Chapter 5: Non-profit Income Equations

The industry profit equations described in the preceding chapters comprise only part of total industry income in an IM model. This chapter describes equations for estimating the remaining components of capital income: Proprietor income, Net interest payments, Depreciation allowances, Inventory valuation adjustments, and Business transfer payments. The chapter also includes a brief discussion of the government portions of value added: Indirect business taxes and Government subsidies.

Proprietor Income

Proprietor income is the profits of non-corporate enterprises. In other words, it is the excess revenue that remains for a proprietorship after labor and material costs have been paid. Because proprietor income and profits are defined similarly, the functional form of the equation chosen for proprietor income closely resembles the equations for corporate profits. Changes in the profit rate, or proprietor income rate, are explained as a mark-up over labor and material costs and as a response to changes in demand.

The estimation of proprietor income equations differs from the procedure for profit equations in terms of the scope of the equations. In Chapter 2, two methods of estimating industry equations were

described. In the first method, industry equations are estimated separately. A single functional form is applied to each industry, and equations differ in their parameters. In the second method, a single equation is estimated for the aggregate variable, which is then distributed to industries based on industry share equations or relative industry-to-aggregate equations. The equations for proprietor income were developed with a hybrid version of those two methods. Proprietor income for four large industries is estimated with individual equations, while the remainder is estimated as "all other proprietor income" and distributed appropriately.

Close to eighty percent of total Proprietor income is accounted for by four industries: Wholesale and Retail Trade, Construction, Business Services, and Agriculture. These industries are different enough to warrant individual equations to determine the proprietor income in each. However, the remaining twenty percent of proprietor income is spread to over thirty industries. Rather than estimating separate equations for each sector's proprietor income, a single equation for their sum is estimated. That subtotal is then distributed to the industries based on their share of that subtotal.

Because the equations for proprietor income closely resemble those for corporate profits developed in the previous two chapters, the form of the equation will be reviewed only briefly here. Changes in the "profit rate", or "proprietor income rate", are modeled as a

function of changes in costs, both material and labor, and changes in demand. The equation results are summarized in Figures 5.1 and 5.2.

Business services (35)

The largest industry in terms of proprietor income is Business services, which includes such diverse activities as building management, advertising, and computer consulting. The dependent variable is defined as the change in the "proprietor income rate," where the rate is the proprietor income share of total output as defined earlier for the profit equations. The change in the rate for Business services depends on changes in material and labor costs and changes in demand, as measured by industry output. As with the profit equations, reasonable long-run properties of the equation are ensured by constraining the coefficients on a variable to sum to zero over time. Initially, an increase in material costs implies a fall in the proprietor income margin. An increase in labor costs, on the other hand, causes an initial increase in the margin.

Agriculture, forestry, fishery services (1)

The second-largest industry, in terms of proprietor income, is Agriculture. The equation uses a combination of demand and cost variables to determine first differences in the Proprietor income

share of output. Costs are measured by lagged changes in input costs. Only lagged changes are used because of the high degree of intra-industry trade for the industry. The intra-industry trade implies that the cost of material inputs is highly collinear with the price of agriculture. A lagged increase in costs initially implies a fall in the proprietor income rate. That decrease is eventually offset, however. Changes in demand, on the other hand, initially are positively linked to changes in the proprietor income share. Lastly, a dummy variable is used in the equation to account for the grain deal of 1973.

As noted in Chapter 4, the price for Agriculture is set exogenously. This implies that total value added for the industry is controlled by an exogenous assumption, since the input-output price equation must hold. If the product price is determined, then value added is a residual and is determined by spreading the value-added implied by the price fix to the components of income. Even though the results of this equation are being overridden, it is included for two reasons. The first is that the equation provides an initial estimate of proprietor income for Agriculture. Since the spreading of value added implied by the price fix is based on the share of proprietor income, profits, and indirect business taxes in total value added, it is important to have a reasonable value for the initial estimate of proprietor income. In addition, proprietor income not only is used in price determination, it also is a significant part of

total personal income. Since proprietor income will affect personal income, it is important that it maintain reasonable values.

Figure 5.1: Equation Estimates for Proprietor Income

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title First Diff in Proprietor Income/Output: 35 Misc Business Services

 SEE   =      0.69 RSQ   = 0.3423 RHO =   0.06 Obser  =   23 from 1965.000
 SEE+1 =      0.69 RBSQ  = 0.1489 DW  =   1.88 DoFree =   17 to   1987.000
 MAPE  =     92.29
  Variable name         Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat             - - - - - - - - - - - - - - - - - - - -     -0.03
 1 pcvuc               -0.01847     0.1  -0.181   4.17  -0.066      5.77
 2 pcvuc[1]             0.01846     0.1   0.181  -4.12   0.067      5.71
 3 pcout               -0.04210     2.0  -0.832   8.45  -0.154      5.13
 4 pcout[1]             0.04210     2.0   0.832  -8.45   0.154      5.13
 5 pcwage               0.07182    12.3   2.103  -5.00   0.342      1.78
 6 pcwage[1]           -0.07183    12.3  -2.103   3.72  -0.270      1.33


title First Diff in Proprietor Income/Output:  1 Agriculture

 SEE   =      4.23 RSQ   = 0.4239 RHO =   0.13 Obser  =   23 from 1965.000
 SEE+1 =      4.21 RBSQ  = 0.2545 DW  =   1.73 DoFree =   17 to   1987.000
 MAPE  =    199.54
  Variable name         Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat             - - - - - - - - - - - - - - - - - - - -      0.15
 1 pcout               0.14652     2.0   0.834   2.04   0.103      2.07
 2 pcout[1]           -0.14652     2.0  -0.834  -2.05  -0.103      2.08
 3 pcvuc[1]           -0.37459    10.6  -1.948 -11.76  -0.399      4.65
 4 pcvuc[2]            0.15358     1.0   0.571   4.92   0.161      4.74
 5 pcvuc[3]            0.22099     3.8   1.155   7.42   0.221      4.97
 6 grdeal             14.92085    22.9   2.946   4.38   0.546      0.04


title First Diff Proprietor Income/Output: 4 Construction

 SEE   =      0.96 RSQ   = 0.2733 RHO =  -0.02 Obser  =   23 from 1965.000
 SEE+1 =      0.96 RBSQ  = 0.0595 DW  =   2.04 DoFree =   17 to   1987.000
 MAPE  =    446.86
  Variable name         Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 fdprat             - - - - - - - - - - - - - - - - - - - -      0.21
 1 pcih                0.02235     6.7   1.532   0.35   0.319      3.33
 2 pcih[1]            -0.02232     6.7  -1.530  -0.36  -0.318      3.41
 3 pcvuc               0.03764     0.7   0.486   1.02   0.168      5.80
 4 pcvuc[1]           -0.03763     0.7  -0.486  -1.01  -0.170      5.72
 5 pcwage              0.10694    17.5   2.547   0.38   0.467      0.77
 6 pcwage[1]          -0.10694    17.5  -2.547  -0.26  -0.439      0.52


title Proprietor income/Output: 31 Wholesale & retail trade

f time     = @cum(time, 1.0, 0.0)
f onetime  = 1/time

 SEE   =      0.50 RSQ   = 0.8965 RHO =   0.58 Obser  =   23 from 1965.000
 SEE+1 =      0.44 RBSQ  = 0.8802 DW  =   0.84 DoFree =   19 to   1987.000
 MAPE  =      8.20
  Variable name         Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 prat               - - - - - - - - - - - - - - - - - - - -      5.51
 1 intercept           0.14104     0.2   0.291   0.03   0.000      1.00
```

2	pcvuc	0.19383	59.7	5.429	0.18	0.484	5.11
3	pcout	0.04719	2.7	1.026	0.03	0.091	3.63
4	onetime	83.42067	196.9	12.184	0.76	0.917	0.05

Figure 5.2: Equation Graphs for Proprietor Income

Construction (4)

The third-largest industry, in terms of proprietor income, is Construction. In addition, proprietor income is a large share of the total capital income for the industry, 63% in 1987. In fostering industry-specific behavior in an IM model, it is reasonable to develop an equation for proprietor income in the Construction industry. Proprietor income for Construction depends on a combination of industry-specific and macroeconomic factors. Costs are measured by industry-specific input and labor costs, while demand is measured by changes in investment in residential structures. (Investment in nonresidential structures was tried in the equation also, but with little success.) Increase in either labor costs or input costs have an initial positive effect on proprietor income. In other words, an increase in costs is not absorbed by a fall in proprietor income, but rather, is passed on to consumers. In addition, increases in demand, as measured by Residential investment, have an initial stimulative effect on proprietor earnings.

Wholesale and retail trade (31)

The last industry whose proprietor income is estimated separately is Wholesale and retail trade, and its equation was estimated with a slightly different procedure than has been used so far. As seen in Figure 5.2, the proprietor income to output share has a distinct downward trend over its entire history. Unlike many

profit series, or proprietor income series, this one is not volatile around that trend. Efforts to estimate the equation as the first difference of the proprietor income rate resulted in equations dominated by the effects of the negative trend. Equations that fit well usually contained a large negative intercept. Even with a negative intercept, the coefficients on behavioral variables also were negative. Although such equations fit well, their forecasting properties were unreasonable. Rather than estimate the first difference of the proprietor income rate, therefore, the rate itself was estimated as a simple function of changes in costs, demand, and a non-linear trend.[1] The non-linear trend captures the overall downward slope of the series and its leveling off in the last few years. Movements around that trend are captured by changes in costs and demand. An increase in costs leads to a temporary increase in proprietor income, as does an increase in demand, as measured by changes in real output.

Remaining Proprietor income

The twenty percent of proprietor income not accounted for by the four previously-discussed industries is distributed among thirty industries. Since the marginal benefit of estimating thirty equations to determine each industry's proprietor income is small, the remaining proprietor income is treated as a single item. Although initial attempts were made to estimate an equation for this "Other proprietor income," few viable equations resulted. Rather than impose tenuously-established behavior on the series, a simple modeling approach was used. In the model, the "All other" portion of Proprietor income is assumed to grow at the same rate as overall labor compensation. The idea is that an individual may choose between self-employment or "regular" employment in an established enterprise.

[1] The nonlinear trend used in this estimation was the inverse of a time-trend. Using the inverse of a time-trend implies that the nonlinear curve depends on the starting point used to calculate the trend.

Since self-employment involves the risks associated with entrepreneurship, the returns for self-employment are assumed to be growing at least at the same rate as the returns from regular employment. After the total for these thirty industries is determined, the result is distributed among the industries based on their relative shares of proprietor income and real growth in the industry. Specifically, each industry's income share is indexed by the change in the industry's real output share from a base year, as follows:

$$npr_{i,t} = \left(\frac{npr_{i,to}}{NPR_{to}} * \frac{out_{i,t}/OUT_{t}}{out_{to}/OUT_{to}} \right) * NPR_{t} \quad 5.1$$

where

to = last year of historical data,
$npr_{i,t}$ = proprietor income for industry i, time t,
NPR = aggregate for Proprietor income,
$out_{i,t}$ = constant dollar output, industry i, time t.

(This method of distributing an aggregate result to industries is used for distributing several components of capital income where an aggregate equation is used to determine the total.) This distribution method allows those industries who are experiencing relatively strong growth, as measured by changes in their share of total real output, to capture an increasing share of the component of return to capital being distributed.

Non-profit capital income

This section describes the equations for the remaining components of value added: Net interest payments, Depreciation allowances, Inventory valuation adjustments, Business transfer payments, and Indirect business taxes. Most of these income components are modeled by using an aggregate equation to determine the total, which is distributed to industries based on their share of the total, and their relative growth.

Net Interest Payments

Net interest payments are the interest payments received by business, less interest paid by business.[2] As shown in Figure 5.3, Net interest as a share of GNP rose rapidly from 1972-1982, during a period of high interest rates and debt accumulation. Although the share stabilized from 1982 to 1987, it rose again through 1989, reaching a peak of 8.9% of GNP. The net interest share of GNP is modeled as a function of a cumulative business deficit, as well as interest rates. The business deficit is calculated as the sum over time of the excess of business investment purchases over the funds available to pay for that investment. The interest rate used is a four-year moving average of the AAA-bond rate. The estimation results are summarized in Figure 5.3. The dependent variable of the equation is domestic Net interest payments (Total Net interest less net payments of Rest of world) as a share of GNP. An increase in business debt as a share of GNP will increase the Net interest share, as will an increase in interest rates. The equation fits well, with R^2 equal to .9623. The rho of .3 and Durbin Watson of 1.5 indicate only a slight degree of serial correlation.

An equation for aggregate Net interest is preferred over industry equations, largely due to the importance of the variable for business debt. While it is a fairly straightforward task to calculate aggregate business debt, it is a more complicated task to construct measures of industry debt. Since business debt is an important explanatory variable for Net interest payments, the aggregate equation approach is chosen.[3]

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[2] The specification of the Net interest equation follows the work of Almon in the Quest model. (Almon, 1989, pp. 230-231.)

[3] Creating industry business debt is complicated by the lack of data for some business funds at the industry level. For instance, funds available equals profit income + depreciation allowances less taxes paid and dividends paid, however, neither taxes paid or dividends are available by industry. Hyle (1986) calculated a simpler measure of industry debt, but his work also used an aggregate equation to

Figure 5.3: Net interest payments

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title Domestic net interest payments as share of GNP
f bpurch$ = ipe + struc
f bfunds  = vccc + ccadj/1000. + vcpr - tc - ydv
f bfunds$ = bfunds/pgnp
f borrow  = bpurch$ - bfunds$
f debt    = @cum(debt, .25*borrow, 0.0)
f ninsh   = nin48/gnpz
f debtsh  = debt/gnp
f smrat   = (raaa + raaa[1] + raaa[2] + raaa[3])/4

 SEE   =      2.93 RSQ   = 0.9623 RHO =   0.27 Obser  =   18 from 1973.000
 SEE+1 =      2.88 RBSQ  = 0.9542 DW  =   1.47 DoFree =   14 to   1990.000
 MAPE  =      3.97
   Variable name         Reg-Coef  Mexval t-value  Elas    Beta      Mean
 0 ninsh              - - - - - - - - - - - - - - - - - -    67.48
 1 intercept            73.84952   203.5  10.720   1.09   0.000      1.00
 2 debtsh              354.62423   244.6  12.339  -0.34   0.891     -0.07
 3 smrat                4.73381    42.7   3.809   0.70   0.570      9.99
 4 smrat[1]            -3.09559    18.1  -2.352  -0.45  -0.392      9.86
```

determine total Net interest payments, with industry share equations to determine detailed results.

Capital Consumption Allowances

Depreciation costs, or Capital Consumption Allowances, for both Corporate and Non-corporate enterprises represent accounting depreciation as calculated for tax purposes.[4] The model currently uses equations to determine aggregate Capital Consumption Allowances, which then are distributed to industries based on shares and relative output growth.[5] Clearly, depreciation allowances should be related to the current value of depreciation of plant and equipment. In determining investment purchases on the real side of the model, replacement investment, or depreciation, is calculated for both investment in Durable Equipment and investment in Structures. The equations for depreciation allowances are:

corpcca = -30 + .992 * replace (5.2)
othcca = -9.7 + .445 * replace (5.3)

where

corpcca = Corporate Capital Consumption Allowances, billion $
othcca = Noncorporate Capital Consumption Allow, billion $
replace = Replacement investment of Producer Durable equipment plus Replacement investment of Structures, billion $

The measure of replacement investment takes into account the different rates at which equipment and structures depreciate, as well as the current and historical mix of spending on equipment and structures.

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[4] Because these allowances do not measure "economic" depreciation, the Department of Commerce calculates an aggregate Capital Consumption Adjustment, as discussed in Chapter 3. There is no such adjustment calculated by industry, however.

[5] Thanks are due to Margaret McCarthy for the estimation of the Capital Consumption equations.

Inventory Valuation Adjustment

As noted in Chapter 3, the BEA makes an attempt to adjust for the effects of inflation on inventory costs as calculated for tax purposes. In other words, the IVA is designed to compensate the change in the book value of inventories for the effects of the price changes of the items in inventory. In periods of high inflation, for example, the book value of inventory change is understated, since the goods are usually evaluated at their price upon entering inventory. The Inventory Valuation Adjustment is purely a price phenomenon, therefore, and is explained with a simple regression equation. An aggregate equation is used for Corporate IVA and one for Noncorporate IVA, and the results are then distributed to industries. The equations, summarized in Figure 5.4, simply relate the amount of IVA to inflation, where high inflation means a lower (more negative) IVA.

Figure 5.4: Inventory Valuation Adjustments

Corporate Inventory Valuation Adjustment

SEE = 7.61 RSQ = 0.6808 RHO = 0.05 Obser = 25 from 1963.000
SEE+1 = 7.62 RBSQ = 0.6669 DW = 1.91 DoFree = 23 to 1987.000
MAPE = 380.21

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	vciv	- - - - - - - - - - - - - - - - - - - -			-12.35		
1	intercept	10.85080	17.5	2.954	-0.88	0.000	1.00
2	infl	-4.47829	77.0	-7.004	1.88	-0.825	5.18

Noncorporate Inventory Valuation Adjustment

SEE = 0.57 RSQ = 0.6501 RHO = 0.16 Obser = 25 from 1963.000
SEE+1 = 0.57 RBSQ = 0.6349 DW = 1.68 DoFree = 23 to 1987.000
MAPE = 92.97

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	vniv	- - - - - - - - - - - - - - - - - - - -			-1.00		
1	intercept	0.62997	10.8	2.283	-0.63	0.000	1.00
2	infl	-0.31396	69.1	-6.537	1.63	-0.806	5.18

Business transfer payments

Business transfer payments are mostly losses due to theft and bad debt, as well as legal settlement payments from business to persons. Total transfers are a small share of GNP (0.7% in 1987), and that share is explained as a function of lagged real interest rates and the unemployment rate. Debt losses are more likely

to increase when interest rates are high, while both bad debt and thievery are counter-cyclical activities (as the economy worsens, crime and bankruptcies are more likely to occur). As the unemployment rate rises, therefore, the Business transfer payment share of GNP increases. The equation fits reasonably well, R^2 equals .8356, although the increase in Transfer payments in 1987 is underpredicted.

Figure 5.5: Business transfer payments

title Business Transfer Payments as share of GNP

SEE = 0.03 RSQ = 0.8356 RHO = 0.39 Obser = 23 from 1965.000
SEE+1 = 0.03 RBSQ = 0.7990 DW = 1.21 DoFree = 18 to 1987.000
MAPE = 4.63

	Variable name	Reg-Coef	Mexval	t-value	Elas	Beta	Mean
0	vtrfsh	- - - - - - - - - - - - - - - - - - - -					0.48
1	intercept	0.50692	353.6	18.770	1.07	0.000	1.00
2	rlraaa[1]	0.00155	0.3	0.334	0.01	0.060	3.30
3	rlraaa[2]	0.00636	3.1	1.056	0.04	0.232	3.11
4	rlraaa[3]	0.01495	23.1	3.049	0.09	0.492	2.86
5	1/un	-0.56903	44.5	-4.427	-0.21	-0.454	0.17

Indirect business taxes and Net government subsidies

Indirect business taxes are mostly property taxes, excises, and sales taxes. (They exclude corporate income taxes.) Since the amount collected in taxes depends largely on legislated tax rates, the equation to determine aggregate

Indirect business taxes is relatively simple. Taxes as a share of GNP (roughly the indirect business tax rate), are modeled as a function of the average share of taxes in GNP, as well as current and lagged GNP growth.

Government subsidies less Current surplus of government enterprises is mostly comprised of the subsidy to agriculture through the Commodity Credit Corporation. Rather than estimate an equation for Government subsidies, the share of Net government subsidies in nominal GNP is exogenous, as are the payments to Agriculture from the CCC.

Conclusion

This chapter described equations for the non-profit components of return to capital. The equations will be included in an Interindustry Macroeconomic model of the U.S. economy that is described in the following chapter.