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Appendix

Derivation of Regional Primary Factor Accounts

The disposition of industrial inputs and outputs that characterizes the general equilibrium we calibrate in our model replicates the input/output data of the 1987 National Income and Product Accounts (NIPA) of the United States. Our regionalized accounts are produced in a manner consistent with the structure of technology we present in this report. Specifically, production functions are linear homogeneous, with a Leontief aggregation of value-added and intermediate inputs. This Leontief structure is unique to each input/output industry but is unvaried across regions. By developing State-level value-added cost share accounts for each input/output industry, we can use these features of the model to allocate industrial output to regions. This appendix describes the development of our State value-added accounts.

Agriculture

There are 32 4-digit SIC farm commodity classifications (SIC4), and 17 I/O farm industries in the 1987 NIPA accounts (io87). With a few of the 32 SIC commodities appearing in several I/O industries, there are a total of 39 unique SIC4/io87 combinations. Our premise is that once farm production is classified into 39 commodities, the value-added cost shares do not vary by State.

First we obtain direct estimates for value-added payments to land in each of the 39 io87/SIC4 industries. Each of the 39 industries is classified as crop or pasture land users. Using multiple sources,[13] and checking for consistency of sources, we obtained acres harvested for each industry and computed the product of acreage and national weighted average rental rates (either dry cropland or pasture, since irrigation rents go to capital), where the weights were State-level industry-specific cash receipts. This gives us national rental land payments for each commodity. To get the same for capital, we must benchmark our capital estimates to these land estimates.

Unpublished USDA data on 1993 State-level market values for land, tractors, autos, trucks, machinery, and buildings were obtained, and this represents over 99 percent of farm capital (U.S. Department of Commerce, Bureau of Economic Analysis, 1998a). These data gave us State-level cost shares, which we used to compute the U.S. total for land value. We allocated this value to each of the 39 agricultural industries, based on their share of national cash rents. We then allocated to each State, based on State shares of cash receipts.

Each capital type is allocated a value for each commodity, based on the statewide cost share ratios. This implies, for example, that for every commodity in a given State, the tractor-to-land cost share ratio is the same. The result is State cost share estimates for each commodity broken into land and five types of capital. We compute a national weighted average value for relative cost shares, where the weights are again State-level cash receipts. This way, those States where a particular crop is important, and thus has more influence on statewide average cost share profiles, is given more weight in forming a national commodity-specific capital cost share profile.

We now have national cost share estimates of the 39 agricultural commodities. For each of the 17 io87 farm industries, the subset of 39 SIC4 belonging to that industry are allocated NIPA capital value added in

[13]Acres harvested are from SIC's 111-139—USDA, NASS (1995); SIC 161—USDA, ERS (1998a); SIC's 171-181—USDA, ERS (1998b); and SIC's 211-279—USDOC, Census Bureau (1990). Cash rental rates are from USDA, ERS (1997a), and unpublished USDA data. Cash receipts are from USDA, ERS (1997b).

proportion to cost shares, and these are allocated to States, based on cash receipts. A final refinement is that national (U.S. Department of Commerce, Bureau of Economic Analysis, 1998a) accounts indicate that 0.9 percent of farm capital is nonagriculture specific (for example, computers and furniture). We assume that a farm operation uses this capital in a fixed proportion to their total farm capital and prorates each commodity cost share estimate accordingly. The result is 39 unique cost share profiles allocated to States in proportion to cash receipts. National value added in each io87 industry conforms to NIPA control totals. Labor payments are allocated from io87 industries to SIC4 in proportion to cash receipts, so capital to labor ratios are the same for all SIC4 within an io87 industry.

Manufacturing

A high level of industrial detail is provided in the NIPA value-added accounts of the manufacturing industry. Net plant value added and net equipment value added are allocated to each io87/SIC4 industry at the U.S. level. From the 1992 Census of Manufacturing, we obtained gross value of plant and gross value of equipment for each SIC4. When no SIC4 data were available, we obtained the value for the corresponding three-digit SIC. We converted these values to net values, using 1992 net-to-gross value ratios for plant and equipment for each of the corresponding two-digit SIC's, based on U.S. Department of Comme rce, Bureau of Economic Analysis (BEA) data. This allows the allocations of io87 industry capital value-added data into plant and equipment value-added. Using State-level data from the county business patterns (CBP) wages data set, we allocated labor, plant, and equipment value added to each State io87/SIC4 manufacturing industry.

Based on special tabulations of unpublished Census of Manufacturing data at the Center for Economic Studies (CES), we computed State-level data on the share of plant value and the share of equipment value for each of the 20 major manufacturing industry groupings (2-digit SIC). Using this information, all State-level plant and equipment value for the io87/SIC4 industry are summed to their respective major industry State totals, and the ratio of this value to the value of the applying CES share tabulations to NIPA value-added measures by major industry groupings is used to adjust plant and equipment values accordingly.

To summarize, direct estimates of labor value added for each State io87/SIC4 industry is computed using the CBP data set and NIPA accounts. Direct estimates of U.S. plant and equipment value added for each io87/SIC4 industry are computed using published Census of Manufacturing data, BEA major industry group net-to-gross value ratios, and the NIPA capital value-added accounts. These are allocated to States by holding constant the national plant/equipment/labor cost share ratios, at the SIC4/io87 industry level. Finally, these cost share ratios are changed at the State-level, using direct State plant and equipment value data based on CES tabulations. These estimates are then prorated to ensure national io87 capital and labor value-added totals are reconciled.

In a final step, equipment value added is allocated in proportion to the shares of each of 27 equipment types reflected in the corresponding major industry grouping, as in the annual fixed reproducible tangible wealth accounts published by the BEA (1998a) and similarly for each of 23 plant classifications.

Construction

Construction industry value added is exclusively from capital. The economic census of construction provides SIC4 detail for most construction industries, including national estimates of gross plant and equipment value and State estimates of gross value of capital. Combining this information with the NIPA value-added accounts and BEA data on net-to-gross plant and equipment value ratios in the construction industry, we first allocate value added to each national io2/SIC4 construction industry into plant and equipment. We then allocate each national industry total to the States, based on net capital value shares for each minor industry classification. Finally, BEA data are used to share out plant and equipment value into

several different types of capital. While each State's plant/equipment value-added ratios may be unique, the allocation of each share into asset types is uniform across all States.

Mining

The Economic Census provides little detail beyond that given in the NIPA accounts, but there is national level detail by SIC4 for total gross value of capital. This is used to allocate national capital value added in mining io87 aggregates to each of the io87/SIC4 minor industries. Using the county business patterns data, these data are allocated to States in proportion to each State's shares of total salary and wages in each industry. Capital is then allocated among the different asset types based on BEA data. The State-level shares are common across all States.

Other Business Industries

All remaining industries are generally labor-intensive. Because the county business patterns data allow a direct means of allocating io87 national data to States, we do so while holding constant the national capital/labor value-added ratios for each io87/SIC4 industry. Finally, we allocate capital between the 50-BEA type classifications, corresponding to the relevant major industry grouping of each io87/SIC4 industry.

Residential Housing

The tax treatment of owner-occupied versus rental dwellings is very different. Further, corporate housing is subject to different tax laws. The imputed rental value of owner-occupied housing is explicitly represented in the NIPA accounts, and a portion of the capital value added in real estate industries of the NIPA accounts is from tenant-occupied residential housing. We allocated these national accounts to the States as follows.

The national stock value of owner-occupied shelter and tenant dwellings is reported, along with business capital, in the BEA fixed reproducible wealth data series (1998a). Using data of the Annual Housing Vacancy Survey (U.S. Department of Commerce, Bureau of the Census, 1998), and State-level personal income data (BEA, 1999), national housing wealth is allocated to States. For each State, owner occupancy rates are multiplied by total household units to derive total State household owner-occupied units. The residual is total State tenant units. By summing the number of owner-occupied units over all States and Washington, DC, and dividing by BEA national owner-occupied dwelling value, we derive a national average value per owner-occupied dwelling. By doing the same for tenant dwellings and taking the ratio of these values, we imputed the national average ratio for owner-occupied to tenant dwelling unit price and denote this in the O/T ratio.

Next, we assumed annual residential housing budgets are a common share of personal income in all regions and allocated total dwelling value to the States. Using the O/T ratio to convert owner-occupied units into tenant equivalent units, we allocated State dwelling value to tenant dwellings proportional to tenant dwelling share of total dwelling equivalent units. This value is allocated to the appropriate io87 industry when cost share ratios are employed. The national BEA tenant dwelling account also is broken down into corporate and noncorporate shares, and this ratio is also held constant across States (corporate housing shares are quite small). Finally, that which is not tenant dwelling value belongs to the owner-occupied residential io87 industry. Each State is allocated imputed rental value added in proportion to dwelling values.

Computing the Marginal Effective Tax Rate on Income From Capital

We begin with a measure of market value for capital stock. With no loss in generality, we will define a unit of capital, in any form, to be the amount supplied at a market price of one monetary unit, for example, $1. Ownership of this single unit of capital affords the owner a predetermined tax allowance that represents a real value to a firm or household. However, this value is realized over an extended period of time, which we call the tax life of the asset. Tax allowances depend on a number of factors, including the financial profile of the household or firm, the nature of the capital owned, and the sector in which the owner will be operating this capital. All of these factors can be described in an allowance function of the form:

$$A = b_1 A_z + b_2 t + b_3, \tag{1}$$

where b_1 represents the percentage of new investment subject to a depreciation allowance schedule, A_z is the present discounted value of total depreciation allowances over the tax life of the asset (assuming full investment is depreciable), b_2 represents the percentage of investment that can be fully expensed in the year of investment, t is the marginal statutory rate of income taxation the capital owner faces, and b_3 represents the percentage of investment subsidized by the government.[14] As the thick legal volumes describing State and Federal tax code indicate, the details required to compute equation 1 are too numerous to summarize here.[15] A numerical example will serve this purpose.

Once the value of special tax allowances is determined, this value can be deducted from the $1 purchase price and the residual is the effective market price of ownerships:

$$C = 1 - A. \tag{2}$$

The hurdle rate (h) that we must determine will equal the residual of the annual revenue from employing this unit of capital (R), net of the real economic depreciation to the productive capacity of this capital over the production year (d), or $h = R\text{-}d$. Note that the depreciation measure d is independent of the depreciation tax allowance A_z. Tax rules are such that the gross of tax income R is the tax base and the depreciation allowance becomes a fixed income to the proprietor. That is, net of tax income is equal to $(1\text{-}t)\times R$, instead of $(1\text{-}t)\times h$.

In the theory of capital, real investment is viewed as permanent. This implies that the owner will anticipate a stream of income from this capital, which will grow annually at the rate of output price inflation, e^{π}, and will incur annual depreciation costs, e^{d}. If we denote as e^{ρ} the subjective discount rate that leads to indifference between income next period and income now, then the present discounted value of this permanent stream of capital income is valued at (see Silberberg):

$$V = \int_0^{\infty} \left[(1-t)R - w\right] e^{-(\rho + d - \pi)}\, dt \quad = \quad \frac{\left[(1-t)(h+d) - w\right]}{\rho + d - \pi}, \tag{3}$$

where w is the rate of property taxation. In equilibrium, an asset's value (equation 3) is equal to its purchase price (equation 2). This result allows us to derive an expression for the hurdle rate:

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[14]This report presents statewide aggregates, so b_1 is determined as the percentage of new investment in a State by investors who have exceeded their maximum annual expensing limit and b_2 equals $1\text{-}b_1$.

[15]A rigorous explanation of the computations described in this section is presented in Canning and Rhoades.

$$h = (1\text{-}t)^{-1} \times [(1\text{-}A) \times (\rho + d - \pi)] + w - d. \quad (4)$$

Based on financial profiles of the asset owner, we can determine the appropriate marginal tax rates, *t* and *w*. With knowledge of the type of asset, there are economic estimates of the value for the annual rate of depreciation, *d*. For the discount rate, the value assumed depends on the manner of financing. For debt, it is the opportunity cost of borrowed funds or the interest rate for borrowing (*I*), net of tax deductions on interest payments, $\rho = I * (1\text{-}t)$. For equity-financed investments (retained earnings if corporate ownership), we use $\rho = I * (1\text{-}m)/(1\text{-}k)$, where *m* is the marginal tax rate on interest income of the asset owner and *k* is the effective rate of taxation on capital gains. For corporations, this reflects the investor's tradeoff between receiving interest payments from issuing debt on a competitive alternative investment, with a net of tax return equal to $(1\text{-}m)*I$, and increasing the value of corporate stock, subject to taxation at a deferment-adjusted rate for capital gains, $(1\text{-}z)*\rho$. For corporate-owned capital, another finance option is through issuance of new shares of corporate stock, which requires a dividend yield equal to the opportunity cost of savings, so we have $\rho = I$.[16] Since *I* and ρ now have an exact relationship, we have reduced our unknowns to three (*h*, *r*, and *I*).

From here, we choose to exogenously specify an equilibrium real rate of return to savings (0.035), and adopt the Fischer equation, which states that nominal interest rates on savings equal the real rate plus the expected annual rate of inflation, $I = 0.035 + \pi$. Using Feldstein's rule of thumb, we set π equal to the average annual rate of general price inflation over the previous three observed values. We can now define the value for the reservation rate of return:

$$r = (1\text{-}m) \times (0.035+\pi) - \pi. \quad (5)$$

All that remains is to determine the appropriate tax provisions to use in equation 1, plug the solution for *A* into equation 4, and calculate the marginal effective tax rate on income from capital as:

$$t^m = (h\text{-}r)/h. \quad (6)$$

The value of t^m measures the share of all marginal capital income paid to meet the tax liability. Calculating A_z is somewhat complicated. Most forms of farm capital are allowed 150 percent of the straight-line depreciation of a declining balance, with a switch to straight-line depreciation at the most advantageous period for the taxpayer (rental dwellings are required to be depreciated on a straight-line basis). A midyear-purchase assumption rule (midmonth for some buildings, and first or third quarter for other assets) allows only partial depreciation in the year of purchase and the final year of depreciation. Optimal switch to straight-line depreciation is at one-third of the asset's tax life (rounded to the nearest half-year interval). Total value of the depreciation allowance over the asset's tax life is:

$$A_z = [1.5/L] * \sum_{t=0}^{0.5} (1+\rho)^{-t} + (1.5/L - 1.5^2/2L^2) * \sum_{j=0}^{L/3.0-1.5} [(L-1.5)/L]^j * \sum_{k=j+0.5}^{j+1.5} (1+\rho)^k$$
$$+ [(L-0.75)/L] * [(L-1.5)/L]^{L/3-0.5} * (3/2L) * \sum_{i=L/3}^{L} [(1+\rho)^i] x\ \tau, \quad (7)$$

were *L* is the asset's tax life. This is the discrete time version of equation 6.5 in King and Fullerton.

[16]For corporate capital, we adopt the traditional view that new investment is financed by equal parts of each financing method. For farm capital, debt and equity shares are based on the State-level primary USDA data of these ratios. Noncorporate, nonfarm households are assumed to finance in the same ratio as farm households.