outputs are also simulated so as to equal actual output, then the error in the prediction will be the corresponding residual from the regression. In June, 1974, the simulated output was 22% higher than the figure used in the regressions. Since the estimated equation indicates that Apparel is an increasing cost industry, this discrepancy is converted into a 9% error in the price. The difference in the two output series is that the so-called "actual" series is constructed from employment and productivity, whereas the simulated series is based on deflated values of shipments. The former, from the Federal Reserve Board, has a different trend from the Census-based data in the most recent years. This could be corrected by using the input-output simulations of the most recent two years - these simulations go beyond the last Annual Survey of Manufactures, but they are based on published Gross National Product accounts - to adjust the trend in the Fed's Industrial Production Index. The equation for Apparel would then yield a smaller elasticity with respect to this reconstituted output data.

Industry 55, Industrial Chemicals, has an equation which responds more slowly than the market. The 4% underestimate appears only in the second quarter of 1974 as the actual price was responding to the new price of crude petroleum. The simulated price of Industry 69, Petroleum Refining, was, itself, 8% high in our snapshot month of June, 1974. The equation is overshooting its mark, and in the later months of 1974, it adjusts downward. The timing is askew from November, 1973, onwards. The serious underestimate for Industry 83, Steel, appears only with May, 1974, and is 8% in June. By December, the simulated price has reached the actual June level; it is another case of delayed reaction. The equation for Industry 133, Motor Vehicles, tracks the actual price very closely. That for Industry 160, Electric Utilities, passes through the oil cost more slowly than actually occurred; in June, the prediction was 9% short.

There are many other cases of less significance to the prediction of the general price level, though they may play a big role in the deflators for components of GNP. The examples above indicate that the technique is in need of many refinements. But it serves as a framework for assessing recent experience with output, cost of production, and prices at the level of three-digit SIC industries.

<u>Simulation with Crude Prices following WPI</u>. We turn next to the effect of crude materials' prices. The columns of Table 7 labeled CRUDE show the per cent by which simulated prices of this first alternative (described on page 108) exceed the base simulation just presented. In one of the most dramatic instances, Industry 69, Petroleum

Refining, it is estimated that the price would have been 46% lower in June, 1974, if the prices of crude materials had held to the level of November, 1972. The gap is estimated to be smaller if the effects are extended four years to the end of 1978. For all of the sectors directly affected, the gap for 1978 is approximately the same as for 1974. But an industry which is at a later stage of processing does not feel the effect so quickly. Thus, Industry 36, Floor Coverings, had experienced only about a third of the long-run effect by mid-1974 (and about two-thirds by November, 1975). The effect on the aggregate price index is seen to be more than half complete by June, 1974. A final group of industries is represented by Industry 103, Farm Machinery. The effect of the CRUDE assumption by June, 1974, is still miniscule. For unlike Floor Covering manufacturers, who buy cotton and petroleum-based yarns and receive the impact of higher crude prices directly, Farm Mahinery makers are several stages removed. Eventually, the higher level of pri worms its way in, especially through the level of wages. Thus by 1978 a difference of 20% has appeared between the two forecasts of Farm Machinery prices.

The other alternative forecast can be seen in the two columns of Table 7 headed STANDARD. This second alternative was computed as if we had never performed the regression analysis described in Chapter 4. It rests on the idea that all costs have to be passed through to the price and that every industry operates on the flat portion of its long-run average cost curve. The Wholesale Price Index is very close to the BASE run in June, 1974. By the end of 1978, it is drifting away. The deflator for consumer durables is computed to be much higher using these more artificial equations, and from 1974 to 1978, the gap between BASE and STANDARD widens. The deviations are generally larger in 1978, industry by industry, and those with strongly negative output elasticities show a big difference; Industry 125, Radio and TV Receiving Sets, is the worst of this category.

5.3. Conclusions

The object of this study was to model industry prices. This has been done.

The model tracks the general level of prices for a period of four years after taking as given crude materials, which constitute 13% of the WPI and which have been unpredictable. The errors at the industry level are sometimes large, but explanations have been adduced which show that they are not fatal flaws. Comparison with a stylized simulation using invented equations suggests that much of the strength in the model resides in the endogenous computation of costs from prices, and that the particular equations are less important. However, the estimated equations give a margin of accuracy and different results. Since in 87 of our 137 equations, one or both elasticities are at the limit of the acceptable range, it is unlikely that by moving elasticities to the center of that range, we would then get similar aggregate results.

Table 7. Price Simulations and Forecasts to 1978 under Three Assumptions

		Comparison for June, 1974					Comparison for Dec, 1978		
		ACTUAL Index	BASE Index	BASE %Err	CRUDE %Dif	STANDARD %Dif	BASE Index	CRUDE %Dif	STANDARD %Dif
186	Wholesale Price Index	1.522	1.524	.1	-14.1	1.2	1.954	-25.2	4.5
187	DEFLATORS:Gross National Product	1.737	1.704	-1.9	-6.4	5.5	2.210	-19.5	9.8
188	Personal Consumption Expenditu	1.473	1.452	-1.4	-6.6	5.7	1.856	-18.7	11.0
189	Durables	1.294	1.286	-.6	-3.6	19.1	1.669	-18.6	23.4
190	Non-Durables	1.760	1.833	4.1	-16.9	2.0	2.238	-24.4	6.2
191	Services	1.758	1.696	-3.5	-3.1	5.3	2.202	-16.6	11.1
192	Gross Private Fixed Investment	1.753	1.677	-4.3	-6.0	4.7	2.260	-21.3	6.2
193	Business Structures	2.146	2.004	-6.6	-8.1	.7	2.704	-22.4	3.7
194	Producers Durable Equipment	1.470	1.476	.4	-3.4	10.9	1.959	-19.7	10.8
195	Residential Construction	1.921	1.773	-7.7	-7.4	.5	2.432	-22.2	2.7
196	Exports	1.720	1.708	-.7	-16.8	4.2	2.227	-28.7	6.3
197	Government Expenditures	2.105	2.084	-1.0	-6.3	4.4	2.790	-21.4	6.0
198	Federal	1.945	2.017	3.7	-5.3	5.6	2.766	-21.7	3.2
199	State and Local	2.190	2.130	-2.7	-6.3	5.8	2.762	-20.5	10.7
200	Public Construction	2.577	2.384	-7.5	-8.9	-1.2	3.227	-22.5	2.5
1	Dairy Farm Products	1.647	1.647	.0	-19.8	.0	2.102	-29.7	3.0
2	Poultry and Eggs	1.272	1.272	.0	-15.6	.0	1.624	-26.1	3.0
3	Meat Animals, Oth Livestk	1.386	1.386	.0	11.0	.0	1.770	-2.7	3.0
4	Cotton	2.000	2.000	.0	-49.8	.0	2.553	-56.1	3.0
5	Grains	2.243	2.243	.0	-48.0	.0	2.863	-54.5	3.0
6s	Tobacco	.000	1.365	.0	-12.2	3.8	1.836	-20.6	9.7
7	Fruit,Vegetables,Oth Crops	2.002	2.002	.0	-36.0	.0	2.556	-43.9	3.0
8	Forestry + Fishery Prod.	1.585	1.585	.0	-21.7	.0	2.023	-31.4	3.0
10s	Agr,Forestry+Fish Services	.000	1.595	.0	-19.9	4.4	1.895	-23.6	5.5
11	Iron Ores	1.233	1.233	.0	-10.9	.0	1.574	-21.9	3.0
14	Coal Mining	3.215	3.215	.0	-36.1	.0	4.104	-44.1	3.0
15	Crude Petroleum, Nat. Gas	2.017	2.017	.0	-38.6	.0	2.262	-38.7	.0
16	Stone and Clay Mining	1.355	1.355	.0	-3.5	.0	1.729	-15.5	3.0
17	Chemical Fertilizer Mining	1.288	1.298	.8	-9.7	-5.7	1.319	8.8	38.6
18s	New Construction	.000	1.389	.0	-4.3	6.2	1.931	-18.8	10.0

Table 7. Price Simulations and Forecasts to 1978 under Three Assumptions (continued)

		Comparison for June, 1974					Comparison for Dec, 1978		
		ACTUAL	BASE	BASE	CRUDE	STANDARD	BASE	CRUDE	STANDARD
		Index	Index	%Err	%Dif	%Dif	Index	%Dif	%Dif
19s	Maintenance Construction	.000	1.663	.0	-3.1	1.9	2.329	-22.7	-.0
20s	Complete Guided Missiles	.000	1.483	.0	-1.2	5.7	2.225	-21.0	-.1
21	Ammunition	1.316	1.338	1.7	-3.4	22.8	1.827	-22.9	15.5
22	Other Ordnance	1.310	1.348	2.9	-2.6	20.8	1.752	-15.0	22.0
23	Meat Products	1.392	1.564	12.4	-9.8	9.7	1.700	-7.2	-1.6
24	Dairy Products	1.429	1.510	5.7	-13.8	7.2	1.941	-24.9	5.7
25	Canned and Frozen Foods	1.598	1.666	4.3	-15.2	-3.9	2.256	-27.9	-6.2
26	Grain Mill Products	1.666	1.616	-3.0	-24.0	12.8	1.979	-30.2	16.5
27	Bakery Products	1.600	1.605	.3	-16.5	-5.3	2.123	-27.3	-2.1
28	Sugar	3.254	2.430	-25.3	-42.6	-26.9	3.311	-45.9	-27.4
29	Confectionery Products	1.517	1.478	-2.6	-10.9	22.4	1.974	-23.5	20.6
30	Alcoholic Beverages	1.218	1.251	2.7	-5.4	19.8	1.509	-16.4	36.6
31	Soft Drinks and Flavorings	1.472	1.431	-2.8	-5.3	10.5	1.977	-21.1	6.6
32	Fats and Oils	1.958	2.167	10.7	-38.1	-14.5	2.603	-41.6	-8.6
33	Misc Food Products	1.718	1.693	-1.4	-17.2	-3.4	2.193	-27.8	-1.8
34	Tobacco Products	1.348	1.395	3.5	-3.3	7.3	1.767	-17.7	14.1
35	Broad and Narrow Fabrics	1.668	1.671	.2	-20.7	-5.0	2.202	-30.5	-10.3
36	Floor Coverings	1.111	1.139	2.5	-7.7	21.4	1.194	-20.1	53.4
37	Misc Textiles	1.340	1.160	-13.4	-7.0	16.8	1.311	-13.6	32.5
38	Knitting	1.140	1.133	-.7	-9.5	14.2	1.187	-20.3	52.2
39	Apparel	1.310	1.423	8.6	-9.9	7.7	1.883	-23.5	4.8
40	Household Textiles	1.533	1.441	-6.0	-13.3	-1.0	1.835	-23.2	4.0
41	Lumber and Wood Products	2.202	2.249	2.1	-23.0	-36.4	3.546	-35.7	-42.1
42	Veneer and Plywood	1.629	1.595	-2.1	-11.4	-15.1	2.517	-32.1	-23.0
43	Millwork and Wood Products	1.586	1.487	-6.2	-5.6	-4.6	2.031	-21.0	-2.0
44	Wooden Containers	1.693	1.507	-11.0	-3.6	11.3	2.126	-23.5	-.7
45	Household Furniture	1.355	1.336	-1.4	-3.0	12.3	1.757	-16.4	13.3
46	Other Furniture	1.473	1.427	-3.1	-4.0	9.9	1.918	-20.2	6.5
47	Pulp Mills	2.057	1.543	-25.0	-8.6	-6.2	2.300	-31.3	-12.5
48	Paper and Paperboard Mills	1.445	1.352	-6.4	-6.5	5.5	1.745	-20.2	15.6
49	Paper Products, Nec	1.501	1.473	-1.8	-7.8	1.0	1.943	-21.7	4.1

Bibliography

[1] Almon, Clopper,Jr., Margaret B. Buckler, Lawrence M. Horwitz, Thomas C. Reimbold. 1985:Interindustry Forecasts of the American Economy. Lexington, Massachusetts:Lexington Books, 1974.
[2] Almon, Shirley M. "The Distributed Lag between Capital Appropriations and Expenditures," Econometrica (1963).
[3] Prepared for the American Economic Association and the Royal Economic Society. Surveys of Economic Theory. New York:St. Martin's Press, 1966.
[4] Belzer, David. "Industry Wage Estimation - A Summary Report," INFORUM Research Memorandum No. 39, University of Maryland, 1973.
[5] Bodkin, Ronald G. The Wage-Price-Productivity Nexus. Philadelphia: University of Pennsylvania Press, 1966.
[6] Bowen, William G. The Wage-Price Issue:A Theoretical Analysis. New York:Greenwood Press, 1960.
[7] Bronfenbrenner, Martin, and F. D. Holzman. "A Survey of Inflation Theory," in [3].
[8] Dantzig, George B. Linear Programming and Extensions. Princeton:Princeton University Press, 1963.
[9] Dicks-Mireau, L. A. "A Study of Inflation in Post-War Britain," Oxford Economic Papers. XIII (October 1961), pp.267-292.
[10] Duesenbury, James S, Gary Fromm, Lawrence R. Klein, and Edwin Kuh, editors. Brookings Quarterly Model of the United States. Chicago:Rand McNally, 1965.
[11] Earl, Paul H. Inflation and the Structure of Industrial Prices. Lexington, Massachusetts:Lexington Books, 1973.
[12] Eckstein, Otto. "A Theory of the Wage-Price Process in Modern Industry," Review of Economic Studies. XXXI(October 1964), pp. 267-287.
[13] Eckstein, Otto, editor. The Econometrics of Price Determination. Washington, D.C.:Board of Governors of the Federal Reserve System and the Social Science Research Council, 1972.
[14] Eckstein, Otto, and Gary Fromm. "The Price Equation." The American Economic Review LVIII (December 1968), pp. 1159-1184.
[15] Eckstein, Otto, and David Wyss. "Industry Price Equations," in [13].
[16] Fromm, Gary, and Paul Taubman. Policy Simulations with an Econometric Model. Washington, D.C.:Brookings Institution, 1968.
[17] Gordon, Robert J. "The Recent Acceleration of Inflation and Its Lessons for the Future," Brookings Papers in Economic Activity, (1:1970), pp. 8-41.
[18] Heien, Dale, and Joel Popkin. "Price Determination and

Table 7. Price Simulations and Forecasts to 1978 under Three Assumptions (continued)

		Comparison for June, 1974					Comparison for Dec, 1978		
		ACTUAL	BASE	BASE	CRUDE	STANDARD	BASE	CRUDE	STANDARD
		Index	Index	%Err	%Dif	%Dif	Index	%Dif	%Dif
50	Wall and Building Paper	1.350	1.234	-8.6	-1.5	2.0	1.298	-3.0	43.3
51	Paperboard Containers	1.439	1.423	-1.1	-8.1	.8	1.939	-24.7	3.1
52	Newspapers	1.574	1.569	-.3	-1.7	5.7	2.140	-15.4	3.5
53s	Periodicals	.000	1.370	.0	-1.6	7.8	1.845	-17.4	13.5
54s	Books	.000	1.513	.0	-1.2	7.1	1.930	-16.4	13.1
55	Industrial Chemicals	1.201	1.153	-4.0	-8.8	15.8	1.186	-11.3	58.0
59	Fertilizers	1.313	1.289	-1.8	-13.9	-.9	1.318	-13.2	35.9
60	Pesticides + Agric. Chem.	1.132	1.181	4.3	-2.1	20.5	1.435	-29.9	34.5
61	Misc Chemical Products	1.755	1.620	-7.7	-11.8	-7.4	2.278	-26.1	-8.3
62	Plastic Matls. + Resins	1.396	1.322	-5.3	-28.4	-10.6	1.301	-29.8	29.3
63	Synthetic Rubber	1.360	1.156	-15.0	-11.1	14.4	1.112	-8.5	66.8
64	Cellulosic Fibers	1.161	1.165	.3	-2.9	16.6	1.407	-15.5	30.5
65	Non-Cellulosic Fibers	.985	1.059	7.5	-5.3	25.2	1.113	-13.7	62.9
66	Drugs	1.113	1.227	10.3	-7.9	9.0	1.540	-22.7	21.9
67	Cleaning + Toilet Prod.	1.226	1.208	-1.5	-3.0	20.2	1.359	-8.2	47.5
68	Paints	1.465	1.422	-2.9	-6.6	6.0	1.849	-20.6	12.2
69	Petroleum Refining	2.017	2.182	8.2	-46.4	-33.7	2.153	-42.2	-1.8
70	Fuel Oil	2.968	3.101	4.5	-59.6	.0	3.101	-54.8	.0
71	Paving and Asphalt	2.185	2.159	-1.2	-34.1	-34.5	2.388	-37.6	-12.8
72	Tires and Inner Tubes	1.310	1.234	-5.8	-4.7	13.0	1.477	-16.6	26.9
73	Rubber Products	1.386	1.468	5.8	-8.1	3.5	1.943	-23.2	3.2
74	Misc Plastic Products	1.105	.985	-10.9	4.6	30.8	.908	14.5	92.5
75	Leather + Ind Lthr Prod	1.571	1.911	21.7	-3.7	-21.5	3.169	-29.0	-34.7
76	Footwear(exc. Rubber)	1.426	1.717	20.4	-5.0	-14.3	2.509	-25.5	-20.9
77	Other Leather Products	1.208	1.227	1.6	-2.1	17.6	1.522	-13.9	23.8
78	Glass	1.591	1.645	3.4	-7.4	5.5	2.201	-22.9	3.7
79	Structural Clay Products	1.362	1.433	5.2	-6.6	7.4	1.827	-19.4	15.7
80	Pottery	1.510	1.553	2.8	-6.0	.1	2.160	-22.4	-3.8
81	Cement, Concrete, Gypsum	1.505	1.521	1.1	-7.9	-.3	2.010	-23.4	7.4
82	Other Stone + Clay Prod.	1.418	1.439	1.5	-4.8	7.7	1.950	-22.3	5.2
83	Steel	1.699	1.554	-8.5	-8.2	-4.1	2.236	-27.1	-5.6

Table 7. Price Simulations and Forecasts to 1978 under Three Assumptions (continued)

		Comparison for June, 1974					Comparison for Dec, 1978		
		ACTUAL Index	BASE Index	BASE %Err	CRUDE %Dif	STANDARD %Dif	BASE Index	CRUDE %Dif	STANDARD %Dif
84	Copper	2.054	2.054	.0	-35.7	-25.0	2.622	-43.7	-23.1
85	Lead	2.087	2.087	.0	-41.7	-41.6	2.664	-48.9	-34.1
86	Zinc	2.730	2.730	.0	-50.2	-59.6	3.485	-56.4	-53.6
87	Aluminum	1.569	1.569	.0	-26.7	-10.2	2.003	-35.8	-3.6
88	Oth Prim Non-Fer Metals	2.609	2.609	.0	-43.1	-46.1	3.330	-50.1	-41.7
89s	Oth Non-Fer Roll + Draw	.000	1.626	.0	-13.8	-11.5	2.497	-40.4	-21.3
90	Non-Ferrous Wire Drawing	1.848	1.777	-3.9	-24.5	-18.1	2.392	-37.4	-16.5
91s	Non-fer Casting + Forging	.000	1.659	.0	-11.1	-5.7	2.552	-34.9	-18.8
92	Metal Cans	1.655	1.568	-5.3	-7.9	-10.8	2.170	-24.3	-9.0
93	Metal Barrels and Drums	1.651	1.494	-9.5	-6.8	4.6	2.039	-23.3	4.0
94	Plumbing + Heating Equip.	1.411	1.492	5.7	-10.8	-1.6	1.982	-26.9	-1.5
95	Structural Metal Products	1.588	1.515	-4.6	-12.4	-4.3	1.917	-24.7	3.0
96	Screw Machine Products	1.709	1.624	-5.0	-6.4	-.5	2.455	-25.6	-13.3
97	Metal Stampings	1.495	1.597	6.8	-6.8	-1.0	2.157	-24.7	1.9
98	Cutlery,Hand Tools,Hardwr	1.353	1.391	2.8	-3.9	4.9	1.908	-21.6	3.2
99	Misc Fabricated Wire Products	1.513	1.517	.3	-13.8	-.8	1.864	-25.8	9.5
100	Pipes, Valves, Fittings	1.660	1.586	-4.4	-12.6	-3.6	2.160	-27.4	-4.6
101	Oth Fabricated Metal Prod.	1.418	1.405	-.9	-2.0	9.9	2.061	-23.2	-.9
102	Engines and Turbines	1.400	1.416	1.2	-4.5	9.4	1.897	-19.2	9.5
103	Farm Machinery	1.399	1.325	-5.3	-1.8	17.5	1.867	-18.4	9.0
104	Constr,Mine,oilfield Mach	1.493	1.416	-5.2	-2.4	14.2	2.041	-19.6	5.3
105	Materials Handling Mach.	1.414	1.414	.0	-2.4	13.1	2.001	-20.4	3.5
106s	Mach. Tools, Metal Cutting	.000	1.486	.0	-2.3	9.3	1.930	-23.3	6.4
107s	Mach Tools, Metal Forming	.000	1.603	.0	-2.3	6.9	2.123	-23.8	2.2
108	Other Metal Working Mach	1.261	1.276	1.2	-1.3	16.8	1.731	-17.1	13.1
109	Special Industrial Mach	1.489	1.471	-1.2	-4.5	9.2	2.101	-22.3	-4.3
110	Pumps,Compressors,Blowers	1.486	1.447	-2.6	-5.6	6.2	2.077	-24.3	-2.3
111	Ball and Roller Bearings	1.385	1.385	.0	-15.3	7.6	1.447	-29.3	38.4
112	Power Transmission Equip	1.489	1.434	-3.7	-1.5	8.9	2.179	-22.1	-5.1
113	Industrial Patterns	1.486	1.501	1.0	-4.3	6.5	2.252	-24.7	-10.3
114	Computers + Related Mach.	1.008	.956	-5.1	.2	1.7	.930	-3.5	27.9

Table 7. Price Simulations and Forecasts to 1978 under Three Assumptions (continued)

		Comparison for June, 1974					Comparison for Dec, 1978		
		ACTUAL Index	BASE Index	BASE %Err	CRUDE %Dif	STANDARD %Dif	BASE Index	CRUDE %Dif	STANDARD %Dif
115	Other Office Machinery	1.263	1.195	-5.4	-.7	23.0	1.477	-10.3	20.7
116	Service Industry Machinery	1.176	1.250	6.3	-10.0	16.6	1.428	-21.4	35.7
117	Machine Shop Products	1.577	1.609	2.0	-4.0	.6	2.408	-20.9	-14.3
118	Electrical Measuring Instruments	1.212	1.201	-.9	-2.6	20.4	1.495	-14.4	25.0
119	Transformers + Switchgear	1.223	1.157	-5.4	-9.3	18.6	1.242	-15.7	47.3
120	Motors and Generators	1.395	1.383	-.9	-13.6	5.7	2.002	-42.7	-5.5
121	Industrial Controls	1.297	1.169	-9.9	-2.9	18.5	1.537	-26.7	13.9
122	Welding App, Graphite Prod	1.452	1.407	-3.1	-14.2	3.3	1.683	-28.8	13.8
123	Household Appliances	1.148	1.140	-.7	-7.3	24.4	1.440	-23.3	34.0
124	Elec Lighting + Wiring Eq.	1.419	1.392	-1.9	-2.1	12.2	1.959	-21.2	8.3
125	Radio and TV Receiving	.931	.844	-9.4	-1.9	70.9	.748	-1.5	152.6
126	Phonograph Records	1.173	1.140	-2.8	-.5	-18.7	1.189	-3.5	-.3
128	Electronic Components	1.113	1.081	-2.9	-1.5	34.3	1.171	-6.2	63.7
129	Batteries	1.241	1.217	-2.0	-1.8	7.9	1.708	-22.5	7.7
130	Engine Electrical Equip.	1.423	1.406	-1.2	-3.4	22.6	2.157	-23.6	2.8
131	X-ray, Elec Equip,nec	1.517	1.537	1.3	-6.2	10.7	2.102	-23.2	5.9
132s	Truck, Bus, Trailer Bodies	.000	1.652	.0	-2.7	7.5	2.200	-23.5	3.9
133	Motor Vehicles	1.261	1.269	.6	-1.9	24.3	1.697	-18.2	26.4
134s	Aircraft	.000	1.636	.0	-1.3	6.4	2.288	-20.6	1.3
135s	Aircraft Engines	.000	1.709	.0	-2.9	4.6	2.449	-22.8	-6.1
136s	Aircraft Equipment, Nec	.000	1.589	.0	-2.4	6.4	2.325	-23.6	-2.3
137s	Ship and Boat Building	.000	1.541	.0	-3.4	5.9	2.127	-23.0	2.1
138	Railroad Equipment	1.635	1.553	-5.0	-2.9	-4.9	2.412	-27.0	-16.1
139	Cycles, Trans Equip Nec	1.435	1.363	-5.1	-4.6	17.6	1.763	-19.4	17.7
140s	Trailer Coaches	.000	1.468	.0	-3.1	8.1	2.105	-23.6	3.9
141s	Engr. + Scientific Instr.	.000	1.343	.0	-2.1	9.1	1.721	-19.5	10.9
142s	Mech. Measuring Devices	.000	1.523	.0	-3.9	6.8	2.085	-22.3	5.0
143s	Optical + Ophthalmic Goods	.000	1.630	.0	-2.9	4.3	1.968	-23.4	1.9
144s	Medical + Surgical Instr.	.000	1.662	.0	-5.2	3.2	2.124	-21.5	3.8
145	Photographic Equipment	1.170	1.155	-1.3	2.5	19.9	1.390	-7.4	29.0
146	Watches and Clocks	1.229	1.256	2.2	-5.4	17.4	1.424	-14.8	34.0

Table 7. Price Simulations and Forecasts to 1978 under Three Assumptions (continued)

		Comparison for June, 1974					Comparison for Dec, 1978		
		ACTUAL Index	BASE Index	BASE %Err	CRUDE %Dif	STANDARD %Dif	BASE Index	CRUDE %Dif	STANDARD %Dif
147	Jewelry and Silverware	2.040	1.869	-8.4	-14.8	-18.1	2.386	-23.2	-13.9
148	Toys,Sport,Musical Instr.	1.316	1.322	.5	-4.2	9.2	1.610	-16.2	17.6
149	Office Supplies	1.076	1.077	.1	1.2	20.3	1.183	-4.5	48.4
150	Misc Manufacturing, Nec	1.312	1.280	-2.4	-4.8	7.8	1.565	-16.7	16.9
151	Railroads	1.405	1.388	-1.2	-4.1	17.4	1.810	-19.3	17.5
153s	Trucking	.000	1.640	.0	-10.9	3.9	2.196	-24.2	4.5
154s	Water Transportation	.000	1.700	.0	-31.9	2.1	2.357	-39.1	1.1
155	Airlines	1.482	1.546	4.3	-8.4	-.6	2.170	-26.6	-6.9
156s	Pipelines	.000	1.504	.0	-3.8	3.5	2.149	-22.4	4.2
157s	Freight Forwarding	.000	1.529	.0	-.9	6.0	2.015	-15.6	10.8
158	Telephone and Telegraph	1.211	1.204	-.6	-.4	1.3	1.657	-19.7	7.2
159s	Radio and TV Broadcasting	.000	1.446	.0	-.3	5.9	1.875	-10.3	11.0
160	Electric Utilities	1.647	1.494	-9.3	-9.4	5.7	1.961	-27.0	25.9
161	Natural Gas	1.411	1.479	4.8	-9.8	2.4	1.613	-13.3	34.7
162	Water and Sewer Services	1.544	1.416	-8.3	.2	12.7	1.816	-2.8	21.5
163	Wholesale Trade	1.467	1.449	-1.3	-2.5	3.6	1.978	-19.2	5.0
164	Retail Trade	1.451	1.415	-2.5	-2.4	5.7	1.648	-18.1	11.2
165	Banks,Credit Agen.,Brokers	1.359	1.463	7.6	-3.1	16.6	1.670	-6.3	38.6
166	Insurance	1.350	1.449	7.4	-2.4	-.7	2.008	-15.6	-2.0
167	Owner-Occupied Dwellings	1.612	1.585	-1.7	-2.9	3.6	2.136	-19.6	4.0
168	Real Estate	1.298	1.257	-3.1	-.0	12.6	1.520	-10.4	25.6
169s	Hotel and Lodging Places	.000	1.458	.0	-1.2	4.7	1.993	-17.8	7.1
170	Personal + Repair Services	1.381	1.415	2.5	-3.4	5.5	1.892	-16.5	4.7
171	Business Services	1.755	1.734	-1.2	-3.1	-5.2	2.659	-23.4	-17.4
172s	Advertising	.000	1.661	.0	-.5	5.9	2.194	-14.0	8.1
173	Auto Repair	1.543	1.536	-.5	-2.6	4.2	2.081	-15.5	1.3
174	Movies + Amusements	1.403	1.395	-.6	-.2	7.7	1.773	-4.2	13.7
175	Medical Services	1.561	1.592	2.0	-5.6	.2	1.906	-11.2	11.1
176s	Private Schools + Npo	.000	.837	.0	-2.0	5.4	1.189	-18.9	9.6

Cost-of-Living Measures in a Disaggregated Model of the U.S. Economy," in [13].

[19] Keynes, John M. The General Theory of Employment, Interest, and Money. New York:Harcourt, Brace, 1936.

[20] Klein, Lawrence R. "Wage and Price Determination in Macroeconomics," in [26].

[21] Langholm, Odd. Full Cost and Optimal Price. Bergen, Norway:Scandanavian University Books, 1969.

[22] Means, Gardiner C. "The Administered-Price Thesis Reconfirmed," American Economic Review LXII (June 1972), pp. 292-306

[23] Nordhaus, William D. "Recent Developments in Price Dynamics," in [13].

[24] Patinkin, Don. Money, Interest, and Prices. New York: Harper and Row, 1965

[25] Perry, George L. Unemployment, Money Wage Rates and Inflation. Cambridge:Massachusetts Institute of Technology Press, 1966.

[26] Phelps, A.,and O.E. Williamson, editors. Prices:Issues in Theory, Practice and Public Policy. Philadelphia: University of Pennsylvania Press, 1967.

[27] Popkin, Joel. "Consumer and Wholesale Prices in a Model of Price Behavior by Stage of Processing," Review of Economics and Statistics

[28] Popkin, Joel, and Paul H. Earl. "Relationship between the Behavior of Consumer and Wholesale Prices," Proceedings of the Business and Economic Statistics Section - American Statistical Association (August 1971), pp. 40-45.

[29] Reimbold, Thomas C. "Simulation with a Dynamic Interindustry Forecasting Model," Unpublished doctoral dissertation, University of Maryland, 1974.

[30] Rousseas, Stephen W., editor. Inflation:Its Causes, Consequences, and Control. City:Calvin K. Kazanjian Economics Foundation, 1968.

[31] Schultze, Charles L. and Joseph L. Tryon. "Prices and Wages," in [10].

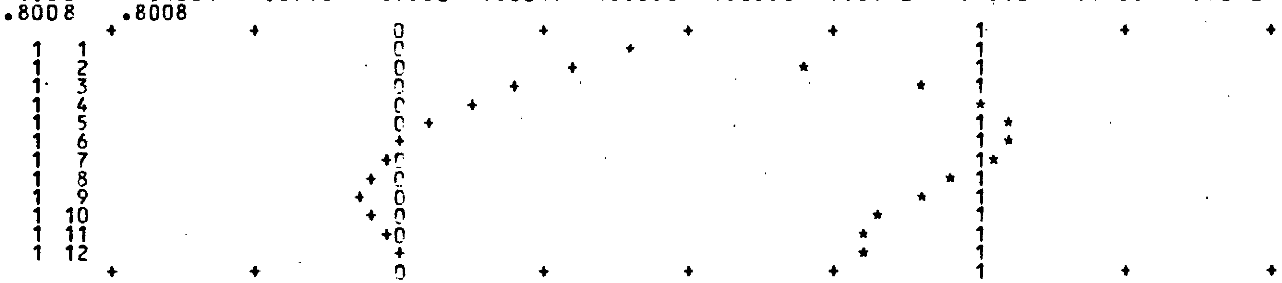
[32] Solow, Robert M. "Recent Controversy on the Theory of Inflation:An Eclectic View," in [30].

[33] Stigler, George, and James Kindahl. The Behavior of Industrial Prices. New York:National Bureau of Economic Research, 1970.

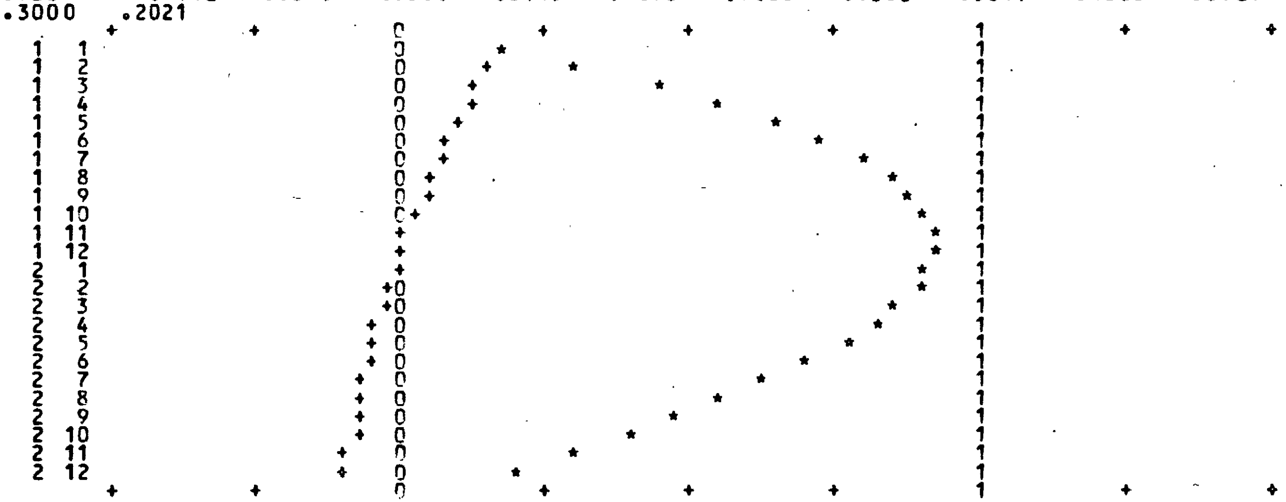
[34] Theil, Henri. A Textbook on Econometrics. 1961.

```
************************************************************
Industry 26   Grain Mill Products                          * BASIQ
************************************************************
RBARSQ =    .948   RTSQ =    .900    Intercept =   -.068      Durbin-Watson =   .70
```

```
    1 Unit Cost                      SUM =  .801                              HIGH POINT =
1.06       .4004    .6916    .8882  1.0047  1.0556  1.0556  1.0192   .9610   .8955   .8372
.8008    .8008
```

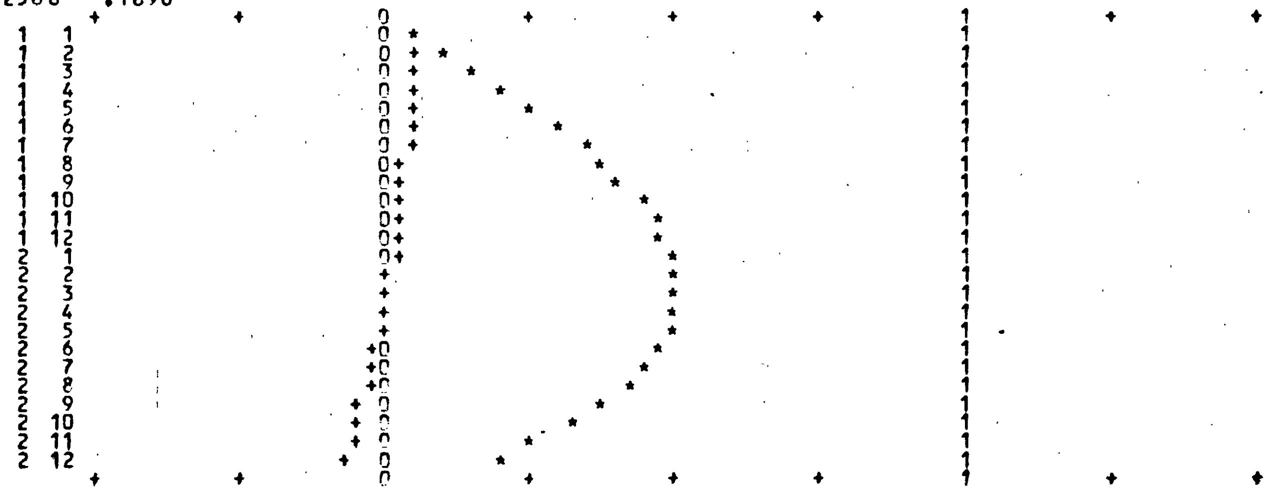


```
    2 Output Level                   SUM =  .202                              HIGH POINT =
.92
   .1646   .3114   .4407   .5534   .6498   .7307   .7967   .8483   .8860   .9106   .9227
.9227     .9112   .8890   .8566   .8145   .7633   .7038   .6363   .5617   .4803   .3929
.3000   .2021
```



```
*************************************************************
Industry 35   Broad and Narrow Fabrics                 * BASIQ
*************************************************************
RBARSQ =      .934   RTSQ =      .914     Intercept =    -.430       Durbin-Watson =   .14

   1 Unit Cost                          SUM = 1.250                                  HIGH POINT =
1.49      .5316     .9268   1.2030   1.3781   1.4695   1.4949   1.4721   1.4185   1.3519   1.2898
1.2500  1.2500
```

```
   2 Output Level                       SUM =  .189                                  HIGH POINT =
 .51
    .0540     .1068     .1579     .2070     .2537     .2976     .3384     .3757     .4091     .4383     .4628
.4823      .4964    .5047    .5069    .5026    .4914    .4730    .4469    .4128    .3704    .3192
.2588    .1890
```

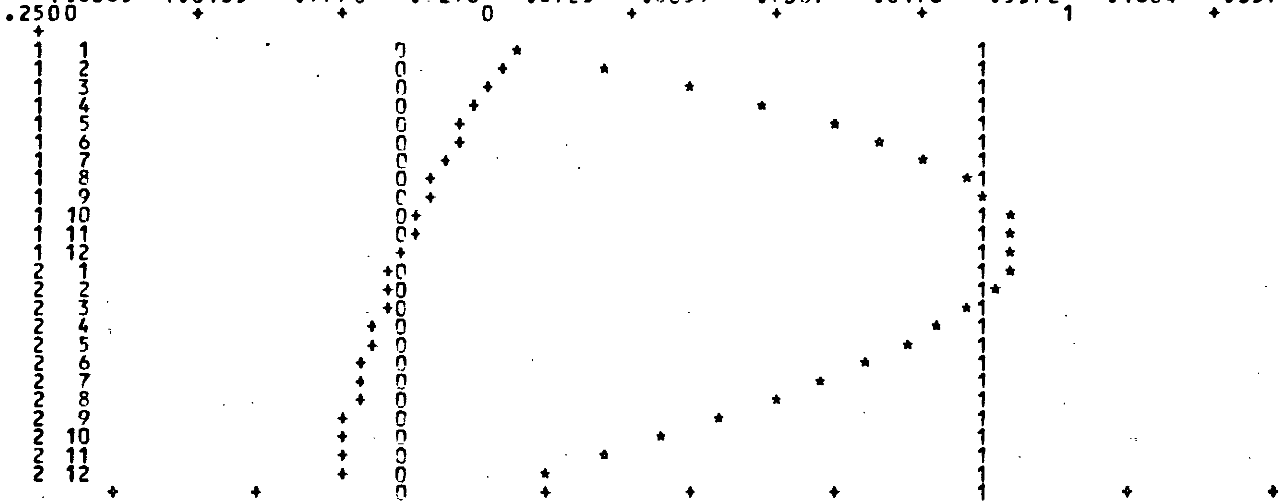


Plot for Industry 35   Page 128

```
**************************************************************
Industry 41   Lumber and Wood Products                * BASIQ
**************************************************************
RBARSQ =    .712   RTSQ =     .320    Intercept =    -.409       Durbin-Watson =   .02
```

```
   1 Unit Cost                          SUM = 1.250                                     HIGH POINT =
1.65     .6250  1.0795  1.3864  1.5682  1.6477  1.6477  1.5909  1.5000  1.3977  1.3068
1.2500  1.2500
```

```
   2 Output Level                       SUM =  .250                                     HIGH POINT =
1.05     .1892   .3557   .5033   .6317   .7416   .8336   .9086   .9671  1.0099  1.0378
1.0514  1.0514
  1.0385  1.0135   .9770   .9298   .8725   .8059   .7307   .6476   .5572   .4604   .3577
.2500
```



```
*****************************************************************
Industry  48   Paper and Paperboard Mills                 * BASIQ
*****************************************************************
RBARSQ =     .973   RTSQ =     .912     Intercept =     .222       Durbin-Watson =    .14

    1 Unit Cost                       SUM =  .750                           HIGH POINT =
 .75
    .1234    .2017    .2452    .2639    .2682    .2682    .2741    .2962    .3446    .4296    .5613
.7500       +        +           0            +        +        +          1        +
 +
 1  1                      0   *                                   1
 1  2                      0 +   *                                 1
 1  3                      0 +     *                               1
 1  4                      0+       *                              1
 1  5                      +        *                              1
 1  6                      +        *                              1
 1  7                      +        *                              1
 1  8                      0+        *                             1
 1  9                      0 +         *                           1
 1 10                      0  +           *                        1
 1 11                      0    +              *                   1
 1 12                      0      +                     *          1
        +        +         0         +        +         +          1        +        +

    2 Output Level                    SUM =  .025                           HIGH POINT =
 .02
    .0000  -.0002  -.0004  -.0008  -.0012  -.0016  -.0021  -.0025  -.0028  -.0030  -.0030
-.0029     -.0025  -.0020  -.0011   .0001   .0016   .0035   .0057   .0085   .0117   .0154
.0197    .0245
        +        +         0         +        +         +          1        +        +
 1  1                      *                                       1
 1  2                      *                                       1
 1  3                      *                                       1
 1  4                      *                                       1
 1  5                      *                                       1
 1  6                      *                                       1
 1  7                      *                                       1
 1  8                      *                                       1
 1  9                      *                                       1
 1 10                      *                                       1
 1 11                      *                                       1
 1 12                      *                                       1
 2  1                      *                                       1
 2  2                      *                                       1
 2  3                      *                                       1
 2  4                      *                                       1
 2  5                      *                                       1
 2  6                      *                                       1
 2  7                      *                                       1
 2  8                      *                                       1
 2  9                      *                                       1
 2 10                      +*                                      1
 2 11                      +*                                      1
 2 12                      +*                                      1
        +        +         0         +        +         +          1        +        +
```

```
****************************************************************
Industry 55   Industrial Chemicals                             * BASIQ
****************************************************************
RBARSQ =      .340   RTSQ =      .316      Intercept =      .383        Durbin-Watson =    .05

   1 Unit Cost                       SUM =  .750                                   HIGH POINT =
 .75
   .1733   .3177   .4358   .5302   .6036   .6586   .6978   .7240   .7396   .7474   .7500
.7500         +         +        0        +        +        +        1        +
 +
 1  1                   0    *                                  1
 1  2                   0   +      *                            1
 1  3                   0  +          *                         1
 1  4                   0 +              *                      1
 1  5                   0+                  *                   1
 1  6                   0+                    *                 1
 1  7                   0+                      *               1
 1  8                   0+                        *             1
 1  9                   0+                         *            1
 1 10                   +                          *            1
 1 11                   +                          *            1
 1 12                   +                          *            1
       +         +      0        +         +        +           1         +         +

   2 Output Level                    SUM = -.211                                   HIGH POINT =
 .15
   .0000   .0046   .0132   .0249   .0391   .0549   .0717   .0888   .1053   .1205   .1338
.1443   .1514   .1542   .1521   .1443   .1302   .1088   .0796   .0417  -.0055  -.0629
-.1311  -.2109
       +         +      0        +         +        +           1         +         +
 1  1                   *                                       1
 1  2                   *                                       1
 1  3                   +*                                      1
 1  4                   +*                                      1
 1  5                   0+*                                     1
 1  6                   0+*                                     1
 1  7                   0+ *                                    1
 1  8                   0+  *                                   1
 1  9                   0+  *                                   1
 1 10                   0+   *                                  1
 1 11                   0+   *                                  1
 1 12                   +     *                                 1
 2  1                   +     *                                 1
 2  2                   +     *                                 1
 2  3                   +     *                                 1
 2  4                   +     *                                 1
 2  5                  +0    *                                  1
 2  6                  +0   *                                   1
 2  7                  +0  *                                    1
 2  8                 + 0 *                                     1
 2  9                 + *                                       1
 2 10                **+0                                       1
 2 11              *  + 0                                       1
 2 12           *     + 0                                       1
       +         +      0        +         +        +           1         +         +
```

```
*****************************************************
Industry  78   Glass                                * PASIQ
*****************************************************
RBARSQ =    .959   RTSQ =    .835    Intercept =   -.361       Durbin-Watson =   .09

   1 Unit Cost                         SUM = 1.250                                 HIGH POINT =
1.44     .4955    .8677  1.1321  1.3045  1.4005  1.4358  1.4261  1.3870  1.3342  1.2833
1.2500  1.2500
      +         +          0         +         +         +         1          +         +
 1  1                      0                   *                   1
 1  2                      0              *                   *    1
 1  3                      0          *                            1     *
 1  4                      0      *                                1            *
 1  5                      0   *                                   1                *
 1  6                      0+                                      1                 *
 1  7                      +                                       1                 *
 1  8                    + 0                                       1              *
 1  9                    + 0                                       1             *
 1 10                    + 0                                       1           *
 1 11                     +0                                       1          *
 1 12                      +                                       1          *
      +         +          0         +         +         +         1          +         +

   2 Output Level                      SUM =  .169                              HIGH POINT =
 .17
   .0289   .0537   .0745   .0918   .1059   .1170   .1255   .1316   .1358   .1382   .1393
.1393   .1385   .1373   .1360   .1348   .1341   .1342   .1354   .1381   .1424   .1488
.1576   .1690
      +         +          0         +         +         +         1          +         +
 1  1                      0*                                      1
 1  2                      0+*                                     1
 1  3                      0+ *                                    1
 1  4                      0+  *                                   1
 1  5                      0+  *                                   1
 1  6                      +    *                                  1
 1  7                      +    *                                  1
 1  8                      +    *                                  1
 1  9                      +    *                                  1
 1 10                      +     *                                 1
 1 11                      +     *                                 1
 1 12                      +     *                                 1
 2  1                      +     *                                 1
 2  2                      +    *                                  1
 2  3                      +    *                                  1
 2  4                      +    *                                  1
 2  5                      +    *                                  1
 2  6                      +    *                                  1
 2  7                      +    *                                  1
 2  8                      +     *                                 1
 2  9                      +     *                                 1
 2 10                      +     *                                 1
 2 11                      +     *                                 1
 2 12                      +      *                                1
      +         +          0         +         +         +         1          +         +
```

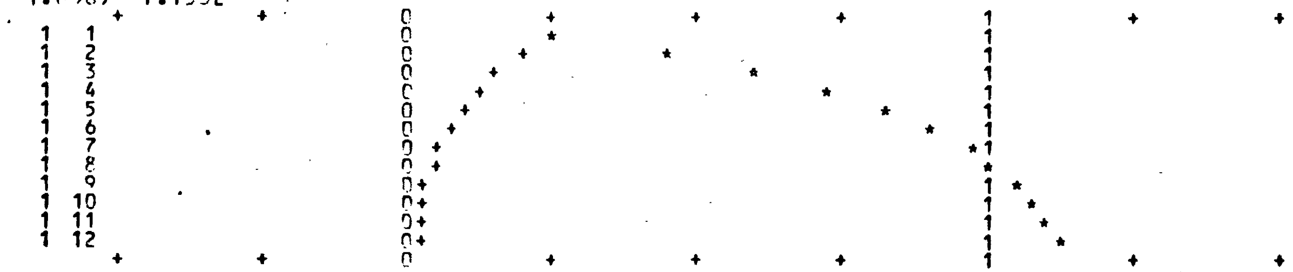
```
**************************************************************
Industry  83   Steel                                         * BASIC
**************************************************************
REARSQ =     .982   RTSQ =     .933     Intercept =    -.184*      Durbin-Watson =    .21

   1 Unit Cost                        SUM = 1.138    T STATISTIC = 73.34            HIGH POINT =
1.14       .2083*   .3813*   .5233*   .6388*   .7322*   .8078*   .8703*   .9239*   .9730* 1.0222*
1.0758* 1.1382*
  ( 8.09) (10.67) (12.94) (10.79) ( 7.47) ( 5.54) ( 4.65) ( 4.50) ( 4.72) ( 4.04) ( 2.82) (
2.10)        +         +         0         +         +         +         1         +
  +
  1  1                     0       *                               1
  1  2                     0      +       *                        1
  1  3                     0     +              *                  1
  1  4                     0    +                    *             1
  1  5                     0   +                        *          1
  1  6                     0  +                            *       1
  1  7                     0 +                                *    1
  1  8                     0 +                                  *  1
  1  9                     0 +                                    *1
  1 10                     0 +                                     1*
  1 11                     0 +                                     1  *
  1 12                     0 +                                     1     *
       +         +         0         +         +         +         1         +         +

   2 Output Level                     SUM =  .058    T STATISTIC =  4.03            HIGH POINT =
  .06
    .0082*   .0143*   .0184*   .0210    .0221    .0219    .0208    .0189    .0163*   .0135*   .0105*
  .0075*    ( 2.52) ( 2.33) ( 2.03) ( 1.56) (  .82) (  .12) (  .98) ( 1.54) ( 1.81) ( 1.91) (
1.89) ( 1.78)
    .0049    .0028    .0014    .0009    .0017    .0038    .0075*   .0130*   .0206*   .0304*   .0427*
  .0577*    ( 1.59) ( 1.31) (  .90) (  .30) (  .54) ( 1.66) ( 2.94) ( 3.99) ( 4.57) ( 4.77) (
4.78) ( 4.71)
       +         +         0         +         +         +         1         +         +
  1  1                     *                                       1
  1  2                     +*                                      1
  1  3                     +*                                      1
  1  4                     +*                                      1
  1  5                     +*                                      1
  1  6                     +*                                      1
  1  7                     +*                                      1
  1  8                     +*                                      1
  1  9                     +*                                      1
  1 10                     +*                                      1
  1 11                     *                                       1
  1 12                     *                                       1
  2  1                     *                                       1
  2  2                     *                                       1
  2  3                     *                                       1
  2  4                     *                                       1
  2  5                     *                                       1
  2  6                     *                                       1
  2  7                     *                                       1
  2  8                     +*                                      1
  2  9                     +*                                      1
  2 10                     +*                                      1
  2 11                     + *                                     1
  2 12                     0+*                                     1
       +         +         0         +         +         +         1         +         +
```

```
***************************************************
Industry 102   Engines and Turbines              * BASIQ
***************************************************
RBARSQ =     .983   RTSQ =     .922     Intercept =     .138       Durbin-Watson =    .10

   1 Unit Cost                      SUM =  .750                          HIGH POINT =
 .75
    .2332    .4129    .5457    .6386   .6981    .7311    .7444    .7445    .7384    .7328    .7344
.7500                                0                                        1
 +         +        +                          +        +        +                  +
 1  1                  0       *
 1  2                  0     *        *
 1  3                  0    *              *
 1  4                  0   *                   *
 1  5                  0 +                       *
 1  6                  0+                         *
 1  7                  0+                          *
 1  8                  +                           *
 1  9                  +                           *
 1 10                  +                          *
 1 11                  +                          *
 1 12                  0+                          *
      +        +       0        +        +        +         1        +        +

   2 Output Level                   SUM =  .127                          HIGH POINT =
 .14
    .0034    .0081    .0140    .0209    .0287    .0371    .0462    .0556    .0652    .0749    .0844
.0938    .1026    .1110    .1185    .1252    .1308    .1351    .1381    .1396    .1393    .1372
.1330    .1267
      +        +       0        +        +        +         1        +        +
 1  1                  *                                    1
 1  2                  *                                    1
 1  3                  +*                                   1
 1  4                  +*                                   1
 1  5                  +*                                   1
 1  6                  +*                                   1
 1  7                  + *                                  1
 1  8                  + *                                  1
 1  9                  +  *                                 1
 1 10                  +  *                                 1
 1 11                  +  *                                 1
 1 12                  +   *                                1
 2  1                  +   *                                1
 2  2                  +   *                                1
 2  3                  +    *                               1
 2  4                  +    *                               1
 2  5                  +    *                               1
 2  6                  +    *                               1
 2  7                  +     *                              1
 2  8                  +     *                              1
 2  9                  +     *                              1
 2 10                  +    *                               1
 2 11                  +    *                               1
 2 12                  +    *                               1
      +        +       0        +        +        +         1        +        +
```

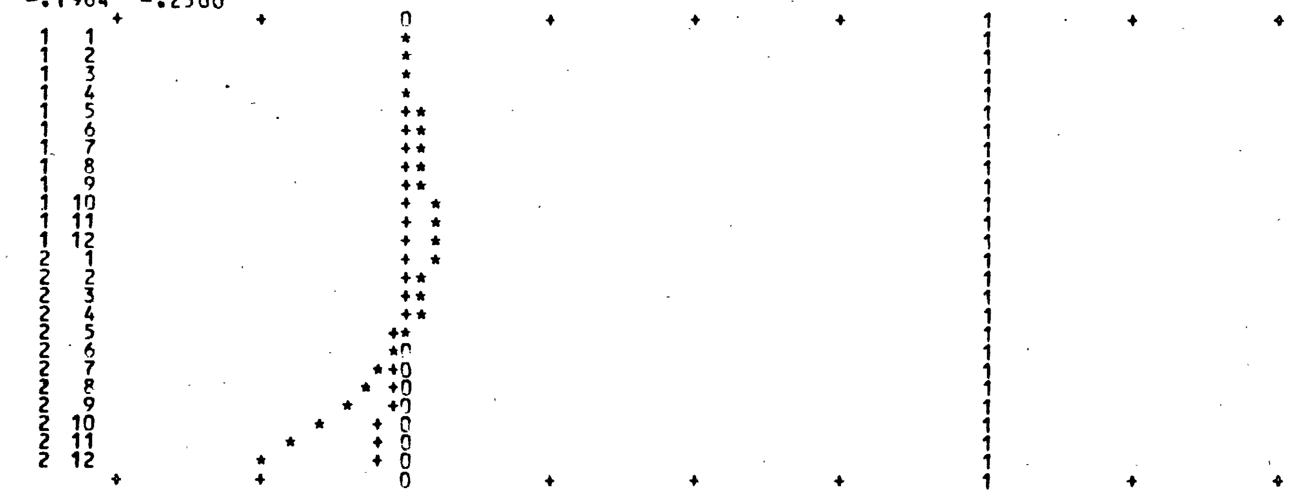
```
************************************************************
Industry 104   Constr,Mine,Oilfield Mach                 * BASIQ
************************************************************
RBARSQ =     .986   RTSQ =     .821     Intercept =    -.230        Durbin-Watson =   .05

    1 Unit Cost                       SUM =  .996                                      HIGH POINT =
 1.00       .1734     .2848     .3479     .3762     .3835     .3835     .3899     .4162     .4763    .5836
.7523    .9955
         +         +         0         +         +         +         1         +         +
 1   1                       0     *
 1   2                       0  +     *
 1   3                       0 +         *
 1   4                       0+           *
 1   5                       +            *
 1   6                       +            *
 1   7                       +             *
 1   8                       0+             *
 1   9                       0 +              *
 1  10                       0  +                 *
 1  11                       0     *                  *
 1  12                       0        +               *
         +         +         0        +    +         +         1         +         +

    2 Output Level                    SUM =  .250                                      HIGH POINT =
 .25
     .0230    .0434    .0615    .0774    .0913    .1035    .1141    .1233    .1314    .1386    .1449
.1507    .1562    .1615    .1668    .1724    .1784    .1851    .1926    .2012    .2110    .2223
.2352    .2500
         +         +         0         +         +         +         1         +         +
 1   1                       0*                                      1
 1   2                       0++                                     1
 1   3                       0++                                     1
 1   4                       0+ *                                    1
 1   5                       0+  *                                   1
 1   6                       +   *                                   1
 1   7                       +    *                                  1
 1   8                       +    *                                  1
 1   9                       +    *                                  1
 1  10                       +     *                                 1
 1  11                       +     *                                 1
 1  12                       +     *                                 1
 2   1                       +     *                                 1
 2   2                       +     *                                 1
 2   3                       +      *                                1
 2   4                       +      *                                1
 2   5                       +      *                                1
 2   6                       +      *                                1
 2   7                       +       *                               1
 2   8                       +       *                               1
 2   9                       +       *                               1
 2  10                       +        *                              1
 2  11                       0+       *                              1
 2  12                       0+        *                             1
         +         +         0         +         +         +         1         +         +
```

```
*************************************************************
Industry 119   Transformers + Switchgear                  * PASIO
*************************************************************
RBARSQ =     .304   RTSQ =     .271     Intercept =     .357        Durbin-watson =    .03

    1 Unit Cost                           SUM =  .750                                 HIGH POINT =
 .89
    .3159    .5511    .7159    .8207    .8759    .8920    .8794    .8485    .8096    .7734    .7500
.7500                +        +        0        +        +        +        1        +
 +
 1  1                           0            *                            1
 1  2                           0        +         *                      1
 1  3                           0      +               *                  1
 1  4                           0    +                     *              1
 1  5                           0  +                         *            1
 1  6                           0+                            *           1
 1  7                          +0                            *            1
 1  8                          +0                          *              1
 1  9                         + 0                        *                1
 1 10                          +0                      *                  1
 1 11                          +0                     *                   1
 1 12                           +                     *                   1
       +         +              0         +         +    +               1          +          +

    2 Output Level                        SUM = -.165                                 HIGH POINT =
 .03
    .0000    .0013    .0036    .0067    .0102    .0141    .0179    .0215    .0246    .0269    .0281
.0281     .0266    .0233    .0179    .0102   -.0000   -.0131   -.0292   -.0486   -.0717   -.0985
 -.1295   -.1648
       +         +              0         +         +         +          1          +          +
 1  1                           *                                         1
 1  2                           *                                         1
 1  3                           *                                         1
 1  4                           *                                         1
 1  5                           *                                         1
 1  6                           +*                                        1
 1  7                           +*                                        1
 1  8                           +*                                        1
 1  9                           +*                                        1
 1 10                           +*                                        1
 1 11                           +*                                        1
 1 12                           +*                                        1
 2  1                           +*                                        1
 2  2                           +*                                        1
 2  3                           +*                                        1
 2  4                           *                                         1
 2  5                           *                                         1
 2  6                          *0                                         1
 2  7                          *0                                         1
 2  8                        * +0                                         1
 2  9                       *  +0                                         1
 2 10                     *    +0                                         1
 2 11                    *     +0                                         1
 2 12                  *       +0                                         1
       +         +              0         +         +         +          1          +          +
```

```
*****************************************************************
Industry 120   Motors and Generators                    * BASIQ
*****************************************************************
RBARSQ =     .582   RTSQ =      .588    Intercept =   ^.136        Durbin-Watson =    .02

   1 Unit Cost                          SUM = 1.133                                    HIGH POINT =
1.13      .2415    .4404    .6016    .7297    .8295    .9057    .9630   1.0063  1.0402  1.0695
1.0989  1.1332
```



```
   2 Output Level                       SUM = -.250                                    HIGH POINT =
 .04
    .0000    .0019    .0054    .0101    .0155    .0214    .0272    .0326    .0373    .0408    .0427
.0427     .0404    .0353    .0272    .0155   -.0000   -.0196   -.0443   -.0738   -.1087   -.1495
-.1964   -.2500
```



```
*****************************************************
Industry 133   Motor Vehicles                      * BASIQ
*****************************************************
RBARSQ =    .973   RTSQ =    .900   Intercept =    .734     Durbin-Watson =   .31
  1 Unit Cost                      SUM =  .750                         HIGH POINT =
 .75
    .0000   .0183   .0529   .1015   .1623   .2330   .3116   .3960   .4641   .5739   .6632
.7500
 +          +          +          0          +          +          +          1          +
 1  1                   *                                          1
 1  2                   0*                                         1
 1  3                   0++                                        1
 1  4                   0 + *                                      1
 1  5                   0 +  *                                     1
 1  6                   0  +    *                                  1
 1  7                   0  +       *                               1
 1  8                   0  +           *                           1
 1  9                   0   +             *                        1
 1 10                   0   +                 *                    1
 1 11                   0   +                     *                1
 1 12                   0  +                         *             1
     +         +        0         +         +         +            1         +         +
  2 Output Level                   SUM = -.062                         HIGH POINT =
 .01
    .0000   .0005   .0014   .0025   .0039   .0053   .0068   .0081   .0093   .0102   .0107
.0107   .0101   .0088   .0068   .0039  -.0000  -.0049  -.0110  -.0184  -.0271  -.0373
 -.0490  -.0624
     +         +        0         +         +         +            1         +         +
 1  1                   *                                          1
 1  2                   *                                          1
 1  3                   *                                          1
 1  4                   *                                          1
 1  5                   *                                          1
 1  6                   *                                          1
 1  7                   *                                          1
 1  8                   *                                          1
 1  9                   *                                          1
 1 10                   *                                          1
 1 11                   *                                          1
 1 12                   *                                          1
 2  1                   *                                          1
 2  2                   *                                          1
 2  3                   *                                          1
 2  4                   *                                          1
 2  5                   *                                          1
 2  6                   *                                          1
 2  7                   *                                          1
 2  8                  **+                                         1
 2  9                  **+                                         1
 2 10                  **+                                         1
 2 11                 *  +                                         1
 2 12                 **+0                                         1
     +         +        0         +         +         +            1         +         +
```

```
*************************************************************
Industry 158   Telephone and Telegraph                     * BASIQ
*************************************************************
RBARSQ =    .908   RTSQ =    .781     Intercept =    .098       Durbin-Watson =   .10

    1 Unit Cost                          SUM = 1.059                                  HIGH POINT =
1.06     .0410    .0673    .0860    .1040    .1282    .1657    .2234    .3083    .4273    .5875
.7958  1.0591
       +        +        0        +        +        +        1        +        +
 1  1                    0 *                                 1
 1  2                    0+ *                                1
 1  3                    0+ *                                1
 1  4                    0+  *                               1
 1  5                    0+   *                              1
 1  6                    0+     *                            1
 1  7                    0 +      *                          1
 1  8                    0  +        *                       1
 1  9                    0   +            *                  1
 1 10                    0    +                  *           1
 1 11                    0      +                      *     1
 1 12                    0        +                          1 *
       +        +        0        +        +        +        1        +        +

    2 Output Level                       SUM = -.179                                  HIGH POINT =
 .03
     .0000    .0014    .0039    .0072    .0111    .0152    .0194    .0233    .0266    .0291    .0305
.0305    .0288    .0252    .0194    .0111   -.0000   -.0141   -.0316   -.0527   -.0776   -.1067
-.1403   -.1785
       +        +        0        +        +        +        1        +        +
 1  1                    *                                   1
 1  2                    *                                   1
 1  3                    *                                   1
 1  4                    *                                   1
 1  5                    *                                   1
 1  6                    +*                                  1
 1  7                    +*                                  1
 1  8                    +*                                  1
 1  9                    +*                                  1
 1 10                    +*                                  1
 1 11                    +*                                  1
 1 12                    +*                                  1
 2  1                    +*                                  1
 2  2                    +*                                  1
 2  3                    +*                                  1
 2  4                    *                                   1
 2  5                    *                                   1
 2  6                   *0                                   1
 2  7                   *0                                   1
 2  8                 * +0                                   1
 2  9                *  +0                                   1
 2 10              *    +0                                   1
 2 11           *       +0                                   1
 2 12         *        + 0                                   1
       +        +        0        +        +        +        1        +        +
```

```
**************************************************** 
Industry 160   Electric Utilities                  * RASIQ
****************************************************
RBARSQ =    .952   RTSQ =    .911     Intercept =    .413       Durbin-Watson =   .06

   1 Unit Cost                  SUM =  .750                                 HIGH POINT =
  .75
    .2741   .4689   .5966   .6695   .6998   .6998   .6817   .6579   .6405   .6419   .6743
.7500        +         +         0         +         +         +         1         +
  +
  1  1                     0          *                            1
  1  2                     0       +          *                    1
  1  3                     0    +                  *               1
  1  4                     0  +                       *            1
  1  5                     0+                          *           1
  1  6                     +                           *           1
  1  7                    +0                          *            1
  1  8                    +0                         *             1
  1  9                    +0                         *             1
  1 10                     +                         *             1
  1 11                     0+                         *            1
  1 12                     0  +                          *         1
       +         +         0         +         +         +         1         +         +

   2 Output Level               SUM = -.196                                 HIGH POINT =
  .03
    .0000   .0015   .0043   .0079   .0122   .0168   .0213   .0256   .0292   .0320   .0335
.0335    .0317   .0277   .0213   .0122   .0000  -.0155  -.0347  -.0579  -.0853  -.1173
 -.1541  -.1962
       +         +         0         +         +         +         1         +         +
  1  1                     *                                       1
  1  2                     *                                       1
  1  3                     *                                       1
  1  4                     *                                       1
  1  5                     *                                       1
  1  6                     +*                                      1
  1  7                     +*                                      1
  1  8                     +*                                      1
  1  9                     +*                                      1
  1 10                     +*                                      1
  1 11                     +*                                      1
  1 12                     +*                                      1
  2  1                     +*                                      1
  2  2                     +*                                      1
  2  3                     +*                                      1
  2  4                     *                                       1
  2  5                     *                                       1
  2  6                    *0                                       1
  2  7                    *0                                       1
  2  8                   *+0                                       1
  2  9                  * +0                                       1
  2 10                *   +0                                       1
  2 11               *    +0                                       1
  2 12             *     + 0                                       1
       +         +         0         +         +         +         1         +         +
```