# Chapter 4: Industry Profit Income: Equation Estimation

The preceding chapter outlined the approach that is used in this chapter to estimate equations for Corporate Profits for thirty-seven industries. The first section of this chapter presents results for an industry whose equation is used to illustrate the estimation process: Wholesale and retail trade. In the second section, summary results for all industries are presented. Finally, the concluding sections describe the results of specific industry profit equations.

## Sample Estimation Results: Wholesale and retail trade

Because the following equations are to be included in a long-term forecasting model, the estimation process involved an attempt to ensure they have reasonable dynamic properties. In other words, each equation not only must provide a reasonable explanation of historical behavior, it also must provide reasonable behavior of industry profits as part of an Interindustry Macroeconomic model. The equations first were evaluated in terms of standard diagnostics, such as $R^2$ and a visual comparison of actual data and the regression prediction. In addition, the reasonableness of coefficients was evaluated based on the equation specification outlined in the previous chapter, and based on the requirement to ensure reasonable long-run properties. In addition, an attempt was made to evaluate the forecasting properties of the equation by conducting a "static" forecast of industry profits.  This forecast is based on projections of the independent variables from a base forecast with the LIFT model.  The forecast of the dependent variable is static in the sense that there is no feedback from the profit variable to the remaining variables in LIFT (the independent variables in the equation).   Finally, once all the industry profit equations were estimated, a "dynamic" forecast of profits was generated by including the new equations in LIFT.  The behavior of profits in the dynamic

Figure 4.1: Estimation of Wholesale & retail trade Profits

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title First Difference in Profits/Output: 31 Wholesale & retail trade
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:              FD in Profits/Output: 31 Wholesale & retail trade
 SEE   =       0.53 RSQ   = 0.3596 RHO =  -0.26 Obser  =   23 from 1965.000
 SEE+1 =       0.50 RBSQ  = 0.2173 DW  =   2.52 DoFree =   18 to   1987.000
 MAPE  =     386.27
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -      0.02
 1 pcwage                 -0.10770     9.5  -1.891  -1.45  -0.430      0.32
 2 pcwage[1]               0.10770     9.5   1.891   0.25   0.371      0.05
 3 pcvuc                  -0.04943     2.9  -1.030 -10.73  -0.295      5.11
 4 pcvuc[1]                0.04943     2.9   1.030  10.57   0.299      5.03
 5 fduninv                 8.68225     8.2   1.750  -0.51   0.396     -0.00
```

forecast provided a final check on each equation.

The results for the Wholesale and retail trade equation are shown in Figure 4.1. The industry includes establishments engaged in middle-man selling, as well as those in direct customer retailing. Wholesale and retail trade activities are closely linked to overall demand in the economy, and one of the variables in the equation is the unemployment rate. An increase in unemployment, signalling a slowdown in demand, leads to a fall in the profit margin. The variable used in the equation is the first difference of the inverse of the unemployment rate. Using the inverse allows the effect on the profit margin to be stronger at lower rates of unemployment than at higher rates, since lower unemployment rates represent relatively tighter labor markets than higher rates.

In addition to responding to aggregate demand, the Wholesale and retail trade profit rate also is influenced by industry-specific costs. Increases in either material or labor costs initially are partially absorbed by a fall in the profit margin. In both cases, the profit margin recovers in the following year. To ensure reasonable asymptotic behavior in the model, the coefficients on each set of cost variables were constrained to sum to zero, and there is no intercept in the equation.

The importance of imposing reasonable long-run properties on the equation can be illustrated by examining an equation with no such properties imposed. For instance, with no constraints on the coefficients and an intercept, the equation for Wholesale and retail trade profits is:

(1) fdpr = .1159 -.05516*pcm + .05971*pcm[1] - .10864*pcw + .12159*pcw[1] + 8.9*fdu

$R^2 = .3730$

where

fdpr = First difference in profit rate for W&R trade,
pcm = Percent change in unit material costs,
pcw = Percent change in unit labor costs,
fdu = First difference in 1/unemployment rate.

The statistical fit of the equation, as summarized by the $R^2$, improves modestly, from .3596 to .3730, compared to the constrained equation in Figure 4.1. However, the implications for asymptotic behavior of the profit margin are unreasonable. According to this equation, a one percent increase in material costs leads to a permanent increase in the profit margin of .005. Likewise, a one percent increase in labor costs leads to a permanent .013 increase in the profit margin. Every one percent of inflation, therefore, leads to a permanent increase in the profit rate of .018 per year. Over ten years, with inflation at, say, 4% per year, the profit margin would increase by .72. In addition, the intercept implies the margin increases by .12 per year, which adds an additional 1.2 percentage points to the profit margin over ten years. Imposing such a trend on the profit rate, especially in the absence of any such trend over the historical period, imparts unreasonable behavior to the model.

The static forecasts shown in Figure 4.2 highlight the implications of allowing a trend in the equation specification. The graph compares two static forecasts of the profit margin using forecasts of the independent variables from a Base forecast with the LIFT model. The forecast labeled 'Intercept' shows a projection based on equation (1) above, while the line labeled 'Constrained' shows the static forecast of the equation chosen for the model. By the year 2000, the 'Intercept' forecast is almost 1.5 points greater than the 'Constrained' forecast. Although the forecasts are based on the same economic outlook, the equation with an intercept and no constraints shows a significant trend that dominates the forecast for the profit margin. Since profits affect the level of prices, based on the input-output dual equation for price determination, the forecast with the trended profit margin implies a higher price for Trade than in the alternate forecast. The trend imposes a change in relative prices in the economy that is not based on any economic, or behavioral, reason.

Of course, the final test of the equation is how it performs as part of the LIFT model. The second graph of Figure 4.1 shows the dynamic forecast of the profit margin and compares it to the static forecast. While oscillating in response to changes in demand and costs, the dynamic forecast of the profit margin is absent any significant trend. In fact, the dynamic forecast is less trended than the static forecast. In the static outlook, overall economic growth had not stablized by the end of the forecast horizon, and the unemployment rate, especially, was trending down. In contrast, the macroeconomic forecast for the Dynamic outlook shows stable growth in the last five years of the forecast. The dynamic model results can be summarized by the changes in real GNP in Figure 4.3. The model projects a significant slowdown through 1991, a short, modest recovery in 1992, followed by another slowdown, before growth eventually stabilizes around 2.0% from 1995 to 2000. The dynamic forecast of the profit margin for Trade is responsive to that overall pattern of demand changes.

Corporate Profit Equations for All Industries

Although equations for each industry's profits were developed separately, some generalizations about the equations as a whole can be made. Table 4.1 summarizes the estimation results for the thirty-seven industries of this study. For the majority of industries, the dependent variable of the equation is the first difference in the profit- to-output rate (as defined earlier). The first group of columns summarizes the variables that are included in each equation, and the last group of columns shows summary statistics for the equation as a whole. The potential variables for each equation include the percent change in unit costs of production (Costs), percent changes in the real labor compensation share of output (Labor), percent changes in real output in the industry (Output), and the first difference in the inverse of the Civilian unemployment rate (1/un). For each of these variables, the current value of the variable, as well as several lags, may be included. If the current value of an independent variable is included in the equation, the sign of the coefficient, + or -, will appear in the column labeled t. If a 1-year lag is used, the sign of that coefficient will appear in the column labeled 1, and so on. In addition, several equations include an additional variable, (Other). The next three

Table 4.1 Summary of Equation Results

| Sector | Costs | Labor | Output | un | Other | $R^2$ | r | r |
|---|---|---|---|---|---|---|---|---|
| | t 1 2 | t 1 2 | t 1 2 | t | | | "p" | "a" |
| GROUP I | | | | | | | | |
| Motor vehicles | | - - + | - + + | | | | .6301 | |
| | .668 | .879 | | | | | | |
| Food | - - + | | - + | | | .6665 | | .688 |
| | .784 | | | | | | | |
| Apparel | - + - | - + + | | | | .5092 | | .746 |
| | .540 | | | | | | | |
| Chemicals | + - + | - + | | + | | .4288 | | .713 |
| | .927 | | | | | | | |
| Metal Industry | | + - - | | | + | cars | .3850 | |
| | .837 | .872 | | | | | | |
| Metal Products | | + + - | | + - | | | | |
| | .4928 | .584 | .781 | | | | | |
| GROUP II | | | | | | | | |
| Whole & Retail | | - + | - + | | + | | .3596 | |
| | .228 | .639 | | | | | | |
| Misc Manufact | | - + | - + | - + | | | .3270 | |
| | .507 | .278 | | | | | | |
| Instruments | - + | - + | | + | dummy | .4816 | | .912 |
| | .952 | | | | | | | |
| Movies | + - | + - | | | PCE,dummy | | .3073 | |
| | .705 | .824 | | | | | | |
| Medicine,Educ | | + - | - + | | | PCE | .2079 | |
| | .574 | .977 | | | | | | |
| GROUP III | | | | | | | | |
| Finance, Insur | | + - | | + -+ | | dummy | | |
| | .6794 | .927 | .969 | | | | | |
| Business Service | | - + | | + - | | | .2194 | |
| | .484 | .549 | | | | | | |
| Auto Repair | - + | | + - | | | .2388 | | .655 |
| | .917 | | | | | | | |
| Elect Machinery | | - + | | + -+ | | | .5231 | |
| | .675 | .880 | | | | | | |
| Printing | - + | | - + | + | | .3124 | | .242 |
| | .594 | | | | | | | |
| Utilities | - + | | | + | | .1254 | | .127 |
| | .915 | | | | | | | |
| GROUP IV | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Textiles | | - + | + - | + | | .3927 | .830 |
| | .844 | | | | | | |
| Paper | | + - | + - | | | .3766 | .318 |
| | .566 | | | | | | |
| Hotels,Repairs | | | | + - + | | + | interest |
| | .4352 | .608 | .870 | | | | |
| GROUP V | | | | | | | |
| Communication | | - + | | - + | | regul | |
| | .2755 | .777 | .965 | | | | |
| Air transport | + - + | - + | | | regul | .5432 | .510 |
| | .803 | | | | | | |
| Railroads | - + | - + | + | | regul | .6095 | .054 |
| | .883 | | | | | | |
| Trucking | - + | + - | | + | | .0707 | .039 |
| | .389 | | | | | | |
| GROUP VI | | | | | | | |
| Construction | | - + | | | house | .0488 | .278 |
| | .707 | | | | | | |
| Furniture | - + | | | | house,rate | .2678 | .812 |
| | .768 | | | | | | |
| Real Estate | | | | + | house | .5417 | .734 |
| | .966 | | | | | | |
| Lumber | | | + - | | mortgage,prod | .4618 | |
| | .611 | .731 | | | | | |
| Stone, clay, | - + + | | + - | | mortgage | .5329 | .721 |
| | .853 | | | | | | |
| GROUP VII | | | | | | | |
| Plastic,Rubber | | | - + | + - | | oil price | |
| | .4955 | .724 | .680 | | | | |
| Petrol refinin | | | - + | | oil price | .4907 | .371 |
| | .819 | | | | | | |
| Trans equip | | | + | | oil price | .3405 | na |
| | na | | | | | | |
| Agriculture * | | | + + + | | depend var | | .5220 |
| | .722 | .725 | | | | | |
| Crude oil * | | | + + + | | depend var | | .6466 |
| | .804 | .876 | | | | | |
| Nonelect mach | | - + - | | + - - | | | |
| | .4340 | .373 | .963 | | | | |
| Leather | + - | | + - | | imports | .3655 | .735 |
| | .650 | | | | | | |

NOTES:

t,1,2 = t is current value, 1 is one-year lag, 2 is two year lag

Costs = Material costs per unit of output, change

Labor = Real labor compensation as share of real

output, change
Output = Percent change in real output
un = First difference in the inverse of the unemployment rate
Other = Other variables included in the equation
$R^2$ = Coefficient of determination for equation
r "p" = Simple correlation coefficient between the actual profit rate and the predicted profit rate computed by using cumulative predictions
r "a" = Simple correlation coefficient between the actual profit rate and the predicted profit rate computed as one-year ahead prediction
interest = Interest rate on AAA-rated bonds, adjusted for inflation
oil price = Changes in the price of petroleum
imports = Percent change in real imports
mortgage = Interest rate on 30-year commercial mortgages
cars = Percent change in real output of motor vehicle industry
house = Percent change in real residential structures
PCE = Percent change in total real Personal Consumption Expenditures
* = Dependent variable is profit rate (not first difference)

columns show the $R^2$ and two simple correlation coefficients between the predicted profit rate and the actual rate. The first correlation coefficient, r "p", measures the correlation between the actual profit rate and the predicted profit rate computed by using cumulative predictions from the estimated equation. The second, r "a", is a correlation coefficient between the actual profit rate and the predicted profit rate computed as a one-step-ahead prediction. Specifically, the predicted first differences are added to the actual value of the profit rate for the prior year. The correlation coefficients are calculated as an indicator of the strength of the equations in predicting movements in the profit margins.

Summary of results: material costs, labor and demand

The equations in Table 4.1 are summarized in terms of their use of the input cost variable. Almost all of the equations used the input cost variable, with most using the current change in costs and one lagged value.[1] The labor share variable showed up in almost half of the equations, and again, the current and lagged variables were most prevalent. In the interest of achieving reasonable steady-state properties, the coefficients on the cost and labor variables were constrained to ensure that they summed to zero.

Several different measures of demand were used in the industry profit equations. Profits of most manufacturing industries depend on industry-specific changes in output, while profits in the service sectors depend on the overall unemployment rate. Profits in several industries, such as Furniture and Lumber, respond to changes in interest rates. The implications of demand and cost changes for each industry are discussed in greater detail in the following section on the individual equation results.

Equation statistics

As expected when estimating equations in first difference form, the fit of the equations, as summarized by the $R^2$, is low. More encouraging are the relatively high correlations between the predicted level of the profit rate and actual profit rate for each industry. Using the more rigorous test for correlation, where the actual data is compared with cumulative predictions (r "p"), twenty-two of thirty-four industries have a greater than 60% correlation between the predicted rate and the actual rate. When a one-period-ahead prediction is calculated that does not build on past errors, the correlation coefficients for most industries exceed 80%. Some examples of the comparison between the cumulative predictions of the profit margin and the step-ahead predictions are shown in Figure 4.4. Wholesale and retail trade is representative of equations that performed fair

[1] The lag lengths on material costs are consistent with preliminary findings reported by Blinder in his interview study on why prices are sticky.

in terms of the correlation between the actual profit rate and the predicted rate as given by the equation for the first difference of the rate. The correlation between the cumulative predictions and the actual rate is .228. When the predictions are added to last year's actual profit rate, the correlation between the predicted and actual rate improves to .639, and, as illustrated in the graph, the predictions capture most of the turning points in the series. The result for Stone, clay, and glass (Figure 4.4(c)) is shown as an example of industries where the volatility of the profit rate is captured well, even when the more rigorous test of the cumulative predictions is used. The equation does not do well at capturing the magnitude of the changes, however. It should be noted that, in many cases, the performance of the cumulative predictions (and the fit of the equation in first differences) is greatly improved when coefficient constraints are removed. Since

Figure 4.4 Profit Margin Estimations

removing those constraints violates the condition for reasonable long-run behavior, however, the constraints are imposed. The remaining examples in Figure 4.4 illustrate cases where both the cumulative predictions and step-ahead predictions fit reasonably well with the actual profit rate. In the case of Finance and insurance, a dummy variable in the equation helps capture the 1980-1982 drop in the margin, while in the case of Food and tobacco, the profit margin is explained extremely well with the price of its largest input, Agricultural goods.

In general, industry profits are responsive to current and lagged changes in costs of production and to different measures of changes in demand. Although it is useful to summarize the results as a whole, the intriguing story is the detailed results for each industry.

Profit Equations by Industry

For each equation estimation, the estimation results and two graphs are presented. The first graph is of the regression results and shows predicted and actual values of the dependent variable. The graph shows the predicted and actual values for the period of estimation, as well as a projection of the dependent variable based on forecasts of the independent variables.[2] The second graph compares two forecasts of the level of the profit margin (rather than

[2] Two projections are shown: the solution to the regression equation ("prediction") and a rho-adjusted solution to the equation. (The forecast is adjusted based on the last error of the estimation and the estimated rho value.) Since the equations are estimated as first differences, the rho adjustment is of minor importance.

the first difference of the margin). The "static" forecast is based on the projection of the first difference shown in the first graph. The second forecast was obtained after including the profit equations in the LIFT model and forecasting with the model to the year 2000. This "dynamic" forecast of the profit margin includes feedback from profits to other variables in the model, including the independent variables of the regression estimation. A word of explanation on the LIFT forecast used for the dynamic analysis is in order.

There are two principal differences between the LIFT forecast used for the static profit projections and the one used for the dynamic analysis: price-side specification and data. As explained in Chapter 2, the price side of the original LIFT model used equations for total return to capital, as well as all components of capital income. In the work for this study, no equations for total industry return to capital were used. Rather, the total is calculated as the sum of individually estimated income components. For pragmatic reasons, introducing new profit equations in LIFT could not easily be accomplished without introducing all new equations for the price side.[3] The equations for non-profit components of capital income consequently differ between the static and dynamic forecast models. (Those equations are described in Chapter 5).

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[3] A large part of the work for this study involved reprogramming the price-income side of LIFT. The new program structure for solving the price side was incompatible with the original programming, so the transition to the new specification was an "all-or-nothing" process.

The second difference between the two forecasts involves data. The profit equations were estimated using data only through 1987 (the most current available data at the time). At the time that the dynamic forecast was completed, data for most variables in the economy were available through 1990.[4] To conduct a test of the profit equations, the model was used to produce a "sim-fore", or combination historical simulation and forecast. Where possible, mostly for macroeconomic aggregates and real-side variables, actual values of data were used through 1990. In terms of income by industry, no industry detail was used from 1988 to 1990. For every income component but profits, however, the known aggregate is imposed on the model for those years. From 1988 to 1990, therefore, the profit equations are generating a crude historical simulation, since actual values of most independent variables are being used by the model. From 1990 onward, however, the model is generating a traditional econometric forecast. Since the goal of this run of the model was to examine the forecasting properties of the profit equations, no attempt was made here to evaluate the overall reasonableness of the forecast outlook. That task is reserved for Chapter 6, when a Base forecast with the new model is developed. The importance of the forecast here is to illustrate the difference between the static and dynamic projections of profits by industry.

[4] Macroeconomic aggregates are available for 1990. Not all industry data, however, is available that currently.

The discussion of the industry results is divided into several groups, which are based on the extent to which the equations rely on the input cost variable. The first group consists of industries whose equations use two lags on input costs (in addition to current costs) in determining the profit margin. In that group, some industries also used the labor share variable, while others relied more on demand variables. Since most of the industries used only one lag of input costs, the second group contains industries with only one lag on input costs plus the labor share variable. The next group contains those industries with one lag on input costs, but with demand variables rather than labor costs. The next group contains those few industries for which input costs were not used in the equations. Because government regulation affected some industries, these are discussed in a single group. The sixth group contains those industries related in some way to construction activity. Finally, there is a miscellaneous collection of industries that are grouped mainly for the reason that each does not belong in any other group.

## Group 1: Lagged costs

The six industries in this group are: Motor vehicles, Apparel, Primary metal industries, Metal products, Chemicals and Food processing. (The Air transportation industry and Stone, clay, and glass also fall into this group, but are discussed below in the sections on regulated industries and construction-related industries.) Each equation uses current input costs and costs lagged for two years. Of all thirty-some equations, very few shared identical specifications. The first equations discussed here, Motor vehicles and Apparel, are an exception, however. Although at first glance, cars and clothes may not appear to be similar items, both industries share a history of import competition and strong labor unions, which has made their profits sensitive to changes in costs.

### Motor Vehicles (22)

The Motor vehicle industry manufactures cars and trucks, including parts and accessories. Although many attempts were made to incorporate some measure of demand (including demand for imports) in the equation, the Motor vehicle profit margin is determined by current and lagged costs. Material inputs for the industry include steel and other metal products, rubber, plastic, textiles, and electronic equipment. Cost increases are not passed on in higher prices initially, but are absorbed partially by a fall in profits.

Likewise, an increase in labor costs leads to an initial fall in the profit margin, which recovers after two years. Without a constraint on the labor variables, the coefficients consistently sum to a negative number. In an industry characterized by labor disputes, it is not surprising to discover that labor and capital must compete for income earned by the industry.

The equation captures the volatile history of the profit margin, and over 60% of the variability of the dependent variable is explained. A relatively low rho of .10 and a Durbin Watson of 1.8 indicate little

Figure 4.5: Estimation of Motor vehicles Profits

```
title First Difference Profits/Output: 22 Motor vehicles
con 99999 0.0 = a1 + a2 + a3
con 99999 0.0 = a4 + a5 + a6

:                    FD Profits/Output: 22 Motor vehicles
 SEE   =       2.43 RSQ   = 0.6301 RHO =   0.10 Obser  =   23 from 1965.000
 SEE+1 =       2.42 RBSQ  = 0.5213 DW  =   1.79 DoFree =   17 to   1987.000
 MAPE  =     190.46
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat                - - - - - - - - - - - - - - - - - - - - -     -0.40
 1 pcvuc                  -0.32249     5.4  -1.371   4.32  -0.308      5.40
 2 pcvuc[1]               -0.02277     0.0  -0.072   0.30  -0.022      5.37
 3 pcvuc[2]                0.34523     7.3   1.600  -4.56   0.337      5.32
 4 pcwage                 -0.28157    31.1  -3.495   0.14  -0.507      0.20
 5 pcwage[1]               0.26285    19.4   2.693  -0.39   0.470      0.60
 6 pcwage[2]               0.01867     0.2   0.231  -0.04   0.034      0.89
```

problem of autocorrelation. After converting the predicted first differences to levels, the predicted profit rate correlates well with the actual rate (r "p" = .668, and r "a" = .879). The dynamic forecast for the profit margin indicates a fairly smooth path, compared to the more volatile historical experience. This is not surprising, since the forecast for other variables for the industry, such as labor compensation and output, are more smooth than experienced historically. As noted in Chapter 2, the original LIFT forecast for this profit margin followed a questionable pattern of constant growth from 1988 to 2000. The dynamic forecast here shows no dominant trend in the profit rate. Rather, the outlook shows a cyclical response of profits to economic slowdowns in 1990 and 1993, and an eventual flattening out of the profit rate over the long-run horizon.

Apparel (7)

Similar to Motor vehicles, the Apparel industry is strongly sensitive to changes in costs, both material and labor. Increases in input or labor costs are absorbed initially by a fall in the profit margin. It takes two years in each case for the profit margin to recover. Without constraints on the coefficients, each set sums to approximately zero, so the effect of the constraints on the fit of the equation is minimal. Attempts were made to incorporate demand and imports in the equation, but the cost-driven equation here produced the most sensible results.  The equation has an $R^2$ over .5 and the predicted rate correlates well with the actual rate, correlation coefficient (r "p") equals .746.  The static and dynamic forecasts differ with the dynamic forecast much less volatile than the static outlook.  The smoother behavior is traced to a less volatile outlook for Apparel's costs in the dynamic forecast than in the static one.

# Figure 4.6: Estimation of Apparel Profits

```
title First Difference in Profits/Output  07 Apparel
con 999999 0.0 = a1 + a2 + a3
con 999999 0.0 = a4 + a5 + a6

:                        FD in Profits/Output  07 Apparel
 SEE   =       0.67 RSQ   = 0.5092 RHO =  -0.33 Obser  =   23 from 1965.000
 SEE+1 =       0.61 RBSQ  = 0.3649 DW  =   2.67 DoFree =   17 to   1987.000
 MAPE  =      83.63
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -      0.06
 1 pcwage                -0.07261    10.7  -1.956   0.38  -0.355     -0.29
 2 pcwage[1]              0.03442     2.5   0.934  -0.05   0.169     -0.08
 3 pcwage[2]              0.03818     4.1   1.191  -0.14   0.190     -0.20
 4 pcvuc                 -0.07201     3.8  -1.140  -5.50  -0.251      4.23
 5 pcvuc[1]               0.09010     3.1   1.042   6.69   0.319      4.11
 6 pcvuc[2]              -0.01809     0.2  -0.289  -1.30  -0.065      3.99
```

Primary metal industries (17)

The Primary metal industry contains firms engaged in smelting and refining metals, as well as manufacturing some basic metal products, such as nails, spikes, and castings. Like the other industries in this group, the profit margin of Primary metals responds to changes in material input costs. Initially, an increase in material costs results in a higher profit margin, as cost changes are more than fully passed on in product prices. The effect is temporary, and, after three years, the positive effect on the profit margin is canceled. The ability to pass cost changes through to prices is consistent with the oligopolistic nature of this industry. The Primary metal industry, mostly steel and copper, is dominated by a few large firms. According to the 1982 Census of Manufacturers, the four largest firms in the Blast furnace and steel mill industry accounted for 42% of the industry's total value of shipments, while the eight largest firms accounted for 64%. A common theory on pricing strategy in oligopolies (and one often applied to the American steel industry) is the kinked demand model and its implication of price leadership. The concept of a kinked demand curve, introduced by Sweezy (1939), is based on the idea that a firm in an oligopoly faces more elastic demand if it raises prices than if it lowers prices. Because of the kink in the demand curve and discontinuity in marginal revenue, several different levels of costs are consistent with a given price-level.  Firms will be reluctant to adjust prices in response to cost changes, unless there is some reason to believe that all other firms will raise prices also.  In industries dominated by a few large firms, a price leader may therefore emerge.  The leader firm will raise prices, which will serve as a signal to other firms to do so also.  In discussion of oligopolies, U.S. Steel or Bethlehem Steel are often cited as examples of price leaders.[5]  An implication of the price leadership strategy is that price changes will be relatively infrequent, but of substantial magnitude.  The results here suggest that the lag on price response is no more than one year, and that the price response is substantial.[6]

The Primary metal industry mostly sells its output to the Motor vehicle industry, and profits are tied to overall demand for motor vehicles as well as overall macroeconomic activity.  An increase in production of Motor vehicles increases the profit margin for Primary metals.  In addition, Metal industries are also tied to other manufacturing activities, and therefore are sensitive to overall changes in demand.  The inverse of the unemployment rate is used as a demand measure in the equation, and an increase in

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[5] See Nicholson, and Browning and Browning, for examples.

[6] The results are consistent with findings by Carlton (1986) in his study on price rigidities by industry using Stigler-Kindahl data.  The average duration of price rigidity for the Steel industry was close to one year (thirteen months), and Steel was the second most rigid industry in the study.  In addition, Carlton concluded "There is a positive correlation between price rigidity and average absolute price change.  The more rigid are prices, the greater is the price change when prices do change." (p. 638)

unemployment leads to a fall in the profit margin for Metals.

Although the equation fits only fairly well, with an $R^2$ of .385, the correlation between the predicted and actual profit margins is a high .837% (r "p"). The profit margin for Metals shows much cyclical activity and an especially volatile response to the 1982 recession. The dynamic forecast shows the margin dipping in response to the recessionary period 1990-1991, followed by a strong recovery. The margin stabilizes for three years until dropping again in response to the 1995 slowdown. In the last five years of the forecast, the profit margin stabilizes, as the economy moves along its long-run trend growth path.

Figure 4.7: Estimation of Metal industries Profits

```
title First Difference Profits/Output for 17 Metal Industries
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4 + a5

:                  FD Prof/Output for 17 Metal Industries
 SEE   =       2.18 RSQ   = 0.3850 RHO =  -0.13 Obser  =   23 from 1965.000
 SEE+1 =       2.16 RBSQ  = 0.2041 DW  =   2.26 DoFree =   17 to   1987.000
 MAPE  =     225.47
   Variable name          Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat              - - - - - - - - - - - - - - - - - - - - -     -0.28
 1 pccars                 0.00111     0.0   0.038  -0.01   0.006      3.73
 2 pccars[1]             -0.00110     0.0  -0.038   0.01  -0.006      3.82
 3 pcvuc                  0.14931     8.7   1.753  -2.75   0.347      5.21
 4 pcvuc[1]              -0.01682     0.1  -0.170   0.32  -0.039      5.35
 5 pcvuc[2]              -0.13249     7.0  -1.575   2.50  -0.305      5.32
 6 fduninv               41.04452    12.8   2.148   0.20   0.442     -0.00
```

Metal products (18)

Firms in this industry manufacture metal products such as automobile body parts, food containers, and nuts and bolts, and the largest sources of demand are Motor vehicles, Machinery, and Food and tobacco processing. The profit margin in the industry responds to changes in demand, as captured by industry-specific output, where an increase in demand initially increases the profit margin. Profits from manufacturing Metal products also depend on the cost of metal inputs.  As with the Primary metal industry, an increase in input costs is passed on to consumers of metal products at first, and the profit margin rises for the two years after the increase.  The effect eventually is overridden, and after the third year, the increase is entirely offset.  Like the Primary metal industry, this is an oligopolistic industry with high concentration ratios.  In 1982, the four largest firms in the Automotive stampings industry, for instance, accounted for 61% of total shipments, and the eight largest accounted for 66%.  The price response to cost changes suggested by this equation for the profit margin is consistent with the oligopolistic structure of the industry.

The static and dynamic forecasts show a first-year increase in the profit margin that is the result of an increase in output forecast for the industry.  The static and dynamic forecasts differ only slightly, and both show the profit margin hovering around a rate moderately greater than its average value from 1965 to 1987. The dynamic forecast shows an expected drop in the margin during the slowdown through 1991, followed by a modest recovery.

Figure 4.8: Estimation of Metal products Profits

```
title First Difference Profits/output: 18 Metal products
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4 + a5

:                     FD Prof/output: 18 Metal products
 SEE   =       0.76 RSQ   = 0.4928 RHO =  -0.07 Obser  =   23 from 1965.000
 SEE+1 =       0.75 RBSQ  = 0.3801 DW  =   2.15 DoFree =   18 to   1987.000
 MAPE  =     342.52
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     0.01
 1 pcout                 0.09758    30.3   3.545  23.57   0.678      2.21
 2 pcout[1]             -0.09757    30.3  -3.545 -24.93  -0.682      2.34
 3 pcvuc                 0.02428     0.7   0.515  14.37   0.114      5.42
 4 pcvuc[1]              0.13003    15.4   2.442  77.24   0.608      5.44
 5 pcvuc[2]             -0.15430    24.3  -3.132 -91.81  -0.720      5.45
```

Chemicals (10)

The Chemical industry is the largest of the manufacturing sectors, with a share of 5.5% of total profits in 1987. Like the other industries in this group, Chemical profits are sensitive to industry-specific costs. Materials for this industry include mostly intra-industry trade and petroleum. Initially, an increase in the cost of materials increases the profit margin, implying that cost changes are passed more than fully into prices. In the two years following the cost increase, the profit margin absorbs the excess cost pass-through. The Chemical industry is dominated by a few large firms and exhibits the pricing behavior of an oligopoly. The 1982 four-firm concentration ratio for Soaps and detergents, a large part of Chemicals, was 60%, while the eight-firm ratio was 73%.

Changes in labor costs also affect the profit margin for the Chemical industry, but, unlike material costs, they are not passed through immediately to prices. Rather, increases in labor costs are absorbed temporarily by the profit margin, which recovers after one year. The different response of the profit margin to changes in labor and material costs suggests an interesting implication for theories of oligopoly pricing. In general, oligopoly pricing models do not distinguish different types of cost increases, but consider only a change in overall marginal costs. The results for the Chemical industry (and also for Medicine and education and Air transportation) suggest that price response to cost changes may differ by type of cost, and by industry.

The profit margin for the Chemical industry also responds to demand. The industry includes firms that manufacture intermediate products, such as organic and inorganic chemicals and plastic resins, as well as end-use products, such as soaps, fertilizer, drugs and paint. Profits are sensitive to the overall business cycle, therefore, and the inverse of the unemployment rate is used in the equation to measure demand for the industry.

The equation captures most of the volatility of the profit margin over the estimation period. When the predictions are summed to calculate a predicted profit rate, the correlation coefficient between the predicted profit rate and the actual rate is greater than 70% (r "p" = .713). The correlation coefficient between the one-step ahead prediction and the actual rate is a reassuring 93% (r "a" = .927).

The profit margin for Chemicals has a volatile history, with a significant drop in the margin from 1975 to 1980. From 1985 to 1987, however, the margin grew strongly and recovered to its level prior to the oil shocks of the late 1970's and the 1980-1981 recession. The dynamic forecast for Chemicals shows that the level of the margin achieved since 1987 is maintained through 2000, with only minor oscillations in response to economic slowdowns in 1991 and 1995.

Food and tobacco processing (5)

Although Food processing is included in this first group of industries, the measure of input costs in this equation differs from most of the other equations.

Since agricultural prices dominate the costs for this industry, the price of agricultural inputs was used rather than the price of all inputs. In estimating the equation, agriculture prices were statistically important in describing movements in the profit margin, both in terms of t-statistics, and mexvals. Without a constraint on the coefficients, they consistently summed to a positive number, indicating that input costs were more than fully passed on as higher prices in this industry. In choosing an equation to be used in the model, the coefficients were constrained to sum to zero, and demand variables were also included. The high Mexval's on material costs support the hypothesis that profits in this industry provide a vehicle to prevent full and immediate pass through of higher costs.

## Figure 4.9: Estimation of Chemicals Profits

```
title First Difference in Profits/Output  10 Chemicals
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4 + a5

:                    FD in Profits/Output  10 Chemicals
 SEE   =       0.98 RSQ   = 0.4288 RHO =   0.36 Obser  =   18 from 1970.000
 SEE+1 =       0.94 RBSQ  = 0.1908 DW  =   1.28 DoFree =   12 to   1987.000
 MAPE  =     196.07
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat              - - - - - - - - - - - - - - - - - - - - -     -0.08
 1 pcwage                -0.10403    23.8  -2.528  -0.47  -0.509     -0.35
 2 pcwage[1]              0.10404    23.8   2.528   0.30   0.512     -0.23
 3 pcvuc                 0.08792    11.0   1.669  -7.34   0.489      6.61
 4 pcvuc[1]             -0.12542     8.2  -1.433  10.35  -0.704      6.53
 5 pcvuc[2]              0.03749     2.0   0.699  -3.17   0.206      6.69
 6 fduninv              12.50622     6.2   1.241   1.09   0.296     -0.01
```

Even with constraints on the coefficients, the equation fits fairly well ($R^2$ equals .6665). The correlation coefficient between the predicted and actual profit rate of .688 shows that the series are almost 70% correlated. The equation captures the effects of the drought in 1973-74 and the static forecast shows the effect of the 1987 drought, with the profit margin falling and remaining at a low level for two years. The margin recovers from the drought-induced decline through 1992. Over the long-run forecast horizon, the profit margin stabilizes in both the dynamic and static forecasts, as demand and cost changes reach a constant growth rate.

Group 2: Lagged costs: input and labor

The industries in this group depend on current and lagged input costs, as well as labor's share of income. The group includes two manufacturing industries, Miscellaneous manufacturing and Instruments, and three service industries, Medicine and education, Movies and amusements, and Wholesale and retail trade. The Railroad industry also falls into this group, but is discussed in the section on regulated industries.

Miscellaneous manufacturing (24)

This industry includes firms that manufacture items such as umbrellas, musical instruments, toys, and artificial Christmas trees, and it is a relatively small share of total profits (.3% in 1987). Profits initially absorb increases in either input or labor costs. The coefficients on the cost variables have been constrained to cancel out, so the net effect on the profit margin of an increase in either type of cost is zero. The profit margin also responds to changes in industry output, where again, the coefficients have been constrained to sum to zero. Without the constraint, the demand coefficients have a net

# Figure 4.10: Estimation of Food Profits

```
title First Difference in Profits/Output of 05 Food
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4 + a5


:                        FD in Profits/Output of 05 Food
 SEE   =       0.57 RSQ   = 0.6665 RHO =  -0.19 Obser  =   23 from 1965.000
 SEE+1 =       0.56 RBSQ  = 0.5923 DW  =   2.38 DoFree =   18 to   1987.000
 MAPE  =    3244.47
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat                - - - - - - - - - - - - - - - - - - - - -     -0.01
 1 pcout                  -0.09612    17.7  -2.632  15.37  -0.222      1.85
 2 pcout[1]                0.09612    17.7   2.632 -15.79   0.225      1.90
 3 pcvuc                  -0.03094    17.0  -2.579  11.76  -0.327      4.38
 4 pcvuc[1]               -0.02347     5.7  -1.459   8.50  -0.250      4.18
 5 pcvuc[2]                0.05441    50.5   4.772 -20.74   0.570      4.40
```

## Figure 4.11: Estimation of Miscellaneous manufacturing Profits

```
title First Difference in Profits/output: 24 Misc. Manufacturing
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4
con 999999 0.0 = a5 + a6

:                   FD in Prof/output: 24 Misc. Manufacturing
 SEE   =       2.28 RSQ   = 0.3270 RHO =  -0.53 Obser  =   18 from 1970.000
 SEE+1 =       1.93 RBSQ  = 0.0465 DW  =   3.06 DoFree =   12 to   1987.000
 MAPE  =     154.04
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.09
 1 pcout                  -0.00917     0.0  -0.107   0.09  -0.024      0.90
 2 pcout[1]                0.00918     0.0   0.107  -0.10   0.024      1.08
 3 pcvuc                  -0.03794     0.2  -0.224   2.40  -0.070      5.99
 4 pcvuc[1]                0.03794     0.2   0.224  -2.39   0.070      5.97
 5 pcwage                 -0.17104    13.7  -1.877   1.13  -0.418      0.63
 6 pcwage[1]               0.17104    13.7   1.877  -0.88   0.416      0.49
```

positive effect on the profit margin. The static and dynamic forecasts move similarly and show the profit margin oscillating in response to cyclical activity, but with no pronounced trend.

Instruments (23)

This industry manufactures medical instruments, scientific instruments, industrial control equipment, and navigation instruments, such as radar. Its profits are determined by a triumvirate of demand, labor costs, and material costs. In addition, reported profits for the industry in 1985 inexplicably dropped. Since no relevant economic reason for the drop could be found, a dummy variable was used in the equation. Although it imparts an upward bias to the forecast of the margin, the dummy variable resulted in reasonable coefficients on the cost and demand variables, so it was kept in the equation. Increases in material costs and labor costs are absorbed partially by the profit margin initially, and recover in the following year. The profit margin responds more to overall demand in the economy, captured by the unemployment rate, than to an industry-specific measure of demand.

The equation fits fairly well, $R^2$ equals .5, and there is a strong correlation between the cumulated predictions and the actual profit rate (r "p" = .91), in part due to the dummy variable. Unlike most industries, Instrument's profit margin exhibits an underlying trend throughout the historical period. Since 1970, the margin has been on a downward trend, and it is negative in the last two years of historical data (1986 and 1987). The forecast for the profit margin shows the margin hovering around zero throughout the forecast. The margin does not recover to a positive value until 1992, when the economy is recovering from the overall slowdown through 1991. During the rest of the forecast, the margin remains relatively flat and barely positive. (Given the low value of the margin throughout the forecast, any upward bias from the dummy variable explaining the

1985 decline, is tolerable.)

Figure 4.12: Estimation of Instruments Profits

```
title First Difference in Profits/output: 23 Instruments
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:                    FD in Prof/output: 23 Instruments
 SEE   =       1.69 RSQ   = 0.5000 RHO =   0.08 Obser  =   23 from 1965.000
 SEE+1 =       1.69 RBSQ  = 0.3530 DW  =   1.85 DoFree =   17 to   1987.000
 MAPE  =     185.25
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -    -0.55
 1 pcvuc                 -0.22346     7.0  -1.569   2.04  -0.382      4.99
 2 pcvuc[1]               0.22346     7.0   1.569  -2.00   0.390      4.89
 3 pcwage                -0.04408     0.7  -0.498  -0.02  -0.072     -0.30
 4 pcwage[1]              0.04408     0.7   0.498   0.03   0.074     -0.41
 5 fduninv               36.85572    19.4   2.693   0.09   0.463     -0.00
 6 dum85                 -5.59905    20.0  -2.735   0.45  -0.479      0.04
```

Motion pictures and amusements (37)

The Motion picture industry and Medicine and education share similar equation specifications.  Both depend on input and labor costs.  In addition, they also depend on changes in consumer demand in the economy, as measured by changes in total Personal Consumption Expenditures (PCE). In the equation for Motion pictures, an increase in either material or labor costs initially is passed on in higher prices, and the profit margin rises.  In the following year, that temporary increase is entirely offset.  The coefficients on the cost variables were constrained to cancel each other out; without that constraint material costs had a large positive relationship with the profit margin, and labor costs had a negative relationship.  The Motion picture industry is another example of an oligopoly in the U.S. economy that exhibits a price leadership strategy in reacting to changes in costs.   The equation also depends on a dummy variable to account for the Hollywood writer's strike which decreased profits in 1984.  The dynamic forecast shows profits remaining flat during the slow period through 1991.  Profits then fall in response to the economic slowdown in 1994, characterized by slow growth in consumption expenditures.  As the economy approaches a steady growth path, and PCE grows at a stable rate, the profit margin for motion pictures likewise stabilizes.

Medicine, education, and npo (38)

This industry includes Medical and Educational institutions, as well as Non-profit organizations, such as professional membership organizations.   As noted, changes in PCE measure demand for this industry, where an increase in demand initially increases the profit margin.  An increase in input costs initially implies an increase in the profit margin for this industry as well, as cost changes are passed more than fully into prices.  Although this industry includes private schools and membership organizations, such as the American Economic Association,

## Figure 4.13: Estimation of Movies Profits

```
title First Difference in Profits/Output: 37 Movies & amusements
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4
con 999999 0.0 = a5 + a6

:              First Diff in Prof/Output: 37 Movies & amusements
 SEE   =       0.78 RSQ   = 0.3073 RHO =  -0.15 Obser  =   23 from 1965.000
 SEE+1 =       0.77 RBSQ  = 0.0475 DW  =   2.31 DoFree =   16 to   1987.000
 MAPE  =     106.55
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.08
 1 pcpce                  0.17884     8.5   1.689  -8.27   0.342      3.56
 2 pcpce[1]              -0.17884     8.5  -1.689   8.55  -0.348      3.69
 3 pcvuc                  0.14128     3.2   1.027 -10.33   0.323      5.64
 4 pcvuc[1]              -0.14128     3.2  -1.027  10.15  -0.338      5.54
 5 pcwage                 0.02909     0.7   0.491   0.21   0.095     -0.55
 6 pcwage[1]             -0.02909     0.7  -0.491  -0.39  -0.064     -1.03
 7 dum84                 -2.01827    13.4  -2.141   1.14  -0.441      0.04
```

it is dominated by the health sector. It is not surprising that when the constraint on the material cost coefficients is removed, the net effect of costs on the profit margin is positive. The price of medical care has grown more rapidly than any other price in the U.S. economy in the last decade, and this is reflected in the relationship between material costs and the profit margin for the industry. Labor costs also affect the profit margin, but, unlike material costs, an increase in labor's share of output decreases the profit margin at first. This result again suggests the importance of distinguishing between types of costs when studying pricing strategies by industry.

From 1965 to 1983, the profit margin for Medical and educational industries grew almost continuously, declining only four times in eighteen years. After stabilizing somewhat from 1983 to 1986, the margin declined in 1987. The forecast for the margin in this industry is mostly flat, as overall consumption demand and input costs stabilize. Given the strong upward trend in the profit margin for much of the historical period, the lack of any such trend in the forecast is open to question. However, the last five observations indicate a change in that upward trend. Rather than include a trend that may or may not exist in the future, the equation models changes in the profit margin around some average level in response to changes in demand or costs.

## Figure 4.14: Estimation of Medical/educational Profits

```
title First Difference in Profits/Output: 38 Medical,education,npo
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4
con 99999 0.0 = a5 + a6

:            First Diff in Prof/Output: 38 Medical,education,npo
 SEE   =      0.10 RSQ   = 0.2079 RHO =   0.08 Obser  =   23 from 1965.000
 SEE+1 =      0.10 RBSQ  = -0.0251 DW  =   1.84 DoFree =   17 to   1987.000
 MAPE  =     77.88
   Variable name          Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     0.04
 1 pcpce                  0.02085     3.2   1.045   1.73   0.321      3.56
 2 pcpce[1]              -0.02085     3.2  -1.044  -1.78  -0.327      3.69
 3 pcwage                -0.01470     9.5  -1.835  -0.38  -0.424      1.10
 4 pcwage[1]              0.01470     9.5   1.835   0.20   0.381      0.58
 5 pcvuc                  0.03398    12.0   2.080   4.87   0.986      6.17
 6 pcvuc[1]              -0.03397    12.0  -2.080  -4.78  -1.020      6.05
```

## Group 3: Inputs costs and demand

In this third group of industries, input costs are the only cost that affect the profit margin. Supplementing the cost variable in these equations are some measures of demand. The group includes mostly services industries: Finance and insurance, Business services, Automobile repair, and Utilities. (Communication services also falls into this group, but is discussed in the section for regulated industries below.) In addition, three manufacturing industries are represented: Electrical machinery, Printing, and Metal products.

### Finance and Insurance Services (32)

The Finance and insurance industry is the second-largest domestic sector in terms of corporate profits, comprising 11.5% of the total in 1987. The profit margin for this industry depends on two demand variables, the unemployment rate and industry output, as well as on input costs. Because this service industry is sensitive to overall demand in the economy, the inverse of the unemployment rate was used as a measure of demand. As the economy worsens, profits in Finance and insurance slow. In addition, the profit margin is responsive to changes in industry activity beyond overall changes in the macroeconomy. An increase in input costs initially increases profits for the industry, although the effect is entirely canceled out by lagged costs.

A dummy variable was included to account for the structural changes that occurred in the banking industry between 1979 and 1982 due to deregulation. One effect of deregulation was increased competition for banks and thrift institutions. That increased competition led, in part, to a large fall in the overall profit margin for the industry. From 1979 to 1982, the profit margin fell from a value of 20% to 4.5%. To the extent that excess profits existed due to lack of competition,

# Figure 4.15: Estimation of Finance Profits

```
title First Difference in Profits/Output: 32 Financial, insurance
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4

:                 FD in Profits/Output: 32 Financial, insurance
 SEE   =       1.46 RSQ   = 0.6794 RHO =   0.20 Obser  =   23 from 1965.000
 SEE+1 =       1.44 RBSQ  = 0.5850 DW  =   1.59 DoFree =   17 to   1987.000
 MAPE  =     105.19
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.47
 1 pcout                   0.46962     8.6   1.743  -4.12   0.245      4.09
 2 pcout[1]               -0.46962     8.6  -1.743   4.14  -0.242      4.11
 3 pcvuc                   0.42703    32.9   3.612  -6.16   0.470      6.74
 4 pcvuc[1]               -0.42703    32.9  -3.612   6.05  -0.486      6.62
 5 fduninv                13.71246     2.3   0.895   0.04   0.159     -0.00
 6 dummy                  -2.66191    22.4  -2.907   0.99  -0.391      0.17
```

then deregulation certainly worked.[7] As the industry adjusted to deregulation, and to the recovery from the 1982 recession, the profit margin recovered from its low of 4.5% to a level close to 9% by 1987.

Other specifications that were tried for this industry included using labor costs and interest rates, but the equation presented here showed the best combination of statistical fit and reasonable forecasting properties.

The dynamic forecast for Finance and insurance shows a gradual decline in the margin through the economic slowdown until 1991. The rest of the forecast follows a damped oscillating pattern of growth, where the margin responds to cyclical activity, but as the economy's turnarounds become less dramatic, the growth in the margin also stabilizes.

Business services (35) and Automobile repair services (36)

Business services and Automobile repair services share the same equation specification. The profit margin depends on changes in input costs, current and lagged once, as well as changes in output, current and lagged. In each equation, an increase in costs implies an initial fall in the profit margin, which is then offset in the following year. The profit margin for both service industries responds positively to changes in demand, and the effect is reversed in the following year. Both industries also share the characteristic that they were extremely difficult equations to estimate. For some of the service industries, an overall measure of demand in the economy, such as the unemployment

Figure 4.16: Estimation of Business services Profits

[7] This fall in profits is interesting given that the call for deregulation came, in part, from within the industry itself. Although, as noted in the Economic Report of the President, 1980, "Even as they sought innovative ways to bypass the regulatory structure and to maintain their markets, some depository institutions urged regulatory agencies to loosen their restrictions. The call for deregulation was less than unanimous, however, since many institutions believed that the regulatory structure still protected their profitable markets from encroachment by competitors." (p. 109)

```
title First Difference in Profits/Output: 35 Misc Business Services
con 9999 0.0 = a1 + a2
con 9999 0.0 = a3 + a4

:            First Diff in Prof/Output: 35 Misc Business Services
 SEE   =       0.37 RSQ   = 0.2194 RHO =  -0.26 Obser  =   23 from 1965.000
 SEE+1 =       0.36 RBSQ  = 0.0962 DW  =   2.53 DoFree =   19 to   1987.000
 MAPE  =      98.99
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -      0.01
 1 pcout                   0.00303     0.0   0.126   1.42   0.022      5.13
 2 pcout[1]               -0.00301     0.0  -0.125  -1.41  -0.022      5.13
 3 pcvuc                  -0.10123     9.6  -1.960 -53.25  -0.721      5.77
 4 pcvuc[1]                0.10123     9.6   1.961  52.68   0.738      5.71
```

## Figure 4.17: Estimation of Auto repair Services

```
title First Difference in Profits/Output:  36 Auto Repair
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:                 First Diff in Prof/Output:  36 Auto Repair
 SEE   =       0.39 RSQ   = 0.2388 RHO =  -0.10 Obser  =   23 from 1965.000
 SEE+1 =       0.39 RBSQ  = 0.1186 DW  =   2.21 DoFree =   19 to   1987.000
 MAPE  =     123.94
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.06
 1 pcout                   0.00450     0.5   0.446  -0.35   0.066      4.31
 2 pcout[1]               -0.00450     0.5  -0.446   0.34  -0.066      4.26
 3 pcvuc                  -0.07194    11.8  -2.184   7.24  -0.607      5.65
 4 pcvuc[1]                0.07193    11.8   2.184  -7.17   0.615      5.59
```

rate or PCE, was found to be helpful. No type of macro variable was helpful for these industries, however. In addition, labor costs did not help the statistical fit of the equations, or yield reasonable coefficients, even when constraints were used. Neither equation has a particularly outstanding statistical fit, with $R^2$'s less than .24 in each case. However, the combination of the input costs and demand resulted in reasonable static and dynamic forecasts for the industries. The forecast for Business services shows sensitivity of profits to the economy's business cycle. The margin oscillates around its average value in the previous twenty years. The forecast for the profit margin of Automobile repair services shows only a slight response to the downturn of 1990. Thereafter, the profit margin remains relatively flat, only barely exceeding its average value from 1965 to 1987.

Electric, gas, and sanitary services (30)

The profit margin for Electric, gas, and sanitary services, or Utilities, depends only on input costs and one demand variable, changes in the unemployment rate. Attempts were made to incorporate oil prices, the deregulation of the natural gas industry, labor costs, and other variables in this equation with no success. Initially, an increase in material costs is passed on in prices and results in a temporary rise in the profit margin. In the following year, however, that increase is reversed. Without constraints on the cost coefficients, the net effect of a cost increase on the profit margin is positive. This positive relationship between costs and profits indicates another oligopoly industry that is able to exercise market power to pass on cost changes. This positive relationship is also consistent with inelastic demand for electric, gas, and water utilities. In general, demand for utilities depends on overall growth in the economy, and the profit margin is partially explained by the unemployment rate. As the economy grows

## Figure 4.18: Estimation of Utilities Profits

```
title First Difference Profits/Output: 30 Utilities
con 99999 0.0 = a1 + a2

:                    First Diff Prof/Output: 30 Utilities
 SEE   =       1.69 RSQ   = 0.1254 RHO =   0.22 Obser  =   23 from 1965.000
 SEE+1 =       1.65 RBSQ  = 0.0380 DW  =   1.56 DoFree =   20 to   1987.000
 MAPE  =     122.81
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - -     -0.40
 1 pcvuc[1]               0.15012     9.4   1.986  -2.91   0.710      7.71
 2 pcvuc[2]              -0.15010     9.4  -1.986   3.14  -0.633      8.31
 3 fduninv               12.83520     1.9   0.873   0.04   0.212     -0.00
```

during an expansion, and unemployment falls, the profit margin for the Utilities industry rises.

Electrical machinery (21)

This industry manufactures household and industrial appliances, communication equipment, lighting and wiring equipment, and radios, televisions, and other electronic goods. Profits in the industry are explained well with a relatively simple equation that depends only on input costs and two measures of demand. Costs are not passed on to consumers fully, and an increase implies an initial fall in the profit margin. In the following year, that increase is offset, partially due to a constraint on the coefficients that ensure they sum to zero. (Without the constraint, the coefficients implied a permanent negative effect on profits.) The profit margin responds to both an industry-specific measure of demand, changes in output, and a measure of overall economic activity, the unemployment rate. The profit margin appears to be less responsive to the business cycle over time, as the response to the 1974 recession was more drastic than to the 1982 recession. There are no major differences between the static and dynamic forecasting properties of this equation. The forecast shows the profit margin declining slightly to 1991, recovering modestly in 1992, and then stabilizing through the rest of the forecast period.

Printing and publishing (9)

Profits in the Printing industry have been extremely sensitive to downturns in the economy and have a volatile history. Changes in input costs, as well as changes in demand explain movements in the profit margin. Cost increases imply an initial fall in the profit margin, that is offset in the following year. Profits respond to demand as captured by industry output, but they also are sensitive to the overall business cycle, as measured by the unemployment rate.

## Figure 4.19: Estimation of Electrical machinery Profits

```
title First Difference Profits/output: 21 Electrical Machinery
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:                   FD Prof/output: 21 Electrical Machinery
 SEE   =       1.37 RSQ   = 0.5231 RHO =  -0.06 Obser  =   23 from 1965.000
 SEE+1 =       1.36 RBSQ  = 0.4172 DW  =   2.12 DoFree =   18 to   1987.000
 MAPE  =      92.91
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.25
 1 pcvuc                  -0.32478    20.7  -2.865   6.15  -0.601      4.66
 2 pcvuc[1]                0.32478    20.7   2.865  -6.04   0.613      4.57
 3 pcout                   0.05612     5.0   1.357  -1.26   0.228      5.51
 4 pcout[1]               -0.05612     5.0  -1.357   1.26  -0.228      5.53
 5 fduninv                 7.21684     0.9   0.566   0.04   0.109     -0.00
```

## Figure 4.20: Estimation of Printing Profits

```
title First Difference Profits/Output 09.Printing
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4

:                        FD Profits/Output 09.Printing
 SEE   =       0.82 RSQ   = 0.3124 RHO =  -0.09 Obser  =   20 from 1968.000
 SEE+1 =       0.82 RBSQ  = 0.1291 DW  =   2.18 DoFree =   15 to   1987.000
 MAPE  =     123.28
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.10
 1 pcout                  -0.05552     3.4  -1.019   1.62  -0.218      2.95
 2 pcout[1]                0.05552     3.4   1.019  -1.54   0.213      2.79
 3 pcvuc                  -0.18426    19.5  -2.537  11.51  -0.711      6.30
 4 pcvuc[1]                0.18426    19.5   2.536 -11.41   0.719      6.25
 5 fduninv                 9.26868     4.6   1.187   0.45   0.278     -0.00
```

The dynamic forecast is slightly less volatile than the static forecast, since the overall economic outlook of the dynamic forecast is more stable than the forecast used for the static analysis. The margin dips in the slowdown through 1990, then recovers well through 1993. Even with this recovery, however, the margin remains below its average value during the historical period.

## Group 4: No input costs

This small group consists of three industries whose profits are explained without using any measure of input costs: Textiles, Paper, and Hotels and non-auto repair services.

### Textiles (6)

The profit margin for the Textile industry is more sensitive to changes in demand and labor than to changes in material costs. Demand is captured with an industry-specific variable, the change in output, as well as a measure of the overall business cycle, the unemployment rate. An increase in output causes an initial surge in the profit margin. In the following year, that temporary increase in profits is offset. In addition, an increase in demand, indicated by a fall in unemployment, also implies an increase in the profit rate. Although unit material costs were not found to be useful in this equation, current changes in labor costs are important. In this industry characterized by labor unions, an increase in labor's share of income implies an initial decrease in the profit margin. The equation captures much of the variability in the profit margin, and the correlation between the actual and predicted profit margin is 83% (r "p"). The static and dynamic forecasts evince no startling differences, and the outlook for the profit margin is appropriately cyclical over the forecast period.

# Figure 4.21: Estimation for Textile Profits

```
title First Difference in Profits/Output for 06 Textiles
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:                    FD in Profits/Output for 06 Textiles
 SEE   =       0.83 RSQ   = 0.3927 RHO =  -0.08 Obser  =   26 from 1962.000
 SEE+1 =       0.83 RBSQ  = 0.2771 DW  =   2.16 DoFree =   21 to   1987.000
 MAPE  =      96.94
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.02
 1 pcout                  0.09755    26.6   3.554 -11.10   0.472      2.35
 2 pcout[1]              -0.09755    26.6  -3.554  10.97  -0.470      2.32
 3 pcwage                -0.02005     1.6  -0.812   0.18  -0.090      0.18
 4 pcwage[1]              0.02005     1.6   0.812   0.18   0.094     -0.19
 5 fduninv                9.12467     4.2   1.335  -0.21   0.247      0.00
```

Paper and allied products (8)

Like the Textile industry, profits for the Paper industry respond more to demand changes than to changes in material input costs. Changes in demand, measured by industry output, help explain the cyclical behavior of Paper profits. In addition, the labor share of output also explains profits. In contrast to the Textile industry, an increase in labor costs initially is passed on to consumers in prices, and the profit margin rises. The underlying trend for the profit margin from the mid-1970's through 1985 was downward, and profits were hard hit by the 1982 recession. In 1987, however, the profit margin jumps significantly, regaining its peak level of 1974 in almost one year. The dynamic forecast of the margin shows cyclical response of this industry to a slowdown in demand in 1993. Thereafter, the margin remains fairly steady to the end of the forecast period.

Hotels and non-automobile repair services (34)

The only service industry in this group, Hotels and repairs depend on changes in demand measured by both industry-specific and macroeconomic variables. Changes in industry output have a three-year effect on the profit margin for this industry. The initial response to a demand change is an increase in profits. The lagged effect, however, is a decrease in the profit margin. Finally, in the third year, any negative effect on the profit margin is canceled out, as the change in industry output increases the profit margin. Profits react to the overall business cycle, and the unemployment rate and interest rates also are included in the equation. As might be expected with only demand variables in the equation, the dynamic forecast shows cyclical behavior for Hotel profits, not unlike historical activity. Profits remain flat through the 1990-1991 slowdown, but then grow quickly during the recovery. As the economy resumes a more stable growth rate, the profit margin for Hotels likewise stabilizes.

## Figure 4.22: Estimation of Paper Profits

```
title First Difference Profits/Output 08.Paper
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:                        FD Profits/Output 08.Paper
 SEE   =       1.15 RSQ   = 0.3766 RHO =   0.32 Obser  =   18 from 1970.000
 SEE+1 =       1.13 RBSQ  = 0.2430 DW  =   1.36 DoFree =   14 to   1987.000
 MAPE  =      87.82
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat                - - - - - - - - - - - - - - - - - - - - -      0.06
 1 pcout                   0.07326    12.7   1.944   3.35   0.269      2.74
 2 pcout[1]               -0.07326    12.7  -1.944  -3.32  -0.269      2.72
 3 pcwage                  0.16805    21.1   2.558  -1.97   0.415     -0.71
 4 pcwage[1]              -0.16805    21.1  -2.558   1.59  -0.432     -0.57
```

## Figure 4.23: Estimation of Hotel Profits

```
title First Difference in Profits/output: 34 Hotels & repair
con 99999 0.0 = a1 + a2 + a3

:                 First Diff in Prof/output: 34 Hotels & repair
 SEE   =       0.24 RSQ   = 0.4352 RHO =   0.29 Obser  =   23 from 1965.000
 SEE+1 =       0.23 RBSQ  = 0.3097 DW  =   1.42 DoFree =   18 to   1987.000
 MAPE  =     171.61
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.02
 1 pcout                  0.02452     3.3   1.106  -2.56   0.212      2.42
 2 pcout[1]              -0.05310    10.7  -2.013   5.58  -0.461      2.43
 3 pcout[2]               0.02859     4.2   1.235  -2.93   0.247      2.38
 4 fdrlint               -0.02114     0.7  -0.512   0.11  -0.101      0.12
 5 fduninv                6.69342    16.5   2.538   0.40   0.624     -0.00
```

Group 5: Regulated industries

The following group contains those industries who have experienced some degree of regulation, and usually de-regulation, during the historical period of estimation.

Communication services (28)

The profit margin for Communication is sensitive to changes in demand and changes in input costs. An increase in costs initially implies a decrease in the profit margin that is offset in the following year. The equation also includes a dummy variable to account for the significant restructuring that occurred in the communication industry in the early 1980's. In 1982, a U.S. district judge gave final approval to a deregulation settlement between the American Telephone and Telegraph Company (AT&T) and the Department of Justice. To account for this deregulation, a dummy variable was introduced into the equation that equals one before the break-up of AT&T, one-half in 1983, as the break-up was being phased in, and zero thereafter. The coefficient of -.6 on the regulation variable implies that regulation of the industry lowered the industry's profit margin by more than half a percentage point. Interestingly, profits in the communications industry fell consistently from 1970 to 1981. Since deregulation, the profit margin has increased at an average annual rate of 13.8% per year, although it fell in 1987. The dynamic forecast of the margin is smooth and indicates that there are no large changes in demand or input costs forecast for this industry.

## Figure 4.24: Estimation of Communications Profits

```
title First Difference in Profits/Output: 28 Communication
 regul   = dummy variable = 1 before break-up of AT&T, 1955-1982
                          .5 in 1983
                           0 thereafter
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4

:                   FD in Profits/Output: 28 Communication
 SEE   =       1.39 RSQ   = 0.2755 RHO =   0.25 Obser  =   23 from 1965.000
 SEE+1 =       1.36 RBSQ  = 0.1145 DW  =   1.51 DoFree =   18 to   1987.000
 MAPE  =     147.65
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -    -0.35
 1 pcvuc                  -0.45209    11.0  -2.039   7.57  -0.741      5.94
 2 pcvuc[1]                0.45209    11.0   2.039  -7.42   0.777      5.82
 3 pcout                  -0.01673     0.1  -0.171   0.29  -0.031      6.16
 4 pcout[1]                0.01673     0.1   0.171  -0.29   0.031      6.24
 5 regul                  -0.57562     6.3  -1.528   1.31  -0.134      0.80
```

Air transportation services (26)

Although attempts were made to include demand variables in the equation for airline profits, the profit margin depends only on changes in material costs, largely fuel, labor costs and a variable representing deregulation of the industry. Increases in labor costs initially imply a fall in the profit margin, which is offset after a one-year lag. The initial effect of an increase in input costs is a small increase in the profit margin, but the one-year lag on costs implies a decrease in the profit margin. The decrease is not made up until the second year after the initial rise in costs. Although airline prices typically respond quickly to changes in fuel costs, rising rapidly after the Iraqi invasion of Kuwait, for example, this equation suggests that the pass-through of cost increases occurs with a delay. The initial pass-through is absorbed in the following year by a decrease in the profit margin. It takes three years for the effect of a cost change to work its way through completely to prices.

From 1979 to 1982, the Airline Deregulation Act of 1979 was being implemented, and the structure of the industry was changing. A dummy variable is used in the equation to account for the changes during this period. The coefficient on the deregulation variable is negative, but interpreting its meaning is difficult, since the restructuring also overlapped with the 1980-1982 recession.

The static and dynamic forecasts differ largely due to the different oil-prices faced by the industry in each scenario. The dynamic forecast shows an expected dip in the profit margin in response to higher oil prices due to the Iraqi invasion and Desert Storm. The profit margin recovers in 1992, and the remainder of the forecast shows a stable profit margin.

## Figure 4.25: Estimation of Air transportation Profits

```
title First Difference Profits/Output: 26 Air Transportation
dereg = dummy variable = 0 before de-regulation

con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4 + a5

:                First Diff Prof/Output: 26 Air Transportation
 SEE   =       1.78 RSQ   = 0.5432 RHO =  -0.25 Obser  =   18 from 1970.000
 SEE+1 =       1.71 RBSQ  = 0.3529 DW  =   2.51 DoFree =   12 to   1987.000
 MAPE  =     118.79
   Variable name          Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -      0.33
 1 pcwage                -0.15041    18.8  -2.224  -0.35  -0.438      0.76
 2 pcwage[1]              0.15043    18.8   2.225   0.04   0.401      0.09
 3 pcvuc                  0.08584     6.2   1.236   2.07   0.265      7.87
 4 pcvuc[1]              -0.34183    31.8  -2.973  -8.12  -1.061      7.77
 5 pcvuc[2]               0.25602    37.7   3.279   6.45   0.727      8.24
 6 dereg                 -1.68476     6.5  -1.269  -0.86  -0.239      0.17
```

Railroad (25)

The profit margin for the Railroad industry is determined by lagged input costs, labor costs, and changes in output. Current changes in costs were insignificant in this equation, but the margin responds to cost changes lagged one and two years. An increase in costs first implies a fall in the profit margin, as Railroads are reluctant to pass the costs on to their customers in higher prices, or, are prohibited from doing so by regulators. Likewise, an increase in the labor share of output initially implies a fall in the profit margin, rather than an immediate pass-through of the cost change into prices. The profit margin also responds to changes in demand, as measured by industry output. Finally, a dummy variable was used to account for the implementation of the Staggers Rail Act in 1981, which deregulated parts of the rail industry. After a sharp drop in profits in 1981 and 1982, due to both deregulation and the 1982 recession, the rail industry experienced a remarkable increase in the profit margin in the middle 1980's.

The static and dynamic forecasts for the profit margin differ significantly for this industry. In the static outlook, the profit margin falls in the first year of the forecast, 1988, by over 5 percentage points. In contrast, in the dynamic forecast the profit margin falls in 1988, but only by 1.8 percent points. In the static outlook, labor costs jumped significantly in the first forecast year, driving the profit margin down, while in the dynamic outlook labor costs actually fall slightly in the first year of the forecast.[8] The result is a less dramatic drop in the profit margin for the Railroad industry

Figure 4.26: Estimation of Railroads Profits

[8] It is difficult to backtrack and determine exactly why the labor cost variable jumped in the static outlook. One explanation for the jump may be that a "group fix" was applied to force total labor compensation to equal the known total for 1988, even though industry data were not available. A group fix in LIFT is applied by scaling the industry results, based on the size of each industry, to equal some given total. In some cases, that type of scaling may lead to jumps in the industry series.

```
title First Difference Profits/Output: 25 Railroads

 regul  = dummy variable for govt regulation of Railroad industry:
               0  before de-regulation  1955-1980
               1  in year of implementation of Staggers Rail Act '81
               0  thereafter
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4
con 99999 0.0 = a5 + a6

:                        FD Prof/Output: 25 Railroads
 SEE   =       1.33 RSQ   = 0.6095 RHO =   0.43 Obser  =   20 from 1968.000
 SEE+1 =       1.24 RBSQ  = 0.4292 DW  =   1.14 DoFree =   13 to   1987.000
 MAPE  =      89.96
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     0.13
 1 pcout                   0.03189     0.9   0.485   0.25   0.099      1.04
 2 pcout[1]               -0.03189     0.9  -0.485  -0.11  -0.097      0.45
 3 pcvuc[1]               -0.15317     9.4  -1.601  -6.74  -0.473      5.90
 4 pcvuc[2]                0.15319     9.4   1.601   7.15   0.442      6.26
 5 pcwage                 -0.10497     8.8  -1.550   0.57  -0.243     -0.73
 6 pcwage[1]               0.10497     8.8   1.549  -0.02   0.235     -0.02
 7 regul                  -3.84363    18.8  -2.310  -1.43  -0.392      0.05
```

in the dynamic forecast than in the static outlook.

Trucking and warehousing (27)

Although Trucking is included in this group because it underwent deregulation in 1980 and 1981, no dummy variable was needed in the equation to explain the effects of regulation.  Prior to the passage of the Motor Carrier Act (MCA) in 1980, the profit margin showed an underlying upward trend, although the margin oscillated around that trend in response to economic conditions.  From 1980 to 1982, in response to implementation of the MCA and to the economy-wide recession, the profit margin for Trucking fell significantly, with most of the drop occurring in 1982.   Recovery in 1983 was strong, and the profit margin performed well until 1987, when it dropped again.

The equation determines the profit margin as a function of lagged input costs, changes in labor costs, and changes in demand as measured by the unemployment rate.  An increase in material costs is absorbed (after a one-year lag) by the profit margin.  The decline in the margin is offset in the following year.  An increase in labor costs initially implies an increase in the profit margin, which is then offset in the next year.  Without constraints on the coefficients, the labor share variable has a large negative effect on profits.   Finally, trucking is sensitive to the overall business cycle, and changes in the unemployment rate affect the profit margin.

The dynamic forecast of the margin shows a decline in the profit margin due to the overall economic slowdown through 1991.  The margin recovers in 1992 and 1993, and remains stable through the rest of the forecast period.

# Figure 4.27: Estimation of Trucking Profits

```
title First Difference in Profits/output: 27 Trucking
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4

:                    First Diff in Prof/output: 27 Trucking
 SEE   =       0.79 RSQ   = 0.0707 RHO =  -0.36 Obser  =   20 from 1968.000
 SEE+1 =       0.69 RBSQ  = -0.1771 DW  =   2.73 DoFree =   15 to   1987.000
 MAPE  =     250.33
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.03
 1 pcwage                 0.02430     0.9   0.534   0.15   0.108     -0.15
 2 pcwage[1]             -0.02430     0.9  -0.534  -0.28  -0.107     -0.30
 3 pcvuc[1]              -0.03067     0.8  -0.506   7.42  -0.175      6.25
 4 pcvuc[2]               0.03067     0.8   0.506  -7.66   0.167      6.45
 5 fduninv                0.65160     0.0   0.088   0.12   0.024     -0.00
```

Group 6: Construction related

The industries in this group share a similar demand factor: change in construction activity in the economy.  The group includes: Construction, Real estate, Lumber and wood products, Furniture, and Stone, clay and glass.

Construction (4)

The profit margin for the Construction industry is responsive to changes in aggregate housing activity in the economy and to labor costs.  Changes in the profit margin depend on current and lagged changes in investment in residential structures.   (Attempts made to incorporate non-residential structures were unsuccessful.)  The profit margin also responds to changes in the labor share of output, and an increase in labor costs initially implies a decrease in the profit rate.

This equation was difficult to estimate, and the chosen equation fits poorly, with $R^2$ equal to .0488 and the correlation between the actual profit rate and cumulative predictions (r "p") only .278.  (When past errors are not cumulated, and the actual profit rate is compared to a one-step ahead prediction, the correlation is a respectable .707.)  The poor fit is due, in part, to the coefficient constraints.  Without constraints on the coefficients, the $R^2$ equals .1324 r "p" equals 44.2%, and r "a" equals 75%.  Efforts to include industry-specific costs, as well as other demand variables, such as interest rates and overall construction activity, did not produce any equations more reasonable than the one here.

The forecast for the profit margin shows cyclical behavior in response to both demand for residential construction and the labor cost share.  As labor costs increase and demand slows, there is a marked dip in the margin in 1993, and a smaller fall in 1997.  Although the margin does not fluctuate in the forecast as much as it does historically, it does show a reasonable pattern of cyclical activity.

## Figure 4.28: Esimation of Construction Profits

```
title First Diff Profits/Output for: 04 Construction
con 99999 0.0  = a1 + a2
con 99999 0.0  = a3 + a4


:               First Diff Profits/Output for: 04 Construction
 SEE   =       0.62 RSQ   = 0.0488 RHO =  -0.04 Obser  =   23 from 1965.000
 SEE+1 =       0.62 RBSQ  = -0.1013 DW  =   2.09 DoFree =   19 to   1987.000
 MAPE  =     226.29
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -      0.00
 1 pcih                  -0.00655     1.8  -0.828  -4.83  -0.167      3.33
 2 pcih[1]                0.00657     1.8   0.830   4.96   0.167      3.41
 3 pclab                 -0.02231     2.0  -0.885  -3.79  -0.174      0.77
 4 pclab[1]               0.02231     2.0   0.885   2.58   0.164      0.52
```

Furniture (15)

Profits in the Furniture industry are determined by a combination of macroeconomic and industry-specific factors. Changes in Residential construction and changes in the mortgage rate both influence the profit margin for the Furniture industry, as do changes in the material costs for the industry. The effect of Residential construction on the profit margin is spread over three years, with the largest, positive, impact occurring with a one-year lag. Changes in the mortgage rate also affect the profit margin for this industry, where an increase in the mortgage rate implies a fall in profits for the Furniture industry. The profit margin also depends on the cost of materials, mostly the costs of wood and wood products, and an increase in material costs initially depresses the profit margin.

The equation captures most of the cyclical behavior of profits in the Furniture industry, and the correlation between the predicted and actual level of the profit margin is 81% (r "p"). The dynamic and static forecasts differ only slightly, and they both show a stable outlook for the profit margin of the Furniture industry.

Real estate services (33)

The equation for profits of Real estate services uses only macroeconomic indicators of demand. Profits respond positively to increases in Investment in residential and nonresidential construction. In addition, demand is measured by the unemployment rate. Attempts were made to include some industry-specific variables in this equation, such as industry costs, labor costs, or industry output. The equation here, however, proved to be the most reasonable. The forecast of the profit margin shows an appropriate response to slow economic activity through 1991. Industry profits recover with the rest of the economy in 1992. The profit margin dips slightly in 1995, in response to a mild downturn, and then stabilizes over the rest of the forecast.

## Figure 4.29: Estimation of Furniture Profits

```
title First Difference Profits/Output: 15 Furniture
con 999999 0.0 = a1 + a2 + a3
con 999999 0.0 = a4 + a5
con 999999 0.0 = a6 + a7

:                        FD Prof/Output: 15 Furniture
 SEE   =       0.99 RSQ   = 0.2678 RHO =  -0.21 Obser  =   23 from 1965.000
 SEE+1 =       0.95 RBSQ  = -0.0068 DW  =   2.43 DoFree =   16 to   1987.000
 MAPE  =     369.33
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat                 - - - - - - - - - - - - - - - - - - - - -      0.02
 1 pcih                   0.00048     0.0   0.027   0.06   0.007      3.33
 2 pcih[1]                 0.01490     1.2   0.629   2.04   0.206      3.41
 3 pcih[2]                -0.01538     4.1  -1.155  -2.11  -0.213      3.41
 4 pcvuc                  -0.17675     9.3  -1.764 -38.08  -0.531      5.36
 5 pcvuc[1]                 0.17675     9.3   1.764  37.35   0.543      5.26
 6 fdrcmor                 -0.26524     1.1  -0.606  -1.61  -0.213      0.15
 7 fdrcmor[1]               0.26524     1.1   0.606   2.07   0.208      0.19
```

Figure 4.30: Estimation of Real estate Profits

```
title First Difference in Profits/Output: 33 Real Estate
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4

:                   First Diff in Prof/Output: 33 Real Estate
 SEE   =       0.17 RSQ   = 0.5417 RHO =   0.45 Obser  =   28 from 1960.000
 SEE+1 =       0.16 RBSQ  = 0.4619 DW  =   1.09 DoFree =   23 to   1987.000
 MAPE  =     158.46
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat              - - - - - - - - - - - - - - - - - - - - -     -0.05
 1 pcih                  0.00838    38.4   4.591  -0.59   0.485      3.30
 2 pcih[1]              -0.00838    38.4  -4.588   0.74  -0.501      4.19
 3 pccst                 0.00086     0.1   0.191  -0.04   0.024      2.20
 4 pccst[1]             -0.00086     0.1  -0.191   0.04  -0.024      2.45
 5 fduninv               4.11970    16.5   2.862   0.07   0.456     -0.00
```

Lumber and wood products (14)

This industry includes activities such as cutting of timber and pulpwood, as well as the manufacturing of some wood products, excluding furniture, such as containers and plywood. The profit margin for the industry is well explained by only three variables: industry output, labor productivity, and the mortgage rate. A percent changes in output, signalling increased demand, increases the profit rate initially. The margin is negatively related to a second measure of demand, the interest rate on 30-year commercial mortgages. A 1 point increase in the mortgage rate initially decreases lumber's profit margin, but the decrease is offset in the following year. Labor productivity, measured as output per hours worked, is negatively related to the profit margin. As labor productivity increases, implying an increase in wages, the profit margin initially falls.

The equation fits fairly well, capturing most of the turning points in lumber's profit margin, including the 1982 recession and eventual recovery. The forecast shows no growth in the profit margin in the first three years of the forecast, as a result of slow demand in the economy. The margin recovers in 1992 and 1993, and follows a stable path for the rest of the forecast period.

Stone, clay, and glass (16)

Profits in the Stone, clay, and glass industry are influenced mostly by changes in industry-specific demand and input costs. However, because the industry's activity is tied closely to construction demand in the economy, profits in Stone, clay, and glass also are influenced by the mortgage rate.

A change in demand, measured by the percent change in industry output, increases the profit margin initially. An increase in costs, on the other hand, initially decreases the profit margin. Over the next two years, however, the margin rises so the initial effect is offset.

Figure 4.31: Estimation of Lumber Profits

```
title First Difference Profits/Output for 14 Lumber
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4
con 999999 0.0 = a5 + a6

:                        FD Prof/Output for 14 Lumber
 SEE   =       2.03 RSQ   = 0.4618 RHO =   0.11 Obser  =   23 from 1965.000
 SEE+1 =       2.02 RBSQ  = 0.3035 DW  =   1.78 DoFree =   17 to   1987.000
 MAPE  =    1553.63
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat                - - - - - - - - - - - - - - - - - - - - -     0.05
 1 pcout                   0.13015    10.5   1.936   6.41   0.285      2.50
 2 pcout[1]               -0.13015    10.5  -1.936  -6.41  -0.285      2.50
 3 fdlprod                -0.82035    31.8  -3.537  -8.35  -0.390      0.52
 4 fdlprod[1]              0.82035    31.8   3.537   8.82   0.387      0.55
 5 fdrcmor                -0.12043     0.1  -0.213  -0.36  -0.041      0.15
 6 fdrcmor[1]              0.12043     0.1   0.213   0.46   0.040      0.19
```

# Figure 4.32: Estimation of Stone, clay, & glass Profits

```
title First Difference Profits/output: 16.Stone.clay.glass
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4 + a5
con 999999 0.0 = a6 + a7

:                     FD Prof/output: 16.Stone.clay.glass
 SEE   =       1.39 RSQ   = 0.5329 RHO =   0.29 Obser  =   23 from 1965.000
 SEE+1 =       1.35 RBSQ  = 0.3577 DW  =   1.43 DoFree =   16 to   1987.000
 MAPE  =      97.67
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.07
 1 pcout                  0.15951    21.8   2.781  -2.97   0.495      1.31
 2 pcout[1]              -0.15951    21.8  -2.781   3.44  -0.500      1.52
 3 pcvuc                 -0.05928     0.8  -0.499   4.84  -0.143      5.76
 4 pcvuc[1]               0.02640     0.1   0.180  -2.14   0.064      5.73
 5 pcvuc[2]               0.03287     0.3   0.330  -2.66   0.080      5.72
 6 fdrcmor               -0.20784     0.8  -0.507   0.44  -0.095      0.15
 7 fdrcmor[1]             0.20784     0.8   0.507  -0.57   0.093      0.19
```

The most important variable in the equation, according to the mexval and the t-statistic, is the change in the mortgage rate. An increase in the mortgage rate decreases the profit margin. The changes in the mortgage rate help explain the strongly cyclical behavior of profits in this industry, and close to 54% of the variability of the change in the profit margin is explained by this equation. In addition, there is a relatively strong correlation between the predicted and actual levels of the profit margin (r "p" = .721, r "a" = .853).

In the dynamic forecast for Stone, clay, and glass, profits respond to the slowdown in construction activity through 1991, but then recover as the mortgage rate again falls. The long-run outlook for the profit margin shows only slow growth in the margin after the period of recovery from the downturn. The profit margin eventually stabilizes and, in the last four years of the forecast, remains relatively flat.

## Group 7: Special industry profit equations

Equations for eight industry profits have been classified as special, since they each required specifications that deviated from the general functional form chosen for profits. The first three special industries are those that are influenced strongly by changes in oil prices: Rubber and plastics, Transportation equipment, and Petroleum refining. The remaining industries are ones whose prices are set exogenously in the model. This implies that their profit equations are relatively unimportant in the overall running of the model. These industries include: Agriculture, Crude oil and natural gas, Mining, Non-electrical machinery, and Leather.

### Rubber and plastic products (12)

In experimenting with equations to explain this industry's profits, it became clear that profits were strongly influenced by changes in oil prices. Crude oil is an input into the production of plastic resins, and consequently represents an important cost of production. In addition, however, oil prices strongly affect the demand for rubber and plastic materials. Rubber is used chiefly for making tires, for instance, whose demand links strongly to automobile sales. Rather than using all material costs, therefore, the equation uses changes in the price of oil. An increase in oil prices is initially absorbed by the profit margin for the Rubber and plastic industry, rather than being passed on fully into prices. The equation relies not only on oil prices, however, and industry labor costs, as well as demand variables are used. Demand is measured by changes in industry output, where an increase in demand leads to an initial increase in the profit margin. In addition, an increase in labor costs initially implies a fall in the profit margin, but the decrease is offset in the following year.

The profit margin for the industry follows two different trends over the historical period. From 1965 to 1980, the margin oscillated in response to the 1970, 1974, and 1980 recessions, but the overall trend was downward. Since 1980, however, the profit margin has increased almost continuously, with only slight pauses in 1984 and 1987. The dynamic forecast differs only modestly from the static forecast, and both show slight response to cyclical activity at the beginning of the forecast period, followed by a relatively stable profit margin to the year 2000.

# Figure 4.33: Estimation of Plastic Profits

```
title First Difference Profits/Output for 12 Rubber & plastic
con 999999 0.0 = a1 + a2
con 999999 0.0 = a3 + a4
con 999999 0.0 = a5 + a6

:                  FD Prof/Output for 12 Rubber & plastic
 SEE   =       1.25 RSQ   = 0.4955 RHO =  -0.18 Obser  =   20 from 1968.000
 SEE+1 =       1.21 RBSQ  = 0.3154 DW  =   2.36 DoFree =   14 to   1987.000
 MAPE  =     121.30
   Variable name          Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.01
 1 pcout                  0.03514     5.2   1.217 -30.01   0.194      5.18
 2 pcout[1]              -0.03514     5.2  -1.217  33.23  -0.203      5.74
 3 pcwage                -0.03401     2.7  -0.867  -1.89  -0.129     -0.34
 4 pcwage[1]              0.03401     2.7   0.867   4.90   0.140     -0.87
 5 pcproil               -0.03266    28.2  -3.004  64.38  -0.499     11.96
 6 pcproil[1]             0.03265    28.2   3.003 -59.76   0.500     11.11
```

Transportation equipment, excluding motor vehicles (19)

Transportation equipment is a disparate industry that includes Ships and boats, Aerospace, Trains and Tanks. Industry demand as well as costs are heavily influenced by the cost of oil, and profits respond to changes in oil prices. In addition, the change in demand, as measured by industry output, also influences profits. The dependent variable for this equation differs from most others in this study. The equation explains simply the change in the level of adjusted profits, rather than the profit margin. As seen in Figure 4.34, profits for this industry are much more cyclical in the last 10 years than in the prior years. The change in behavior made an equation explaining the profit margin exceedingly difficult to estimate.

Positive and negative changes in the price of oil do not have symmetric effects on profits in the Transportation equipment industry. An increase in the price of oil initially implies an increase in operating costs for the industry. In addition, a higher price of oil can also imply a slowdown in demand for Transportation equipment. An increase in the price of oil consequently implies a fall in profits for the industry over two years. Eventually, the increase in oil prices is passed on in higher prices, and profits recover partially. A fall in oil prices, however, implying both lower costs and higher demand, results in an increase in industry profits.

The forecast of the profit margin shows a response to the Iraqi oil shock and the 1990-1991 recession that closely resembles the behavior of the profit margin after the 1979 shock and the 1980-1982 recession. In the long-run, the profit margin eventually flattens, as the overall economy stabilizes.

# Figure 4.34: Estimation of Transportation equipment Profits

```
title First Difference Profits: Transp.equipment
f fdprat = acpr19 - acpr19[1]
con 9999999 0.0 = a1 + a2

:                    FD Profits: Transp.equipment
 SEE   =    1510.79 RSQ   = 0.3405 RHO =   0.08 Obser  =   23 from 1965.000
 SEE+1 =    1506.42 RBSQ  = 0.0932 DW  =   1.85 DoFree =   16 to   1987.000
 MAPE  =   13379.02
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat              - - - - - - - - - - - - - - - - - - - - -    105.03
 1 pcout                 44.35699     1.6   0.728   0.91   0.175      2.16
 2 pcout[1]             -44.35705     1.6  -0.728  -0.89  -0.175      2.12
 3 incpoil               -7.59202     0.5  -0.395  -0.98  -0.088     13.56
 4 incpoil[1]           -28.06789     4.7  -1.240  -3.41  -0.329     12.77
 5 incpoil[2]            33.30023     8.5   1.679   4.05   0.390     12.77
 6 decpoil              -31.35653     1.9  -0.782   0.93  -0.156     -3.11
 7 decpoil[2]           -45.49943     0.4  -0.366   0.53  -0.070     -1.22
```

Petroleum refining (11)

Petroleum refining makes a perfect transition between the industries who are related to oil prices and the following group who are affected strongly by exogenous prices in the model. Clearly, the primary input for the petroleum refining industry is Crude oil. Profits in the industry follow petroleum prices, therefore. In the model, profits consequently are determined largely by an exogenous variable, the price of crude petroleum. The equation is a simple one, therefore, that relates profits to changes in output and to changes in the prices of oil. As expected, the forecast of the profit margin shows a dip in response to the 1990 oil shock, followed by moderate growth that reflects the assumption for the price of crude oil.

Agriculture, Forestry, Fisheries (1)

There are several reasons why profits in the Agriculture industry require special treatment. First, the Agriculture industry processes chiefly raw materials, such as food crops, lumber and fibers (such as cotton), and most of the industry's trade is intra-industry, sales from one agricultural unit to another. This large proportion of intra-industry trade implies that the cost of material inputs is mostly determined by the industry price, implying that current material costs and the industry price are highly correlated. On one hand, including the current cost of material inputs in the agriculture profit equation insures a well-fitting equation. On the other hand, the equation then has poor forecasting properties, since the equation is essentially self-determining. In addition, and most importantly for running the LIFT model, the price of agriculture is set exogenously, so profits are determined to a certain extent, by the price. As noted in Chapter 2, LIFT allows prices to be set exogenously. When a price is given as an exogenous assumption, the accounting identity implied by the dual input-

## Figure 4.35: Estimation of Petroleum refining Profits

```
title First Difference Profits/Output for  11 Petroleum refining
con 9999999 0.0 = a1 + a2
con 9999999 0.0 = a3 + a4 + a5

:                FD Prof/Output for  11 Petroleum refining
 SEE   =       1.48 RSQ   = 0.4907 RHO =  -0.16 Obser  =   18 from 1970.000
 SEE+1 =       1.46 RBSQ  = 0.3340 DW  =   2.31 DoFree =   13 to   1987.000
 MAPE  =     275.44
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -      0.31
 1 pcout                  -0.16880    24.8  -2.692  -0.80  -0.417      1.47
 2 pcout[1]                0.16880    24.8   2.692   0.90   0.420      1.66
 3 pcproil                -0.02631    14.6  -2.018  -1.09  -0.356     12.95
 4 pcproil[1]              0.00084     0.0   0.044   0.03   0.011     12.22
 5 pcproil[2]              0.02548     9.9   1.646   1.21   0.304     14.74
```

output equation must be enforced. In other words, given a level of labor income and a sectoral price, the remaining value added for the industry is then a residual. In LIFT, the accounting identity is imposed by spreading the difference between value added implied by the price level and value added implied by the model's equations to three components of value added: corporate profits, proprietor income, and indirect business taxes. An equation for Agricultural profits will determine the initial share of profits in value added, but the level of profits will be determined by the exogenous price assumption.

For these reasons, agricultural profits are determined by a simple equation based on a moving average of the dependent variable, changes in output, and a dummy variable for the 1973 grain deal. The dependent variable is profits, deflated by the agriculture output deflator, as a share of output. Profits depend positively on the previous year's average profits and positively on the three-year moving average of percent changes in output. This equation gives a reasonable first guess of the profit level for Agriculture, which is then scaled as needed to impose the exogenous price for Agriculture.

Crude oil and natural gas extraction (2) and Mining (3)

As with Agriculture, Oil and gas extraction and Mining require special treatment. Since both industries process raw materials that are subject to factors not easily modeled, such as weather and politics, and since profits are determined largely by an exogenous price assumption, the equations are relatively simple ones. The profit to output share depends on a three-year moving average of the profit rate, changes in output, and a dummy variable for OPEC supply shocks.

## Figure 4.36: Estimation of Agriculture Profits

```
title Profit Rate (profits/output)  1 Agriculture
  ratav   =  3-year moving average of profit rate
  outav   =  3-year moving average of changes in real output
  grdeal  =  dummy variable equal 1 in 1973

:                  Profit Rate (profits/output)  1 Agriculture
 SEE   =       0.20 RSQ   = 0.5220 RHO =   0.28 Obser  =   23 from 1965.000
 SEE+1 =       0.19 RBSQ  = 0.4465 DW  =   1.44 DoFree =   19 to   1987.000
 MAPE  =      70.28
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 prat                  - - - - - - - - - - - - - - - - - - - - -     0.50
 1 intercept              0.21110     7.1   1.672   0.42   0.000      1.00
 2 ratav                  0.30586     5.2   1.430   0.30   0.228      0.49
 3 outav                  0.04427     6.2   1.557   0.19   0.249      2.17
 4 grdeal                 0.90060    34.8   3.943   0.08   0.628      0.04
```

# Figure 4.37: Estimation of Crude oil Profits

```
title Profits/output: 2 Crude oil & Natural gas extraction

  ratav    = 3-year moving average of profit rate
  outav    = 3-year moving average of changes in real output
  opec     = dummy variable = 1 in 1974 and 1979

:           Profits/output: 2 Crude oil & Natural gas extraction
 SEE   =       6.72 RSQ   = 0.6466 RHO =   0.15 Obser  =   23 from 1965.000
 SEE+1 =       6.65 RBSQ  = 0.5909 DW  =   1.70 DoFree =   19 to   1987.000
 MAPE  =      44.62
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 prat                 - - - - - - - - - - - - - - - - - - - - -    23.88
 1 intercept              -1.55305     0.2  -0.279  -0.07  -0.000      1.00
 2 ratav                   0.88663    41.7   4.374   0.96   0.599     25.96
 3 outav                   0.66097     3.2   1.120   0.02   0.154      0.74
 4 opec                   22.18376    36.2   4.030   0.08   0.553      0.09
```

## Figure 4.38: Estimation of Mining Profits

```
title Profit Rate (profits/output) for: 03 Mining
   ratav = 3-year moving average of profit rate
   outav = 3-year moving average of changes in output
   opec  = dummy variable equals 1.0 in 1974

:                 Profit Rate (profits/output) for: 03 Mining
 SEE   =     797.41 RSQ   = 0.6954 RHO =   0.08 Obser  =   23 from 1965.000
 SEE+1 =     797.01 RBSQ  = 0.6473 DW  =   1.84 DoFree =   19 to   1987.000
 MAPE  =     109.13
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 prat                 - - - - - - - - - - - - - - - - - - - - -   1806.49
 1 intercept             498.47080     4.0   1.238   0.28   0.000      1.00
 2 ratav                   0.49549    20.1   2.900   0.55   0.372   1998.58
 3 outav                  40.94988     0.7   0.527   0.05   0.068      2.07
 4 opec                 5354.31111    68.8   5.929   0.13   0.756      0.04
```

Non-electrical machinery (20)

The Non-electrical machinery industry manufactures specialty machinery, such as agricultural machinery, construction, mining and oilfield equipment, and metalworking machinery.  This industry also includes manufacturers of computers, which is the reason for its designation as a special industry.  The Department of Commerce, in an attempt to account for the changing technology of the computer industry, developed a hedonic price index for computers.  This index is supposed to capture the changing price per unit of "quality", say price per unit of computing power.  The price of computers measured by this hedonic index fell through most of the 1980's.  Use of a special method for one industry's price calculation, and especially a method that shows a price declining, introduces several technical problems into modeling both real and income activity for the industry.[9]   To avoid those problems in the model, the price of computers is assumed to be flat.  As noted earlier, when a price is introduced exogenously, the implication is that value added is also exogenous to a large extent.  For purposes of completeness, however, the estimated equation for profits of Non-electrical machinery will be described.

Profits are explained by two variables: demand and material costs, both of which are lagged for two years.  An increase in demand implies an initial increase in the profit margin.  Over the next two years, that increase is offset.  An increase in material costs initially has a small negative effect on the profit margin, but in the following year, the profit margin falls as cost changes are absorbed by the industry.  After the third year of the change, however, the profit margin recover.

Explaining profits with only demand and cost changes results in an equation that captures turning points in the series well, including the recessionary drops in 1974 and 1982, as well as the 1985 decrease.    Figure 4.39: Estimation of Nonelectrical machinery Profits

[9] See McCarthy (1991) and Meade (1990).

```
title First Difference Profits/output: 20 Non-elect.machinery
con 99999 0.0 = a1 + a2 + a3
con 99999 0.0 = a4 + a5 + a6

:                    FD Prof/output: 20 Non-elect.machinery
 SEE   =       1.04 RSQ   = 0.4340 RHO =   0.02 Obser  =   23 from 1965.000
 SEE+1 =       1.04 RBSQ  = 0.2675 DW  =   1.96 DoFree =   17 to   1987.000
 MAPE  =     105.58
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat               - - - - - - - - - - - - - - - - - - - - -     -0.49
 1 pcout                   0.09817    32.1   3.557  -0.63   0.612      3.18
 2 pcout[1]               -0.08449    18.7  -2.633   0.58  -0.534      3.41
 3 pcout[2]               -0.01369     0.8  -0.529   0.11  -0.086      3.88
 4 pcvuc                  -0.08572     3.4  -1.085   0.92  -0.256      5.32
 5 pcvuc[1]                0.30748    17.1   2.509  -3.31   0.917      5.32
 6 pcvuc[2]               -0.22178    16.2  -2.443   2.38  -0.665      5.30
```

The implication of a flat computer deflator can be seen in the illustration of the dynamic forecast for this industry's profit margin in Figure 4.39. The profit margin for Nonelectrical machinery falls throughout the forecast period, and it is negative. Although this negative profit margin does not look reasonable, it results from the effort to compensate for the hedonic price index for computers. It also is relatively inocuous in the model, in the sense that it has little effect on other variables. One of the main roles of profits is to determine prices, but the price in this case is given. Of course, profits also affect aggregate profit income, but this industry is relatively small, only .8% of the total in 1987, so its effect on aggregate income is small.

Leather and leather products (13)

The final industry to be considered in the special category is another one whose behavior in the model is largely determined by exogenous assumptions. Although the domestic price of Leather is not set exogenously, most of the activity for this industry is. The outlook for the profit margin is affected greatly, therefore, by exogenous assumptions. Nevertheless, the estimated equation includes the response of profits to demand, imports, and input costs. The shoe industry has been highly sensitive to foreign trade, so the change in imports was used in the equation. Increases in output for the industry, indicating domestic demand, initially increase the profit margin, although that increase is offset in the following year. Finally, increases in production costs are passed on to consumers in higher prices at first, and overridden after two years. The dynamic and static forecasts for the profit margin differ modestly, with the dynamic forecast more volatile in the first few years than the static forecast. The margin stabilizes and remains relatively flat over the last nine years of the forecast.

Figure 4.40: Estimation of Leather Profits

```
title First Difference Profits/Output for 13 Leather
con 99999 0.0 = a1 + a2
con 99999 0.0 = a3 + a4
con 99999 0.0 = a5 + a6

:                        FD Prof/Output for 13 Leather
 SEE   =       1.60 RSQ   = 0.3665 RHO =  -0.48 Obser  =   23 from 1965.000
 SEE+1 =       1.32 RBSQ  = 0.1802 DW  =   2.96 DoFree =   17 to   1987.000
 MAPE  =     372.32
   Variable name           Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat                - - - - - - - - - - - - - - - - - - - - -    -0.01
 1 pcout                   0.06791     4.1   1.196  16.16   0.170     -2.56
 2 pcout[1]               -0.06791     4.1  -1.196 -14.24  -0.178     -2.26
 3 pcimp                   0.06228    13.7   2.233 -71.65   0.392     12.39
 4 pcimp[1]               -0.06229    13.7  -2.233  73.16  -0.390     12.65
 5 pcvuc[1]                0.40774    17.9   2.578-200.67   0.772      5.30
 6 pcvuc[2]               -0.40773    17.9  -2.578 195.90  -0.799      5.18
```

## Conclusions

This chapter has shown the development of thirty-seven equations to determine profits by industry in an Interindustry Macroeconomic model. The equations developed here are just part of the income side of an IM model. The next chapter describes equations to determine the remaining components of industry income.

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