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Department of Agricultural & Applied Economics

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Small Food Processing in the Context of Local Foods

By

Steven Deller and Maureen Stickel

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Steven Deller & Maureen Stickel

Department of Agricultural and Applied Economics
University of Wisconsin – Madison/Extension

I. Abstract

In this study, we explore the role of small scale food processing in economic growth. Growth in small scale food processing is relevant due to the growing emphasis on local food initiatives used to spur local economic growth. We utilize US county level data on small food processors and a neo-classical growth model to better understand if small food processors are affecting economic growth. Preliminary results suggest that small scale food processing has a mixed role in helping understand local economic growth.

II. Introduction

Encouraging small business development, often in the guise of entrepreneurship, is a popular economic growth strategy touted by politicians and practitioners. This strategy is widely supported in the academic literature where the empirical evidence supporting small business development as a driver of economic growth is quite robust (e.g., Aquilina, Klump and Pietrobelli 2006). This same literature, however, also demonstrates that the impact of small businesses on local and regional economies varies across regions and industries (e.g., Deller 2010). Interest in small business development has been strong for over 40 years, particularly since the work of Birch (1979, 1987) and work by the U.S. Small Business Administration (1983, 1987). Over the past few years, however, there has been a growing interest in alternative agriculture as a growth policy. Much of this alternative agriculture takes the form of production specifically aimed at local markets. While some

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larger agricultural producers have entered the local foods market, it remains dominated by smaller farmers. As such, we have seen a blending of the local foods movement and small business development efforts in many communities.

The local foods movement is not a homogenous effort: the industry is composed of several parts. The dominant aspect of the local foods market is small farmers producing commodities for sale at farmers markets, road-side stands, or CSA-type farms (Community Supported Agriculture). There are two market segments, though, that are perhaps more important in terms of the sustainability of the industry, from a purely economic perspective. One is what Low and Vogel (2009) refer to as "intermediate sales" which includes sales into local distribution chains such as grocery stores, restaurants and public institutions such as jails, schools and hospitals. Unfortunately, we lack quality data on the size and make-up of this market segment.

The other component of the local foods movement, which has received little attention, is value added processing. Many farmers focusing on local foods are looking beyond producing raw commodities to adding value through processing their commodities. This could include fruit farmers introducing a line of jams and jellies, livestock farmers producing sausages, or dairy farmers developing a line of artisan cheeses. Many of these food processors are not farmers themselves, but producers who partner with local farmers.

Small scale food processers can sit at the intersection of entrepreneurship and the local food movement. For this reason, understanding how small food processors impact local economic conditions will help to indirectly gain insight into how the local food movement impacts economic growth. Theory would suggest that a higher prevalence of small food processors should increase economic growth for an area. This small food processor analysis models simple economic growth while controlling for relevant demographic variables.

Small scale food processing has not been studied within the context of community economic growth and development. This exploratory study hopes to shed a small amount of light on the role of food processing, particularly small scale processors, on community economic growth and development. The structure of the study is as follows: the next section will outline the current literature on local foods and entrepreneurship. This will give the background necessary to develop the empirical model used in the following section. The subsequent section discusses the results of the estimation. The study will conclude with a discussion of next steps.

III. Literature Review

Before looking at the impact of food processing, particularly small scale processors, on economic growth, it is important to begin by defining small scale or micro-enterprises. When discussing small businesses, there are nearly as many different terms and definitions used as there are researchers studying the issue. Whether one is using the term entrepreneurship, small business, micro-enterprise or some other term, the broader idea is that there are people with marketable ideas starting, running, and growing small businesses. These small businesses exist across all industries of the US economy and are started for a variety of different reasons. Goetz and colleagues (2010) note just that in their suggested research agenda. The authors maintain that because entrepreneurs have diverse goals in starting their enterprises, the effects these businesses will have on the economy will not be uniform (Goetz et al 2010). Additionally, there is a range of criteria for distinguishing what should be classified as a micro-enterprise. An easy measure for classification is by firm size measured in the number of employees. Micro-enterprises can be defined as those having fewer than 5 employees (Deller 2010, Deller and McConnon 2009) to as many as 20 employees (Fritsch and Mueller 2007). For the purpose of this analysis, we use two definitions of small food processers: those with fewer than five employees and those with fewer than ten. From the perspective of the small business literature, these could be deemed micro-enterprises. Due to unavailability of data on small food processer owners' motivations, no further granularity will be used with regards to the type of entrepreneur.

As mentioned, the effects of micro-enterprise on the economy might not be uniform across all types of business owners. In general, though, the literature supporting micro-enterprise as a key driver of economic growth is well developed. In fact, this positive association with economic growth holds across a variety of different indicators such as wages, income, and poverty alleviation (Goetz, Fleming and Rupasingha 2012; Loveridge and Nizalov 2007; Rupasingha and Goetz 2011). Some examples from the literature include Henderson and Weiler's (2010) use of county level data to demonstrate how enhanced entrepreneurship is positively associated with job growth. Additionally, Stephens and Partridge's (2011) analysis of the Appalachian region shows how self-employment is a significant contributor to both income and employment growth, particularly for regions historically lagging in terms of economic development.

While the general impacts are positive, it is worth noting that outcomes do vary across both industry and region of the country. One reason explaining this variance might be in line with Goetz and colleagues' (2010) notion of varied entrepreneurial motivations. Whatever the reason, though, the literature on micro-enterprise does note the heterogeneity in impacts. Deller and McConnon (2009) demonstrate that the type of small business is important. They show service-based micro-enterprises having a stronger relationship with income growth than goods producing ones. Deller (2010) also demonstrates the strong spatial variation in how micro-enterprise influence economic growth and thus the importance of accounting for local context prior to making policy recommendations. Work by Henderson and Weiler (2010) support this by demonstrating how positive economic impacts were most pronounced for urban counties. These differences form the basis for evaluating the effects micro-enterprise has on economic growth industry by industry.

This analysis focuses on the industry of small food processers and is particularly relevant given the growing importance of the local foods movement. The literature on the economic impacts of local foods remains fairly underdeveloped. Many articles focus on describing the current conditions and the customer base of the local food industry (Willis and Carpio 2013; Adalja 2013; Martinez 2010). There are also a few authors working to estimate the current multiplier effects of the local foods industry (Sadler 2010; Henneberry 2009) as well as estimate potential for future impacts of the industry (Swenson 2011; Kremer and DeLiberty 2011). In general, though, much of the literature on the local food movement argues how local foods supports economic growth, but there is weak empirical evidence supporting the link. Many authors have written on this weakness of the local foods literature. Critiques include the observation that much of the published work relies on assumptions about the positive benefits of local foods which, while possibly true, have yet to be proven (Mount 2011, Brown and Purcell 2005, Pearson 2006).

Small food processers are directly related to the local food movement as they process much of the food that is then being sold through local food mechanisms like farmers markets. Understanding how small food processers are associated with economic growth will shed further light on how local foods impacts economic growth. Additionally, as most of the local food literature focuses on the direct sales themselves, this analysis can be seen as a new approach to measuring the economic impact of local foods.

IV. Growth Framework & Empirical Methodology

The purpose of this analysis is to investigate the impact of small food processors on economic growth. To estimate the effects of small food processers on economic growth, this analysis will employ a partial adjustment growth model first developed by Carlino-Mills and then further expanded by Deller, et al (2001). The general model takes the following form:

$$P^* = p(E^*, I^* | \Psi^P)$$
$$E^* = e(P^*, I^* | \Psi^E)$$
$$I^* = i(E^*, P^* | \Psi^I)$$

where P^*, E^*, I^* are equilibrium levels of population, employment and income and Ψ^P, Ψ^E, Ψ^I are a set of variables describing initial conditions and other historic information. This growth model represents a holistic approach to growth by simultaneously modelling changes in population, income, and employment. A simple linear representation of this framework can be written as follows:

$$\Delta P = \alpha_{op} + \beta 1_P P_{t-1} + \beta_{2P} E_{t-1} + \beta_{3P} I_{t-1} + \gamma_{1P} \Delta E + \gamma_{2P} \Delta I + \Sigma \delta_{IP} \Omega_P$$
$$\Delta E = \alpha_{oE} + \beta_{1E} P_{t-1} + \beta_{2E} E_{t-1} + \beta_{3E} I_{t-1} + \gamma_{1p} \Delta P + \gamma_{2E} \Delta I + \Sigma \delta_{IE} \Omega_E$$
$$\Delta I = \alpha_{oR} + \beta_{1R} P_{t-1} + \beta_{2R} E_{t-1} + \beta_{3R} I_{t-1} + \gamma_{1R} \Delta E + \gamma_{2R} \Delta I + \Sigma \delta_{IR} \Omega_I$$

Or, in reduced form:

$$\Delta P = \alpha_{oP} + \beta_{1P} P_{t-1} + \beta_{2P} E_{t-1} + \beta_{3P} I_{t-1} + \Sigma \delta_{IP} \Omega_P$$
$$\Delta E = \alpha_{oE} + \beta_{1E} P_{t-1} + \beta_{2E} E_{t-1} + \beta_{3E} I_{t-1} + \Sigma \delta_{IE} \Omega_E$$
$$\Delta I = \alpha_{oR} + \beta_{1R} P_{t-1} + \beta_{2R} E_{t-1} + \beta_{3R} I_{t-1} + \Sigma \delta_{IR} \Omega_I$$

The above expressions allow for relationships between population, employment, and income to be interdependent. Take population, for example: in the reduced form equation, changes in population can be explained by a combination of population, employment, and income levels from the previous period, in addition to relevant control variables. This more closely models real world scenarios as labor makes location decisions period to period adjusting to wage and employment opportunities.

The control variables include the initial conditions (P_{t-1}, E_{t-1}, I_{t-1}) and a range of socio-demographic and socio-economic variables (Ω):

Initial Conditions

- Per Capita Earnings 2000
- Population 2000
- Employment 2000

Socio-Demographic

- Population Density
- Percent of Population Over Age 75
- Percent of Population Between Ages 20-24
- Percent of Population Non-Caucasian
- Percent of Population Naturalized Citizens
- Percent of Population Speaks Language Other than English at Home

Socio-Economic

- Percent of Population Living in Same House 1995-2000
- Percent of Housing Stock Vacant
- Median Rent
- Management, Business, Science, and Arts Occupations (%)
- Service Occupations (%)
- Sales and Office Occupations (%)
- Construction Occupations (%)
- Industry Diversity Index
- Percent of Households with Income less than $15k
- Percent of Households with Income above $150k
- Poverty Rate for those Under Age 18
- Poverty Rate for those Over Age 65
- Income Distribution Index
- Percent of those Over Age 25 With Some High School, No Degree

- Percent of those Over Age 25 With Some College, No Degree
- Percent of those Over Age 25 With a Bachelor's Degree

All variables are for the year 2000, the beginning of the growth period we are examining, unless otherwise noted. For this exploratory analysis, we look at five different types of food processors: (1) fruit and vegetable; (2) cheese; (3) animal (including sea food) processing; (4) bakeries and baked goods; and (5) beer, wine and liquor manufacturing. We use a simple dummy variable to indicate if one of these types of food processors is present in the county, regardless of size; then we use a simple dummy if a firm with fewer than five employees is present; finally we use a dummy if a firm with fewer than ten employees is present. To test the sensitivity of our results we also use the concentration of different types of food processor by dividing the number of food processors by county population (per 1,000 persons). We do the for all food processors and by size of food processors

Because county boundaries are somewhat arbitrary in a modern setting and economic activity freely flows across county boundaries it is imperative to capture the spatial relationships between counties. We do this by employing the Spatial Durbin Model which takes into account the influence of neighboring region's characteristics. The Spatial Durbin Model can be expressed as follows:

$$y = \rho W y + \beta X + \delta W X + e$$
$$e \sim N(0, \sigma^2 \Omega), \qquad \Omega = (\omega_1, \omega_2 \cdots, \omega_n)$$

$$y = \rho W y + \beta X + \delta W X + e$$
$$(I - \rho W)^{-1} y = (I - \rho W)^{-1} \beta X + (I - \rho W)^{-1} \delta W X + (I - \rho W)^{-1} e$$

Where y is our measure of growth, (income, employment, or population) and W is a weight matrix that explicitly corrects for spatial heteroskedasticity but also allows us to explicitly model how factors of growth spill over or influence county boundaries. Let

$$V(W) = (I - \rho W)^{-1}$$
$$y = V(W) \beta X + V(W) \delta W X + V(W) e$$

Because $V(W)$ is a matrix and not a scalar, the common approach of using point estimates to test the hypothesis as to whether or not spatial spillovers exist can lead to erroneous conclusions (LeSage and Pace 2009, p.74). We need to instead use the partial derivatives to properly interpret the impact of changes to the variables.

$$y = (V(W)\beta + V(W)\delta W)X + V(W)e$$
$$\frac{\partial y}{\partial x} = V(W)\beta + V(W)\delta W$$
$$\frac{\partial y}{\partial x} = direct + indirect = total$$

For reporting purposes, LeSage and Pace (2009) suggest using the averages of the diagonal element of $V(W)\beta$ and the averages of the sum of the columns or rows. The diagonal elements are used for the direct effects. These direct effects would be the within geographical unit effects. The use of the column or rows is for the indirect effects, or across geographical unit effects. The symmetric nature of the matrix makes it irrelevant if one used the columns or rows.

This specification requires us to move beyond traditional maximum likelihood because the number of integrals makes the estimation problem intractable. Specifically, by allowing the error variance to vary over space ($e \sim N(0, \sigma^2\Omega),\ \Omega = (\omega_1, \omega_2 \cdots, \omega_n)$) the first order condition of the likelihood function becomes intractable. Using diffuse prior information, our econometric analysis relies on Bayesian estimation methods. Simply stated, $P(\theta|D)$ is the posterior probability of the parameters θ given the data D and reflects the prior belief about the parameters after collect the data:

$$P(\theta|D) = \frac{P(D|\theta)P(\theta)}{P(D)}$$

The posterior distribution represents an update of the prior distribution given the data. The model likelihood is $P(D|\theta)$ and the prior distribution of the parameters is $P(\theta)$ and reflects prior knowledge about the underlying relationship being studied before observing the data. The probability of the data $P(\theta)$ is not of great interest because it does not help us with the parameters contained in θ.

Following LeSage and Pace (2009), we use the Bayesian Markov Chain Monte Carlo approach to estimate the parameters $\theta \equiv (\rho, \beta, \delta, \sigma)$. We assign the normal prior to β and δ, the inverse gamma prior to σ^2 and the uniform prior to ρ. For the heteroscedastic error structure in $\Omega = (\omega_1, \omega_2 \cdots, \omega_n)$, which are unknown and need to be estimated we use a chi-squared prior distribution. With the prior distributions denoted by π, the Bayesian priors are:

$$\pi(\beta, \delta) \backsim N(c, N)$$
$$\pi(1/\sigma^2) \backsim \Gamma(d, v)$$
$$\pi(\rho) \backsim \mathrm{U}[0,1]$$
$$\pi(\Omega) \backsim \chi^2(n)/n$$

Again following the suggestions of LeSage and Pace (2009), we set n to four (4) so $\Omega = (\omega_1, \omega_2, \omega_3, \omega_4)$. The parameters ρ, β, δ and σ can be estimated drawing sequentially from the conditional distributions of these parameters in a Bayesian framework using a MCMC or Gibbs sampling process. Here, we randomly select values of the parameters $\rho_0, \beta_0, \delta_0$ and $\sigma_0$and sample from the conditional distributions. We sample β from a normal distribution given ρ_0, δ_0 and σ_0 giving us β_1. We now sample δ from a normal distribution given ρ_0, β_1 and σ_0. In a similar fashion we draw ρ_1 given β_1, δ_1 and σ_0 then σ_1 given $\rho_1, \beta_1, \delta_1$. Let $\pi(\theta_{i+1})$ be the probability of the parameters on draw *i+1* draw and if $\pi(\theta_{i+1}) > \pi(\theta_i)$ move to the new parameter set θ_{i+1} and repeat these four steps. If $\pi(\theta_{i+1}) < \pi(\theta_i)$ we reject the new parameter set θ_{i+1}, return to θ_i and repeat these four steps. We repeat this process 25,000 times and use a burn-in period of 2,500 draws which allows the Gibbs sampler to settle into a steady state. The removal of the first 2,500 draws or burn-in period is useful if the initialized values of the parameters are poor.

We use the following interpretations of small food processing in our estimations:

Base Model: $\lambda_i = 0 \ \forall i$

Food Processing 1 (FP_1): Dummy variable for if a food processor is present for the different groups.

Food Processing 2 (FP_2): Dummy variable for if a food processor with four (4) or few employees is present for the different groups.

Food Processing 3 (FP_3): Dummy variable for if a food processor with nine (9) or few employees is present for the different groups.

By using three metrics of food processing (presence regardless of size and two thresholds of small scale of definitions of microenterprise), we indirectly test the robustness of the food processing and economic growth relationship. We also re-estimate the models using the concentration of food processors measured on a per capita basis (per 1,000 population). We explore this alternative measure of food processing to explore the robustness of our results.

V. Results

Consider first the results of the base model where all metrics of food processing are removed from the model ($\lambda_i = 0 \; \forall i$) (Table 1). For brevity, we report only the total effects; the direct and indirect effects are available from the authors. The models perform reasonably well overall and are consistent with the performance of similar models reported by others. The control variables explain 21.3 percent of the growth in employment, 49.6 percent of population growth, and 33.3 percent of per capita earnings growth. In addition, the posterior estimate of the spatial lag coefficient is statistically significant in all three models of growth.

We also find that the impact of the individual control variables varies greatly across the three metrics of growth (population, employment and per capita earnings). A detailed discussion of the results of all the control variables would be tedious and we prefer to highlight what we believe to be some of the more interesting results. For example, both lagged per capita earnings and employment have a dampening effects on job and population growth, but no impact on earnings growth. Similarly, the share of the population over age 75 has a negative effect on employment and population growth but a positive impact on earnings growth. A higher percentage of people speaking language other than English at home has a negative impact on population growth, but a positive impact on employment and earnings growth. Residential stability (same house 1995-2000) had a negative effect on employment and population growth but a positive impact on earnings growth. More specialized economies tended to see higher growth rates across all three metrics but counties with higher levels of income inequality experienced slower growths rates in employment and earnings. Education, measured by traditional metrics of educational attainment, appears to play a minimal role in helping understand growth rates.

As with other studies that have used this type of partial adjustment growth model, the policy implications can be somewhat confusing. The reasoning is simple: the policy implications on the control variables vary by the metric of growth. If the aim of policy is to promote job growth, perhaps at the expense of income growth, the results point policy recommendations in one direction. If on the other hand the goal of policy is to enhance income or earnings, again perhaps at the expense of job growth, the results point policy recommendations in another direction. This suggests that there may be trade-offs across the different metrics of growth.

Turn attention now to the variables of interest: the presence of food processing enterprises on economic growth (Table 2). For brevity, we again report only the total effects and suppress the results for the control variables. Recall that we use simple dummy variables to identify if a food processor is present within the county. We look at overall food processing regardless of size (employment) and two definitions of small or micro food processor; fewer than five employees and fewer than ten employees. For this exploratory analysis we look at five different types of food processors: (1) fruit and vegetable; (2) cheese; (3) animal (including sea food) processing; (4) bakeries and baked goods; and (5) beer, wine and liquor manufacturing. We selected these types because when we think of value added food processing within the local foods movement, most would fit into one of these five categories. There are 45 separate possible results (three measures of economic activity, three firm size thresholds, and five types of food processors) and only 12 (26.7%) are statistically significant.

The first specification defines small food processing as a simple presence of food processing firms. It appears that the presence of food processing firms are most significant with regards to changes in population and this relationship is positive in all significant categories (fruit and vegetable processing, cheese processing, and animal including sea food processing) and associated with a 2.2 – 4.3% increase in population. The one exception is for beer, wine, and liquor manufacturing where it is associated with negative population growth at a rate of 4.7%. The significance level for these estimates is either at the 90% or 95% level. The presence of small food processers is also significant with regards to employment, but only for firms specializing in bakeries and baked goods where the influence is positive and associated with a 5.1% increase in employment.

The second specification counts the number of small food processing firms within each category that have fewer than 5 employees. The results change quite drastically here with only a few estimates showing significance. Animal including sea food small food processers are significant in explaining growth in employment and growth in income, but only at the 90% level. Beer, wine and liquor small food processers were again significant at the 95% level in explaining negative growth in population and the estimate is similar to the first model at -5.1%.

The final specification counts the number of small food processing firms within each category that have fewer than 10 employees. These results again appear quite different than previous estimations. Cheese processing is significant at the 95% level in explaining changes in population and employment and significant at the 90% level in explaining changes in income. Beer, wine and liquor manufacturing again is significant at the 95% level in explaining changes in population and the point estimate is again negative at a fairly consistent value of -5.1%.

When we redefine our measure of food processing away from a simple dummy variable to a concentration variable (i.e., number of firms per capita (1,000 pop)) the general results are weaker from a statistical significance perspective (Table 3). While the general patterns observed with the simpler dummy variables is retained, are level of statistical confidence in the results are reduced. For example, there remains weak evidence that cheese processing, including small scale cheese processing as well as animal processing, may have a positive impact on growth. But the overall results using concentration measures suggests that food processing and in particular small scale food processing may not be a viable growth strategy.

While small food processing does appear to have some role in explaining variation in income, employment, and population growth, the exact nature of this role remains unclear. Estimation results were not consistent across model specification both in terms of actual values and in terms of significance. This suggests the need for further research to understand which specification of small food processing makes the most sense and what the results would mean in terms of policy implications. Overall, though, most estimates were significant and positive with the exception of when looking at beer, wine, and liquor manufacturing.

VI. Conclusion

It is well established in the literature that encouraging small business growth is good for economic development. The strength and direction of this relationship can change across different industries. This analysis looked at the impact of small food processing on growth as measured by income, employment, and population. The focus on small food processing was motivated by the growing popularity of local food activity which involves growth in processed food sales from small firms in addition to sale of fresh produce. Small food processing can be seen as sitting at the intersection of the small business and local food literatures. While results of the estimation suggest that small food processing does play some role in economic growth and that this role is generally positive, the exact nature remains unclear, particularly when looking across different categories of small food processing.

Further research is suggested before results of this estimation are used in policy formation. For example, our use of only dummy variables to identify the presence of a food processor of a particular type may be losing important information such as density of operations. We could incorporate measures of concentration by using concentration of firms by population or a crude location quotient using firm count data. Unfortunately, data disclosure rules at this level of industry detail limits us at this time to using firm county data. In addition, we may wish to explore the split between metro and nonmetro areas (preliminary results for nonmetro areas is provided in an Appendix to this study). While the production of local foods and small scale food processing is generally associated with rural areas, many food processors, particularly larger ones, tend to be located in urban areas. While we include population density as a control variable to acknowledge this issue, we found that population density does not influence any of our three growth metrics. Finally, the study period (2000 to 2011) covers the Great Recession and it may be that there are lingering effects of the Great Recession which are distorting our results.

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Table 1: Base Model, Spatial Durbin, Heteroscdastic, Total Effects All Counties

draw = 25,000 omits=2,500	Growth in Jobs	Growth in Population	Growth in Earnings per Capita
Per Capita Earnings 2000	-1.0974	-1.0759	1.0400
	(0.0026) **	(0.0001) ***	(0.2122)
Population 2000	0.1591	0.0568	-0.0569
	(0.0001) ***	(0.0796) *	(0.4766)
Employment 2000	-0.3589	-0.0832	0.0076
	(0.0001) ***	(0.2402)	(0.9660)
Population Density	-0.0025	-0.0018	-0.0094
	(0.5253)	(0.5719)	(0.2493)
Percent of Population Over Age 75	-1.1029	-0.8208	2.4881
	(0.0095) **	(0.0090) **	(0.0114) **
Percent of Population Between Ages 20-24	-0.3700	0.4744	1.9479
	(0.4427)	(0.1795)	(0.0853) *
Percent of Population Non-Caucasian	-0.0855	-0.1046	0.4097
	(0.1230)	(0.0116) **	(0.0012) **
Percent of Population Naturalized Citizens	1.6942	0.9217	2.5555
	(0.0451) **	(0.1191)	(0.1852)
Percent of Population Speaks Laugange Other than English at Home	0.1689	-0.1172	0.6045
	(0.0499) **	(0.0565) *	(0.0037) **
Percent of Population Living in Same House 1995-2000	-0.3513	-0.5627	1.1328
	(0.0019) **	(0.0001) ***	(0.0001) ***
Percent of Housing Stock Vacant	-0.1325	0.0631	-0.6324
	(0.0935) *	(0.2718)	(0.0006) **
Median Rent	-0.0390	0.0111	-0.1582
	(0.0039) **	(0.2573)	(0.0001) ***
Management, Business, Science, and Arts Occupations (%)	1.1027	0.3904	2.1214
	(0.0001) ***	(0.0078) **	(0.0001) ***

Marginal significance in parentheses.

*** Significant at the 99.9 percent level.

** Significant at the 95.0 percent level.

* Significant at the 90.0 percent level.

Table 1 (cont): Base Model, Spatial Durbin, Heteroscdastic, Total Effects All Counties

draw = 25,000 omits=2,500	Growth in Jobs		Growth in Population		Growth in Earnings per Capita	
Service Occupations (%)	-0.6430		-0.5467		0.2043	
	(0.0256)	**	(0.0090)	**	(0.7546)	
Sales and Office Occupations (%)	0.6078		0.6050		0.5314	
	(0.0696)	*	(0.0132)	**	(0.4807)	
Construction Occupations (%)	1.5467		1.0675		2.1219	
	(0.0001)	***	(0.0001)	***	(0.0019)	**
Industry Diversity Index	76.6496		26.0802		89.8384	
	(0.0001)	***	(0.0408)	**	(0.0265)	**
Percent of Households with Income less than $15k	-0.9203		-1.2730		0.9147	
	(0.0350)	**	(0.0002)	**	(0.3634)	
Percent of Households with Income above $150k	-0.2850		-0.8383		3.6832	
	(0.7658)		(0.2539)		(0.0882)	*
Poverty Rate for those Under Age 18	0.0805		-0.0142		-0.4864	
	(0.8754)		(0.9707)		(0.6893)	
Poverty Rate for those Over Age 65	0.2424		1.1343		-1.6559	
	(0.3162)		(0.0001)	***	(0.0026)	**
Income Distribution Index	-47.5539		8.9816		-193.7298	
	(0.0088)	**	(0.4991)		(0.0001)	***
Percent of those Over Age 25 With Some High School, No Degree	-0.3378		0.1366		-0.8525	
	(0.2369)		(0.5003)		(0.2011)	
Percent of those Over Age 25 With Some College, No Degree	-0.4584		-0.0853		-0.0498	
	(0.0040)	**	(0.4573)		(0.8907)	
Percent of those Over Age 25 With a Bachelor's Degree	0.4331		0.1177		-0.2009	
	(0.2190)		(0.6492)		(0.8047)	
Posterior Estimate of ρ	0.3213		0.4960		0.5458	
	(0.0001)	***	(0.0001)	***	(0.0001)	***
R^2	0.2127		0.5235		0.3330	

Marginal significance in parentheses.
*** Significant at the 99.9 percent level.
** Significant at the 95.0 percent level.
* Significant at the 90.0 percent level.

Table 2: Food Processing Result Spatial Durbin, Heteroscdastic, Total Effects All Counties

draw = 25,000 omits=2,500 (Control variables removed for brevity.)	Growth in Jobs	Growth in Population	Growth in Earnings per Capita
Presence of Food Processing Firms			
Fruit and Vegetable Processing	0.2372	2.9688	-3.3806
	(0.9160)	(0.0726) *	(0.5033)
Cheese Processing	4.0732	4.2719	5.2216
	(0.1035)	(0.0180) **	(0.3570)
Animal Including Sea Food Processing	5.1296	2.2409	6.5425
	(0.0045) **	(0.0865) *	(0.1120)
Bakeries and Baked Goods	1.7322	-0.0084	-1.6402
	(0.3799)	(0.9953)	(0.7109)
Beer, Wine and Liquor Manufacturing	-2.3739	-4.6568	-3.7014
	(0.3477)	(0.0150) **	(0.5038)
Presence of Food Processing Firms with Less Than Five (5) Employees			
Fruit and Vegetable Processing	-3.7808	2.0851	-6.1566
	(0.2643)	(0.4097)	(0.4219)
Cheese Processing	-2.6777	1.1359	1.1259
	(0.6633)	(0.8018)	(0.9366)
Animal Including Sea Food Processing	4.5532	2.1786	10.0365
	(0.0750) *	(0.2569)	(0.0894) *
Bakeries and Baked Goods	2.6625	0.5168	3.2481
	(0.2093)	(0.7385)	(0.4956)
Beer, Wine and Liquor Manufacturing	-1.8261	-5.0935	-0.3492
	(0.5500)	(0.0263) **	(0.9592)
Presence of Food Processing Firms with Less Than Ten (10) Employees			
Fruit and Vegetable Processing	-2.3431	5.3652	-4.4380
	(0.6535)	(0.1818)	(0.7044)
Cheese Processing	16.7920	10.6336	25.0403
	(0.0088) **	(0.0216) **	(0.0680) *
Animal Including Sea Food Processing	1.3123	0.4744	15.4529
	(0.6873)	(0.8484)	(0.0379) **
Bakeries and Baked Goods	3.1702	0.1815	0.8763
	(0.2038)	(0.9218)	(0.8779)
Beer, Wine and Liquor Manufacturing	-3.9182	-4.0952	-9.1364
	(0.3878)	(0.2439)	(0.3460)

Marginal significance in parentheses.
*** Significant at the 99.9 percent level.
** Significant at the 95.0 percent level.
* Significant at the 90.0 percent level.

Table 3: Food Processing Concentration Result Spatial Durbin, Heteroscdastic, Total Effects All Counties

draw = 25,000 omits=2,500 (Control variables removed for brevity.)	Growth in Jobs	Growth in Population	Growth in Earnings per Capita
Concentration of Food Processing Firms			
Fruit and Vegetable Processing	25.9640	32.8681	18.5110
	(0.4247)	(0.1794)	(0.8167)
Cheese Processing	39.1459	34.6058	50.0009
	(0.1216)	(0.0388) **	(0.3773)
Animal Including Sea Food Processing	38.1445	10.0267	57.5795
	(0.0152) **	(0.3819)	(0.1307)
Bakeries and Baked Goods	23.1668	-1.1532	-19.8382
	(0.2625)	(0.9388)	(0.6908)
Beer, Wine and Liquor Manufacturing	-5.4139	-3.9934	9.9462
	(0.8190)	(0.8291)	(0.8539)
Concentration of Food Processing Firms with Less Than Five (5) Employees			
Fruit and Vegetable Processing	-56.8212	-45.8982	-115.8361
	(0.3613)	(0.3731)	(0.4543)
Cheese Processing	-83.6863	10.3438	160.1207
	(0.4723)	(0.9028)	(0.6213)
Animal Including Sea Food Processing	56.7697	33.2656	153.1360
	(0.1175)	(0.2135)	(0.0951) *
Bakeries and Baked Goods	8.2516	-16.8925	-16.4423
	(0.7531)	(0.3540)	(0.7967)
Beer, Wine and Liquor Manufacturing	13.2096	18.4163	101.2341
	(0.8207)	(0.6841)	(0.4681)
Concentration of Food Processing Firms with Less Than Ten (10) Employees			
Fruit and Vegetable Processing	-100.6298	140.1927	480.4334
	(0.5112)	(0.1911)	(0.2590)
Cheese Processing	146.7947	113.3185	437.4776
	(0.1120)	(0.0573) *	(0.0680) *
Animal Including Sea Food Processing	11.4604	-15.2335	222.4079
	(0.8529)	(0.7503)	(0.2145)
Bakeries and Baked Goods	95.0929	42.7616	63.8479
	(0.0532) *	(0.2477)	(0.6033)
Beer, Wine and Liquor Manufacturing	-36.6982	-44.4958	-28.8937
	(0.7386)	(0.5981)	(0.9020)

Marginal significance in parentheses.

*** Significant at the 99.9 percent level.

** Significant at the 95.0 percent level.

* Significant at the 90.0 percent level.

Appendix A

Subset Results for Non-Metro Areas

To further explore the relationship between food processing and economic growth we estimated a sub-set of models using data for only nonmetropolitan counties. The notion here is that small scale food processing that might be linked to the local foods movement may more likely be located in rural areas. Indeed, from an economic growth and development perspective local foods is generally promoted as a rural development strategy. For brevity we do not report out the control variables.

The results are largely consistent with the analysis in the main body of the text: there is limited evidence that higher activity in food processing, regardless of size of operation, is associated with higher levels of economic growth. We do find that the presence of animal processing facilities, including smaller scale operations, tends to be associated with higher rates of growth and there is some evidence that the presence of cheese processors is tied to higher rates of population growth.

These results suggest that care must be taken when considering the promotion of food processing, particularly small scale food processing, as a rural economic growth strategy.

Table A1: Non-Metro Food Processing Result Spatial Durbin, Heteroscdastic, Total Effects

draw = 25,000 omits=2,500 (Control variables removed for brevity.)	Growth in Jobs	Growth in Population	Growth in Earnings per Capita
Presence of Food Processing Firms			
Fruit and Vegetable Processing	1.0637	1.5588	4.7828
	(0.7311)	(0.4246)	(0.5496)
Cheese Processing	1.5356	1.7726	7.1063
	(0.6709)	(0.4282)	(0.4396)
Animal Including Sea Food Processing	5.6426	4.7492	0.1824
	(0.0184) **	(0.0022) **	(0.9771)
Bakeries and Baked Goods	1.1533	-0.7281	-0.2884
	(0.6458)	(0.6494)	(0.9648)
Beer, Wine and Liquor Manufacturing	-0.5882	0.5158	-4.4100
	(0.8774)	(0.8320)	(0.6437)
Presence of Food Processing Firms with Less Than Five (5) Employees			
Fruit and Vegetable Processing	-3.3803	1.6895	-14.0096
	(0.5083)	(0.6030)	(0.2852)
Cheese Processing	-10.4502	-0.8613	12.8280
	(0.2396)	(0.8773)	(0.5913)
Animal Including Sea Food Processing	7.5700	5.3036	15.5860
	(0.0424) **	(0.0337) **	(0.1115)
Bakeries and Baked Goods	0.8969	-2.0185	2.4689
	(0.7499)	(0.2660)	(0.7366)
Beer, Wine and Liquor Manufacturing	0.1834	1.3612	-5.7163
	(0.9666)	(0.6264)	(0.6004)
Presence of Food Processing Firms with Less Than Ten (10) Employees			
Fruit and Vegetable Processing	-10.8953	-4.2295	-15.5038
	(0.2218)	(0.4636)	(0.1627)
Cheese Processing	10.3478	8.7894	13.6037
	(0.3044)	(0.1595)	(0.5099)
Animal Including Sea Food Processing	2.8903	2.9975	11.0167
	(0.5765)	(0.3700)	(0.0958) *
Bakeries and Baked Goods	2.0509	0.9317	5.5106
	(0.5633)	(0.6846)	(0.2302)
Beer, Wine and Liquor Manufacturing	0.4202	1.8347	-6.3339
	(0.9585)	(0.7321)	(0.4090)

Marginal significance in parentheses.
*** Significant at the 99.9 percent level.
** Significant at the 95.0 percent level.
* Significant at the 90.0 percent level.

Table A2: Non-Metro Food Processing Concentration Result Spatial Durbin, Heteroscdastic, Total Effects

draw = 25,000 omits=2,500 (Control variables removed for brevity.)	Growth in Jobs		Growth in Population		Growth in Earnings per Capita
Concentration of Food Processing Firms					
Fruit and Vegetable Processing	22.1505		33.7270		81.3788
	(0.5414)		(0.1542)		(0.4090)
Cheese Processing	29.5383		42.8175		23.9697
	(0.2977)		(0.0114)	**	(0.7432)
Animal Including Sea Food Processing	48.9673		17.7692		50.9264
	(0.0056)	**	(0.1315)		(0.3074)
Bakeries and Baked Goods	-7.7457		2.0929		-35.0557
	(0.7308)		(0.8843)		(0.5652)
Beer, Wine and Liquor Manufacturing	32.6699		12.9554		33.3817
	(0.4540)		(0.6250)		(0.7572)
Concentration of Food Processing Firms with Less Than Five (5) Employees					
Fruit and Vegetable Processing	-77.8055		9.9591		-318.5367
	(0.2848)		(0.8519)		(0.1260)
Cheese Processing	-51.4858		37.2871		429.1945
	(0.7018)		(0.6724)		(0.3260)
Animal Including Sea Food Processing	87.8204		45.7314		181.9411
	(0.0362)	**	(0.0946)	*	(0.1202)
Bakeries and Baked Goods	-20.7706		-14.4539		-58.3337
	(0.4443)		(0.4041)		(0.4280)
Beer, Wine and Liquor Manufacturing	43.3638		36.8262		66.8453
	(0.5700)		(0.4607)		(0.7509)
Concentration of Food Processing Firms with Less Than Ten (10) Employees					
Fruit and Vegetable Processing	-180.2518		-1.8943		829.9464
	(0.2713)		(0.9854)		(0.1167)
Cheese Processing	141.8700		159.2517		395.3629
	(0.1433)		(0.0113)	**	(0.2252)
Animal Including Sea Food Processing	28.7181		-15.3635		102.5578
	(0.6775)		(0.7474)		(0.6565)
Bakeries and Baked Goods	37.5748		42.0242		191.2426
	(0.4791)		(0.2413)		(0.2197)
Beer, Wine and Liquor Manufacturing	54.9483		37.0465		213.1499
	(0.7076)		(0.6897)		(0.5375)

Marginal significance in parentheses.
*** Significant at the 99.9 percent level.
** Significant at the 95.0 percent level.
* Significant at the 90.0 percent level.