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Submitted Article

Local Foods and Local Economic Performance

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Abstract *Using US county-level data, we employ a difference-in-difference approach to model the effect of direct to consumer local foods activity on local economic performance. We find no evidence that growth in local foods activity is linked to economic performance measured by per capita income and some evidence of a decline in employment. These results casts doubts on the notion that the promotion of local foods can improve the performance of local economies. While the local foods market can present viable business opportunities for some producers, the overall size of the market is too thin to influence overall local economic performance.*

Key words: economic performance, local foods, spatial analysis.

JEL codes: Q19, R11, C23.

Introduction

The promotion of local foods as a community economic development strategy remains popular across multiple fronts (Boys and Hughes 2016; Carson et al. 2016). Schmit et al. (2017) speak in terms of the fostering of local foods as a means of rural wealth creation and Green, Worstell, and Canarios (2017) talk of local food systems and community sustainability and resilience. Telligman, Worosz, and Bratcher (2017) note that consumer interest in local and regional foods is connected to socially defined food criteria, including improved environmental, social, and economic outcomes. Consumers are willing to pay extra for locally sourced food because they believe it is better for the local community. Almost within the Tönnies-Weber notion of *gesellschaft*, Bergstrom and Ready (2008) note that the general public places a premium on certain agrarian characteristics such as access to fresh, local foods, which can be reflected in the amenity valuation of farmland. Winfree and Watson (2017) use a deductive theoretical framework to explore local foods in a two region economy and find that if consumers generally feel that there are sufficient positive externalities from local production or negative externalities from non-local production the net welfare gain from local foods is positive. This is consistent with the intuition of Castle, Wu, and Weber (2011) who suggest that access to local foods can strengthen both the economic as well as the social and political ties between urban consumers and rural producers.

Despite the improvement in the rigor of the more recent literature, the challenge is that much of the research foundation remains speculative and lacking analytical rigor (Deller, Lamie, and Stickel 2017b). As a result, the research foundation, while improving, remains undeveloped thus casting a shadow in the validity of local foods as an economic development policy.

Throughout the local food systems literature one of the more common arguments is the notion that the development of local foods can have a positive impact on the performance of the local economy. While there are many studies offering approaches to modeling the economic impacts of local food systems (*e.g.*, McFadden et al. 2016; Jablonski et al. 2016a; Bauman and McFadden 2017; Watson et al. 2017) there is little available within the literature relating local food systems and overall economic performance. The small handful of studies that explore how local foods impact economic growth patterns find that the relationship is weak or has no impact on growth rates (Brown et al. 2014; Deller et al. 2014). Even assuming there are positive economic outcomes, many authors express uncertainty with regards to the scalability and replicability of many of the local foods models (Blay-Palmer et al. 2013; Albrecht and Johnson 2013; Wittman, Beckie and Hergesheimer 2012; Jarosz 2008; McFadden et al. 2013). This is partially due to the fact that the local infrastructure and the regulatory framework necessary to grow the industry is either not in place or not currently designed to support local foods (Donald and Blay-Palmer 2006; Lusk 2017; Lusk and McCluskey 2018).

The research presented in this study employs a difference-in-difference (DID) framework to evaluate the effect local food activity has on metrics of economic performance. We use county-level data from the U.S. Census of Agriculture, from the U.S. Bureau of Economic Analysis, and from Woods and Poole Economics to test the assumption that local food activity supports improved economic performance. In order to fully capture the long-term trends in local foods growth we look at two time periods: period one is changes from 1997 to 2002 and period two is 2002 to 2007. These years are dictated by the availability of data from the Census of Agriculture. While the Census of Agriculture for 2012 is available, we elected to shorten the time period for two reasons. First, the rapid growth in local foods activity occurred from 1997 to 2007 and stagnated from 2007 to 2012. It is not clear if the growth in local foods itself stagnated by hitting its upward potential or a by-product of the Great Recession. If there is a relationship between local foods activity and local economic performance, we would expect to see it during periods of expansion and not stagnation. Second, because we are interested in modeling economic performance, defined by as growth—specifically growth in per capita income and employment—inclusion of the 2007 to 2012 period would be compromised by the effects of the Great Recession itself. This is particularly true for much of rural America where the recovery from the Great Recession has been particularly slow (Thiede, Lichter, and Slack 2018). Thus, we elected to look at growth in local foods activity prior to the Great Recession.

This decision to model the 10-year period pre-Great Recession, unfortunately, limits our ability to measure local foods activity. Local foods activity can be grouped into two categories, direct sales to the consumer through things like farmers' markets, roadside stands, community-supported farms (CSAs), among others, and intermediate sales which would include sales to local restaurants, grocery stores, local schools, or distribution through food hubs, among other challenging methods. As outlined in detail by Low and Vogel (2011) and Low et al. (2015) much of the more recent growth in local foods has fallen into the latter category of intermediate sales (also see Richards et al. 2017). Unfortunately, consistent and reliable data on intermediate sales began being collected in the 2007 Census of Agriculture. Thus, for our study period, which avoids the complications of the Great Recession, our measure of local foods is limited to direct sales to consumers.

Analysis by Deller, Lamie, and Stickle (2017b) finds that attempts to combine several different measures of local food activity, using 2012 data, into a scalar measure of density of activity is dominated by measures most associated with direct sales to consumers. Thus, while we acknowledge the limitation of not explicitly examining intermediate sales in our analysis, the focus on direct sales prior to the Great Recession is sufficient to gain the insights between local foods and economic performance.

Results are consistent with the limited available literature and suggest that local food activity does not currently impact common measures of economic performance in a meaningful way. Further, these results hold across a range of sensitivity tests. Despite the apparent growth in the local foods movement, the sector likely remains too small to significantly affect the larger regional economy. This is not to say that local foods do not create viable business opportunities for some, but when viewed in aggregate those markets are too thin to influence the larger local economy in a statistically meaningful way. More investigation is required to understand if local food activity affect other measures of community well-being.

A Difference-in-Difference Modeling Approach

Local food systems are supposed to positively affect economic performance (Carson et al. 2016; Deller et al. 2017b). The main channel through which these affects are supposed to occur is via keeping more dollars local. Thus a larger proportion of sales accrues to local actors and as Hughes and Boys (2015) note, increasing locally sourced sales implies decreasing sales sourced from outside sources. Local food activity can be thought of then as driving growth *via* import substitution (Bellows and Hamm 2001; Hughes and Boys 2015; McFadden et al. 2016). Communities embracing local foods would keep more food sale dollars circulating within the community. This should translate to economic growth via increased levels of per capita income and wages as well as greater small business activity and jobs. In this study we work through a series of estimation models, each building off of the previous one, to develop a framework to test whether enhanced local food activity does have a positive effect on local economic performance.

Local food activity in many ways lends itself to classic before-and-after impact or program evaluation tools. This is because there is often a clear-cut beginning to new local foods activity: a new farmers' market is built, a new CSA is formed, or a food hub facility is constructed. In an ideal world, we would be able to do an intervention such as building a new farmers' market, and then we could see what happens in a community with the farmers' market. Much of the work thinking about how such events are related to the economy follow traditional economic impacts methods, specifically the use of input–output modeling (generally IMPLAN sourced) and the ensuring scalar multipliers (e.g., Swenson 2009; Jablanski et al. 2016; Bauman and McFadden 2017; Watson et al. 2017).[1] Such economic multiplier analysis, however, is static and provides no insights how the promotion of local food systems affects the overall performance of the local economy. Specifically, is the development of a local foods system sufficient to alter the growth patterns of local economies?

The issue with local foods' effect on economic performance at the aggregate level is that activity has been gradually growing across the country. There is no broad-based policy initiative making it simple to conduct before and after analyses at the aggregate level as the before and after periods vary from place to place, county to county. Further complicating estimation is the fact that local food activity is not a top-down policy intervention. In other words, there have been no randomized policy interventions. Without randomization, there can be issues of selection bias. This means that it is difficult to guarantee that there is not some characteristic influencing why some communities create and promote farmers' markets when others do not. This is important as the influential characteristic, if not controlled for in the estimation, could bias the estimation results.

In addition, there remains significant issues of endogeneity, or reverse causality, in much of the empirical literature that seeks to understand the relationship between local foods and community outcomes. Consider, for example, the analysis by Deller, Canto, and Brown (2017a) that explores the relationship between public health outcomes and local food systems activity. While they find a positive relationship, it is not at all clear if access to local foods drives healthier outcomes (the hypothesis of the study) or if healthier people drive greater market opportunities for local foods. The two studies directly related to the work presented here (Brown et al. 2014; Deller et al. 2014) do not consider that a growing local economy can create demand for local foods. Because the demand for local foods has been shown in the literature to be a function of income (Zepeda and Nie 2012; Sadler, Clark, and Gilliland 2013; Willis et al. 2013), without correcting for endogeneity it is impossible to know if any results are because communities with a higher income have stronger demand for local food or if new local food activity does affect the growth rate in community income.

To address this potential issue we adopt a difference-in-difference (DID) approach which has been shown to be a powerful approach for aggregate-level impact evaluation and is often employed in both experimental and non-experimental settings (Donald and Lang 2007). The framework rests on the idea of measuring the difference between a "treated" and a "nontreated," or comparison, group. Comparing the outcomes of the "treated" group against those of the "nontreated" group allows for isolating the "treatment effect." The treatment effect is found by a double difference calculation: differencing the mean values of the treated and untreated groups and differencing the mean values before and after the intervention. This is summarized by the following formula:

[1] *IMPLAN is a standardized input–output modeling software system that is widely used to assess the contribution of agriculture to local/regional economies and has been suggested as the "go to" method for assess the economic impact of local food systems (Thilmany et al. 2016).*

Table 1 Overview of "Early" & "Late" Adopters

	Treated/"early adopter"	Non treated/"late adopter"
Period one	>75th percentile growth	No growth
Period two	—	>75th percentile growth

$$Treatment\ Effect = \left[E(\widehat{Y_1|T}) - E(\widehat{Y_0|T}) \right] - \left[E(\widehat{Y_1|C}) - E(\widehat{Y_0|C}) \right] \quad (1)$$

where Y is the outcome of interest, T indicates being part of the treatment group, C indicates being part of the control group, and the subscripts indicate the time period, either before or after the intervention. The key assumption in this framework is that the nontreated group provides a reasonable comparison: it is similar enough that one can be sure that the effects measured are a result of the intervention and not due to some other factor. In other words, absent the treatment, the two treated and untreated groups would have experienced the same trend, or no difference in growth.

Local food activity is not the result of a systemized intervention or experiment, thus there is no obvious comparison group to use in estimation. In a nonexperimental setting, one must proxy for the untreated group (Smith and Todd 2005). To accomplish this for evaluating the impact of local food activity, we use time as a source of exogenous variation. This allows for the definition of "early" and "late" adopters of local foods that can then be compared against one another by defining a threshold of local food activity to determine which counties "received the intervention." Specifically, the "treatment" or "intervention" is having new local foods activity. One can easily identify counties that experience large growth in local foods activity. Evaluating the impact of such activity then rests on finding a reasonable comparison against which to benchmark changes.

We identify some counties as "Early Adopters" (counties who experience an early surge in local foods activity) that can then exploit the time variation to compare the results of the early adopters against counties who have no growth in local foods activity during the period of interest (period one) but that do eventually experience growth in local food activity during period two, specifically "Late Adopters" (Table 1). By comparing the outcomes of early adopters against those of late adopters, we isolate the *treatment effect*, the effect local foods activity has on metrics of economic performance.

To implement the analysis, we rely on the U.S. Agricultural Census to define our periods: period one is 1997–2002 and period two is 2002–2007 (Table 2). Dummy variables indicating early and late adopting counties are constructed based on the criteria outlined in Table 1. Those counties who experienced high growth in local food activity, limited to direct sales to consumers, between 1997 and 2002, the early adopters, will be compared against those counties who experienced no growth in local food between 1997 and 2002 but then experienced high growth in local food activity between 2002 and 2007, the late adopters. For the primary set of results, "adoption" is defined as growth in local foods activity above the 75th percentile.[2],[3]

[2] *75th percentile selected based off of a natural break in the data.*
[3] *In addition to the complications of the Great Recession in studying more recent data, the relative stagnation of growth in direct sales creates a problem with constructing the treatment effect. Because so few counties experienced any meaningful growth, the treatment effect because small limiting the statistical robustness of this method over this latter time period.*

As with nearly all economic events, this is clearly not a truly randomized experiment. For example, the analysis relies on a dataset that is available only every five years. To check the robustness of the results we altered the analysis along five lines: definitions of local foods, measures of economic performance, redefining the treatment threshold to 90%, expansion of the set of control variables, and limit the analysis to just urban counties. We use three measures of local foods, all based off of "direct sales": direct sales per capita, number of farms with direct sales *per capita*, and direct sales per farm with direct sales. The second check looks at the stability of the results over two measures of economic performance: per capita income and total employment.[4]

As outlined in the introduction, we acknowledge that limiting our measure of local foods to direct sales—defined as sales by farmers direct for human consumption, often through farmers' markets, roadside stands, and CSAs—represents a narrow, almost minimalistic, view of local foods. Unfortunately, as we note in the introductory comments, in order to look at local foods activity over a long period of time we require a measure of local foods that has been collected in a consistent manner over that time period. Also, to eliminate the effects of the economic shock of the Great Recession and the complicating factors associated with overall flat growth in direct sales activity we elected to model growth in the pre-Recession period. Direct sales is the one measure that meets that requirement as other measures of local foods, such as number of farmers' markets or intermediate sales have only recently been collected and reported with any consistency.

Using per capita income (*PCI*) for notional convenience the basic estimation model to be estimated follows the general form:

$$\begin{aligned}\phi = [E(PCI|LF=1,\mathrm{T}=1) - E(PCI|LF=0,T=1)] \\ -(E(PCI|LF=1,T=0) - E(PCI|LF=0,T=0))\end{aligned} \tag{2}$$

where ϕ represents the treatment effect, T is a dummy variable indicating the time period, and LF is a dummy variable indicating an early-adopting county. The treatment effect is estimated by differencing the expected or mean values between treatment groups as well as between periods. The general form (eq. (2)) can be expressed as a general linear model:

$$PCI_{it} = \beta_0 + \beta_1 LF_i + \beta_2 T_t + \beta_3 T_t LF_i + \theta_i \Omega_{it} + \epsilon_{it} \tag{3}$$

where i denotes county, t denotes time period, PCI is *per capita* income, LF is a dummy variable indicate being an early-adopting county, T is a time dummy variable indicate the year (0 for 1997 and 1 for 2002), Ω represents a set of control variables, ϵ is an error term to be discussed in further detail below, and β and θ are the parameters to be estimated. The dataset used in estimation thus includes two observations for each county, one for 1997 and one for 2002. Per capita income for each observation is a level amount. Thus in this estimation equation, β_3 measures the "treatment effect," the difference in per capita income for early-adopting counties in 2002, as compared to 1997. The difference-in-difference discussed with ϕ above (equation (2)) is

[4] *As a set of simple robustness tests we also modeled number of proprietors and total wages, strengthened the treatment threshold from 75% to 90%, and as a final check we ran the models for only urban counties as much of the market for local foods in within urban areas. We found that the basic results on local foods and economic performance were stable and the policy implications did not change.*

accomplished via this specific specification. Theoretically, β_3 in equation (3) is equal to ϕ in equation (2). Using the equation (3), though, facilitates empirical estimation and permits the use of thresholds for treatment effects.

Given the nonexperimental nature of this estimation and the availability of data, we also estimated an expanded model that includes a larger panel of data and treatment effects. The empirical framework takes the following form:

$$PCI_{it} = \beta_0 + \beta_1 LF_i + \sum_{t=1997,2002,2007} (\gamma_t T_t + \delta_t T_t LF_i) + \theta_i \Omega_{it} + \epsilon_{it} \quad (4)$$

where i denotes county and PCI, LF, T and Ω remain the same and β, γ, δ, and θ are the parameters to be estimated. The difference in this specification is that it includes several different time periods and interaction terms. With four time periods of data included in the estimation, each county has four observations. The coefficients on each of the interaction terms give treatment effects, or the effect of being an early adopter, in each year. Given the nonexperimental nature of the estimation, including multiple years helps control for any time trends in the data. A fixed effects estimator will also be used in calculations in order to account for different county level attributes not captured in the model.

The analysis of local foods and economic growth by Deller et al. (2014) found the presence of significant levels of spatial dependency within the growth and local food metrics. This is not completely unexpected as county boundaries, for which our data is collected and reported, are political boundaries that do not reflect modern functioning economic areas. This is particularly true for local foods where production can be taking place in rural counties but much of the actual sales takes place in nearby urban counties. In the simplest sense the activities of one county spillover and affect the activities of another county thus violating the independency assumption of classical regression. To account for the potential presence of spatial dependency within the data we use a general spatial autoregressive specification, referred to as a spatial Durbin model (SDM) by LeSage and Pace (2009), that can be expressed as:

$$\begin{aligned} PCI_{it} = {} & \beta_0 + \rho W \cdot PCI_{it} + \beta_1 LF_i + \beta_2 T_t + \beta_3 T_t LF_i + \theta_i \Omega_{it} + \beta_{12} W \cdot LF_i \\ & + \beta_{22} W \cdot T_t + \beta_{32} W \cdot T_t LF_i + \theta_{i2} W \cdot \Omega_{it} + \epsilon_{it} \end{aligned} \quad (5)$$

where W is a spatial weight matrix capturing the spatial proximity of individual counties where more proximate counties are more dependent than more distant counties. The weight matrix is the inverse distance between counties and standardizes the values to sum to one. This allows for counties in closer proximity to have greater weights than those counties located farther away.[5]

A difficulty with this structural spatial specification outline in equation (5) is that the individual variables of interest (β) are not directly interpretable. Rather, the model must be placed into reduced form. For ease of discussion,

[5] *One of the biggest debates in spatial econometrics is the correct specification of the spatial weight matrix. LeSage and Pace (2014) make a convincing argument that the exact specification of the weight matrix is secondary to a well specified model and the appropriate spatial estimator. Thus, we use the traditional row-stochastic containing values constructed from an average of neighboring observations.*

consider the more general form of the income and local foods growth relationship:

$$PCI = \rho W \cdot PCI + \alpha + \beta LF + \gamma W \cdot LF + \epsilon \quad (6)$$

Here the spatial relationship captured by $\rho W \cdot PCI$ reflects that *per capita* income in one county is influenced by neighboring counties and γWLF explicitly allows for spillover effects in local foods across county borders. Use of the Spatial Durbin Model thus allows us to explicitly specify interregional relationships. In reduced form, this equation becomes:

$$PCI = (I - \rho W)^{-1}\beta LF + (I - \rho W)^{-1}\gamma W \cdot LF + (I - \rho W)^{-1}\epsilon \quad (10)$$

Because of the spatial Durbin specifications, the β estimates from the above equation are not marginal effects. LeSage and Pace (2009) show that with a little manipulation, the marginal effects is composed of two parts:

$\partial PCI/\partial LF = \beta + \rho W(I - \rho W\beta)^{-1}$ = *direct effect* + *indirect effect* = *total effect*(11)

The above equation decomposes the total effect of local foods (*LF*) on *PCI* into two additive parts: the direct effect, β, and the indirect effect, $\rho W(I - \rho W\beta)^{-1}$. Note that the impact of local foods on income is composed of two parts: the direct effect (β) captures the relationship within a county and the indirect effect $(\rho W)^{-1}\beta$ captures the spatial spillover effect. The direct effect captures the marginal impact of a change in *LF* on the dependent variable in the absence of spatial effects. When $\rho \neq 0$, the indirect effect captures the impact of a marginal change in *LF* on *PCI* due to neighborhood spatial effects. Because *W* is a matrix and not a scalar, we follow LeSage and Pace (2009) and use the averages of the diagonal element of *W*.

In addition to estimating three distinct difference-in-difference models, a one-period fixed effect model (eq.(3)), a multiperiod fixed effect model (eq. (4)), and a spatial Durbin version of the multiperiod fixed effect model, we also estimate each model with and without the control variables as a form of sensitivity analysis. While the regional economic performance literature is awash with empirical studies using US county data (*e.g.*, Carlino and Mills 1987; Deller et al. 2001; Swaminathan and Findeisl 2004; Partridge, Rickman, and Ali 2008) there is little consensus on the core set of control variables (Deller and Lledo 2007). Thus, we elect to keep the set of control variables to a minimum and include share of the population African American, share of the population white, median age, and both the share of the population over age 65 and under 18. We also explored an expanded set of control variables that included local characteristics such as education, levels of amenities, and distribution of employment across different industries. We found no differences in our results between the simpler and expanded set of control variables and elected to move forward with the simpler set of controls. Descriptive data for all the variables used in the analysis are provided in Table 1.

Empirical Results

Given two measures of economic performance (*per capita* income and employment), three measures of local foods (direct sales *per capita*, number of farms with direct sales *per capita*, and direct sales per farm with direct sales), and three specifications of the difference-in-difference model (a one-period fixed effect model (eq.(3)), a multiperiod fixed effect model (eq.(4)), and a

Table 2 Summary Statistics

Variable	Year	Obs	Mean	Std. Dev.	Min	Max
Direct sales *per Capita*	1997	949	3.15	4.93	0.01	71.36
	2002	949	6.31	9.39	0.03	121.38
	2007	949	9.15	12.92	0.01	178.28
Direct sales per Farm	1997	949	3,004.1	3,534.3	200.0	36,555.6
	2002	949	5,456.2	7,373.3	200.0	90,304.4
	2007	949	6,918.0	8,655.9	333.3	99,100.0
Farms with direct sales *per capita*	1997	949	0.0011	0.0008	8.01E-06	5.60E-03
	2002	949	0.0013	0.0010	4.38E-06	7.42E-03
	2007	949	0.0015	0.0012	6.54E-06	8.38E-03
ln(PCI)	1992	949	2.79	0.18	1.94	3.63
	1997	949	3.00	0.19	2.16	3.87
	2002	949	3.19	0.19	2.43	4.08
	2007	949	3.42	0.19	2.75	4.37
ln(Employment)	1992	949	9.33	1.21	6.61	14.19
	1997	949	9.45	1.22	6.60	14.35
	2002	949	9.48	1.25	6.50	14.41
	2007	949	9.55	1.27	6.59	14.46
ln(Number of Proprietors)	1992	949	7.95	0.95	5.62	12.27
	1997	949	8.09	0.96	6.01	12.36
	2002	949	8.12	1.01	5.68	12.46
	2007	949	8.26	1.07	5.73	12.75
ln(Wages)	1992	949	11.90	1.47	8.34	17.41
	1997	949	12.18	1.47	8.39	17.79
	2002	949	12.39	1.49	8.59	18.06
	2007	949	12.62	1.50	8.99	18.26

(Continues)

Table 2 Continued

Variable	Year	Obs	Mean	Std. Dev.	Min	Max
Proportion Black	1992	949	8.58	14.30	0.00	85.82
	1997	949	8.84	14.44	0.00	86.00
	2002	949	8.86	14.43	0.00	85.41
	2007	949	8.89	14.45	0.00	86.24
Proportion White	1992	949	84.36	18.05	2.54	99.81
	1997	949	82.83	18.52	2.07	99.50
	2002	949	81.79	18.93	2.53	99.73
	2007	949	80.58	19.33	2.90	99.78
Median age	1992	949	35.27	3.49	22.79	54.66
	1997	949	36.67	3.57	23.05	52.47
	2002	949	38.35	4.12	23.34	53.05
	2007	949	39.76	4.58	23.97	53.81
Proportion over 65	1992	949	14.99	4.37	1.45	34.07
	1997	949	14.80	4.15	1.61	34.73
	2002	949	14.87	4.15	1.54	34.63
	2007	949	15.20	4.08	3.06	34.22
Proportion under 18	1992	949	26.78	3.39	15.68	45.68
	1997	949	26.14	3.18	15.20	46.16
	2002	949	24.80	3.17	13.73	44.95
	2007	949	23.82	3.22	10.77	42.34

spatial Durbin version of the multiperiod fixed effect model), there are twelve basic sets of results. Further, we estimate each model with and without the control variables giving us twenty-four sets of results. The results for the one-period fixed effect model (eq.(3)) is provided in Tables 3 (income) and 4 (employment), the multiperiod fixed effect model (eq.(4)) results are provided in Tables 5 (income) and 6 (employment) and finally the spatial Durbin specification results are in Tables 7 (income) and 8 (employment). Given the volume of results we will focus on two key issues, the results on the local foods treatment effects and the spatial spillover patterns.

Across nearly every model the local foods treatment effect is either statistically insignificant or provides weak evidence of a negative relationship. For the one period fixed effect model there is weak evidence that direct sales per farm, one of the three local foods measures, has a negative effect on *per capita* income and employment. For the multiperiod model, again, the preponderance of the results on the treatment effect is either statistically insignificant or a weak negative effect on employment. For these two modeling specifications there is no evidence that higher levels of local foods activity, measured by direct sales from farmers to consumers, is associated with higher levels of economic performance. Turning to the spatial Durbin specification where we explicitly model spatial spillover effects across county boundaries we find strong evidence of spatial dependency within the data (strongly significant spatial parameters) but no evidence of local foods improving economic performance. As a robustness check we re-estimated the models using a higher treatment threshold (90% vs. 75%) and only urban counties and we again find the same basic pattern: there is no evidence that local foods activity is linked to higher levels of economic performance and there is weak evidence that local foods may hinder economic performance.

Our results are consistent with the general findings of Brown et al. (2014) and Deller et al. (2014) who find either no or a very weak relationship between local foods activity and regional economic performance. Several reasons are offered for why more rigorous analysis have been unable to identify the positive relationship postulated in the local foods literature. First, the local foods markets are simply too thin to significantly impact the growth rates of the larger economy. When one looks at the scale of direct sales from farmers to consumers, it is often a very small part of a larger farm operation. The typical farm with direct sales had such sales of only $6,792 (2012) and only three counties had average direct farm sales of over $100,000 per farm. While only a handful of counties had no farm with direct sales in 2012, the vast majority of farms with direct sales had modest levels of sales.

Second, the geographic locations of local foods activities may be too concentrated in a handful of markets and thus insufficient to impact overall growth rates. A simple mapping of local foods activity by Deller, Lamie, and Stickel (2017b) reveal that there are spatial "hot spots" of activity in the northeastern part of the US—particularly along the coastal areas, parts of the upper Midwest, and along the Pacific Coast and vast areas across the US with little local foods activity.[6] It may be the case that the areas with limited local foods activity is outweighing those areas with activity. If this is the case, then care must be taken when making broad general statements about the influence of local foods on local economic performance, what may hold true for large parts of the US may not hold true to smaller pockets of the US.

[6]*These spatial "hot spots" reinforce the spatial dependency identified in the spatial Durbin model.*

Table 3 One Period Fixed Effect (equation 3): *Per Capita* Income

	Direct sales		**Number of farms with direct sales**		**Direct sales per farm**	
Year	**0.1882** ***	**0.1736** ***	**0.1793** ***	**0.178** ***	**0.1878** ***	**0.1746** ***
	(0.0033)	(0.0086)	(0.0029)	(0.0092)	(0.0026)	(0.0084)
Treatment effect	−0.0081	−0.0085	0.0039	0.004	−0.0068	−0.0080*
	(0.0044)	(0.0043)	(0.0040)	(0.0040)	(0.0039)	(0.0038)
Constant	3.0023 ***	3.0304 ***	2.9899 ***	3.1601 ***	3.0123 ***	2.9505 ***
	(0.0011)	(0.1528)	(0.0010)	(0.1434)	(0.0010)	(0.1341)
Obs (N)	1,898	1,898	2,174	2,174	2,274	2,274
Controls	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.8817	0.8831	0.8822	0.8833	0.8836	0.8856

Note: *Asterisks indicate level of significance: *** for 99.9% level, ** for 95% level, * for 90% level. Estimation results reported with standard errors.*

Table 4 One Period Fixed Effect (equation 3): Employment

	Direct sales		Number of farms with direct sales		Direct sales per farm	
Year	**0.0388** ***	**0.0653** ***	**0.0249** ***	**0.0521** ***	**0.0472** ***	**0.0771** ***
	(0.0059)	(0.0099)	(0.0044)	(0.0083)	(0.0047)	(0.0087)
Treatment effect	−0.0111	−0.0098	−0.001	−0.0003	−0.0164 *	−0.0132 *
	(0.0075)	(0.0075)	(0.0064)	(0.0063)	(0.0067)	(0.0067)
Constant	9.4483 ***	9.6888 ***	9.4523 ***	10.0036 ***	9.5473 ***	9.9331 ***
	(0.0018)	(0.2110)	(0.0016)	(0.1716)	(0.0017)	(0.2101)
Obs (N)	1,898	1,898	2,174	2,174	2,274	2,274
Controls	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.0750	0.0889	0.0492	0.0644	0.1075	0.1210

Note: *Asterisks indicate level of significance:* *** *for 99.9% level,* ** *for 95% level,* * *for 90% level. Estimation results reported with standard errors.*

Table 5 Multiperiod Fixed Effect (equation 4) *Per Capita* Income

	Direct sales		Number of farms with direct sale		Direct sales per Farm	
1997	**0.2058** ***	**0.195** ***	**0.2135** ***	**0.2077** ***	**0.2123** ***	**0.2034** ***
	(0.0031)	(0.0047)	(0.0023)	(0.0039)	(0.0026)	(0.0041)
2002	0.394 ***	0.3675 ***	0.3928 ***	0.3763 ***	0.4001 ***	0.3787 ***
	(0.0040)	(0.0074)	(0.0033)	(0.0068)	(0.0031)	(0.0065)
2007	0.6255 ***	0.5878 ***	0.6207 ***	0.596 ***	0.6292 ***	0.5981 ***
	(0.0052)	(0.0094)	(0.0040)	(0.0089)	(0.0041)	(0.0085)
Treatment effect (1997)	0.0048	0.0041	−0.0045	−0.0046	−0.0001	−0.0008
	(0.0039)	(0.0040)	(0.0035)	(0.0035)	(0.0036)	(0.0036)
Treatment effect (2002)	−0.0033	−0.0045	−0.0006	−0.0008	−0.0069	−0.0087
	(0.0052)	(0.0052)	(0.0045)	(0.0046)	(0.0047)	(0.0047)
Treatment effect (2007)	0.0039	0.0018	0.0059	0.0064	0.0029	0.0001
	(0.0064)	(0.0063)	(0.0056)	(0.0055)	(0.0059)	(0.0058)
Constant	2.7935 ***	2.7788 ***	2.7789 ***	2.8637 ***	2.8001 ***	2.7455 ***
	(0.0015)	(0.1246)	(0.0014)	(0.1122)	(0.0015)	(0.1147)
Obs (N)	3,796	3,796	4,348	4,348	4,548	4,548
Controls	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.9579	0.9589	0.9588	0.9595	0.9565	0.9573

Note: *Asterisks indicate level of significance:* *** *for 99.9% level,* ** *for 95% level,* * *for 90% level. Estimation results reported with standard errors.*

Table 6 Multiperiod Fixed Effect (equation 4) Employment

	Direct sales		**Number of farms with Direct sale**		**Direct sales per farm**	
1997	**0.1232** ***	**0.1675** ***	**0.1166** ***	**0.1625** ***	**0.1274** ***	**0.1799** ***
	(0.0054)	(0.0089)	(0.0040)	(0.0069)	(0.0042)	(0.0075)
2002	0.162 ***	0.2512 ***	0.1415 ***	0.2323 ***	0.1745 ***	0.2785 ***
	(0.0094)	(0.0163)	(0.0067)	(0.0125)	(0.0074)	(0.0139)
2007	0.2382 ***	0.3606 ***	0.1956 ***	0.3214 ***	0.2548 ***	0.3953 ***
	(0.0126)	(0.0219)	(0.0089)	(0.0171)	(0.0100)	(0.0191)
Treatment Effect (1997)	−0.0061	−0.0042	−0.0059	−0.0067	−0.0072	−0.0044
	(0.0066)	(0.0066)	(0.0053)	(0.0054)	(0.0057)	(0.0057)
Treatment Effect (2002)	−0.0172	−0.0117	−0.0068	−0.0067	−0.0236 *	−0.0149
	(0.0117)	(0.0117)	(0.0094)	(0.0093)	(0.0102)	(0.0101)
Treatment Effect (2007)	−0.0317 *	−0.0241	0.0004	−0.0003	−0.042 **	−0.0289 *
	(0.0157)	(0.0153)	(0.0125)	(0.0120)	(0.0138)	(0.0136)
Constant	9.3290 ***	10.0795 ***	9.3390 ***	10.1892 ***	9.4238 ***	10.2776 ***
	(0.0039)	(0.2284)	(0.0032)	(0.1702)	(0.0035)	(0.2095)
Obs (N)	3,796	3,796	4,348	4,348	4,548	4,548
Controls	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.4167	0.441	0.4089	0.4369	0.445	0.4744

Note: *Asterisks indicate level of significance:* *** *for 99.9% level,* ** *for 95% level,* * *for 90% level. Estimation results reported with standard errors.*

Table 7 Multiperiod Spatial Durbin (eq(4)) *Per Capita* Income

	Direct sales		Number of farms with direct sales		Direct sales per farm	
			Direct effects			
1997	0.1850	0.2080	−0.2360	0.1560 ***	−0.2530 ***	0.1480 ***
	(4.6770)	(4.5610)	(0.2070)	(0.0120)	(0.0200)	(0.0130)
2002	−0.0140	0.4070	−0.0200	0.3540 ***	−0.0140	0.3500 ***
	(0.3930)	(3.9570)	(0.1930)	(0.0120)	(0.0500)	(0.0230)
2007	0.7470	0.5160 **	0.2830	0.6260 ***	0.2280 *	0.6030 ***
	(5.3190)	(0.1660)	(0.5050)	(0.0180)	(0.1100)	(0.0150)
Early adopters	16.0940	−0.2410	0.2060	−0.0450	−1.3130	0.0430
	(167.6690)	(3.5400)	(9.1360)	(0.0570)	(5.3030)	(0.0960)
Treatment*1997	−0.6720	0.0420	0.0010	−0.0100	0.0150	−0.0020
	(7.2520)	(0.3490)	(0.3600)	(0.0150)	(0.0270)	(0.0160)
Treatment*2002	−0.0120	−0.0510	0.0210	−0.0030	−0.0160	−0.0160
	(0.4130)	(0.8200)	(0.3280)	(0.0090)	(0.1010)	(0.0320)
Treatment*2007	−0.7520	−0.0710	0.0130	0.0150	0.0630	0.0020
	(8.1490)	(0.9380)	(0.8740)	(0.0250)	(0.2010)	(0.0170)
	Indirect effects					
1997	355.4940	−0.1290	−10.0160	3.5930	−11.4130	2.6250
	(3858.4090)	(3.9640)	(196.1860)	(9.9820)	(14.2670)	(10.0500)
2002	12.1140	−0.1530	−17.3110	2.5560	0.9280	6.9240
	(326.3470)	(3.4390)	(184.2710)	(6.0340)	(49.5310)	(20.5470)
2007	403.2700	−0.0110	−10.0080	−3.4690	−37.3970	−0.0130
	(4389.0890)	(0.1460)	(478.5490)	(10.7290)	(105.5180)	(6.1590)
Early adopters	13224.3420	−0.1150	157.0090	−23.9460	−1360.2750	37.3390
	(138269.0020)	(3.0710)	(8608.1360)	(54.0250)	(5225.5990)	(95.8840)
Treatment*1997	−551.0510	−0.0330	17.3260	−4.7480	21.1690	−2.2560

(Continues)

Table 7 Continued

	Direct sales		Number of farms with direct sales		Direct sales per farm	
	(5980.8720)	(0.3050)	(339.6630)	(13.6680)	(26.1000)	(15.2300)
Treatment*2002	−2.6890	−0.0360	30.4600	−3.1790	−3.1760	−10.3790
	(340.8390)	(0.7150)	(309.5300)	(7.1370)	(99.6840)	(31.3980)
Treatment*2007	−616.9110	−0.0520	17.7800	7.7150	70.1550	3.3610
	(6721.5380)	(0.8170)	(825.2620)	(23.6160)	(196.2900)	(16.3400)
	Total effects					
1997	355.6780	0.0790	−10.2520	3.7490	−11.6660	2.7730
	(3863.0860)	(0.5980)	(196.3930)	(9.9910)	(14.2820)	(10.0610)
2002	12.1000	0.2550	−17.3310	2.9100	0.9140	7.2740
	(326.7400)	(0.5180)	(184.4620)	(6.0390)	(49.5780)	(20.5670)
2007	404.0170	0.5040***	−9.7250	−2.8430	−37.1690	0.5900
	(4394.4090)	(0.0240)	(479.0540)	(10.7410)	(105.6280)	(6.1670)
Early adopters	13240.4350	−0.3560	157.2150	−23.9900	−1361.5880	37.3830
	(138436.6710)	(0.4720)	(8617.2710)	(54.0810)	(5230.9010)	(95.9790)
Treatment*1997	−551.7230	0.0090	17.3270	−4.7570	21.1830	−2.2580
	(5988.1240)	(0.0440)	(340.0230)	(13.6830)	(26.1260)	(15.2450)
Treatment*2002	−2.7000	−0.0870	30.4800	−3.1810	−3.1920	−10.3950
	(341.2520)	(0.1050)	(309.8580)	(7.1450)	(99.7840)	(31.4300)
Treatment*2007	−617.6620	−0.1230	17.7930	7.7310	70.2180	3.3630
	(6729.6860)	(0.1210)	(826.1360)	(23.6410)	(196.4910)	(16.3560)
Spatial parameter ρ	0.0070***	0.2920***	0.0060***	0.0060***	0.0060***	0.0060***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
N	4,745	3,796	5,435	4,348	5,685	4,548
Controls	No	Yes	No	Yes	No	Yes

Note: *Asterisks indicate level of significance: *** for 99.9% level, ** for 95% level, * for 90% level. Estimation results reported with standard errors.*

Table 8 Multiperiod Spatial Durbin (equation 4) Employment

	Direct sales		**Number of farms with direct sales**		**Direct sales per farm**	
			Direct effects			
1997	−0.0280	−0.0280	−0.0190	0.2040 ***	−0.0410 **	0.1940 ***
	(0.0160)	(0.0160)	(0.0130)	(0.0150)	(0.0140)	(0.0190)
2002	0.0440 *	0.0440 *	0.0470 *	0.3250 ***	0.0450	0.3200 ***
	(0.0200)	(0.0200)	(0.0180)	(0.0220)	(0.0370)	(0.0340)
2007	0.1480 ***	0.1480 ***	0.1500 ***	0.4620 ***	0.1650 *	0.4600 ***
	(0.0270)	(0.0270)	(0.0170)	(0.0270)	(0.0650)	(0.0380)
Early adopters	−0.5200	−0.5200	−0.5220	−0.1850 **	−0.3950	−0.1500
	(0.9790)	(0.9790)	(0.9900)	(0.0670)	(3.2970)	(0.1660)
Treatment*1997	0.0150	0.0150	−0.0140	−0.0070	0.0160	0.0001
	(0.0120)	(0.0120)	(0.0100)	(0.0080)	(0.0090)	(0.0100)
Treatment*2002	0.0020	0.0020	−0.0110	0.0000	0.0010	−0.0070
	(0.0190)	(0.0190)	(0.0190)	(0.0080)	(0.0610)	(0.0110)
Treatment*2007	−0.0210	−0.0210	0.0010	0.0060	−0.0210	−0.0170
	(0.0350)	(0.0350)	(0.0120)	(0.0080)	(0.1220)	(0.0260)
			Indirect effects			
1997	−3.3890	−3.3890	0.1380	−0.1080 *	−1.5230	−0.1250
	(4.8220)	(4.8220)	(3.8440)	(0.0490)	(2.8620)	(0.1430)
2002	−0.4210	−0.4210	−0.0870	−0.3340 ***	−1.5200	−0.2290
	(9.4410)	(9.4410)	(9.6960)	(0.0870)	(31.9380)	(0.3500)
2007	6.3480	6.3480	−2.9670	−0.4720 ***	2.2140	−0.2730
	(18.6020)	(18.6020)	(4.4820)	(0.1240)	(63.6990)	(0.3510)
Early adopters	−437.4590	−437.4590	−390.4370	3.1430 ***	−305.8160	1.7370
	(805.8460)	(805.8460)	(932.8730)	(0.7120)	(3251.2270)	(2.1840)
Treatment*1997	5.3430	5.3430	−0.1450	−0.0550	2.9860	0.0140

(Continues)

Table 8 Continued

	Direct sales		Number of farms with direct sales		Direct sales per farm	
	(7.5590)	(7.5590)	(6.6670)	(0.0570)	(5.4750)	(0.0970)
Treatment*2002	0.5240	0.5240	0.0300	0.0290	2.6280	–0.0350
	(14.6050)	(14.6050)	(16.6500)	(0.0680)	(59.1190)	(0.0960)
Treatment*2007	–9.9530	–9.9530	5.0450	0.0210	–4.3200	–0.1380
	(29.0440)	(29.0440)	(7.8800)	(0.0810)	(120.4810)	(0.3680)
Total effects						
1997	–3.4160	–3.4160	0.1190	0.0960	–1.5640	0.0690
	(4.8260)	(4.8260)	(3.8440)	(0.0500)	(2.8640)	(0.1540)
2002	–0.3770	–0.3770	–0.0400	–0.0090	–1.4740	0.0910
	(9.4490)	(9.4490)	(9.7040)	(0.0870)	(31.9700)	(0.3760)
2007	6.4960	6.4960	–2.8170	–0.0100	2.3790	0.1870
	(18.6210)	(18.6210)	(4.4820)	(0.1220)	(63.7620)	(0.3770)
Early adopters	–437.9790	–437.9790	–390.9590	2.9580***	–306.2120	1.5860
	(806.8220)	(806.8220)	(933.8600)	(0.7290)	(3254.5220)	(2.3300)
Treatment*1997	5.3580	5.3580	–0.1580	–0.0620	3.0020	0.0130
	(7.5670)	(7.5670)	(6.6740)	(0.0570)	(5.4800)	(0.1020)
Treatment*2002	0.5260	0.5260	0.0190	0.0280	2.6290	–0.0420
	(14.6220)	(14.6220)	(16.6670)	(0.0690)	(59.1800)	(0.1020)
Treatment*2007	–9.9740	–9.9740	5.0460	0.0270	–4.3410	–0.1550
	(29.0780)	(29.0780)	(7.8880)	(0.0820)	(120.6030)	(0.3920)
Spatial parameter ρ	0.0070***	0.0070***	0.0060***	0.0170***	0.0060***	0.0190***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
N	4,745	4,745	5,435	4,348	5,685	4,548
Controls	No	Yes	No	Yes	No	Yes

Note: *Asterisks indicate level of significance: *** for 99.9% level, ** for 95% level, * for 90% level. Estimation results reported with standard errors.*

Third, as noted by Richards et al. (2017) much of the prior work on local foods focuses on direct sales to the consumer (*e.g.*, farmers markets, CSAs, *etc.*) with little work on intermediate sales (*e.g.*, sales to institutions, restaurants, or through traditional retail outlets) but the growth potential for local food systems is in these intermediate sales. While this realization is reflected in the growth in the study of food hubs (*e.g.*, Matson and Thayer 2016; Jablonski, Schmit, and Kay 2016b), the lack of solid data on the size and location of intermediate sales makes the study of their influence on regional economic growth difficult at best.[7]

Conclusions

The local foods literature is awash with studies that advocate local foods as a means to foster stronger local communities. This includes better health outcomes, increased labor productivity, stronger sense of community by fostering social capital, and retaining more of the local food dollar within the local economy (Deller, Lamie, and Stickel 2017b). At the forefront of these discussions is the notion that the promotion of local foods activities will have a positive impact on local economic activity. Unfortunately, there is limited rigorous research aimed at shedding light on the local foods and economic performance argument. Much of the available literature is descriptive and speculative at best. This study uses a difference-in-difference (DID) approach to test if growth in local foods activity impacts regional economic activity. By using a DID we directly addressed issues of endogeneity, specifically the market for local foods has been shown to be stronger in higher performing local economies. Local foods is measured by direct sales by farms to consumers and economic activity is measured by *per capita* income and employment.

Three basic difference-in-difference models are estimated using county-level data from 1992, 1997, 2002, and 2007 (the Census of Agriculture years) include a one-period fixed effect model, a multiperiod fixed effect model, and a spatial Durbin specification that allows for spatial spillover effects across counties. The results of the different models are fairly consistent: local foods activity as measured by direct sales to consumers has no effect on regional economic performance. Indeed, there is weak evidence that local foods activity actually has a negative effect on performance, particularly employment. At a minimum this study provides rigorous evidence that local foods activity, again as measured by direct sales, does not have the positive impact on regional economic performance that is so often advocated within the literature. This is not to say that for some farmers, entering into the local foods market cannot be a profitable option that should be explored. What these results do suggest is that the local food markets are simple too thin to positively impact local economic performance.

As noted throughout the study, the one limitation to this study is the lack of reliable data on intermediate sales. As noted, there is some evidence that the growth in direct sales to consumers, the measure of local foods activity used in this study, may have reached an upper boundary and the growth potential is in intermediate sales. The latter would include local producer sales through

[7] *A major focus of the rural growth study by Deller et al. (2014) was the sensitivity of the results across a range of alternative measures of local foods. Using principal component analysis to build local food indices they found that direct sales and farmers' markets tended to dominate the analysis and both of these two are highly correlated. Thus, while limiting our analysis to direct sales may seem like a weakness of the analysis, there are few alternative measures that perform better or have a sufficient time series to be of practical use.*

local or regional retail outlets, restaurants, and other local institutions such as hospital and schools, among others. Clearly, the availability of rigorous analysis of the interplay between local foods, however defined and measured, and local economic performance is limited to a small handful of studies and additional research is required. As more consistent data on intermediate sales becomes available and the recovery from the Great Recession becomes more sustained, this line of work should continue by addressing the limitations of the currently available research, this study included.

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