Intra-industry economics

1978

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Presented at the AAEA Meetings
August 1978

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Staff Paper No. 78-53

ABSTRACT

Structural Change in Agricultural Production Firms and Regional Employment

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Projections of regional employment in 1980 under five scenarios are calculated for a seven county region in south-central Iowa. Scenarios were designed to identify the impacts of: (1) shifts in farm size, (2) the multiplier effect of agricultural employment, (3) structural changes resulting from the increase in farm size, (4) the income effect of absentee ownership, and (5) an industrial-type organzation of farms purchasing most agricultural inputs from outside the region. The employment impacts are calculated using an eight sector input-output model based on employment data.

Key Words: Input-Output
Regional Employment
Projection

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STRUCTURAL CHANGE IN AGRICULTURAL PRODUCTION FIRMS AND REGIONAL EMPLOYMENT

Expanding farm size in the United States causes transitional problems for farmers and rural communities. It is increasingly difficult for the traditional owner-operator to own or control sufficient capital for an efficient size operation. Management requirements are also moving toward a point where management and labor may no longer be most efficiently conducted by one individual or family. The present trend of the agricultural labor force is toward an increasing proportion being hired labor. The depopulation of farm land and changes in the organizational structure of the farm firm have significant and differing impacts on rural regions.

The future of farm size and organizational structure will be strongly influenced by both technological advancements and government policy. Government policy affecting farm size and organizational structure should be guided by information on the impact of the reasonable alternatives. Input-output analysis provides a method for analyzing changes in sector interactions within regions. This article presents estimates of the impacts of changes in rural regional employment patterns.

Employment Projections

Changes in the organization of agricultural production firms resulting from increase in farm size have three major effects on regional employment. The first effect is the reduction in the man-land ratio, that is reduction in the number of people employed in agriculture. The second is the indirect employment effect resulting from the reduction in agricultural employment. The third effect is the structural effect of changing the per capita demands on non-agricultural sectors by the agricultural sector. The objective of this investigation is to calculate employment impacts which could serve either as planning guidelines for rural regions, or as information for analyzing the benefits and costs of national policies which affect the structure of the agricultural production industry.

The Midcrest Study Area

The seven rural counties comprising the Midcrest region[1] have an area of approximately 8,000 square miles and have been declining in population since the turn of the century. In the region, there are 51 towns, nine having population over 1,000. The largest town, Creston, had a population of 8,234 in 1970. The major activity of every town in the region is providing services to the dominant primary employer, agriculture. Firm organization is almost totally family owned and operated.

THEORETICAL FRAMEWORK

Input-output analyses has a long history of development and use as an estimator of regional economic change resulting from shifts in export demands on a region or the addition of new industry to a region. Thus, comments are limited to its use to estimate the impacts of sectoral employment change and structural change. There are significant time and money costs associated with the direct survey required in the analytical procedure. However, the implications of this study have generalized implications for all rural regions remote from off-farm employment opportunities that depend upon agriculture as a primary employer.

The employment impacts of five separate scenarios for future sector interactions are calculated. First is a look at the technical interaction coefficients resulting from the reduction of agricultural employment with no impacts on non-agricultural employment. The second scenario assumes no changes in technical interaction coefficients tables except in the agricultural producing sector. In the third scenario, estimates of actual technical coefficients resulting from the shift in agricultural employment assuming a continuance of a traditional family farm type with family ownership, management, and labor. The fourth scenario isolates the impact of absentee ownership of agricultural firms, implying hired management and labor without shifting purchases of factors of production from firms outside the region. This scenario looks at the impact of a shift in the returns to capital accruing to owners who live outside the seven county area. The fifth scenario assumes that much of the purchasing of the agricultural sector is conducted with large firms outside the region. This scenario implies that, through vertical

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[1]Adair, Adams, Clarke, Decatur, Ringold, Taylor, and Union counties in south-central Iowa.

integration or through an ability to deal in large quantities, an industrial-type organization of agriculture will find direct negotiations with manufacturers or wholesale distributors more advantageous than dealing with local businesses.

Since all scenarios assume an employment level of 5,015 for the agricultural sector, standard input-output calculations cannot be used. But standard input-output notation will be maintained to retain clarity in the calculations. Employment in each sector will be represented as:

$$(1)\quad X_i = \sum_{j=1}^{n} x_{ij} + Y_i \quad \text{(for } i=1. \ . \ . \ n)$$

where

X_i = Total employment in the i^{th} sector

x_{ij} = The number of employees in the i^{th} sector whose output is needed for the j^{th} sector in its production

Y_i = The number of employees in the i^{th} sector whose output is exported from the region.

The technical interaction coefficients (a_{ij}) make up the elements of matrix (A) and are calculated as:

$$(2)\quad a_{ij} = x_{ij}/X_j \qquad \text{and} \qquad A = [a_{ij}]$$

In standard linear algebra, the input-output relationships of the Midcrest region are:

$$(3)\quad X = AX + Y$$

where X and Y are vectors and A is a matrix. These standard notation conventions will be used in the calculation of impacts for each scenario.

Procedure

In 1965, the Iowa State University Cooperative Extension Service performed an economic base study of the Midcrest region [Eldridge and Julius]. The employment interactions table (Table I) from that study along with their estimate of the 1980 employment level of 5,015 in the agricultural sector provides the data base. The technical coefficients calculated from the employ-

ment interactions table are displayed in Table 2.

The important impacts of the first scenario are conveyed in the changes within the technical interaction matrix. This matrix is calculated from the employment interactions table after the coefficients in the first row are proportionately adjusted by the ratio of projected laborers in agriculture in 1980 over the number of laborers employed in agriculture in 1965 (5,015/ 10,018). This adjustment changes only the first row and the first column of the technical interactions matrix. Using equation (2), the last seven elements of the first row are .004, .004, .004, .037, .004, .004, and .004 and the last seven elements for the first column are .098, .010, .062, .400, .044, .384, and .000. These shifts imply that an increase in productivity per agricultural laborer has brought about an ability to service the export requirements for the region from the agricultural sector and the sales required by other sectors within the region with approximately half the employment level. It also implies that each agricultural laborer requires approximately twice as much employment demand per capita from the other sectors.

In the second scenario, which assumes no changes in the technical interaction matrix with the exception of the reduction in the first row, the solution is derived using equation (3). However, we are not dealing with the traditional input-output problem since the first element of the X vector is 5,015, and all elements of the Y vector, with the exception of the first element, are assumed constant. Implicitly, this assumes that all production of the agricultural sector not sold within the region can be absorbed by external markets and avoids over identification of the system. This assumption is quite realistic since the Midcrest produces a very small portion of the total output of the national market for each commodity produced in the region. And since over 95% of the agricultural production in 1965 was exported, any increase in export would be small. The result of this configuration is a system of eight equations with eight unknowns that can be solved by matrix manipulation involving the inversion of a 8x8 matrix. Since this research is focused on changes in total employment, a much simpler solution can be achieved by partitioning the employment interactions table from the first scenario into a agricultural and non-agricultural sector division. The resulting 2x2 A matrix is:

$$A = \begin{bmatrix} .008 & .014 \\ 1.004 & .431 \end{bmatrix}$$

The advantage of this form of partitioning is that the technical coefficient for purchases by the agricultural sector from the non-agricultural sector is composed of a summation of the technical coefficients for agricultural purchases from the seven non-agricultural sectors. To determine regional employment under the assumption that there is no change in per capita demand from other sectors by the agricultural sector, information from Table 2 is applicable, yielding a coefficient of .502. Using equation (3), non-agricultural employment is 10,436. This calculates the impact of an increase in productivity of the agricultural sector, assuming no per capita change in purchasing patterns to be an employment reduction of 4,417. An estimate of the impact of a shift in purchasing patterns of this more efficient agricultural sector is the purpose of the third scenerio.

The third scenario was designed to reflect a dominance of traditional family type in 1980 with the primary source of labor for the family being family labor with hired labor being a minor factor. The larger farm size and increase in productivity of agricultural employees will result in a larger per capita demand on the production of other sectors from the 1965 coefficients. The estimation of the technical coefficients with the seven non-agricultural sectors allows for much more clarity with respect to structural changes and causes for shifts than the use of the partitioned matrix. The estimated technical coefficients for agricultural purchases from the seven non-agricultural sectors are .074, .006, .035, .200, .022, .194, and .000 following the order these sectors are listed in the original employment interactions table. Multipling through by the number of agricultural workers yields the corresponding direct demand employment levels of 371, 30, 175, 1003, 110, 972, and 0. From the equation (3), non-agricultural employment is 10,689, a level that is 253 greater than found under scenario two.

The remaining two scenarios isolate the impacts of moving to an industrial-type structure of agricultural production firms into the impacts of absentee ownership then of shifts in purchasing patterns for the factors of production. In the fourth scenario, the returns to capital investment leave the Midcrest region; and, hired managers and hired laborers are used in the agricultural sector. These changes in the composition of the rural farm work force will have impacts due to income differentials in addition to differing relations with the local communities. From a survey in Wisconsin, Rodefeld found that net family income is approximately equal for family type farm

owners and hired managers on absentee owned industrial-type farms. However, management composed only fifteen per cent of the total industrial-type farm labor force and hired full-time workers received considerably less than managers. There were no significant differences between the percentage of eleven personal goods brought locally by the three different categories of individuals in the agricultural labor force. The income differential for hired workers on industrial-type farms reduces purchasing from local businesses. This is the income effect of absentee ownership. In addition, Rodefeld found that full-time workers on industrial-type farms subscribed to fewer magazines and newspapers, were involved in fewer voluntary organizations, made smaller contributions per week to local churches, and had less political and public leadership participation. The estimated technical coefficients for the seven non-agricultural sector sales to the agricultural purchasing sector are .040, .005, .025, .200, .011, .194, and .000. The corresponding direct demand employment levels are 200, 25, 125, 1003, 55, 972, and 0. Total non-agricultural employment resulting from this scenario is 10,198, approximately a five percent decrease from the scenario three results. Thus, it appears that the effects of absentee ownership is fairly minor in isolation as an influence on total employment in the Midcrest region.

The estimation of technical coefficients for scenario five has significant limitations. The lack of information on input purchases by industrial-type farms requires a rough estimation of these coefficients. The technical coefficients used for scenario five are .020, .003, .015, .100, .008, .110, and .000. The corresponding direct demend employment levels for the seven non-agricultural sectors are 100, 15, 75, 502, 40, 552, and 0. Total non-agricultural employment, calculated using equation (3), is 8,269.

Under all five scenarios, the crucial determinant of employment in the non-agricultural sector is the direct employment purchases by the agricultural sector. Under the assumption that total agricultural employment is fixed, the direct demand employment multiplier for the agricultural sector is 1.757 and is the same as the final demand multiplier for the non-agricultural sector. This multiplier can be used to develop alternative scenarios of structural changes in the agricultural sector of the Midcrest region. The results for all five scenarios are presented in Table 3.

Summary

This paper has presented estimates of the separate impacts of changes in agricultural employment, changes in technical interaction coefficients, changes in ownership patterns, and changes in purchasing patterns for the agricultural sector. Since these impacts were isolated, severe constraints were placed on other factors which may strongly interact with these shifts. The important implications of these impacts are that the reduction of dependence on other sectors within a region by the dominant basic employment sector will greatly reduce employment opportunities within the region, and these impacts will have significant repercussions through depressing regional income. In general, for regions that are beyond commuting distance to industrial centers and presently primarily dependent on agriculture for its basic source of income, a shift to industrial-type of farming would depress regional income, employment, ability to provide government and voluntary activities, and school facilities.

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TABLE 1. EMPLOYMENT INTERACTIONS

Producing Sectors	Purchasing Sector									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Export	Total
(1) Agriculture	81	9	7	9	339	4	44	8	9,517	10,018
(2) Construction & Mining	493	31	34	49	103	23	234	13	173	1,153
(3) Manufacturing	54	4	6	5	116	2	22	1	671	881
(4) Transportation Communications Public Utilities	315	39	92	23	287	11	113	12	262	1,154
(5) Wholesale & Retail	2,001	163	115	144	699	66	685	140	597	4,610
(6) Finance, Insurance Real Estate	220	25	20	25	101	12	120	9	0	532
(7) Services	1,945	224	171	224	895	103	1,064	179	674	5,479
(8) Out-Commuters	0	0	0	0	0	0	0	0	1,044	1,044
Total	5,109	495	445	479	2,540	221	2,282	362	12,938	24,871

TABLE 2. INDUSTRY TECHNICAL INTERACTION COEFFICIENTS FOR THE MIDCREST REGION

Producing Sector	Purchasing Sectors							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	.008	.008	.008	.008	.074	.008	.008	.008
(2)	.049	.027	.039	.042	.022	.043	.043	.012
(3)	.005	.003	.007	.004	.025	.004	.004	.001
(4)	.031	.034	.104	.020	.062	.021	.021	.011
(5)	.200	.141	.131	.125	.152	.124	.125	.134
(6)	.022	.022	.023	.021	.022	.023	.022	.009
(7)	.194	.194	.194	.194	.194	.194	.194	.171
(8)	0	0	0	0	0	0	0	0

TABLE 3. 1965 EMPLOYMENT IN MIDCREST AND UNDER THE FIVE DIFFERENT SCENARIOS IN 1980

	Non-Agricultural Employment	Total Employment
1965 Actual	14,853	24,871
Scenarios for 1980		
1) No impact on non-agriculture	14,853	19,868
2) No change in agricultural purchasing technical co-efficients	10,436	15,451
3) Realistic technical co-efficients for larger family farms	10,689	15,704
4) Corporate farms purchasing inputs in Midcrest	10,198	15,213
5) Corporate farms purchasing inputs from outside Midcrest	8,269	13,284

*Under all five scenarios, agricultural employment is assumed to be 5,015 people.