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IMPLAN's Weakest Link: Production Functions or Regional Purchase Coefficients?

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Abstract. Regional purchase coefficients (RPCs) are often seen as the weakest link in input-output modeling systems such as IMPLAN. In IMPLAN the RPCs are estimated either by the supply-demand pool (SDP) method, which ignores cross-hauling, or by econometric methods, based on 1977 data. Yet, how much difference do the RPCs make relative to the production functions, which reflect national and not local conditions? This study uses a case study of the swine industry in Martin County, Minnesota to explore this question. While this is a limited test, the results suggest that the production function changes are much more important than the changes due to regional purchase coefficients.

1. Introduction

The most common way to arrive at regional purchase coefficients (the percentage of local demand that is met by local production, referred to below as RPCs) in non-survey, regional input-output (I-O) models is to use a variety of secondary data means including location quotients, supply-demand pooling, and econometric estimates. Several authors have suggested that these traditional methods for estimating RPCs are one of the weakest aspects of non-survey I-O models (Ralston, Hastings, and Rucker, 1986; Stevens, Treyz, and Lahr, 1989). Swanson, Morse, and Westeren (1999) suggest a new approach for developing RPCs using value-added tax (VAT) data and demonstrate that there are significant differences between the theoretically solid VAT estimates and traditional methods. They find that while the approach of using VAT data to develop RPCs is very practical in most of the world, it is not feasible in the USA since this country does not have a VAT.

This paper reports on how a set of primary data-based RPC estimates compare with the 1998 version of the econometrically-derived default RPCs in the IMPLAN input-output computer model (Minnesota IMPLAN Group).

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Likewise, the IMPLAN default production functions are compared to ones derived from accounting data. Our case study is done on large farrow-to-finish hog operations in Martin County, Minnesota. A survey of hog producers was used to derive the RPCs. Hog production function estimates are based on farm management accounting data. The case study focused on a specific type of hog enterprise and place because both the RPCs and the production functions are functions of the specific enterprise and place. We discuss how the differences we have observed in the RPCs and production functions may be related to the rapid technological and structural changes taking place in the swine industry. We also explore whether re-estimating the RPCs or the production functions cause a greater difference in the model's estimate of value-added income. While this paper only reports on one case study (hog production in Martin County, Minnesota), it suggests that giving attention to the production functions is much more important than re-estimating the RPCs.

2. Input-Output Production Functions and Regional Purchase Coefficients

This section reviews the definitions of production functions and regional purchase coefficients as they are used in input-output models such as IMPLAN. The Leontief production function requires fixed proportions of the inputs. Neither substitution nor diminishing returns are allowed. The Leontief production function can be represented as:

$$X_j = \min \{ z_{1j} / a_{1j}, z_{2j} / a_{2j}, z_{3j} / a_{3j}, \ldots z_{nj} / a_{nj} \} \quad (1)$$

where X_j denotes the total output of j, z_{ij} denotes the monetary value of the flow from sector I to sector j and a_{ij} denotes the cents of input from section I to sector j per dollar's worth of output by sector j (Miller and Blair, p. 12).

The standard practice in creating regional input-output models is to assume that the national n*n matrix A of national technical coefficients (a_{ij}) holds for the region. However, we would expect the regional coefficients to be less because of imports. We can show this as:

$$a_{ij} = r_{ij} + m_{ij} \quad (2)$$

where input coefficient r_{ij} denotes the regional input coefficient without imports and m_{ij} denotes the import coefficient.

If there is no regional production, the r_{ij} falls to zero and the import coefficient for that sector becomes $m_{ij} = a_{ij}$. With regional production, the regional input coefficient will be equal to or lower than the regional technical coefficient, which in turn is constrained by the ratio of pooled supply and pooled demand in the region.

Solving for r_{ij}, each element of the new regional technical input matrix (R) can be expressed as follows:

$$r_{ij} = a_{ij} - m_{ij} \quad (3)$$

IMPLAN used the common practice of assuming that the proportion of imports for a given commodity will be the same across all industries (Minnesota IMPLAN Group, 1999, pp. 141-146; Miller and Blair, 1985, p. 295). Conversely, the proportion of total local demand that is met by local production would be constant across all industries. This proportion p_i is commonly called the regional purchase coefficient. If $p_i = 1$, this indicates that there are no imports. In contrast, if p_i = zero, this indicates that local suppliers provide none of the local demand. For example, $p_i = 0.65$ for an input indicates that for each additional dollar of local demand, 65 percent will come from regional firms. Once p_i is estimated for each sector, the regional input coefficients are calculated by pre-multiplying the national technical coefficient matrix by the diagonal matrix of p_i elements.

$$R = \hat{p} A^n \quad (4)$$

where: R = matrix of regional input coefficients; $\hat{p}$ = diagonal matrix of p_i coefficients; and A^n = national technical coefficients matrix.

3. Empirical Estimation of Production Functions and Regional Purchase Coefficients

IMPLAN provides production (gross absorption) function coefficients as well as RPCs for each industry based on national averages. While IMPLAN has a very high level of disaggregation (528 sectors), it is still forced to aggregate the production functions of related sectors. Of particular concern to our study, all types and sizes of swine operations are combined into one sector. The swine industry is differentiating and consolidating rapidly, making this level of aggregation problematic for analyzing the impacts of the structural changes occurring in this industry. In particular, the farrowing phase of production (managing the breeding herd and producing pigs of 10 to 50 pounds ready for the next phase of further "finishing" or feeding up to a slaughter weight of 250 to 300 pounds) is being consolidated into large operations often connected with companies involved in supplying inputs and/or slaughtering. The finishing out of the market hogs is consolidating less rapidly. Many independent producers who once operated farrow-to-finish swine operations have quit farrowing due to the complexity of managing a breeding herd. Some have exited the swine industry altogether, but

others have continued and often expanded the size of their finishing operations.

In a recent study, farm accounting data was used to develop five different modified versions of the 1998 default IMPLAN production functions, two each for farrow-to-finish and finishing-only swine operations of two different sizes, along with a fifth for a large farrowing-only operation that supplies pigs to the finishers (Platas, 2000). The modifications were derived from 1998 average costs and returns for 359 swine operations in the Minnesota State College University System's (MnSCU, 1998) farm business management program. The derivation was performed by first translating each expense category in the MnSCU enterprise summary format to the closest IMPLAN industry classification. The IMPLAN format is on a per dollar of output or sales basis while the MnSCU data are on a per hundredweight produced basis. Consequently, feeder pig and breeding stock purchases, which are netted out in the gross return section of the MnSCU format, were reclassified as expenses for our purposes.

In adjusting the inputs, the value-added components must also be considered. The coefficients on hired labor and operator labor and management were based on the labor quantities from the MnSCU data along with the salary data from Hurley (2000), with the residual assumed to fall into the "other industries" category.

Only one of the five modified productions is discussed in detail in this paper, with the discussion of the other four confined to summary comments in the interest of space. The one that is discussed in detail is the one for large farrow-to-finish operations (5,000 head or more finished per year). The coefficients of 23 IMPLAN sectors were assigned to expense categories in the accounting averages. For these operations, these 23 sectors were allocated 95 percent of inter-industry purchases plus value-added. The five percent residual was then allocated to the remaining IMPLAN sectors by means of a proportional adjustment of their coefficients.

The regional purchases for our study were estimated using data from a 1999 survey of pork producers in Martin County, which also provided additional information to supplement the accounting data used to develop the production functions. Martin County was chosen for this case study because it is a moderate-sized rural area (population 22,462) and has been experiencing rapid hog industry growth. The default IMPLAN data showed Martin County with the highest number of pork production workers in Minnesota (526 in 1997) and the third highest percentage (3.9 percent) of its workforce in swine production.

While there are other types of swine operations, the only two types in Martin County with sufficient numbers to provide arguably generalizable results were farrow-to-finish operations and finishing-only ones that purchased pigs farrowed elsewhere. A review of the 1997 USDA *Census of Agriculture* showed that a production level of 5,000 market hogs sold per year

was likely to be a convenient breakpoint at which to divide the operations into "large" and "small" groups with sufficient numbers in each to avoid confidentiality concerns.

The population surveyed was 234 pork producers that belong to the Minnesota Pork Producers Association. Data was available on the size of operation that allowed us to sub-divide the population into those marketing over 5,000 market hogs per year (32) and the other 202 who sold fewer than that amount. We elected to sample all 32 of the large producers due to their small number. A random sample of 60 of the smaller operations was surveyed, for a total sample of 92. Thirty-five responded, for a response rate of 38 percent. Of the 35 respondents, nine were large farrow-to-finish operations that maintained sow herds of 1,000 or more. In the survey, 12 were small farrow-to-finish operations, and the remaining 14 only finished pigs purchased from other farrowing operations. The RPCs discussed below are those calculated from the responses of the nine large farrow-to-finish operations.[2]

The questionnaire listed the major inputs and services required for a swine operation. The focus was on inputs and services that might reasonably be purchased either in or outside of their home county. We omitted services for which there is little choice of source, such as electric utilities. The inputs included in the survey were:

1) replacement gilts
2) boars
3) artificial insemination
4) complete feeds
5) premixes
6) veterinarian services
7) health supplies
8) trucking services
9) financial analysis and taxes
10) production records
11) new construction by type

The questionnaire asked them to list the county and state in which each type of input is purchased. To estimate the RPCs, we simply added the number of responses where the input or service was purchased in the home county and divided that total by the total number of responses (in-county plus outside-county) for that question. The percentages shown are averages of the individual input purchase percentages weighted by each input's production function coefficient. Individual responses were aggregated using

[2] Data was also collected in three other counties but it is not discussed here. See Platas (2000) for the results for the other counties and for the other types and sizes of operations in Martin County.

number of hogs sold as the weighting factor. Two other questions on the questionnaire asked whether they purchased complete feeds for the sow herd and the market animals, or whether they processed their own feed for each. These latter two questions were useful as a check on the accounting information on how much of the feed expenses were incurred for complete feeds and for ingredients.

Table 1 compares selected accounting-based and default production function coefficients for the operations. The top panel of the table shows the ten sectors with the largest coefficients after the accounting-based adjustment. The first two columns show the accounting expense categories and the IMPLAN industries we matched them with. These are followed by the default IMPLAN coefficients, the adjusted coefficients, and the ratio of the two. One sector that was reduced but remained large was purchases from their own "Hogs, Pigs and Swine" sector. This adjusted coefficient was 6.9 cents / dollar of output compared to a 22-cent default. This difference illustrates the type of aggregation problem one encounters when attempting to represent an industry as diverse as this one in a single sector. Farrow-to-finish operations purchase mainly replacement breeding gilts and boars. While their per-unit prices are higher, fewer are purchased which accounts for the smaller 6.9-cent coefficient. The finishing-only operations, by contrast, averaged around 40 cents / dollar of output in purchases of pigs from the farrowing operations in the sector (not shown in the table).

Feed is usually the largest single expense in hog production. According to the adjusted coefficients, the amount that hog operations purchased from the "Feed Grains" sector is 15.3 cents / dollar of output, which is almost twice as much as the 8.1 cents in the IMPLAN defaults. Feed expenses in the accounting averages are broken out into a number of categories with the main ones being corn; protein, vitamins, and minerals; and complete rations. For the purpose of this study, corn was assumed to be purchased from the IMPLAN "Feed Grains" sector. The complete feed expenses were allocated to the "Prepared Feeds" sector. Protein, vitamins, and minerals were allocated to "Soybean Mills" because soybean meal is the main source of protein for hog feed. Information was not available on whether suppliers of vitamins and minerals tend to be grouped into the "Soybean Mills" or "Prepared Feeds" sectors, so they were left in the former one along with the protein portion of that expense.

Table 1. Comparison of Selected Default and Accounting-Based IMPLAN Production Function Coefficients for Large Farrow-to-Finish Operations, Martin County, Minnesota, 1996

Sector	Farm Accounting Expense	IMPLAN Industry Description	Default	Accounting-Based	Accounting / Default
Ten largest coefficients based on accounting averages:					
87	Protein, vitamins and minerals	Soybean Mills	0.009	0.2316	25.78
12	Corn and barley	Feed Grains	0.081	0.1525	1.89
78	Complete ration and starter feeds	Prepared Feeds	0.093	0.1250	1.33
52	Depreciation and building and machinery leases	New Farm Structures	0	0.1181	na
7	Purchased animals	Hogs Pigs, and Swine	0.220	0.0688	0.30
456	Interest paid on debt	Banking	0.008	0.0504	6.25
26	Veterinary services and breeding fees	Agricultural, Forestry, Fishery Services	0.026	0.0385	1.48
204	Health supplies	Agricultural chemicals	0.0027	0.0135	5.00
282	Repairs	Farming structure	0.00016	0.0133	81.25
503	Dues and professional fees	Business Associations	0.001	0.0090	9.00
Selected coefficients for which the accounting averages were less than the defaults:					
435	Trucking and marketing	Motor Freight Transport & Warehousing	0.027	0.0038	0.15
443	Utilities	Electric Services	0.0101	0.0058	0.57

One interesting difference that was observed in the feed coefficients is that the farrow-to-finish operations shown in Table 1 tended to buy mainly ingredients from the "Soybean Mills" and "Feed Grains" sectors, indicating that they prepare most of their own feeds. They bought 23 cents and 15 cents, respectively, from those two ingredient sectors (38 cents total or 75 percent of the feed expenditures) compared to only 12 cents worth or 25 percent as prepared feeds. This result from the accounting records differed significantly from the responses reported on the mail survey. On the mail survey, two-thirds of the operations reported purchasing complete feeds for the market animals and 45 percent reported purchasing complete feeds for their sow herds. The largest operations responding to the mail survey tended to report using complete feeds while the smaller ones (but still over 1,000 sows) mainly processed their own feeds. We used the accounting-based estimates in this analysis because they were derived from a larger number of farms than was the mail survey, but the discrepancy shows how differences in

production systems can affect the industry mix of impacts derived in an economic impact analysis.

We added four sectors that were not in the default Martin County database. Three were added in order to better represent the components that go into construction of a hog building: 52 (new farm structures), and 347 (heating and ventilation equipment). Two other sectors were added in order to represent operating inputs: 444 (gas production and distribution), and 460 (insurance agents). Sectors that were increased beyond the default values included 78 (prepared feeds), 87 (soybean mills), 282 (framing structures), 456 (banking), and 507 (accounting services).

The bottom panel shows, for comparison, two sectors for which the default coefficients were fairly large and were reduced substantially in the adjustment process. We based the "Motor Freight Transport" coefficient on the amounts allocated to marketing expenses in the accounting records. That coefficient was reduced from 2.7 cents to 0.4 cent. The marketing expense item may underestimate transportation costs in that they would normally represent costs of transporting the animal to market but not costs of transporting inputs to the farm, which are not typically separated from the costs of the inputs themselves. On the other hand, marketing expenses could be an overestimate of transportation costs because other items such as check-off fees for pork promotion are included. "Electric Services" is another sector we reduced by half based on accounting data on utility costs. Seven other sectors were reduced from the defaults.

The 18 sectors that were adjusted came to 84.4 percent of total inputs. Value added for employee compensation and proprietors' income added another 11.0 percent. IMPLAN automatically adjusts all the remaining coefficients to meet the constraint that the total inputs must be equal to:

$$\text{Sum of Total Absorption Coefficient} = 1 - \text{VA Coefficients}$$

or 4.6 percent in this case.

4. Survey-Based Regional Purchase Coefficients for Martin County Minnesota

Table 2 shows the regional purchase coefficients (RPCs) that were derived from the survey, and compares them to the default values from IMPLAN. The gross absorption coefficients are shown in the third column. The next two columns show the default IMPLAN RPCs based on supply-demand pooling and the econometrically-derived ones. The survey-based RPCs are shown next, and then compared as a ratio to the econometric defaults. The rightmost column shows the regional inputs calculated using the smaller of the survey-based RPCs or the supply-demand pool maximums. For example, the survey found that 97 percent of all the hogs, pigs and swine purchased

by the large farrow-to-finish operations in Martin County come from within Martin County along with 80 percent of the agricultural services they used. In contrast, only 25 percent of the new farm structures come from within the county.

The survey estimates were higher than the IMPLAN econometric RPCs for 10 of the 14 inputs examined, including six for which the defaults were either zero or very small (less than 0.001). The survey RPCs were smaller than the econometric estimates in four cases. Since we believe the survey RPCs and accounting-based production functions are superior to the IMPLAN estimates, we used this data to estimate the regional inputs shown.

The survey did not delve into how much of the corn consumed by the swine industry was either supplied by the cropping enterprises on the farms producing the hogs or by other farms in the county. Martin County is in a corn-surplus area, with the default IMPLAN data showing supplies of almost double the local demand. With such a large surplus, the IMPLAN econometric RPC of only 0.086 for the feed grains sector is difficult to interpret. Rather than using the default 0.086, we follow the approach used by Otto, Lawrence and Swenson, and run two scenarios. In the first scenario, we set the RPC for the feed grains sector to 1.0 for this analysis to reflect utilization of the locally-produced corn. The assumption implicit in the IMPLAN input-output analysis that sectors other than swine would change in size as the swine sector size is varied seems rather unrealistic, however, as in the case of crops such as corn. Corn is already exported from the county, and if utilization by the swine industry declined, the corn no longer consumed would likely just go into increased exports. The second scenario uses an RPC of zero for the feed grains sector, to reflect a situation where corn production is not affected by a change in the swine industry.

5. “Hidden” Imports

With our adjustment to RPCs, we faced the question of what to do with the additional purchases. We could have forced the model to accept the higher RPCs by modifying the regional information, increasing the output for that input until it could satisfy the local demand. However, this would overestimate the total impacts, assuming that the IMPLAN regional output estimates are correct. We could have used the maximum RPCs (as constrained by the S-D estimate) and simply ignored the rest of the demand. But this would underestimate the impacts. We chose to use the maximum RPC (as constrained by S-D) and add the residual demand to the wholesale trade sector. Only the margins in the wholesale trade are then picked up as regional impacts.

Four sectors were identified as having economically significant production function coefficients based on the accounting data, and for which the survey indicated larger local demands than available local supply, as indicated by the IMPLAN supply-demand pool RPCs. This was the case for sectors 78 (prepared feeds), 87 (soybean mills), 204 (agricultural chemicals), and 309 (farm machinery and equipment). Two possible reasons for these discrepancies were hypothesized: 1) the IMPLAN default data might underestimate local supplies, or 2) the suppliers where the producers reported purchasing the inputs may have been acting as wholesale distributors of the inputs, while the IMPLAN data represents manufacture of the inputs. The information that was available on the county suggested that the second hypothesis was the more likely one, especially for sectors 87, 204, and 309. The county did not have a soybean processing plant, a manufacturer of animal health products, or a major machinery manufacturer. It did have a feed mill that would fall within sector 78, and indications were that more of the complete feed used by the swine industry may be manufactured in the county than captured by the IMPLAN numbers, although there is also at least one other large feed mill in a nearby county that may be supplying a significant share of the feed.

Because three of the sectors in question and at least part of the fourth seemed to fit the wholesaling hypothesis, their impact was captured by increasing demand on the wholesale trade sector 447 by an amount calculated to represent the "hidden" wholesale margins that would be captured on regional purchases of inputs from these sectors. The shock to the wholesale trade sector was calculated for each of the four sectors as:

$$WT_{hidden} = PF_{coef} * \left(RPC_{survey} - RPC_{S-D}\right) * M_{wholesale} \quad (5)$$

Where WT_{hidden} is “hidden” wholesale trade which is equal to the relationships embodied in equation 5. With respect to this equation, $PF_{coefficient}$ is the production function coefficient, RPC_{survey} is the survey based regional purchase coefficient, $RPC_{S\text{-}D}$ is the supply-demand regional purchase coefficient, and $M_{wholesale}$ is the wholesale margin in percent.

The increase in wholesale demand represented by these four sectors amounts to $162,820. Most of this amount, $131,390, is due to the soybean milling sector. Its production function coefficient is quite large at 0.2316, and 57 percent was reported to have been purchased in the county. Its wholesale margin percentage is quite low at 2.5 percent, however. The margins are much higher for agricultural chemicals (health supplies) at 26 percent and for farm machinery at 22 percent. Their production function coefficients of 0.0135 and 0.0012, respectively, are one to two orders of magnitude less than for the soybean mills, however, so they do not contribute significantly to the wholesale trade amount. Neither does prepared feed. It has a production

function coefficient of 0.1525, but only 12 percent was reported to be purchased in the county and its wholesale margin is only 1.1 percent.

6. Regional Inputs

Table 3 compares the relative effects of modifying the production functions and regional production functions, on the regional purchases represented by $40 million in swine industry output. The first column of Table 3 shows the regional input purchases that the model estimates on the basis of the modified production function and RPCs. The other columns of the table then show the total difference in the regional input purchases compared to those estimated with the defaults, and the relative contributions of the new production function and the new RPCs to that total difference.

The top panel of the table shows the sectors that were originally in the default IMPLAN data but which had either their production functions, RPCs, or both modified. The next panel shows new sectors that were added. The total of the "hidden" imports and the value added as employee compensation, proprietary income, and business taxes are shown at the bottom.

Using the first line of Table 3 as an example, since the original IMPLAN value for regional inputs of hogs was $8.57 million, the revised number represents a $5.89 million decline. This is expected since the default averages in IMPLAN include purchases by finishing units of feeder pigs which are aggregated with the farrow-to-finish units examined in this study.

The difference due to the new RPCs is derived by creating a model that uses the original production function coefficients but uses the new RPCs. Column 4 shows the change due to the new RPCs as a percentage of the total change. In the case of sector 7 (hogs), the difference due to the RPCs is only $18,000, or less than one percent of the total difference.

In sector 309 (feeding and manure handling equipment), a small positive change in the RPC partially offsets a negative change due to the production function modification. The production function and RPC changes were in the same direction for the other sectors modified.

Note that in only six sectors do the new RPCs contribute to more than two percent of the change in regional input purchases. In part, this result comes from the fact that the new RPCs were constrained by the Supply-Demand Pool concept. If the survey estimated RPC was higher than the IMPLAN generated S-D estimate of the RPC then we used the SDP estimate. We reasoned that a region could not supply more than it has and that the survey results must be incorrect in these instances.

Recall that the survey asked the hog farmers where they bought the input and not where it was produced and that we assumed the purchase location was the same as the production location. This would probably lead to overestimating the RPCs. To correct for this we accepted the S-D estimates

as the maximum that could be feasible. This supply-demand pool adjustment was necessary in over half of the cases.

Table 3. Differences in Regional Input Purchases Estimated Using Modified Versus Default Production Functions and RPCs, Based on $40 Million Demand by Large Farrow-to-Finish Hog Operations, Martin County, Minnesota

Sector	Description	Regional Inputs[a]	Difference From Default[b]	Difference due to: RPCs		Production Function
		($ mill.)	($ mill.)	($ mill.)	(percent)	(percent)
Sectors Revised						
7	Hogs, Pigs and Swine	2.675	-5.896	-0.018	0.3%	99.7%
12	Feedgrains	6.100	5.819	2.959	50.9%	49.1%
26	Agricultural, Forestry, Fishery Services	0.516	0.168	0.000	0.0%	100.0%
282	Framing structures	0.012	0.012	0.000	1.2%	98.8%
309	Feeding manure and Handling equipment	0.028	-0.028	0.004	-13.9%	113.9%
435	Transport	0.096	-0.756	-0.253	33.5%	66.5%
443	Electric services	0.081	-0.061	-0.002	2.5%	97.5%
503	Business Associations	0.141	0.126	0.000	0.0%	100.0%
507	Accounting	0.013	0.013	0.000	0.0%	100.0%
New Sectors Added						
52	New Farm Structures	0.727	0.727	0.000	0.0%	100.0%
347	Heating and ventilation equipment	0.021	0.021	0.000	0.0%	100.0%
444	Gas production & distribution	0.049	0.049	0.000	0.0%	100.0%
460	Insurance agents	0.166	0.166	0.000	0.0%	100.0%
Hidden Imports (wholesale trade)[c]		0.163	0.163	0.011	6.5%	93.5%
Value Added						
VA	Employee compensation	3.116	-0.684	0.000	0.0%	100.0%
VA	Proprietary income	1.179	0.417	0.000	0.0%	100.0%
VA	Indirect business taxes	0.119	-0.447	0.000	0.0%	100.0%
	TOTAL	**15.203**	**-0.191**	**2.702**		

[a] The inputs purchased within the county based on the accounting-based production function and the smaller of the survey-based or supply / demand pool RPCs.

[b] The difference between the purchases based on the accounting-based production function and the survey-based RPCs, compared to those calculated based on the default IMPLAN production function and the IMPLAN econometric default RPCs.

[c] Prepared feed, soybean mills, agricultural chemicals and farm machinery.

7. Regional Value-Added Impacts

Having seen that only a small fraction of the change in the top 20 regional inputs is due to the change in RPCs, does this carry through to the total impacts? To test this, we shocked the large farrow-to-finish hog production sector with $40 million in final demand change. The value-added income results are shown in Table 4. Using the survey-based RPCs alone, value-added is calculated to be 25 percent higher than for the default analysis. This increase appears to be entirely due to our assumption that all of the feed grains were purchased locally, however. Table 3 shows that the net effect of the other RPC adjustments would have been negative. When the production function coefficients are changed as well, however, the effects offset the RPC changes to a large extent, so the net effect is an increase of less than three percent. Also, the way the feed grains sector is handled has a greater impact on the results than does the modifications we made to the rest of the production function coefficients and RPCs. Assuming that the land in the county stays in crop production, with swine utilization changes made up from exports rather than local production, reduces the change in value-added by $3 to $4 million in the analysis.

Table 4. Value-Added Income Impacts of a $40 Million Change in the Large Farrow-to-Finish Hog Production Sector, Martin County, Minnesota

Sector	IMPLAN default data	IMPLAN production Fn and Survey RPCs	New production function and new survey RPCs
Agriculture	$4,756,606	$6,393,395	$6,274,110
Mining	0	0	0
Construction	538,862	662,726	536,353
Manufacturing	70,491	88,418	64,217
TCPU	822,566	768,836	325,250
Trade	3,032,309	3,751,949	1,887,525
FIRE	1,801,403	2,253,758	2,409,943
Services	1,085,563	1,251,068	1,007,895
Government	214,796	247,725	150,321
Other	96	114	119
Total	**$12,322,692**	**$15,417,988**	**$12,655,732**
Total with all Feedgrains Changes Made in Exports/Imports Holding local Production Constant		**$11,384,278**	**$9,736,675**

8. Conclusions

If analysts cannot collect primary data on both production functions and on regional purchase coefficients, this study found two major conclusions.

First, generally the production function changes are much more important than changes in the regional purchase coefficients. Second, the regional purchase coefficient for a single major input can outweigh the impacts of all of the other production functions and RPCs combined. One reason the RPCs did not have a major impact (other than in the case of the feed grains sector) is that the changes were constrained by the supply-demand pool ratio. This significantly reduced about half of the survey RPCs. Naturally, these are tentative conclusions since they are based on one industry in one county. Given the central role of RPCs and production functions in input-output models, additional research is needed to determine whether the conclusions hold for other industries and places.

References

Chism, J., R. Levins. 1994. Farm Spending and Local Selling: How Do They Match Up? *Minnesota Agricultural Economist* 676:1-4.

DeLind L. 1998. Parma: A Story of Hog Hotels and Local Resistance. Thu K., E. Durrenberger (eds.) *Pigs, Profits, and Rural Communities*. Albany, NY: State University of New York Press, pp. 23-38.

DiPietre, D., C. Watson. 1994. *The Economic Effect of Premium Standard Farms in Missouri*. Columbia, MO: University Extension, Commercial Agriculture Program, CA 144, University of Missouri.

Goldschmidt, W. 1978. *As You Sow: Three Studies in the Social Consequences of Agribusiness*. Montclair, NJ: Allanheld, Osmun and Co. Publishers, Inc.

Hertel, T. 1990. General Equilibrium Analysis of U.S. Agriculture: What Does it Contribute? *The Journal of Agricultural Economics Research* 42(3).

Hurley, T., J. Kliebenstein, P. Orazem. 1999. The Structure of Wages and Benefits in the U.S. Pork Industry. *American Journal of Agricultural Economics* 81(February): 144-163.

Hurley, T., P. Orazem, J. Kliebenstein. 2000. *Changes in the Structure of Wages in the U.S. Pork Industry*. Selected Paper – American Agricultural Economics Association Annual Meeting, Tampa, FL (July 30 August 2, 2000).

Iker, J. 1998. Sustainable Agriculture, Rural Economic Development, and Large-Scale Swine Production. Thu, K., Durrenberger, E., *Pigs, Profits, and Rural Communities*. Albany, NY: State University of New York Press, pp. 157-69.

Lasley, P. 1995. Economic Development. Thu, K., *Understanding the Impacts of Large-Scale Swine Production: Proceedings from an Interdisciplinary Scientific Workshop*, June 29-30, 1995, Des Moines, IA: North Central Regional Center for Rural Development, pp. 117-51.

Lazarus, W., G. Morse, D. Platas, S. Guess-Murphy. 2000. *Economic and Local Government Impacts of the Minnesota Swine Industry*. University of Minnesota, Department of Applied Economics. Final Research Report prepared for the Minnesota Pork Producers Association (April).

Marousek, G. 1979. Farm Size and Rural Communities: Some Economic Relationships. *Southern Journal of Agricultural Economics* 11(December):57-62.

Miller, R. and P. Blair. 1985. *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs, NJ: Prentice Hall, Inc.

Minnesota IMPLAN Group, Inc. 1999. *IMPLAN Professional, Version 2.0, Social Accounting and Impact Analysis Software: User's Guide, Analysis Guide, Data Guide*. Stillwater, MN.

Minnesota State Colleges and Universities (MnSCU). 1998. Farm Business Management Reports by Region for the 1998 Calendar Year (Web page),http://www.mgt.org/fbm/reports/98index.htm, accessed on August 30, 2001.

Otto, D., J. Lawrence, D. Swenson. 1996. Local Economic Impacts of Hog Production. *Pork Industry Economic Review*, pp. 27-38.

Platas, D. 2000. *Economic and Fiscal Impacts of Different Sizes of Swine Operations on Minnesota Counties*. University of Minnesota, Department of Applied Economics, Ph.D. thesis.

Ralston, D., S. Hastings, S. Rucker. 1985. Improving Regional I-O Models: Evidence Against Uniform Regional Purchase Coefficients Across Rows. *Journal of Regional Science* 25(4) (November): 65-80.

Stevens, B., G. Treyz, M. Lahr. 1989. On the Comparative Accuracy of RPC Estimating Techniques. R. Miller, K. Polenske, A. Rose, editors. *Frontiers of Input-Output Analysis*. New York, NY: Oxford University Press.

Swanson, M. J., G. Morse, K. I. Westeren. 1999. Regional Purchase Coefficients Estimates from Value-Added Tax Data. *The Journal of Regional Analysis and Policy* 29(2):31-50.

Thu, K., E. Durrenberger, (eds.) 1998. *Pigs, Profits, and Rural Communities*. Albany, NY: State University of New York Press.

Thompson, N., L. Haskins. 1998. *Searching For "Sound Science:" A Critique of Three University Studies on the Economic Impacts of Large-Scale Hog Operations*. Walthill, NE: Center for Rural Affairs.

Table 2. Comparison of Supply / Demand Pool, Econometric, and Survey-Based and Default Regional Purchase Coefficients for Large Farrow-to-Finish Hog Operations, Martin County, Minnesota

Sector	Description	Gross Absorption Coefficients[a]	Supply/ Demand Default RPC	Econometric Default RPC	Survey-based RPC	Ratio Econometric/ Survey	Regional inputs[b]
7	Hogs, Pigs and Swine	0.0688	1.000	0.974	0.972	1.002	2.6749
26	Agricultural, Forestry, Fishery Services	0.0385	0.335	0.335	0.800	0.419	0.5159
52	New Farm Structures	0.1181	0.154	0.000	0.256	-	0.7275
78	Prepared feeds	0.1525	0.0001	0.0001	0.061	0.002	0.0006
87	Soybean mills	0.2316	0.000	0.000	0.567	-	-
282	Fabricated Structural Metal	0.0133	0.025	0.000	0.022	-	0.0117
309	Farm Machinery and Equipment	0.0012	0.575	0.538	0.609	0.883	0.0276
347	Refrigeration and Heating Equipment	0.0016	1.000	0.000	0.334	-	0.0214
435	Motor Freight Transport and Warehousing	0.0038	1.000	0.904	0.635	1.424	0.0965
443	Electric Services	0.0058	0.390	0.378	0.348	1.086	0.0807
444	Gas Production and Distribution	0.0047	1.000	0.000	0.265	-	0.0498
460	Insurance Agents and Brokers	0.0063	1.000	0.000	0.664	-	0.1673
503	Business Associations	0.0090	0.393	0.393	0.650	0.605	0.1415
507	Accounting, Auditing and Bookkeeping	0.0005	0.941	0.767	0.650	1.180	0.0130

[a] Accounting-based production function coefficients from Table 1.

[b] The inputs purchased within the county based on $40 million in demand, the accounting-based production function and the smaller of the survey-based or supply / demand pool RPCs, in million