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Measuring the Impact of Meat Packing and Processing Facilities in the Nonmetropolitan Midwest: A Difference-in-Differences Approach

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Abstract

Considerable controversy exists regarding the costs and benefits of growth in the meat packing and processing industry in the rural Midwest. This study uses proprietary data from the Bureau of Labor Statistics' Longitudinal Database (LDB) to investigate the effects of this industry on social and economic outcomes in non-metropolitan counties of twelve Midwestern states from 1990-2000. A difference-in-differences specification is used to measure how local growth in meatpacking and processing affects growth in local economies, government expenditures, and crime rates. Propensity score matching is used as a check on possible non-random placement of meatpacking and processing plants. Results suggest that as the meat packing industry's share of a county's total employment and wage bill rises, total employment growth increases. However, employment growth in other sectors slows, as does local wage growth. There is some evidence that slower wage growth swamps the employment growth so that aggregate income grows more slowly. We find no evidence that growth in the industry changes the growth rates for crime or government spending.

JEL : O14, R11, R3

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Measuring the Impact of Meat Packing and Processing Facilities in the Nonmetropolitan Midwest: A Difference-in-Differences Approach

Meat packing and processing facilities have a prominent, yet controversial presence in the Midwestern United States. On the one hand, attracting agricultural processing facilities is an increasingly popular strategy for rural communities since it is viewed as a good fit for agriculturally dependent regions. The industry is an important provider of entry-level opportunities for low-skilled labor and new immigrants to the country and the region (Huffman and Miranowski 1996). New facilities may provide expanded job opportunities, supplemental income for farm families, increased public revenues, and stimulus for further development in other sectors such as retail trade and services (Leistritz and Sell, 2001; Drabenstott, Henry and Mitchell 1999). On the other hand, the expansion of large-scale meat processing facilities generates concerns about the potential negative impacts on the host communities. Opponents fear environmental damage to air and water quality, the inconvenience of bilingual commerce, higher levels of crime, increased welfare loads, and heavier burdens on public services such as schools and low-income housing.

The controversy surrounding the siting of a new plant is illustrated by the 1999 attempt by Excel Corporation and the Iowa Cattlemen's Association to locate a beef packing plant in Iowa. The proposed plant was expected to be a state-of-the-art facility, employing 1,000 workers and processing 500,000 head of cattle per year. As potential locations for the plant were named, local residents were quick to voice their opposition to the plant. In Pleasant Hill, Iowa, residents organized anti-packing plant meetings even before the company announced proposed locations (Eckhoff 2000). In Cambridge, Iowa, one proposed location for the plant, citizens posted roadside signs opposing the plant and turned out in force to voice their concerns about the

plant in a town meeting later described in the *Des Moines Register* as "ugly" (August 6, 2000). Shortly thereafter, the county supervisors refused to support the proposal. Supervisors in Hardin County, another named prospective location, voted unanimously to oppose hosting the plant, citing concerns about the existing infrastructure's ability to support the large facility. Given this opposition to the plant, Excel Corporation and the Iowa Cattlemen's Association put the project on hold. It was later abandoned in 2003 when the Cattlemen's Association decided instead to renovate a closed plant in Tama, Iowa.

The debate over the impact (good or bad) of livestock packing and processing plants on their host communities is largely informed by journalistic accounts, such as in the 2001 bestseller *Fast Food Nation*. Author Eric Schlosser paints a grim picture of the effects of a new meatpacking plant on Lexington, Nebraska:

> In 1990, IBP opened a slaughterhouse in Lexington. A year later, the town, with a population of roughly seven thousand, had the highest crime rate in the state of Nebraska. Within a decade, the number of serious crimes doubled; the number of Medicaid cases nearly doubled; Lexington became a major distribution center for illegal drugs; gang members appeared in town and committed drive-by shootings; the majority of Lexington's white inhabitants moved elsewhere; and the proportion of Latino inhabitants increased more than tenfold, climbing to over 50 percent. (p. 165)

The academic research on this topic consists primarily of case study analyses. These studies document a variety of social and economic consequences following the opening of large meat packing plants that may be described as a mixed blessing for host towns. The opening of a new establishment may increase local demand for animals and feed in the region (Broadway 2000). It also provides new jobs to the community. The evidence from these studies suggests

that host communities experience growth in employment and payroll, not only in manufacturing, but also in retail and services, yet the job growth tends to be concentrated in low-paying jobs. In Garden City, Kansas, the per capita income level and average wage in the area rose in the decade following the opening of a large packing plant, but not as much as in the rest of the state (Broadway, Stull, and Podraza 1994). A number of social problems have been documented in meat packing towns, including increased crime rates and child abuse cases, higher housing and rental prices due to shortages, and additional strain on social services and the health care system. (Broadway 1990; Broadway, Stull, and Podraza 1994; Grey 1997b). Schools in host communities feel the impacts of the plant through greater numbers of limited-English proficient students and unstable school enrollments that reflect high turnover rates at the plant (Grey 1997a). In addition, there are environmental concerns regarding odor and ground and water pollution (Hackenberg, 1995).

These studies examine changes in a particular community or set of communities before and after the opening of plants, but generally do not provide a frame of reference by comparing the meat packing towns with similar communities that do not have meat packing or processing facilities. They all focus on very large plants despite the fact that, except for poultry processing, the majority of meat packing and processing firms have fewer than 100 employees (County Business Patterns, 2001).[1] It is true, however, that industry concentration has increased dramatically over the past few decades (Ollinger, MacDonald and Madison 2005; MacDonald and Ollinger 2005). Rising firm size increases the chance a community will experience adverse external effects from expansion.

Recent research on whether large plant sitings generate positive and significant net economic benefits for their host communities is mixed. In a study of new firm locations

employing at least 1,000 workers over the period 1980 to 1989, Fox and Murphy (2004) find little evidence to suggest that the presence of these large firms affects future employment or income growth in the local region. Edmiston (2004) examines large plant locations and expansions in Georgia counties from 1984-1998. His results show that while firm expansions yield approximately two hundred workers on net for every one hundred new firm employees, new locations yield a net gain of only 29 workers in the county for every one hundred new firm employees. In contrast, a study by Greenstone and Moretti (2003) of "million dollar plants" finds that the opening of a large plant significantly increases the trend in the host county's total wage bill. Five years after the plant's opening, they estimate that the average county wage bill for host counties is nine percent higher due to the new plant. In addition, they find no evidence that the plant reduces property values or affects local government spending.

Our focus on meatpacking plants is particularly useful in light of these more general studies of plant siting effects. Because the acrimony surrounding the siting of meatpacking plants arguably exceeds that in other sectors, this sector could be viewed as a worst case scenario for new plant sitings. Secondly, meatpacking represents one of the few sectors expanding manufacturing jobs in rural areas that have otherwise faced slow economic expansion. Finally, because meatpacking plants are more homogeneous than the variety of manufacturers analyzed in these previous studies, we have many similar cases to evaluate, and our results are less likely to be driven by the unique circumstances surrounding the siting of one-of-a-kind plants. Our concentration on Midwestern non-metropolitan counties assures that the counties are of similar size and face similar economic opportunities and challenges.

This research employs longitudinal cross-sectional data on meat packing and processing facilities from the Bureau of Labor Statistics' Longitudinal Database (LDB) from 1990 to 2000.[2]

We compare changes in social and economic indicators in non-metropolitan counties with and without meat packing and processing jobs. The social and economic outcomes include changes in county employment, wages and income, as well as changes in county crime rates and local government expenditures for education, police protection and health. The industries we consider are Animal (except poultry) Slaughtering (NAICS 311611), Meat Processed from Carcasses (NAICS 311612), Rendering and Meat Byproduct Processing (NAICS 311613), Poultry Processing (NAICS 311615) and Frozen Specialty Food Manufacturing (NAICS 311412). Using the LDB, counties in twelve Midwestern states are classified into one of five categories based on whether a facility in any of these industries (a) was present continuously, (b) entered, (c) closed, (d) both entered and exited, or (e) was not present, during the period 1990-2000. Establishment-level employment and wage data are aggregated to the county level and used to construct relative measures of earnings and employment in order to analyze the importance of overall size of the industry in the county. In addition, we investigate the possibility that higher-value processing facilities generate social and economic impacts that are different from those of packing facilities.

We find that as the meat packing and processing industry's share of a county's total employment and wage bill rises, total employment growth increases, while wage growth slows relative to counties without the industry. Income growth, the product of employment and wage growth, is relatively slower as well, indicating that the negative wage effect swamps the positive employment effect. Employment net of the meatpacking sector grows more slowly, suggesting that meatpacking employment grows at the expense of employment growth in other sectors of the economy. However, contrary to the findings of previous research on this topic, there is no significant difference in the growth of violent or property crime in counties with and without meatpacking, and the point estimates, although imprecise, suggest slower crime growth in

counties with these plants. In addition, there is little evidence that growth in the industry affects local government expenditures in total, or on education, police protection, or health. Our results are robust to differences in assumptions regarding the exogeneity or endogeneity of the presence of a packing or a processing plant. Our findings are also basically unchanged when we examine meat packing separately from meat processing or poultry processing.

Conceptual Framework

Previous research suggests that the presence of the meat packing industry may have positive or negative effects on a county's economic growth. On the one hand, the industry adds jobs and income to the local economy, and potentially spawns additional business growth up and down the supply chain. On the other hand, the presence of the industry may deter additional growth if it generates negative social impacts such as increased crime or pollution or if it imposes costs on the local government (education, transportation, sewage or other infrastructure investments) that dissuade other businesses from entering.

We follow the model of local growth presented in Glaeser, Scheinkman, and Shleifer (1995). Let total output in county i at time t be a function of county technology, $A_{i,t}$ and employment, $L_{i,t}$:

$$A_{i,t} f(L_{i,t}) = A_{i,t} L_{i,t}^{\alpha} \quad (1)$$

This production function, assumed to be Cobb-Douglas with $\alpha<1$, is common across counties. A potential migrant's labor income is the marginal product of labor and his utility in county i at time t is the product of wages and a quality of life good, $Z_{i,t}$:

$$U(\cdot) = \alpha A_{i,t} L_{i,t}^{\alpha-1} Z_{it} \quad (2)$$

Individuals are assumed to freely migrate across counties; in equilibrium utility will be constant across space at any point in time. Given these assumptions, each individual's utility level in each county must equal the reservation utility at time t, denoted Ur. Therefore, for each county:

$$\ln Ur_{i,t+1} - \ln Ur_{i,t} = (\ln A_{i,t+1} - \ln A_{i,t}) + (\ln Z_{i,t+1} - \ln Z_{i,t}) + (1-\alpha)(\ln L_{i,t+1} - \ln L_{i,t}) \quad (3)$$

Assume further that growth in quality of life and county productivity are determined by $X_{i,t,}$ a vector of county level characteristics:

$$\ln A_{i,t+1} - \ln A_{i,t} = X'_{i,t}\gamma + \psi_{i,t+1} \quad (4a)$$

$$\ln Z_{i,t+1} - \ln Z_{i,t} = X'_{i,t}\theta + \xi_{i,t+1} \quad (4b)$$

Substituting these equations into (4) and rearranging, we obtain:

$$\ln L_{i,t+1} - \ln L_{i,t} = \frac{1}{(1-\alpha)}\left(X'_{i,t}(\gamma+\theta)\right) + \chi_{i,t+1} \quad (5a)$$

$$\ln w_{t+1}(\cdot) - \ln w_t = X'_{i,t}(2\gamma+\theta) + \upsilon_{i,t+1} \quad (5b)$$

where $\chi_{i,t+1}$ and $\upsilon_{i,t+1}$ are error terms that are uncorrelated with county characteristics. Let the set of outcomes that we are interested in measuring, including employment growth, wage growth, and changes in quality of life goods, be denoted by Q. Then, more generally, growth in each outcome is a function of the same county level attributes:

$$\ln Q_{i,t+1} - \ln Q_{i,t} = X'_{i,t}\beta + \varepsilon_{i,t+1} \quad (6)$$

Empirical Specification

Equation (6) provides the basis for our empirical specification, a difference-in-differences model. The difference-in-differences estimation method is commonly used to measure the effects of a treatment, such as a training program, on the behavior of those who have received the treatment. A comparison of outcomes is made both before and after treatment and with a control group of similar people not receiving the treatment. In this study, the treatment group is composed of

counties that have meat packing or processing jobs at some time during the study period. The control group is composed of otherwise similar counties that do not have jobs in the industry during the study period.

In addition to measuring growth in employment and wages, we also analyze income growth. Our measures of changes in quality of life, Z, include growth in local government expenditures in total and on health, education, and police protection and changes in crime rates. County attributes, $X_{i,t}$, include environmental amenities and other local attributes, as well as the presence and relative size of the livestock processing industry.

Let the share of the livestock processing industry in county i and year t be represented by the variable M_{it}, a continuous measure between 0 and 1. M_{it} will vary across types of counties and also within the treatment group of counties having the meat packing/processing industry (MPP). The impact of changes in M_{it} from period 0 to period 1 can be captured by modifying equation (6) as in:

$$\ln Q_{it+1} - \ln Q_{it} = \delta(\ln M_{it+1} - \ln M_{it}) + \beta(\ln X_{it+1} - \ln X_{it}) + (\varepsilon_{it+1} - \varepsilon_{it}) \qquad (6)$$

where M_{it} measures livestock processing in county i at time t and $X_{it,}$ is a vector of variables measuring other attributes in county i at time t. The effect of growth in the relative size of the MPP industry in the county on the growth rate of Q is measured by δ.

There may be differential impacts for counties that lost or gained MPP plants relative to counties that always or never had plants. Let $C_{i,}$ $G_{i,}$ L_i and B_i be dummy variables equal to one if the county had the industry continuously during the period, gained the industry during the period, lost the industry during the period, or both gained and lost the industry, respectively. Equation (5a) can be modified as follows:

$$\begin{aligned}\ln Q_{it+1} - \ln Q_{it} = {} & \delta_G G_{it}(\ln M_{it+1} - \ln M_{it}) + \delta_L L_{it}(\ln M_{it+1} - \ln M_{it}) \\ & + \delta_C C_{it}(\ln M_{it+1} - \ln M_{it}) + \delta_B B_{it}(\ln M_{it+1} - \ln M_{it}) + \beta(\ln X_{it+1} - \ln X_{it}) \\ & + (\varepsilon_{it+1} - \varepsilon_{it})\end{aligned} \quad (7)$$

This specification allows growth in the MPP industry to have different effects according to the status of the industry during the study period. In each case the reference group is the counties that never had livestock packing or processing facilities, and δ_G, δ_L, δ_C and δ_B measure the relative effect on Q growth of gaining, losing, continuously having, or both gaining and losing MPP jobs.

Table 1 describes the variables used in the estimation. Measures of economic change include growth in county income, employment and average wage rates. These data were obtained from the Bureau of Economic Analysis. In addition, we examine the growth in net employment, measured as total county employment growth minus employment growth in the meat packing and processing industry. While growth in the industry is expected to spur total employment growth, it is unclear whether the industry will induce positive employment growth in other sectors due to agglomeration effects or if MPP industry growth will deter employment growth in other sectors due to negative spillovers, such as increased factor costs or congestion.

One of the biggest concerns of communities gaining meat packing facilities is the potential impact on crime rates. We have included two measures of crime, the change in property crime rates and the change in violent crime rates, obtained from FBI Uniform Crime reports. The measures of fiscal changes included in the analysis are total direct general expenditures by local governments as well as direct general expenditures on police protection, education, and health and hospitals. A separate regression is estimated for each of these outcome variables.

Two measures of the MPP industry are used. The first measure is the industry's share of total county employment; the second is the industry's share of county earnings. Few time-varying control variables were available on an annual basis to measure the change in county characteristics. Annual population estimates from the U.S. Census were included as were the average annual changes in the proportion of high school and college graduates in the county. These latter variables were constructed from 1990 and 2000 census data. In addition, a number of control variables representing initial conditions are included in the estimation.

Since plant locations are not randomly assigned, this is not a true experimental design. There is some evidence that local officials do use tax abatements and other economic incentives to attract livestock processing firms and this may be one source of unobserved heterogeneity across counties. A major advantage of the first differenced approach is that any unobserved time invariant county fixed effects are removed from the estimation. However, there may still be time varying unobserved variables that are correlated with the presence of the livestock industry.

One method to control for potential nonrandom assignment of counties into the treatment group is to use instrumental variables that exogenously shift the probability of having a meatpacking plant but that do not directly affect growth rates in the county. The best candidates for instruments are factors that uniquely affect the productivity of a meatpacking plant, such as access to feed and animals, but have no obvious effect on the county growth rate. Since the industry generally serves national markets, variation in local demand is unlikely to provide identification. An alternative method involves a matching strategy in which a treatment group is paired with a control group based on similar values of explanatory variables (Angrist and Krueger 1999). Observations are matched using a propensity score, based on the predicted share of MPP jobs in the county in 1990. By creating a weighted sample of the control counties based

on the distribution of propensity scores in the treated counties, we are able to generate a distribution of control counties that exactly matches the distribution of propensity scores in the treated counties. In contrast with closest neighbor matches, this method has the advantage of preserving all observations in the sample.

The weighted least squares estimator is given by:

$$\beta_{WLS} = (X'\Omega^{-1}X)^{-1}(X'\Omega^{-1}Y) \qquad (8)$$

where Y corresponds to $\ln Q_{it+1} - \ln Q_{it}$, X is a matrix of regressors including the change in the share of MPP share, $(\ln M_{it+1} - \ln M_{it})$, as well as changes in other exogenous factors, $(\ln X_{it+1} - \ln X_{it})$, and Ω is a diagonal matrix of weights, ω_i. Our main focus is to estimate the coefficient on $(\ln M_{it+1} - \ln M_{it})$, which is interpretable as the effect of MPP growth on our various measures of county growth.

We construct the weights in Ω using predicted MPP employment shares for each county in 1990. The weights reflect the number of counties in the treatment group (counties with MPP) relative to the number of matched counties in the control group (counties without MPP) where the match is based on comparable predicted MPP employment shares in the treatment and control counties.

To be precise, let T represent the treatment counties with meat packing plants at some point in the 1990-2000 period and C represent the control counties that never had an MPP plant in the period. The number of treatment counties is N_T, and the number of control counties is N_C. We regress 1990 MPP employment share in county i and group j, S_{ij} on a vector of observable attributes of the county in 1990, X_{ij} , that are believed to affect the probability of having a livestock processing plant, [3].

$$S_{ij} = X_{ij}^{'}\Pi + \varepsilon_{ij}; \quad i = 1,2,...,N_j; \quad j = T,C \tag{9}$$

where Π is a vector of parameters that are common across the T and C groups. We then generate the predicted MPP employment share for each county, $\hat{S}_{ij}$. Figure 1 charts the distribution of $\hat{S}_{ij}$ for the two groups. The distributions are relatively well matched, with slightly more mass in the treatment distribution toward higher predicted shares. The considerable overlap in the distributions suggests that the non-host, non-metropolitan counties in the study states serve as a good control group for the host counties.

The weighting is used to make the control group distribution match the sample distribution of the treatment group. We order group T from smallest to largest $\hat{S}_{ij}$ and then subdivide group T into deciles. The lowest decile has $n_T = (N_T/10)$ observations with $\hat{S}_{ij}$ values ranging from $(-\infty, \hat{s}_{1T})$; the next decile also has n_T observations ranging from $(\hat{s}_{1T}, \hat{s}_{2T})$; and so on up to the highest decile of n_T observations ranging from $(\hat{s}_{9T}, +\infty)$. There is a corresponding number of control group counties lying in each range so that nc_1 counties lie within $(-\infty, \hat{s}_{1T})$; nc_2 lie within $(\hat{s}_{1T}, \hat{s}_{2T})$; and so on up to nc_{10} that lie within $(\hat{s}_{9T}, +\infty)$. In (8), each treatment group observation receives a weight of 1 in Ω while each control group observation is weighted by $\omega_i = nc_k/n_T$, for k=1…10. This method overweights control observations for which $nc_k<n_T$ and underweights control observations for which $nc_k>n_T$.[4].

The Sample

There are 858 non-metropolitan counties in the twelve Midwestern states included in this analysis. This region accounted for roughly one-third of the establishments and 40% of the employment and annual payroll in this industry in both 1990 and 2000. Some livestock processing industry was present in 376, or 44%, of these counties in 1990. By 2000, the number

of counties with livestock processing had fallen slightly to 353, or 41% of these counties. In 1990, meat packing firms were present in 32% of the counties, 18% had meat processing firms, and 8% of the counties had poultry processing establishments. The MPP industry was present continuously between 1990 and 2000 in approximately one-third of the counties (288) in the sample. Eighty-eight counties lost the industry during the period while fifty-four gained it. In twenty-eight counties, the industry entered and exited during the study period.

In 1990, the average county with MPP presence had 241 jobs in the industry. The average industry employment for counties with poultry processing firms was much higher (507 employees on average) than for counties with meat packing (135 employees) or meat processing firms (146 employees).[5] Average county-industry employment rose over the decade by about 46%; in 2000, the industry employed 352 employees in the average host county. For most host counties, industry employment accounted for less than 1% of county employment; however, the share of industry employment ranged as high as 35%. Industry wages in counties with livestock processing firms averaged about $4.3 million, in 1990, rising to an average of $6.9 million (in inflation-adjusted, 1990 dollars) by 2000. In most host counties, the industry represented less than one percent of the total county wage bill, but accounted for as much as 35% of total earnings for counties in the sample.

Results

Tables 2 and 3 summarize the regression results for equations (6) and (7). Our measures of local attributes that might affect growth independent of the presence of the meat packing and processing industry include: 1990 values of county population, employment, income and average wage, percent of the population with a high school education, percent of the population with a college education, poverty rate, property crime and violent crime rates, the presence of an

interstate highway, and the USDA natural amenities scale. The annual county population growth rates and average annual rate of change in the proportion of high school and college educated populations are also included as explanatory variables.[6] Results using two different measures of industry size are reported: employment share is the change in the proportion of MPP industry jobs in the county; wage share is the change in the proportion of the MPP industry's wage bill in the county.

Since plant location may not be randomly determined, ordinary least squares estimates may be biased measures of the impact of the growth in MPP employment share on county economic and social outcomes. We present estimates from weighted least squares regressions, using the propensity score matching technique described above to construct weights[7].

Table 2 reports the weighted least squares estimates for δ_{WLS} from regressions for each of the ten outcomes. Columns (1) and (2) provide estimates for all MPP industries combined; columns (3) and (4) give estimates for the packing industry only (NAICS 311611), columns (5) and (6) provide estimates for the poultry processing industry only (NAICS 311615) and estimates for the processing industry (NAICS 311612, 311613 and 311412) are presented in the remaining columns. In each case, results are shown for the two measures of the MPP industry; growth in the proportion of industry employment share and growth in the proportion of industry wage share in the county.

The estimates in table 2 suggest that growth of the MPP industry as a share of total county employment raises county employment growth, while lowering wage growth. The negative wage effect appears to swamp the positive employment effect, resulting in lower income growth. Net employment (total county employment minus MPP industry employment) slows as the industry grows in relative importance in the county, suggesting that growth in the

MPP industry may deter additional job growth in the county. The magnitudes of the implied changes are very small, however. The coefficients, which can be interpreted as elasticities, are generally less than one, meaning a one percent increase in the industry's employment share in year t relative to year t-1 leads to a corresponding change in the outcome variable that is less than one-percent.

The results provide little evidence that the growth in the relative share of the meat packing/processing industry affects government spending or crime rates. The estimates suggest that host counties have relatively faster growth in total government expenditures, but the difference is very small and the coefficients are measured imprecisely. There is no significant effect of industry growth on the growth in crime rates. That said, the negative sign suggests that growth in the industry lowers the rate of change in violent crime as opposed to increasing it, a charge commonly leveled against the industry in existing case study literature.[8]

The results do not differ markedly when these more detailed industry classifications are used to define treatment county status. In general the signs of the coefficients for income, wages, employment and net employment are consistent across industry type although the significance levels vary. In the meat processing and poultry processing equations, growth in the relative employment share does not lower significantly income growth as it does in the meat packing equations. In addition, the negative effects on wage growth and net employment growth are significant only for the meat packing industry. Positive employment growth effects are significant only in the processing industry equations. While growth in the share of poultry processing tends to slow government expenditures relative to counties without the industry, these estimates do not provide only limited support for the notion that growth in the meat packing and processing industry significantly impacts government spending.

When the effects of growth in the MPP industry are allowed to vary according to whether the industry entered, exited or was present continuously throughout the decade, some differences emerge. These results are presented in table 3. The first two rows of estimates correspond to δc, the coefficient on the growth in the share of the meatpacking and processing industry in equation (7) for counties that had the industry continuously throughout the decade (relative to counties that never had the industry during the same time period). The second set of estimates correspond to δ_G, the effect of industry growth in counties that gained the industry; the third set are estimates of δ_L, the coefficients on industry growth for counties that lost the industry, and the final set are δ_B, for the set of counties that both gained and lost the industry during the decade.

The negative effect of an increasing share of MPP industry on income growth appears to be driven mainly by counties that both gained and lost the industry over the decade. When industry size is measured by its share of the total county wage bill, the results suggest that the industry also slowed income growth in counties that had MPP jobs continuously throughout the decade. In counties that lost the industry, income growth was higher before the loss of the MPP jobs, although not significantly higher.

Counties that gained the MPP industry experienced faster employment growth, as did counties that had the industry continuously during the study period. Counties that lost the industry had higher employment growth before losing the plant, but the estimates are imprecise. Net employment growth was relatively slower in counties that had the industry continuously and in counties that lost the industry. While the coefficients on net employment growth are likewise negative for counties that gained MPP jobs, the estimates are not significant. There is no evidence that growth in the relative share of the industry affects growth in crime rates or local

government expenditures whether the industry was present continuously, entered, exited or both entered and exited over the sample period.

Conclusions

Growth in the meat packing and processing industry in the Midwestern United States has generated a significant amount of debate regarding the costs and benefits of this type of economic development. Previous studies, employing a case study approach, have documented both positive and negative consequences following the opening of large meat packing plants, but generally have failed to provide a frame of reference for evaluating these changes. Our goal was to provide this frame of reference by assessing the changes in economic and social outcomes resulting from growth (or decline) in the meat packing and processing industry relative to changes in similar settings without meat industry jobs. Using a broad array of social and economic growth indicators, we find neither the large systematic gains envisioned by proponents of MPP expansion, nor the significant losses feared by the industry's opponents.

Local officials seek to attract the meat packing and processing industry because they believe it will generate employment and spur wage growth in their communities. This research does find evidence that the industry affects total county employment growth, but does not support the case for positive spillovers on employment in other sectors or on wage growth. Instead, we find that expansion in meat packing and processing has a negative effect on overall wage growth and slows employment growth in other sectors of the host county economy. There is some evidence that the slower wage growth swamps the faster employment growth so that aggregate income grows more slowly. In contrast to previous studies, there is no systematic effect of growth in the industry on either local crime rates or local government spending.

Counties that lost the MPP industry did not have appreciable changes in employment growth. Apparently, firms in other sectors were able to absorb labor shed by the shuttered MPP firms. Counties that gained the industry had significantly faster employment growth, but no appreciable advantage in any of the other growth measures. On the other hand, there is no evidence of more rapid growth of crime in counties gaining MPP firms. Finally, examining the impacts by industry reveals some differences between meat packing facilities and higher-value processing plants. In particular, expansion in the packing industry lowers wage, income growth and net employment growth, without the accompanying increase in total employment growth seen in the estimates for all industries combined. Growth in the meat processing industry appears to spur total employment growth, while not significantly impacting wages or employment in other sectors.

This research helps provide a context for evaluating the impact of the livestock processing industry on rural communities in the Midwestern U.S. As the industry continues to expand in rural America, further research will be needed to address questions regarding its effect on environmental quality and other quality of life aspects not addressed in this study.

Endnotes

[1] According to data from the 2001 County Business Patterns, 64% of poultry processing firms had more than 100 employees; 17% had 1,000 employees or more. In contrast, only 8% of animal (except poultry) slaughtering firms have more than 100 employees. The corresponding percentages for other meat processing firms are: 20% of firms classified as 'meat processed from carcasses' and 6% of rendering and meat by-product processing firms.

[2] The data are not publicly available, but research using the data was permitted upon approval of an application to the Department of Labor. Only the aggregated results can be released to the public. The research was carried out at the Bureau of Labor Statistics (BLS) in Washington, D.C. in 2004. (See http://www.bls.gov/bls/blsresda.htm for more details.)

[3] These regression results are available upon request from the authors. We also experimented with propensity scores based on the presence or absence of an MPP plant as opposed to the employment share. The fit of the probit was poor and generated few significant coefficients, suggesting that the presence of a plant was close to a random event. Employment share equations provided greater variation in the dependent variable and a better fit.

[4] This a version of a kernel-based, conditional difference-in-difference matching estimator. See Heckman, Ichimura and Todd (1997).

[5] This reflects considerable returns to scale in poultry processing (Ollinger, MacDonald and Madison 2005 and more modest scale economies in beef packing (Ollinger and MacDonald 2005).

[6] The addition of control variables does little to change the estimates. In general the addition of control variables strengthens the results rather than mitigating them. This is perhaps not surprising given the empirical specification. A major advantage of the first-difference approach is that it eliminates county specific unobservables that may affect growth. Adding additional county-level controls provides little new information. The discussion of the results will refer to the specifications including control variables. The results from specifications without controls are available from the authors upon request.

[7] As it turns out, our results are not sensitive to the type of estimation strategy used. The results from ordinary least squares are available from the authors upon request

[8] Otto, Orazem and Huffman (1998) point out in an analysis of the community and economic impacts of the hog industry in Iowa that it is the relative change in crime rates that matters. Although crime may be rising in counties with a meat packing plant, if crime rates are rising in all other counties as well, the rise in crime can not be attributed to the presence of the packing plant. "Numerous complaints have been registered regarding increases in criminal activity in areas that have meat packing plants. Incidence of violent crime rose 56 percent in Louisa County between 1980 and 1990. However, this is only a marginally greater increase in criminal activity than the statewide increase of 49 percent during the same period. More telling, violent crimes rates rose an average of 168 percent in the seven counties that lost meat packing plants. So if meat packing is to be associated with increased criminal activity, it is the loss of the industry rather than its expansion that is to blame."

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Table 1. Definitions and Sources of Variables

Variable	Description	Source
Dependent Variables		
incdif	Log difference in county total real personal income	BEA
Wagesdif	Log difference in average county real wages (Earnings / Wage and Salary Employment)	BEA
Empdif	Log difference in county employment	BEA
NetEmpdif	Log difference in county employment minus industry employment	BEA, LDB
Getotdif	Log difference in total direct local government expenditures	Census of Govt.
Geedudif	Log difference in direct local government expenditures on education	Census of Govt.
Gepolicedif	Log difference in direct local government expenditures on police protection	Census of Govt.
Gehealthdif	Log difference in direct local government expenditures on health and hospital	Census of Govt.
Pcratedif	Log difference in property crime rates	FBI Uniform Crime Reports
Vcratedif	Log difference in violent crime rates	FBI Uniform Crime Reports
Measures of the Meat Packing & Processing Industry		
Indempshare	County meat processing employment/Total county employment	LDB, BEA
Indempsharedif	Log difference in Indempshare	LDB, BEA
Indwageshare	County meat processing wage bill /Total county earnings	LDB, BEA
Indwagesharedif	Log difference in Indwageshare	LDB, BEA
Control Variables		
bcollrate	Percent of county population with bachelor's degree or higher	U.S. Census
bhsrate	Percent of county population with a high school diploma or equivalent, but not a college degree	U.S. Census
bpovrate	Percent of county population with incomes below poverty, 1990	U.S. Census
bemp	Total wage and salary employment, 1990	BEA
bwage	Average county real wage (Earnings / Wage and Salary Employment), 1990	BEA
bpop	County population, 1990	U.S. Census
bincome	County real personal income, 1990	BEA
bpcrate	Number of property crimes per 1,000 population, 1990	FBI Uniform Crime Reports
bvcrate	Number of violent crimes per 1,000 population, 1990	FBI Uniform Crime Reports
amenities	USDA Natural Amenities Index	USDA
interstate	Presence of an interstate highway	ESRI, ArcView Version 3.2

Table 2. Weighted Least Squares Estimates of the Impact of Growth in the Meat Packing/Processing Industry on Growth in Selected Indicators by Detailed Industry Classification

	All Industries		Packing		Poultry		Processing	
Dependent Variable	**Employment Share (1)**	**Wage Share (2)**	**Employment Share (3)**	**Wage Share (4)**	**Employment Share (5)**	**Wage Share (6)**	**Employment Share (7)**	**Wage Share (8)**
Income	-0.26***	-0.68***	-0.29***	-0.71***	0.30	-0.28	0.44	0.16
	(5.35)	(6.81)	(5.53)	(6.03)	(0.47)	(0.38)	(1.49)	(0.47)
Wage	-0.37**	-1.13***	-0.35*	-0.96***	0.31	-0.79	-0.51	-1.00
	(2.01)	(3.00)	(1.81)	(2.16)	(0.14)	(0.32)	(0.46)	(0.88)
Employment	0.07*	0.25**	0.02	0.14	0.59	0.66	1.20***	1.23***
	(1.89)	(3.31)	(0.62)	(1.52)	(1.47)	(1.43)	(5.22)	(4.78)
Net Employment	-0.07*	-0.28***	-0.05	-0.23***	-0.51	-0.49	-0.13	-0.16
	(1.81)	(3.70)	(1.23)	(2.58)	(1.28)	(1.07)	(0.56)	(0.63)
Total Govt. Exp.	0.02	0.04	0.04	0.12	-1.04***	-1.18***	-0.08	-0.10
	(0.55)	(0.56)	(0.96)	(1.44)	(2.61)	(2.58)	(0.39)	(0.47)
Educ. Govt. Exp.	0.00	0.01	0.003	0.02	-0.34	-0.22	-0.10	-0.10
	(0.05)	(0.10)	(0.12)	(0.31)	(0.94)	(0.51)	(0.51)	(0.49)
Police Govt. Exp.	0.02	0.03	0.02	-0.01	0.62	1.19	-0.24	-0.28
	(0.12)	(0.10)	(0.10)	(0.01)	(0.47)	(0.78)	(0.25)	(0.25)
Health Govt. Exp.	-0.18	-1.11	0.41	0.72	-1.63	-3.62	-8.22	-8.76
	(0.15)	(0.45)	(0.29)	(0.23)	(0.09)	(0.17)	(1.05)	(0.99)
Property Crime Rate	0.10	-2.32	-0.85	-1.00	2.39	0.99	0.17	-3.17
	(0.02)	(0.41)	(0.09)	(0.11)	(0.09)	(0.03)	(0.01)	(0.29)
Violent Crime Rate	-2.11	-4.12	-1.25	-1.98	0.61	-1.69	-5.77	-9.02
	(0.21)	(0.44)	(0.08)	(0.13)	(0.02)	(0.04)	(0.25)	(0.48)

Notes: t-statistics are in parentheses, * significant at the 10-percent level; ** significant at the 5-percent level; *** significant at the 1-percent level. Two measures of industry size are reported; employment share is the change in the proportion of MPP industry jobs in the county; wage share is the change in the proportion of MPP industry wage bill in the county. Column (1) presents

estimates for all MPP industries combined; column (2) shows estimates for the packing industry only (NAICS 311611), column (3) provides estimates for the poultry processing industry only (NAICS 311615) and estimates for the processing industry (NAICS 311612, 311613 and 311412) are presented in the remaining columns. Weights are derived using a propensity score matching technique.

Table 3. Weighted Least Squuares Estimates of the Impact of Growth in the Meat Packing/Processing Industry on Growth in Selected Indicators by Timing of Industry Presence

	Dependent Variable									
	Income	**Wage**	**Employ-ment**	**Net Employ-ment**	**Total Govt. Exp.**	**Educ. Govt. Exp.**	**Police Govt Exp.**	**Health Govt. Exp.**	**Property Crime Rate**	**Violent Crime Rate**
Continuous Presence of Industry										
Employment Share	0.01	-0.30	0.47***	-0.82***	0.04	0.04	-0.01	-1.08	-0.40	-1.12
	(0.05)	(0.43)	(3.31)	(5.72)	(0.31)	(0.35)	(0.01)	(0.24)	(0.06)	(0.10)
Wage Share	-0.65***	-1.31***	0.33***	-0.60***	0.05	0.05	0.11	-1.25	-2.70	-3.21
	(4.11)	(2.19)	(2.75)	(4.95)	(0.43)	(0.56)	(0.25)	(0.32)	(0.44)	(0.32)
Gained Industry										
Employment Share	0.51	-0.57	1.31***	-0.06	-0.02	-0.12	-0.36	-9.09	-2.82	-4.79
	(1.57)	(0.47)	(5.25)	(0.22)	(0.08)	(0.67)	(0.39)	(1.14)	(0.11)	(0.12)
Wage Share	0.32	-0.90	1.48***	-0.10	0.06	-0.14	-0.47	-10.54	-2.71	-6.39
	(0.83)	(0.62)	(5.02)	(0.36)	(0.24)	(0.70)	(0.43)	(1.12)	(0.12)	(0.17)
Lost Industry										
Employment Share	0.31	0.16	0.34	-0.75*	-0.06	0.00	-0.19	-1.98	4.18	-4.53
	(0.60)	(0.08)	(0.85)	(1.87)	(0.17)	(0.01)	(0.13)	(0.15)	(0.23)	(0.15)
Wage Share	0.23	0.16	0.22	-0.91**	-0.13	-0.04	-0.25	-1.25	3.61	-14.62
	(0.38)	(0.07)	(0.49)	(2.02)	(0.33)	(0.12)	(0.15)	(0.09)	(0.14)	(0.34)
Both Gained and Lost										
Employment Share	-0.31***	-1.12**	0.00	-0.01	0.02	0.00	0.00	0.17	0.37	-4.41
	(6.03)	(2.10)	(0.09)	(0.19)	(0.52)	(0.17)	(0.01)	(0.14)	(0.01)	(0.09)
Wage Share	-0.90***	-1.09*	0.02	-0.03	0.03	0.00	-0.03	0.35	0.33	-8.36
	(6.39)	(1.72)	(0.20)	(0.26)	(0.36)	(0.04)	(0.08)	(0.10)	(0.01)	(0.12)

Notes: t-statistics are in parentheses, * significant at the 10-percent level; ** significant at the 5-percent level; *** significant at the 1-percent level. Two measures of industry size are reported; employment share is the change in the proportion of MPP industry jobs in the county; wage share is the change in the proportion of MPP industry wage bill in the county. Counties are classified

into five groups; continuous, the meat packing industry was present in the county continuously throughout the study period; gained, the county gained the industry; lost, the county lost the meat packing industry; both, the county both gained and lost the industry during the study period; the omitted category is counties that never had the industry between 1990 and 2000. Weights are derived using a propensity score matching technique. See text for further details.

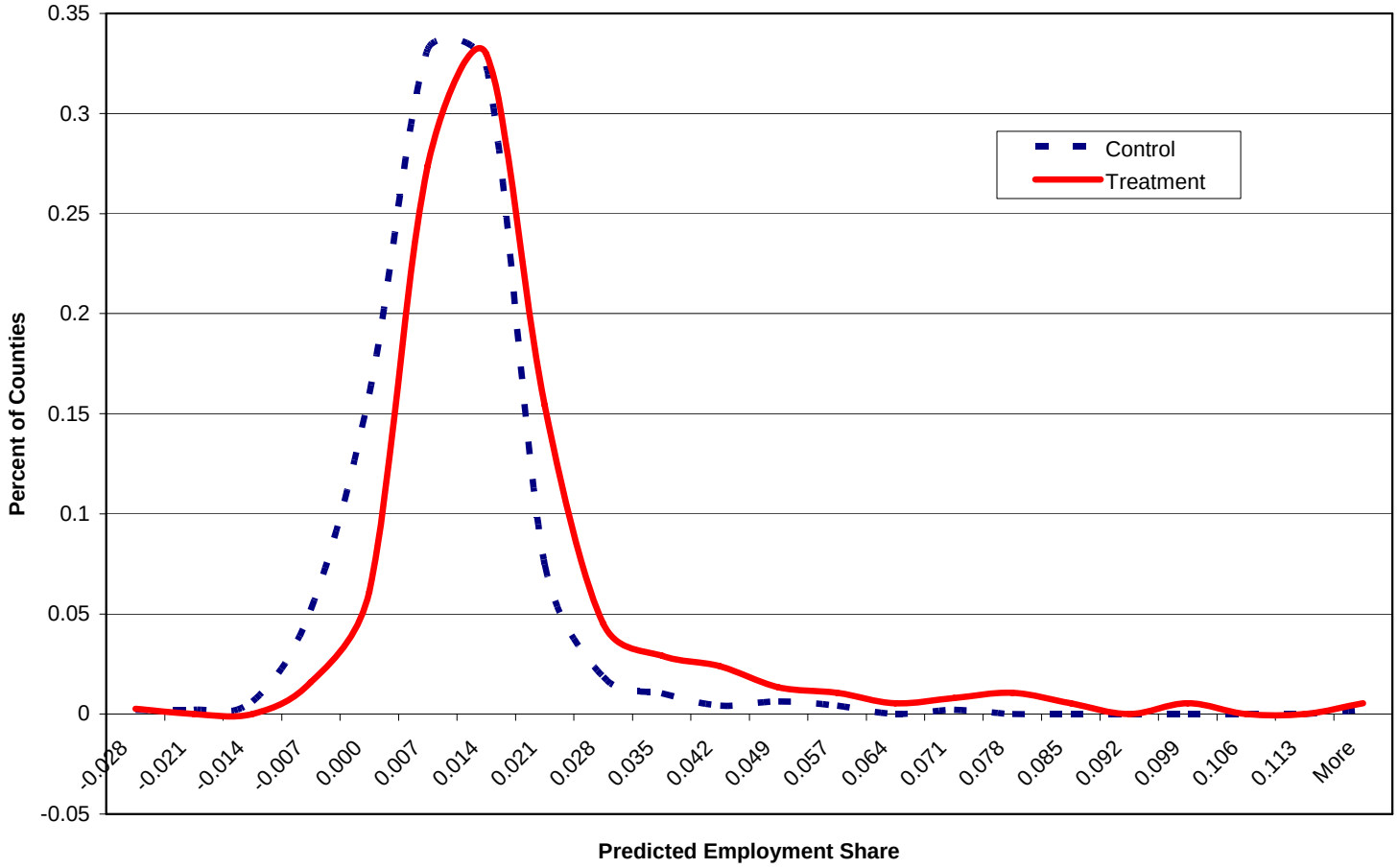

Figure 1. Distribution of predicted livestock processing employment share in 1990: treatment counties versus control counties