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Helping Clientele Understand Elements of the Local Economy Through Input-Output Modeling

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Abstract: Extension clientele often seek assistance from Community Development professionals in understanding how their local economies operate. Provision of local economic data has long been an important role for Extension. But many of the questions clientele raise require substantial analysis of this data. This article demonstrates how an input-output model (IMPLAN) can be used to describe a local economy with considerable precision. The model is appropriate for estimating the economic impacts of current or proposed activities. We include estimations of impacts of initial job losses stemming from the recent recession as well as impacts of a long-term plan for economic recovery.

Introduction, Problem Statement, and Purpose

People who are concerned about local economic development oftentimes seek information on how their local economies operate. Officials who are interested in promoting employment and income for their constituents often express frustration at a lack of understanding as to why these goals are elusive (Shields & Deller, 2003).

A detailed knowledge of how money flows into, out of, and within a region can assist those who are attempting to achieve an understanding not only of how the current economy operates, but also about how specific policies, proposals, projects, investments, and events can influence the local economy (Fortenbery & Deller, 2008).

For example, public officials may be confronted with a decision regarding infrastructure development necessary for business expansion. Infrastructure development in many cases involves a considerable public investment (say, for an improved road or the expansion of water/sewer capacity). Such public investment may benefit the community by creating conditions in which

business can expand, providing new employment and income. However, estimating both the costs and additional income/employment of such changes typically requires a reasonably sophisticated model of the local economy (Kelsey, 1996).

Over the past few decades, members of the general public have increasingly looked to Extension for information of this type. Educators and specialists operating in the field of Community Development are routinely asked to provide local economic data and to disseminate knowledge to local officials and business leaders about how the local economy operates, as well as the effects associated with a current or proposed economic activity (Conglose, 2000; Weber, 1987). More recently, this topic has taken on an increasing urgency as a result of the economic crisis and the resulting recession of 2008-2009.

The purpose of this article is to demonstrate how an input-output (IO) model can be used to describe changes to a rural economy dependent largely on manufacturing and how the IO model can be used to estimate the local economic impacts of a variety of changes which local officials and other Extension clientele are required to consider.

Input-Output Models

Input-Output (IO) models are not completely new to Extension educators (Marcouiller, Ray, Schreiner & Lewis, 1992). An IO model consists of a system of equations that describe the flow of money in exchange for goods and services into, out of, and within a given region or study area (Richardson, 1972).

When goods or services are exported from a region, the money flow into the region is called an *injection*. Firms within the region who receive this money use a portion of it to pay for items (such as labor and equipment) that they purchase within the region. To the extent that this money continues to be turned over locally, it has a *multiplier effect* on the local economy.

A key obstacle to economic development in any community is referred to as *leakage*. Leakage exists when firms purchase inputs from outside the region. Communities that rely only on one or two specialty exports tend to face chronic low incomes and high unemployment rates because, even with high exports, money brought into the region quickly leaves because of a paucity of local purchasing opportunities for firms and laborers.

On the other hand, when firms have opportunities to purchase inputs locally, these dollars remain in the local economy for a second round of spending. In turn, if those who receive this money from the exporting firms spend their money locally, we have a third round of spending, and as a result, the initial impact of the export gets multiplied through the local economy. Economists use the following terms to describe each round of spending associated with an export: the *direct effect* (which measures initial impact, or injection), the *indirect effect* (which measures the impact of the purchase of local inputs), and the *induced effect* (which measures the impact all subsequent rounds of local spending associated with the first two rounds).

The total of all three of these effects sums to a multiplier of a given export or industry (also referred to as economic sector). Multipliers may be expressed in terms of overall impacts (*output multipliers*), actual contribution to the local economy (*value added multipliers*) and in terms of the number of jobs created (*employment multipliers*) by economic sector.

Calculating multipliers typically requires an input-output model that can trace the flow of money through an economy over a number of rounds. Historically, the creation of an IO model for any given community required a tremendous amount of survey work in order to determine where firms and consumers spend their money and on what items. Furthermore, the costs of finding this data, as well as the expertise needed to construct the system of equations to express money flow, reached well beyond the abilities of local economic development professionals, including Extension personnel.

IMPLAN

In the early 1970s, the U.S. Forest Service developed an IO modeling program for mainframe computer use. By 1993, a

variation of this modeling program was made available for use on personal computers by the Minnesota IMPLAN Group (MIG), offering data from national accounts to create an input-output model for every county in the U.S. More than 1,500 public and private institutions are currently users of the MIG applications, training, and databases (MIG webpage). As a result of the MIG, in-depth study of a local economy is no longer beyond the reach of local economic development professionals, especially if they have colleagues with training in IMPLAN, which enables users to examine economic activity within a county or among a cluster of counties (IMPLAN, 2004).

Local economic development officials in Van Wert County (Ohio) identified the need for a better understanding of how to balance their economy, which was heavily reliant on manufacturing. The local leadership requested assistance from Extension. As a result, we took the opportunity to apply IO modeling to help them achieve this goal.

Study Area

Van Wert County is a rural county in western Ohio. In many respects it is typical of rural midwestern communities where a traditional agricultural economy was diversified through the addition of heavy manufacturing in the mid 20th century. Similar to most other communities that fit this profile, Van Wert County saw its population decline in the closing decades of the 20th century. Its population was just below 30,000 in the year 2000 (U.S. Census, 2000), and it has continued to decline to an estimated 28,496 in 2009 (U.S. Census, 2009).

In 2008, total employment in the county was 15,541, with the manufacturing sector claiming the largest portion of employment at 27% (IMPLAN). The recent economic downturn caused the unemployment rate to surge from an average annual unemployment rate of 5.6% earlier in the decade to 15.2% as of June, 2009 with total employment dropping to 14,000. The manufacturing share of employment also fell to a low of just below 20% (Ohio Labor Market Information).

These changes suggest that the downward trend in population that the county has experienced for decades will likely continue and could even accelerate. As the population numbers suggest, a large proportion of children who grow up in Van Wert County may be forced to seek employment opportunities elsewhere—a theme that is being replayed across the rural U.S.

Historically, much of Van Wert County's manufacturing economy has been heavily concentrated in automotive-related sectors. The economic crisis and the subsequent recession of 2008-2009 were especially difficult for the automotive industry. This situation has created urgency for the community to diversify and strengthen other sectors.

A comprehensive plan completed by the Van Wert County Regional Planning Commission in 2007—just before the economic crisis unfolded—identified the need to diversify as a key component of economic development strategy. While community leaders understood such an undertaking would be a slow, deliberate process, they also realized that diversification would be essential to sustain the local economy over time. In the meantime, many manufacturers continued to downsize or restructure their plants, reducing their labor force in the process, not only in order to compete better on an international level, but simply to survive the crisis (Bowen-Ellzey, 2009).

IO Scenario I—Economic Crisis 2008-2009

When the economic crisis hit in 2008, manufacturing orders within the county's automotive sector abruptly stopped by December. Plants immediately began to lay off employees. One employer, an automotive parts supplier, closed in March 2009, terminating 300 jobs. In addition to the plant closure, Van Wert County's largest employer cut another 150 jobs related to automotive. Three other employers in the automotive sector cut a total of 180 more jobs. In total, about 630 jobs within the automotive-related sector (the largest employing sector in the county) were lost within 6 months.

To estimate the full effects of these job losses on the Van Wert County economy, we used IO modeling. Using IMPLAN and the job loss figures above, we created a model of the Van Wert County economy that was some 630 jobs short in five specific

automotive-related sectors. The estimated impact including the direct, indirect, and induced effects of these losses to employment in other economic sectors in Van Wert County is described in Table 1.

Table 1.
Estimated Impacts of Initial Job Losses on Employment in Van Wert County

Most Impacted Sectors	Total
Transportation equipment	340
Machinery manufacturing	234
Fabricated metal products	127
Food services & drinking places	31
Professional, scientific & tech services	20
Ambulatory health care	19
Truck transportation	17
Admin support services	13
General merchandise stores	12
Hospitals	12
Motor vehicle & parts dealers	10
food & beverage stores	10
Total from these sectors	845
Total impact in all economic sectors	992

The results show that an estimated 362 other jobs in Van Wert County were lost as a result of the 630 positions cut in the automotive-related sectors. According to the model, many of these job losses were in fields not seemingly related to the auto industry or even to manufacturing. These include 31 jobs lost in food services and drinking places, 12 in hospitals, and another 10 in food and beverage stores. Employment in these and other sectors outside of manufacturing is adversely affected because the dollars generated and spent locally by the 630 initial positions lost are no longer available.

In short, the dollars available for circulation in Van Wert County to support employment and spending by companies and employees across all economic sectors are reduced as a result of the 630 lost jobs, and the initial effect is "multiplied," adversely influencing other sectors.

The IO model also enabled us to estimate the impacts on overall income in the county. Income losses were experienced in all economic sectors. Overall income lost and income lost by sector for the most highly impacted sectors are revealed in Table 2. As we would expect, income lost to employees and proprietors of ventures within the transportation equipment, machinery manufacturing, and fabricated metal products sectors was higher than any of the other sectors because these sectors employed the greatest number of automotive-related positions cut. Other sectors that lost income include health care, retail, and services.

Table 2.
Estimated Impacts of Reduction in Employment on Income in Van Wert County

Most Impacted Sectors	Total \$
Transportation equipment	16,648,152
Machinery manufacturing	13,038,550
Fabricated metal products	6,676,883
Professional, scientific & tech services	768,959
Ambulatory health care	661,073
Truck transportation	649,114
Hospitals	565,004
Government & non NAICs	383,615
Wholesale Trade	363,922
Food services & drinking places	340,096
Motor vehicles & parts dealers	297,347
Rental & leasing services	266,912
General merchandise stores	255,840
Plastics & rubber products	255,783
Total impact in all economic sectors	45,011,228
*employee compensation and proprietor income - 2007 dollars *Note: Employee Compensation includes wages, salary, all benefits and payroll taxes paid by the employer. Proprietor Income includes payments received by self-employed individuals and unincorporated business owners.	

The relationships and linkages among economic sectors in a community's economy are oftentimes not readily apparent without IO modeling. But the results in Tables 1 and 2 show that an initial impact on one industry influences economic sectors seemingly unrelated to it. In other words, though they may appear to be unrelated at first glance, the sectors identified in the tables above remind us that dollars circulate throughout an entire economy as goods and services are purchased from a wide variety of economic sectors.

IO Scenario IIâ A Plan for Recovery

The county had adopted a comprehensive plan in 2007 that identified a strategy for growth well before the economic crisis ever began to unfold. While the effects of the recession have been devastating to the county, arguably, rebuilding based on the recommendations of the comprehensive plan might constitute a sound strategy for recovering much of the employment the community had lost.

The plan identified specific industries that could add value to existing economic sectors, could help to diversify the economic base, and could promote employment opportunities. Expected outcomes of a targeted strategy to diversify the economy include creating new jobs with higher than average wages in industries that compliment existing industries or strengthen an existing industry cluster. Specifically target sectors included:

- Value added agriculture, i.e., food processing or alternative energy

- Polymers, plastics, and rubber

- Distribution and logistics

- Information technology/insurance industry

- Advanced manufacturing

Progress had already begun in the insurance sector, with a \$50 million expansion of a large insurance company headquarters in 2007. The company estimated this expansion would lead to the creation of 100 jobs within 10 years.

The comprehensive plan also identified the need for additional sites for industrial development, including a 1,600 Mega-Site project. Jobs and private sector investment from support industries and the industry clusters expected to develop in the area due to a mega-manufacturing facility locating at this site would provide significant direct and indirect positive economic development impacts. New suppliers often locate near or adjacent to facilities of this type, and existing suppliers usually increase their business by a significant percentage.

Table 3 projects job gains planned within each of the targeted industries in the economic recovery of Van Wert County spanning from 2010 to 2020.

Table 3.
A Strategy for Economic Growth and Recovery: Projected Job Gains in Targeted Industries in 10-Year Recovery (2010-2020)

Targeted Industry	Event(s)	Number of Jobs
Value added agriculture (to include food processing and alternative energies)	300 megawatt wind farm, expansion of two existing food processing plants, one new food processing plant	205
Polymers, plastics and rubber	Consolidation of two plastics operations in Van Wert, new plastics plant	150
Distribution and logistics	Rebounding of existing logistics operations in Van Wert in addition to new distribution facility.	300
Information technology and insurance industry	Expansion of insurance headquarters in Van Wert and existing back office operations, in addition to	90

	two new technology businesses.	
Advanced manufacturing	End user targeted for super site projected to be diversified advanced manufacturing plant involved in aerospace, military, heavy equipment, or wind.	1,500

We can describe with IO how stimulating increased employment across the impacted sectors can help to diversify the economy and offset automotive-related job losses.

Table 4 illustrates the estimated increase in employment resulting from the plan for recovery. The estimated increases in the table include the 2245 jobs directly created by the five targeted industries above as well as the indirect and induced employment resulting from those newly created positions

Table 4.
Estimated Impact of Growth Strategy on Employment

Most Impacted Sectors	Total
Chemical Manufacturing	1590
Truck transportation	379
Food products	207
Plastics & rubber products	170
Professional, scientific & tech services	153
Insurance carriers & related activities	116
Food services & drinking places	112
Admin support services	72
Ambulatory health care	70
Hospitals	43
Repair & maintenance	42
Government & non NAICs	39
Total from these sectors	3097
Total Impact over 68 Economic Sectors	3606

The results show that the 2245 new positions created by the businesses in the five targeted industries can lead to the creation of an additional 1,361 jobs in Van Wert County. Those 1,361 positions are distributed over 68 economic sectors, helping to diversify the employment base. Note that while many of these jobs are in sectors not seemingly directly related to the targeted sectors, they are created as a result of indirect and induced effects. These include 153 jobs in professional, scientific, and technical services; 112 jobs in food services and drinking places; 70 jobs in ambulatory health care; and 43 jobs in hospitals.

Table 5 lists the income generated as a result of the 2,245 new positions directly created by the businesses in the five targeted industries as well as the indirect and induced income effects.

Table 5.
Estimated Impacts of Growth Strategy on Income

Most Impacted Sectors	Total \$
Chemical Manufacturing	90,097,024
Truck transportation	14,298,413
Plastics & rubber products	8,592,016
Food products	7,111,071
Insurance carriers & related activities	6,595,883
Professional, scientific, & tech services	5,689,972
Ambulatory health care	2,393,658
Management of companies	2,203,657
Government & non NAICs	2,188,709
Hospitals	2,045,766
Wholesale Trade	1,472,825
Utilities	1,386,387
Admin support services	1,297,873
Rental & leasing services	1,262,914
Total impact in all economic sectors	162,439,245
*employee compensation and proprietor income - 2007 dollars	

As we would expect, the sectors feeling the direct impact of job growth would produce much of the growth in income. However, as the results show, there is substantial growth in income in sectors such as management of companies, rental and leasing services, and utilities. These sectors support the companies being "directly developed" as a result of the plan for recovery.

A caveat: while IO modeling helps us understand the potential for new job and income growth, it cannot estimate the extent to which new jobs are filled by unemployed residents of Van Wert County and consequently how much the income of existing residents will increase. The new jobs could be filled by workers from outside the county and could potentially lead to increased migration and population growth for the county.

Conclusions and Suggestions

Many rural communities throughout the U.S. have seen limited economic opportunities and as a result, declining populations in recent decades. As economic development professionals, Extension educators and their clientele go about their work in

creating healthy, vibrant communities, they may wish to gain a better insight as to how their local economies operate. An input-output (IO) model such as IMPLAN provides a relatively straightforward description of an economy disaggregated to the county level.

This article has shown the kind of results that can come from such modeling for a county that in many respects is typical of rural Midwestern communities that acquired a manufacturing base during the era when de-industrialization had already begun in many areas of the U.S. (mid to late 20th century).

Specifically, we illustrate how major job cuts in a manufacturing sector influenced employment and income in seemingly unrelated sectors. We also show how a multi-pronged economic development strategy could help restore employment in a wide range of sectors. The results show how changes in economic activity create or reduce jobs and income in other sectors that at first glance seem to be completely unrelated.

An improved understanding of linkages within a local economy can assist members of a community in coming to terms with how changes in one or a few sectors become multiplied as they influence employment and income in other sectors. As communities across the country continue to adapt to long-term trends in the changing economy and short-term changes caused by the economic crisis and the resulting recession, exploring these linkages is a worthwhile part of planning for the future.

Although a community might see an initial change in only one or two sectors (e.g., a plant closing, establishment of a new industry), an understanding of how the initial impact will influence overall employment and income in various sectors can be obtained through the use of an IO model and may be useful in helping the community adjust to changes and take advantage of the opportunities they present.

Van Wert County used the results of the input-output analysis to quantify the types of jobs lost across all sectors during the most recent recession. Workforce development opportunities were pursued to retrain residents in new jobs that are being created in emerging industries. Results were also used to tell the story of how dependence on one industry (automotive) can impact a local economy. The results helped to underscore the need for a diversified, balanced economy that includes strength in numerous sectors in addition to a focus on growing your own jobs (entrepreneurship) in targeted sectors. In short, the IO analysis helped to frame the problem so that Van Wert County could better plan for the future.

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