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Direct and Intermediated Marketing of Local Foods in the United States

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Abstract

This study uses nationally representative data on the marketing of local foods to assess the relative scale of local food marketing channels. This research documents that sales through intermediated marketing channels, such as farmers' sales to local grocers and restaurants, account for a large portion of all local food sales. Small and medium-sized farms dominate local foods sales marketed exclusively through direct-to-consumer channels (foods sold at roadside stands or farmers' markets, for example) while large farms dominate local food sales marketed exclusively through intermediated channels. Farmers marketing food locally are most prominent in the Northeast and the West Coast regions and areas close to densely populated urban markets. Climate and topography favoring the production of fruits and vegetables, proximity to and neighboring farm participation in farmers' markets, and good transportation and information access are found to be associated with higher levels of direct-to-consumer sales.

Keywords: Local foods, direct marketing channels, direct sales, intermediated sales

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Summary

What Is the Issue?

Despite increased production and consumer interest, locally grown food accounts for a small segment of U.S. agriculture. For local foods production to continue to grow, marketing channels and supply chain infrastructure must deepen. Information on U.S. local food producers and their marketing channels, however, is incomplete. New information on farmers that market foods locally and the marketing channels they use presented in this report could aid private- and public-sector efforts to support this sector of the agricultural economy. This report uses the 2008 Agricultural Resource Management Survey (ARMS) to explore farmers' use of both direct-to-consumer and inter-mediated marketing channels in selling locally produced foods to consumers.

What Did the Study Find?

- Marketing of local foods, via both direct-to-consumer and intermediated channels, grossed $4.8 billion in 2008—about four times higher than estimates based solely on direct-to-consumer sales.
- Farms marketing food commodities exclusively through intermediated channels reported $2.7 billion in local food sales in 2008—over three times higher than the value of local foods marketed exclusively through direct-to-consumer channels, and two times higher than the value of local foods marketed by farms using a combination of direct-to-consumer and intermediated channels.
- Small farms (those with less than $50,000 in gross annual sales) accounted for 81 percent of all farms reporting local food sales in 2008. They averaged $7,800 in local food sales per farm and were more likely to rely exclusively on direct-to-consumer marketing channels, such as famers' markets and roadside stands.
- Medium-sized farms (those with gross annual sales between $50,000 and $250,000) accounted for 17 percent of all farms reporting local food sales in 2008. They averaged $70,000 in local food sales per farm and were likely to use direct-to-consumer marketing channels alone or a mix of direct-to-consumer and intermediated marketing channels.
- Large farms (those with gross annual sales of $250,000 or more) accounted for 5 percent of all farms reporting local food sales in 2008. They averaged $770,000 in local food sales per farm and were equally likely to use direct-to-consumer channels exclusively, intermediated channels exclusively, or a mixture of the two.
- Large farms accounted for 92 percent of the value of local food sales marketed exclusively through intermediated channels.
- For small and medium-sized farms with local food sales, more operators identified their primary occupation as farming and devoted more time to their farm operation than operators of similarly sized farms without local sales.

- Vegetable, fruit, and nut farms dominated local food sales.
- Direct-to-consumer sales of food commodities were affected by climate and topography that favor fruit and vegetable production, proximity to farmers' markets and neighboring local food farms, and access to transportation and information networks.
- The value of locally sold food is highest in metropolitan areas and is geographically concentrated in the Northeast and on the West Coast.

How Was the Study Conducted?

We used the 2008 ARMS data to analyze farmers' use of *specific* direct-to-consumer marketing channels (i.e., use of roadside stands, farmers' markets, onfarm stores, and community-supported agriculture arrangements) and *intermediated* marketing channels (i.e., farmers' sales to local retail, restaurant, and regional distribution outlets), but also farm characteristics and the value of sales for farmers engaged in local food sales. Data from the 2007 Census of Agriculture supported the spatial econometric model used to identify determinants of direct-to-consumer sales.

Introduction

Although locally grown foods sold by farmers directly to consumers, restaurants, or grocers have become more popular, information on local U.S. food producers and their marketing channels is incomplete. Case studies have provided detailed information about local food sales in certain U.S. regions (e.g., King et al., 2010), but the scope of nationally representative data has been limited to direct-to-consumer sales. This report provides new information on marketing channels based on the 2008 Agricultural Resource Management Survey (ARMS).

Whether purchased at a farmers' market or at a nearby grocer, "local food" is an ambiguous characteristic of consumer purchases. In this study, the definition of "local food" is based on the set of marketing channels (as measured from the farmgate to the consumer) used by farmers (Hand and Martinez, 2010; Martinez et al., 2010). Thus, *direct-to-consumer* and *intermediated* (direct-to-grocer/restaurant) food sales are considered "local foods" in this study.[1] National data on direct-to-consumer food sales have been available since the 1978 Census of Agriculture, long before the current surge in local foods interest. Nationally representative data on intermediated sales by farm operators, however, became available in the 2008 ARMS. In this report, we explore the use of both direct-to-consumer and intermediated sales by size of farms, their commodity specializations, and the characteristics of farm operators participating in local foods marketing channels. Data from the 2007 Census of Agriculture allow us to explore regional patterns in direct-to-consumer sales.

[1]Martinez and others (2010) explored the conceptual and policy cross-currents embedded in defining local foods. Defining local foods through farmers' marketing channels avoids problematic definitions based on geographic distances between producers and markets and is congruent with relevant literature.

Farms Marketing Local Foods

Farmers selling food commodities through farmers' markets, roadside stands, and other local food sales outlets may account for a small segment of U.S. agriculture, but this segment has experienced recent growth and increased popularity. Historically, nationally representative data on food sold directly to consumers by farmers has been used to characterize farms participating in such sales.

Historical Trends in Direct Sales

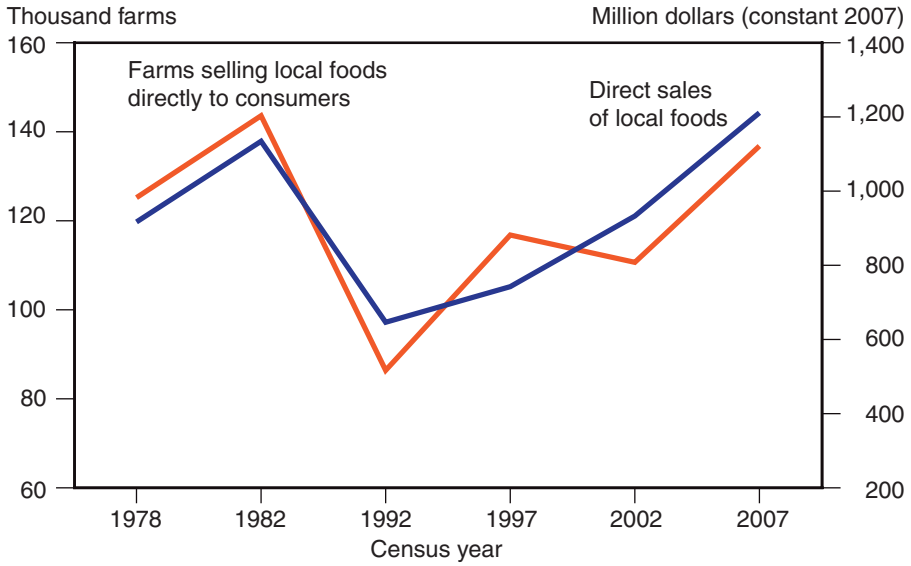
Data on direct-to-consumer food sales were first collected in the 1978 Census of Agriculture, after the Farmer-to-Consumer Direct Marketing Act was passed, and direct-to-consumer sales data have been collected every 5 years since (except for 1987).

Over the 1978-2007 period, farms with direct-to-consumer food sales represented an average 5.5 percent of all farms, and total direct-to-consumer sales accounted for 0.3 percent of total farm sales. The number of farmers engaged in direct-to-consumer sales peaked in 1982, likely due to the 1976 Farmer-to-Consumer Direct Marketing Act, which provided funding for activities that fostered direct marketing, such as technical assistance via agricultural extension (fig. 1). Between 1992 and 2007, the number of farmers participating in direct-to-consumer sales increased by 58 percent to 136,000, and the constant dollar value of direct sales increased by 77 percent to $1.2 billion.[2]

The Census of Agriculture contains a limited amount of data on direct-to-consumer sales—the number of farms engaged in this activity and the value of direct-to-consumer sales. Researchers have called for the census to collect information on different local food marketing channels (Brown, 2002; Lev

[2]In 1997, USDA adjusted census data to correct for small farms previously missed and, consequently, part of the 1997 increase may be due to changes in data collection and weighting procedures.

Figure 1
Direct-sales farms and direct sales of local foods, 1978-2007



Note: Inflation adjusted sales were calculated based on the gross domestic product implicit price deflator published by the Bureau of Economic Analysis, U.S. Department of Commerce and calibrated to 2007=100.
Source: 1978, 1982, 1992, 1997, 2002, and 2007 U.S. Censuses of Agriculture.

and Gwin, 2010). The 2008 ARMS collected this information, and these data suggest that prior data collection efforts that focused on direct-to-consumer sales missed a relatively large portion of local food sales—sales of food for human consumption to grocers and restaurants (see box, "What Can We Learn From the 2008 ARMS Data on Local Food Sales?").

Using the 2008 ARMS, we measured *direct-to-consumer* sales of local foods through four outlets: farmers' markets, roadside stands, onfarm stores, and community-supported agriculture arrangements (CSAs).[3] *Intermediated* marketing channels include sales to regional distributors and grocery stores, restaurants, or other retailers.[4] Generally, marketing channels are classified as intermediated when local food products pass through one or more intermediate steps in the local food supply chain before reaching the consumer (King et al., 2010). While the 2008 ARMS collected data on farmers' use of specific local food marketing channels, it did not collect data on the value of sales linked to a specific channel. Without these data, researchers must adhere to the strict trichotomy that groups local food sales by exclusive use of direct-to-consumer outlets, exclusive use of intermediated channels, or marketing through both channels (fig. 2).

The 2008 ARMS estimates shed light on two characteristics of local food supplies.

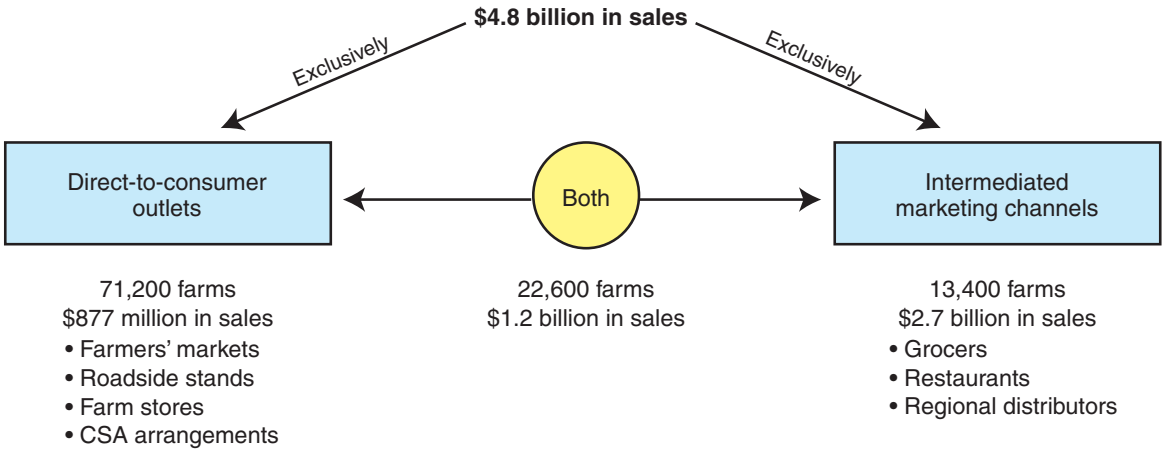
- Gross sales of locally marketed food (to consumers and local intermediaries) are four times larger than previous census and ARMS estimates suggested, representing 1.9 percent of total gross farm sales, primarily because intermediated sales were included for the first time.
- Most local foods are marketed through intermediated channels, accounting for 50-66 percent of the value of all local food sales.

Our findings validate local foods researchers' concerns that direct-to-consumer sales account for only a relatively small portion of total local food sales (Lev and Gwin, 2010; Clancy and Ruhf, 2010).

[3]A CSA buying club is a marketing arrangement in which a group of households agree to purchase shares of a farmer's expected yield before planting. These upfront cash payments allow the farmer to buy inputs and share the output and yield risks with CSA members. These arrangements are referred to as "subscription agriculture." Some CSAs tie households to formal contracts and others to informal arrangements and/or barter.

[4]Regional local food distributors make up a very small portion of intermediated local food sales, suggesting that farmers perceive the difference between regional local food distributors and national distributors. Also, the 2008 ARMS did not explicitly collect data on emerging institutional outlets, such as farm-to-school arrangements.

Figure 2
Farmers' local food marketing, 2008



CSA=Community-supported agriculture.
Source: USDA, Economic Research Service calculations based on 2008 Agricultural Resource Management Survey, conducted by USDA, National Agricultural Statistics Service and Economic Research Service.

Comparing ARMS Data on Local Foods Sales

Prior to the 2008 ARMS, data collected on local food sales to consumers referred to "direct sales of agricultural products for *human consumption*" in the Census of Agriculture and ARMS surveys. The 2008 ARMS questionnaire asked an extensive set of questions on farmers' direct sales; however, the phrase "*for human consumption*" was omitted. As a result, the 2008 ARMS data had to be manipulated to provide estimates of direct food sales that were consistent with estimates from previous ARMS and census of agriculture data.*

* See "Appendix 1: Developing Data on Marketing Local Agricultural Products Using the 2008 ARMS" for a discussion of the 2008 ARMS questionnaire and how sales of local foods were estimated for this study.

Which Marketing Channels Do Local Food Sales Farms Use?

Given that the market for local foods is more extensive than previously measured, we explored how local food sales farms (by farm sales class) differ in their use of marketing options. According to the 2008 ARMS, small local food farms (gross farm sales less than $50,000) represented almost 81 percent of all local food farms; medium-sized farms (gross farm sales $50,000-$249,999) represented 14 percent; and large farms (sales of $250,000 or more) accounted for almost 5 percent of all local food farms (table 1).

The ratio of local food sales to total farm sales measures how these farms rely on local food sales for their financial viability.[5] For all sizes of local food farms, marketing local food products accounts for 61 percent of gross farm sales, on average (table 1). The median ratio of local food sales to total farm sales is higher than the mean ratio for each farm size, highlighting the fact that many of these farms rely on local food sales. Almost two-thirds of all local food producers reported that local food sales accounted for at least 75 percent of their total gross farm sales, while 22 percent of all local food sales farms reported that such sales accounted for less than 25 percent of their total gross farm sales. Higher local food sales shares suggest that local food sales farms are well integrated into existing direct-to-consumer and intermediated supply chains.[6]

A difference exists in the size class distribution of direct-to-consumer sales, as observed in the 2007 Census of Agriculture, and total local foods sales, as observed in the 2008 ARMS. Small farms in 2008 accounted for 11 percent of total local food sales; medium-sized farms accounted for 19 percent of total local food sales; and large farms accounted for almost 70 percent (table 1). These shares of total local food sales based on farm size are at odds with those for direct-to-consumer sales only, in which each sales class accounted for roughly a third of direct-to-consumer sales.

Small farms are more likely to market through direct-to-consumer outlets, perhaps because small farms cannot generate enough volume for distributors and institutions that demand high volumes of local food (i.e., grocers, restaurants, and schools) (Gale, 1997; Brown, 2002). Small farms account for 81 percent of all local food sales farms and many rely on exclusive use of direct-

[5]About 20 percent of all farms are point sales farms (sales less than $1,000). Due to statistical reliability problems associated with few observations, this study was not able to report any local food farms classified as point sales farms. This suggests that point sales local food farms may have been part of the 146,000 farmers excluded from this study that reported direct sales to consumers but failed to report the marketing channels used or the value of their direct sales (see Appendix 1 for further discussion).

[6]Local foods specialists and analysts studying the economic viability of small- and medium-sized farms advocate public- and/or private-sector initiatives to deepen and widen the infrastructure of these supply chains (Clancy and Ruhf, 2010; Matteson and Heuer, 2008). As an example of a private-sector initiative on local food, Walmart's Heritage Agriculture program has been covered in the press including *The New York Times* (Clifford, 2010) and *The Atlantic Monthly* (Kummer, 2010), but no study to date has looked at this program's effects on small farms and local communities.

to-consumer marketing channels, grossing $6,740 in sales on average in 2008 (table 1). The share of small- and medium-sized farms exclusively marketing through direct-to-consumer channels is higher than the corresponding share of large farms.

Selling local foods through intermediated outlets may require less farm labor than selling via direct-to-consumer outlets because farmers are not required to spend time at intermediated outlets (Brown, 2002). Larger farms may have a comparative advantage in intermediated sales because many restaurants, grocers, and regional distributors demand timely delivery of large volumes of food with consistent quality. In 2008, large local food sales farms accounted

Table 1
Marketing channels used by local food sales farms, by farm size

	Farm size			
IItem	Small (sales of less than $50,000)	Medium (sales of $50,000-$249,999)	Large (sales of $250,000 or more)	All
	Number			
Local food sales farms	86,726	15,202	5,301	107,229
	Percent			
Local food sales farms	80.9	14.2	4.9	100.0
All farms	5.3	5.1	2.5	5.0
Average ratio of local food sales to total farm sales	68.8	67.2	57.5	61.2
Median ratio of local food sales to total farm sales	100.0	80.0	80.0	100.0
Farms by marketing channels	100.0	100.0	100.0	100.0
Direct-to-consumer channels only	72.1	46.5	31.0	66.4
Intermediated marketing channels only	11.3	10.4	37.1	12.5
Both marketing channels	16.6	43.0	31.9	21.1
Local food sales:	*Percent*			*Million dollars*
Marketed through all channels	11.1	19.1	69.8	4,806
Direct-to-consumer channels only	33.7	38.9	27.4	887
Intermediated marketing channels only	3.5	3.6	92.9	2,720
Both marketing channels	11.7	39.5	48.8	1,199
Average local food sales per farm:	*Dollars*			
Marketed through all channels	7,856	69,985	771,965	56,240
Direct-to-consumer channels only	6,737	66,247	305,181	17,621
Intermediated marketing channels only	10,242	73,126	1,338,257	217,150
Both marketing channels	9,768	72,312	352,375	53,103

Source: USDA, Economic Research Service calculations based on 2008 Agricultural Resource Management Survey, conducted by USDA, National Agricultural Statistics Service and Economic Research Service.

for 93 percent of the $2.7 billion in sales generated exclusively through intermediated channels, averaging $1.3 million in local food sales per farm (see table 1). Medium and large local food sales farms together accounted for 88 percent of almost $1.2 billion in sales marketed by farms using both intermediated and direct-to-consumer outlets.

Small local food sales farms gross, on average, $10,240 per farm annually when marketing exclusively through intermediated channels (see table 1). Formal and informal collaboration with other farmers provides a way for these small farms to meet the quantity, quality, packaging, and delivery requirements of grocers and restaurants (PFI, 2009). Medium-sized farms accounted for 17 percent of food farms relying solely on intermediated marketing channels, averaging $203,900 in local food sales per food farm.

In 2008, 107,000 local food sales farms reported using 160,800 marketing channels to sell local food (table 2). Direct-to-consumer outlets accounted for approximately 75 percent of these marketing channels. Roadside stands and farmers' markets accounted for about 80 percent of the direct-to-consumer outlets used by farmers. According to the 2008 ARMS, farmers selling local food at farmers' markets traveled an average 30.7 miles, driving past the nearest town of 10,000 residents to their destination, suggesting that small towns may not generate enough consumer demand to support farmers' markets.[7] Onfarm stores and CSAs were used much less frequently. Intermediated outlets accounted for the remaining 25 percent of local food marketing channels used by farmers.

[7] Farmers travel 30.7 miles to their farmers' market, on average, whereas their nearest town of 10,000 or more residents lies 5.3 miles away. The median distance traveled to a farmers' market was 15 miles, while the maximum distance was 275 miles.

Table 2
Local food marketing channels used, by farm size

Sales channels	Farm size: Small (sales of less than $50,000)	Medium (sales of $50,000-$249,999)	Large (sales of $250,000 or more)	All
		Number		
Local food sales outlets used	121,198	15,202	5,301	160,795
Average number of outlets used per farm	1.4	1.7	2.1	1.5
		Percent		
By marketing outlet	**100.0**	**100.0**	**100.0**	**100.0**
Direct-to-consumer outlets	**78.0**	**70.7**	**55.5**	**75.3**
Roadside stands	34.1	24.9	23.7	31.8
Farmers' markets	34.6	25.9	14.7	31.8
Onfarm stores	8.3	17.4	15.7	10.4
CSAs	1.1	2.5	1.4	1.3
Intermediated outlets	**22.0**	**29.3**	**45.0**	**24.7**
Grocers and restaurants	17.2	26.0	23.7	19.2
Regional distributors	4.8	3.4	21.4	5.5

CSAs=Community-supported agriculture.
Source: USDA, Economic Research Service calculations based on 2008 Agricultural Resource Management Survey, conducted by USDA, National Agricultural Statistics Service and Economic Research Service.

As the size of local food sales farms increases, the frequency of farms selling through direct-to-consumer marketing channels declines and the frequency of sales through intermediated marketing channels increases. Small local food farms are three times more likely to use direct-to-consumer outlets than intermediated outlets (see table 2). With larger sales, large local food sales farms divide local food sales in a 55-45 split between direct-to-consumer and intermediated marketing channels. Reducing direct-to-consumer marketing likely reduces marketing costs for these large farms.

Consumers may acquaint the public face of "local foods" with farmers using direct-to-consumer outlets because they represent most producer-consumer interactions (see table 2). Small- and medium-sized farms account for 95 percent of direct-to-consumer local food sales farms. In a variety of surveys, consumers reported that consumer-farmer interactions and consumers' desires to support local producers were as important as the quality of the commodity (Hunt, 2005; Brown and Miller, 2008; Thilmany et al., 2008).

Direct-to-consumer marketing channels, however, are not how most local foods are purchased; at least 60 percent of the value of local food sales passed through intermediated channels dominated by large food farms (see table 1). Could consumer interactions with small and medium farmers at direct-to-consumer outlets have translated into increased local foods purchases at grocery stores and restaurants? The popular press assumes this to be the case, but the extent to which consumer-farmer interactions at direct-to-consumer outlets have influenced retail purchases of local foods has yet to be tested empirically.

What Commodities Are Being Produced for Local Food Sales?

Just as marketing outlets vary, commodities produced by local food farms differ from all U.S. farms. Local food farms principally produce fresh vegetables, fruits, and nuts, contrasting with traditional farm production, which is principally composed of livestock and program commodity crop production. According to the 2008 ARMS, vegetable, fruit, and nut farms represented almost 6 percent of the 2.1 million farms, yet they accounted for 43 percent of all local food farms and generated $3.0 billion, or 65 percent, of total sales of locally grown food.[8] While only 5 percent of all farms engaged in local food sales, about 40 percent of vegetable, fruit, and nut farms sold through local food channels. That is, a vegetable/fruit/nut farm is eight times more likely to sell food commodities locally than other farms.

Vegetable, fruit, and nut farms also rely more on local food sales to generate gross farm sales than field crop or livestock farms. Among all local food farms, local food sales account for 65 percent of gross farm sales for fruit, vegetable, and nut farms, on average, but only 37 percent for livestock and field crop farms. Excluding local food sales farms marketing solely through intermediated channels, vegetable, fruit, and nut farms grossed $32,000 per farm in local food sales in 2008 compared with $13,800 per farm for field crops and livestock farms.[9]

Vegetable, fruit, and nut farms participate at varying levels in the three major marketing channel combinations, but they account for the largest share

[8]ARMS classifies farms into 19 production types according to the agricultural commodity that accounts for at least 50 percent of farm sales. For more information, see USDA, NASS, 2009. For the purposes of this study, we aggregated all food farms into three basic categories: fruit/vegetable/nut farms, all other field crop farms, and farms producing livestock and livestock products.

[9]Including farmers who use only intermediated channels would skew the distribution of average sales per farm even further. Among those local food sales farms that rely solely on intermediated marketing channels, vegetable, fruit, and nut farms grossed $509,400 per farm compared with $105,900 per farm for field crops and livestock farms.

of sales in each combination. Vegetable, fruit, and nut farms represent 40 percent of farmers using direct-to-consumer sales exclusively, 25 percent of farmers using intermediated channels exclusively, and almost 60 percent of farmers using both types of marketing channels. Vegetable, fruit, and nut farms generate roughly 60 percent of all local food sales that pass through direct-to-consumer and intermediated channels, and over 70 percent of local food sales marketed by farms using both types of channels.

The disproportionate presence of vegetable, fruit, and nut farms among all local food farms shapes the typical profile of local food sales farms. These farms operate fewer acres while generating higher gross sales per acre than field crop or livestock farms.[10] The average local food sales farmer grows high-valued food commodities on 149 acres that yield, on average, $590 per acre in sales. In contrast, the operator of the average farm generates $304 in sales per acre on 392 acres.

Comparing Farms That Market Local Foods With Farms That Do Not Market Local Foods

By some measures, a higher percentage of farmers who market local foods appear to devote more time to farming as an occupation than is the case for farmers who do not market local foods. In particular:

- Primary operators of local food sales farms are 30 percent more likely to list their primary occupation as farming (table 3). Small local food sales

[10]Vegetable, fruit, and nut farms, on average, generate $1,338 per acre in sales on 76 acres—four to six times the revenue per acre on a farm that is 33-50 percent the size of the average field crop or livestock farm. Average gross sales per acre ranges from $640 per acre for vegetable, fruit, and nut farmers using direct-to-consumer outlets only to $1,310 per acre for those using both direct-to-consumer and intermediated outlets, and to over $3,100 per acre for those relying exclusively on intermediated outlets.

Table 3
Farms that have local food sales compared with those with no local food sales

Item	Farms with local food sales	Farms with no local food sales
Primary operator characteristics:		
Age of the primary operator	57.2	57.8
Women as primary operators (*percent of all farms*)	10.2	10.5
Beginning farmers (with 10 years or less experience—*percent of all farms*)	25.4	23.3
Age first became farm operator*	33.7	31.7
Years of experience as an operator **	23.4	25.9
Years of education***	14.0	13.2
Internet use (*percent of farms*)*	69.9	63.4
Measures of operator commitment to farming:		
Farming as primary occupation (*percent of farms*)***	58.3	44.6
Full-time equivalent operator jobs per farm***	1.3	0.9
Either one or both spouses work in off-farm jobs (*percent of farms*)	57.3	61.4
Average off-farm labor income (*dollars*)*	36,739	44,196

Note: Difference-of-means test statistics (t) were calculated for each variable. *Statistically significant at the 10-percent level. **Statistically significant at the 5-percent level. ***Statistically significant at the 1-percent level.
Source: USDA, Economic Research Service calculations based on data from the 2008 Agricultural Resource Management Survey, conducted by USDA, National Agricultural Statistics Service and Economic Research Service.

farm operators are 50 percent more likely to do so, but this difference disappears for large local food sales farm operators.

- Household members of farms marketing local foods devote more time to farm operation than do household members of farms that do not market local foods. Local food sales farms devote 40 percent more operator work time to farming—filling 1.3 operator full-time-equivalent jobs (1 FTE equals 2,000 hours worked annually) compared with a 0.9 operator FTE job for the average farm.
- Farm households that sell local foods earn 17 percent less, on average, in off-farm labor income than average farm households that do not sell local foods.

These measures suggest that the occupational and time commitments to farming are valued more by local food sales farm households than the foregone labor income they could have earned off farm.

To examine how local food farmers' commitment may translate into increased farm business viability, we compared two financial performance measures between local food farms and farms without local food sales:

- Farms earning positive profits.
- Mean operating expense ratios.

The same share of farms with and without local food sales earned positive profits. For the lowest and highest sales classes, we found some statistical evidence of differences in mean operating expense ratios (defined as total cash expenses divided by gross cash income); however, they were not detected for the sample as a whole. Once farmers pass $10,000 in annual gross sales, operating expense ratios of farms engaged in local food sales may be lower than the average farm not engaged in local food sales, implying that local food sales farms may reach profitability at a lower gross sales point.

When comparing other farm operator characteristics, we detected differences in experience and education between farm operators who market local foods and those who do not market local foods. Operators of local food sales farms have an average of 2 years less experience in farming, and they started farming 2 years later in life than the average farmer (see table 3). Local food sales farm operators have completed an average of 1 more year of education and are about 6.5 percent more likely to use the Internet. We did not find significant differences in operator characteristics with regards to gender, the average age of the primary operator, beginning farmers as a percentage of all farmers, or whether one or both spouses worked in off-farm jobs.

Location of Local Food Sales Farms

To better understand where local food sales farms are located, we supplemented our analysis of the 2008 ARMS data with direct-to-consumer sales data from the 2007 Census of Agriculture. Modeling direct-to-consumer sales with Census of Agriculture data allows us to examine the location of production, while controlling for other factors (e.g., urbanization and cropland availability).[11] There were not enough respondents with local food sales in the 2008 ARMS sample to model local food production.

We found that proximity to a metro area, access to farmers' markets and farmland, and being in the coastal regions of the United States are drivers of direct-to-consumer sales, but we cannot say much about consumer-side drivers of direct-to-consumer sales (e.g., demographics). Our results suggest that local food sales have the greatest potential for economic development in specific places and regions of the country. These results are consistent with prior research also using the 2007 Census of Agriculture (Vogel and Low, 2010).

[11]We estimated county-level and commuting-zone level spatial econometric models of factors correlated with direct-to-consumer sales and its location using 2007 Census of Agriculture data on direct sales as a dependent variable. For a detailed discussion about the econometric analysis, see Appendix 2.

Local Food Sales in U.S. Regions

Local food sales vary regionally. Direct-to-consumer sales are highest in the Northeast, on the West Coast, and around a few isolated metropolitan areas throughout the country (fig. 3). Even after controlling for urbanization, our analysis of direct-to-consumer sales suggests that such sales are significantly higher on the West Coast and in the Northeast.[12] This result correlates with the evidence on both direct-to-consumer sales and intermediated sales from 2008 ARMS data and other research (USDA-AMS, 2009). Direct-to-consumer sales analysis suggests that some factors affecting the supply of direct-to-consumer sales are influenced by neighbors, while others are regionally influenced. For example, farms with direct-to-consumer sales are most likely to have neighbors who also participate in direct sales—this is a *neighborhood* effect rather than a regional effect. Direct-to-consumer sales are highest in regions that produce more fruits and vegetables—a result likely driven by the geographic suitability for growing fruits and vegetables (e.g., regional climate, topography, and infrastructure).

[12]This result would likely be even stronger if intermediated sales were included in Census of Agriculture data.

According to 2008 ARMS data, farms on the West Coast (California, Oregon, and Washington State) with local food sales accounted for only 7.8 percent of all local food sales farms, but they accounted for 23.8 percent of all local food sales and 31.4 percent of all local foods sales of fruit, nut, and vegetable sales. Recognized for its varied microclimates, long growing season, and extensive irrigation networks, the West Coast supplies the Nation with 56 percent of all vegetables, fruits, nuts, and other specialty crops.

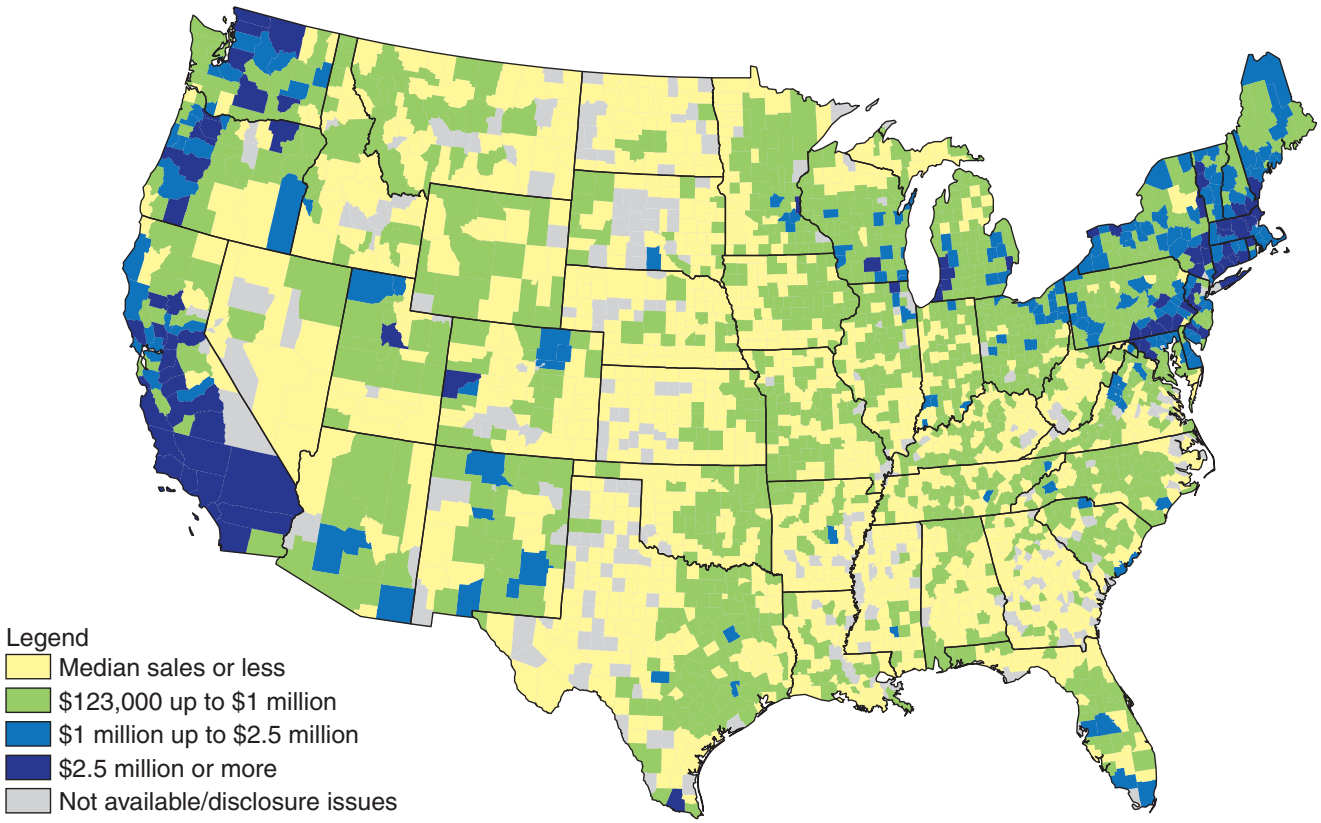
The West Coast has a long-standing system of farmers' markets and farmer-to-grocers' marketing channels dating back to the 1970s. Small-scale farmers began selling organic and high value-added niche foods to upscale restaurants in the late 1970s (now a national trend) and are now part of farm-to-school marketing arrangements. Another U.S. hot spot for local food sales is the Atlantic seaboard, particularly the Northeast census division. Local food sales farms in the Northeast generated 14.4 percent of U.S. local food

production. Regional differences in local food sales may be explained by the availability of logistics and distribution infrastructure (e.g., King et al., 2010).

Direct-to-consumer and intermediated food sales' marketing practices differ between regions. West Coast local food sales farms are more likely than those in the Northeast to be large farms located farther from metro areas. As a result, these farms predominantly market through intermediated marketing outlets, which are less time and effort intensive than direct-to-consumer marketing outlets. Indeed, 85 percent of West Coast local food sales occurred through intermediated channels. Local food sales farms in the Northeast tend to be smaller, located closer to densely populated urban markets, and more likely to use only direct-to-consumer marketing outlets.

The share of local food producers who are beginning farmers with 10 years of experience or less also varies regionally and is highest in the West. Forty-eight percent of West Coast local food producers are beginning farmers as are 28 percent of Northeast local food producers, both higher than the national share of 24.3 percent. More beginning farmers may be driven by high local food demand, but without data on the same producer over time, it is difficult to understand why more beginning farmers are located on the West Coast and in the Northeast.

Figure 3
Value of direct-to-consumer sales, by county, 2007



Source: USDA, National Agricultural Statistics Service; 2007 Census of Agriculture.

Local Food Sales Highest in Urban Areas

According to the 2008 ARMS, over half of all farms with local food sales were located in metropolitan counties, compared with only a third of all U.S. farms.[13] Using Census of Agriculture data on direct-to-consumer sales, we found that even when controlling for region-specific factors, the dominance of direct-sales farms in metropolitan counties holds (see "Appendix 2: Modeling Direct-to-Consumer Sales"), suggesting that proximity to urban markets is strongly related to the production of directly sold goods. There were not enough observations in the ARMS data to test metropolitan dominance, but tabular evidence suggests this result would not change if intermediated sales were included.

The dominant metro location of direct-sale farms could be driven by demand-side factors (e.g., access to thickly populated markets and farmers' markets) or by supply-side factors (e.g., access to labor, agricultural land, or transportation networks). Our analysis suggests that, all other factors being equal, both demand-side factors and supply-side factors, including regional production of fruits and vegetables and availability of tillable land, affect direct-to-consumer sales at the county and commuting-zone level. Our evidence did not find a clear correlation between consumer characteristics (population demographics) and direct-to-consumer sales, however.

More than 50 percent of small local food sales farms were found in metro counties and 30 percent in rural counties adjacent to metro counties, while nonlocal food sales farms were, on average, more equally distributed across metro, adjacent rural, and remote rural counties. On the demand-side, metropolitan concentration gives producers access to the urban local food sales markets essential to their economic viability. On the supply-side, concentration near urbanized areas may be the result of urban development pressures on land prices leading to the dissolution of large farms. As such, the remaining farm operations are smaller and must produce higher valued, niche agricultural commodities (Heimlich and Anderson, 2001; Nickerson, 2001).

Larger local food farms are more likely to be located in remote, nonmetropolitan areas. ARMS estimates show that 50.1 percent of large farms with local food sales were located in nonmetro counties not adjacent to metropolitan areas—only 32.6 percent of all large farms were located in these remote counties—and there were far fewer of these large local food farms.

Our analysis of direct-to-consumer sales data from the Census of Agriculture suggests that, while controlling for urbanization, the availability of farmland and other costs may drive location decisions of farms with direct-to-consumer sales. The availability, cost, and quality of labor may affect local food sales farms because they are more labor-intensive than comparable farms not engaging in direct sales. Fruit and vegetable farms with local food sales employed 61,000 workers in 2008, or 13 FTE employees per million dollars of sales, while fruit and vegetable farms not engaged in local food sales employed only 3 FTE employees per million dollars of sales.

[13] We used the Office of Management and Budget's 2003 definition of metropolitan counties in this analysis. Counties outside but adjacent to a metropolitan statistical area are referred to as *adjacent* counties. Remote counties are those outside of and not adjacent to a metropolitan area.

Conclusion

The 2008 ARMS data provide a broader picture of farms engaged in marketing local foods. By assessing both direct-to-consumer and intermediated sales, we can develop a more complete picture of local food markets and producers. Local food sales via intermediated marketing channels are an important component of the industry that has not previously been extensively studied.

We found that small farms with gross sales under $50,000 accounted for 81 percent of local food sales farms and were more likely to use direct-to-consumer marketing channels, such as farmers' markets and roadside stands, exclusively. Making up 14 percent of all local food sales farms, medium-sized farms were equally likely to use only direct-to-consumer marketing channels or a mixture of direct-to-consumer and intermediated marketing channels, with only 11 percent using intermediated channels exclusively. Combining marketing channels may represent the appropriate market strategy for medium-sized farms to thrive. Large farms represented 5 percent of all local food sales farms. Most local food sales by large farms were marketed by those exclusively using intermediated channels. In doing so, these farms were able to reduce labor expenses per dollar of sales by leaving the labor-intensive distribution of local foods up to intermediaries.

According to the 2008 ARMS, for small and medium local food sales farms, more primary operators identified their primary occupation as farming and all operators devoted more work time to production than similarly sized farms without local sales.

Our model of the location of producers with direct-to-consumer sales and the analysis of direct-to-consumer and intermediated local food sales with respect to location indicates that local food sales are a regional phenomenon and that marketing practices vary among regions. Controlling for various production factors, direct-to-consumer sales were highest in and near urban areas and production likely depended on the availability of labor, tillable land, and the market infrastructure essential for direct-to-consumer sales. Policy decisions that foster local food sales must account for the importance of vital, but unalterable, regional characteristics, such as climate, water availability, and access to densely populated markets, which affect the viability of local foods as an economic development tool. Findings suggest that local food sales have the potential for community economic development in certain areas of the country, particularly those close to urban areas.

While the findings of this study provide additional quantitative information at the national level on farmers engaged in local food marketing, the 2008 ARMS data are not without problems. These data are not comparable with previous USDA direct sales estimates. Additionally, we do not have dynamic data that might enable us to understand the tenure and success of local food sales farms. Further work is necessary to understand the profitability of local food sales farms and noneconomic reasons for direct-to-consumer marketing.

Improving data collection methods on local foods occurs iteratively given the time span between developing and refining the current year's ARMS

questionnaire. The 2009 ARMS questionnaire restored the phrase "for human consumption." The 2010 ARMS separates the value of direct-to-consumer sales from intermediated marketing sales and, for the first time, also includes institutional sales as part of the intermediated marketing category. These data sets are available to researchers.

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Appendix 1—Developing Data on Marketing Local Agricultural Products Using the 2008 ARMS

The 2008 ARMS is the first nationally representative survey to query farmers about the local marketing channels they used to sell their agricultural commodities. The intent of the questions in the 2008 ARMS questionnaire was to focus on marketing local foods (USDA/NASS, 2009). However, the design and structure of the questions created obstacles to deriving estimates that were both internally and externally consistent. Internal consistency means that tabulated responses to one or more questions must be consistent with tabulated responses to subsequent questions. External consistency means that the 2008 ARMS must produce estimates on direct-to-consumer sales of food as close as possible to estimates generated from the 2007 ARMS and 2007 Census of Agriculture when attempting to measure the same phenomenon.

Results for questions 21-28 of Section I, "Farm Management and Use of Time," of the 2008 ARMS questionnaire are presented in appendix table 1. To see the exact wording of each question, refer to the end of this appendix. If a respondent answered "yes" to questions 21a or 21b, the respondent proceeded to the remaining questions in the module. Question 22 asks the farmer a set of questions related to the commodities sold and if processing was required before sale. Question 23 queries which marketing channels the farmer used to sell a product. Question 23 allows us to distinguish between direct-to-consumer and intermediated sales. Question 24 asks what share of total farm sales were marketed through any of the channels listed in question 23, which allows us to calculate the value of local sales. Questions 25-28 asks the farmer about other practices indirectly linked to sales marketed in the channels listed in question 23.

We used the farmers' positive responses to questions 23a-23e and 23g to construct an estimate of the number of farmers selling farm goods "locally" to consumers. Responses to question 23f on State branding of farm products were excluded because State-branded products are often marketed nationally, perhaps even internationally. According to appendix table 1, the number of farms using one or more marketing channels accounted for 134,200 farmers marketing $8.0 billion of food and nonfood products through 199,000 direct-to-consumer (23a-23d) and intermediated outlets (23e, 23g).

Since question 21a does not include the phrase "for human consumption" or specify if local channels were used, positive responses to this question generated an estimated 280,100 farms selling farm goods directly to consumers—more than twice the number of farmers who reported direct sales for human consumption in the 2007 ARMS and the 2007 Census of Agriculture. This means that 145,900 farmers reported selling farm output to consumers in 2008 but failed to specify their marketing channels and the volume of direct sales. Two possibilities may explain this result. First, responses to question 21a may capture sales of food and nonfood products without distinguishing between local and national direct marketing channels, such as Internet or mail-order sales. Second, responses to this question may capture point sales to consumers by farmers whose sales were too low to report using direct

Appendix table 1

Direct sales farms, by farm size, 2007 Census and 2007 and 2008 ARMS

Data source	Number of direct sale farms	Percent of all farms	Gross value of direct sales	Percent of all farm sales
	Thousands	*Percent*	*Millions (nominal dollars)*	*Percent*
2007 Census of Agriculture	136.8	6.2	1,211	0.4
2007 ARMS	115.5	5.3	1,292	0.6
2008 ARMS – all farms	134.2	6.3	8,058	3.2
2008 ARMS – local food sales farms	107.2	5.0	4,806	1.9
Direct-to-consumer	71.2	3.3	877	0.4
Intermediated	13.4	0.6	2,715	1.0
Both marketing channels	22.6	1.1	1,198	0.5

Source: USDA, National Agricultural Statistics Service 2007 Census of Agriculture; 2007 and 2008 Agricultural Resource Management Survey, Version 1, conducted by the National Agricultural Statistics Service and Economic Research Service.

marketing supply chains. These farmers may be just "testing the waters." Hence, this question by itself adds no useful information and was omitted from our evaluation. Question 21b also suffers from this same lack of marketing-channel and geographic specificity and was not used.

The 2008 ARMS survey does not allow the researcher to separate out the value of sales of food and nonfood products sold directly by a respondent, forcing us to rely on indirect methods to estimate the value of food sales. We used the Economic Research Service (ERS) farm production typology to separate out direct sales farms selling food products and those selling nonfood products. The ERS farm typology categorizes farms by commodity if a particular commodity accounts for at least 50 percent of farm sales. Farms categorized as "Nursery and Cut Tree Farms" were classified as nonfood farms and accounted for over 95 percent of direct nonfood sales.[1] Excluding this category generated 107,200 estimated famers marketing $4.8 billion in local food products through 160,000 channels (see appendix table 1).

As a result, 2008 ARMS estimates of farmers engaging in local food sales appear similar to estimates from the 2007 ARMS and 2007 Census of Agriculture. That the estimated value of local food sales is four times higher than previous estimates suggests that new information in the 2008 ARMS provides a broader, more complex picture of farmers engaged in direct marketing of local foods.

The 2008 ARMS did not collect data linking the value of sales to the use of a particular marketing channel. Question 24 asked for the volume of sales associated with any of the channels listed in question 23. The design of this question forced us to adhere to a strict trichotomy, grouping sales by exclusive use of direct-to-consumer outlets, exclusive use of intermediated channels, or marketing simultaneously through both channels (see appendix table 1). If we were to try to tease out the value of local food sales by marketing channel, we would encounter problems with double counting, confidentiality, and statistical reliability. For those farms using both types of marketing

[1]Although nurseries and cut tree farms can and do sell food items directly to consumers, we have no way of quantifying their food sales separate from direct sales of nonfood products in the 2008 ARMS. According to the 2007 ARMS, 3,400 nurseries and cut tree farms, or 7 percent of all nursery and cut tree farms, sold $171 million of food products directly to consumers. For this small segment of nursery and cut tree farms, direct sales of local food are important to the viability of their farm operations, accounting for 34 percent of total gross sales. For the sector as a whole, however, direct sales of food represent less than 2 percent of total gross sales of nursery products and cut trees. Less than 2,000 farms sold directly to consumers and were also categorized as primarily producing nonfood products, such as horses, other live animals not for meat consumption, and aquaculture. These farms accounted for very little of the direct sales reported in question 23.

channels, the data did not allow us to quantify the contribution each type of marketing channel makes to overall farm performance.

Optimal marketing strategies are of particular importance when assessing the viability of the medium-sized farms that make the greatest use of both types of channels. Clancy and Ruhf (2010) pointed out that without direct and intermediated marketing channels, sufficient scale economies for mid-sized farms cannot be achieved.

The data presented additional challenges for our study, namely our ability to distinguish how local food sales through the Internet may be tied to our estimates of intermediated sales.[2] As described in Martinez et al. (2010), the term "local food sales" does not include any geographic reference. Only 15 percent of the respondents reporting direct sales responded in question 28 that they used the Internet to directly market their products. Because there was no follow-up question related to the volume of Internet sales, responses to question 28 remain ambiguous and we cannot estimate the volume of Internet sales among the 15 percent of farms indicating local food participation. As Internet use becomes more ubiquitous in all facets of farm operations, a set of questions will need to be included that identify Internet sales as a distinct marketing outlet.

[2]For direct-to-consumer sales, we avoided this issue by counting only those producers and the value of their sales linked to the specific place-based direct marketing channels in question 23.

MANAGEMENT PRACTICES

21. Next, I have some questions about your marketing practices. Are you currently using…

		CODE
a. direct sales to consumers?	YES = 1	1151
b. sales to retail outlets?	YES = 1	1152
c. advisory services?	YES = 1	1153
d. options?	YES = 1	1154
e. futures?	YES = 1	1155
f. on-farm storage?	YES = 1	1156
g. contract shipping (*hiring the hauling of your products*)?	YES = 1	1157
h. collaborative marketing or networking to sell commodities?	YES = 1	1158
i. farmer owned co-ops?	YES = 1	1159

ENUMERATOR NOTE: [*If 21(a) = 1 or 21(b) = 1 continue, otherwise go to Item 29*]

22. In 2008, did you sell products originating from:

		CODE
a. crop production other than nursery or floriculture products?	YES = 1	1160
(i) did you have these products processed prior to sale?	YES = 1	1161
b. nursery and floriculture production?	YES = 1	1162
c. livestock production?	YES = 1	1163
(i) did you have these products processed prior to sale?	YES = 1	1164
(ii) if meat products were sold, did you sell by “cut” of meat?	YES = 1	1165
(iii) if meat products were sold, did you sell by “fraction of the animal”?	YES = 1	1166
d. poultry production?	YES = 1	1167
(i) did you have the birds processed prior to sale?	YES = 1	1168
e. other animal production?	YES = 1	1169

SECTION I continued on next page.

23. Did you use any of the following outlets to market these products (Item 22):

		CODE
a. roadside stand or on-farm facility (exclude on-farm store)?	YES = 1	1171
b. on-farm store?	YES = 1	1172
c. farmer's market?	YES = 1	1173
(i) If product was sold through a farmer's market, what was the distance to the market where the majority of the product was sold?	MILES	1174
d. Community Supported Agricultural (CSA) buying club?	YES = 1	1175
(i) If product was sold through a CSA buying club, what percent of the households/families participating in the club reside in the same county as your farm?	PERCENT	1176
e. regional distributor?	YES = 1	1177
f. State branding program?	YES = 1	1178
g. direct sales to local grocery stores, restaurants, or other retailers?	YES = 1	1179

		PERCENT
24. If product was sold through any of the marketing outlets in Item 23, what percent share of total farm sales did these outlets represent in 2008?		1180

		CODE
25. If you sold livestock, poultry, or other animal products (slaughtered animals, milk, cheese, etc.) through any of the above marketing outlets, were facilities available locally (within 50 miles) for processing?	YES = 1	1181
26. Did you collaborate with other farmers to market these products?	YES = 1	1182
27. Was your product sold as a farm or regional brand?	YES = 1	1183
28. Did you use the Internet or mail order to market any of these products?	YES = 1	1184

Appendix 2—Modeling Direct-to-Consumer Sales

Prior research has raised many questions about the production and consumption of local foods, but relatively few answers exist (Brown, 2002; Lev and Gwin, 2010). Are local foods production and consumption in equilibrium? Are farmers producing local food for nonmarket reasons (e.g., enjoyment, environmental impact, or as an entry into national marketing)? Data on direct-to-consumer sales drawn from the 2007 Census of Agriculture does allow us to address factors correlated with supply and demand for local food and its spatial location. We based our conceptual model on the Brown et al. (2006) county-level model of direct sales for West Virginia and extended it to encompass all U.S. counties and commuting zones, while accounting for detected spatial autocorrelation.

We found that direct sales are driven by immobile spatial factors correlated with growing conditions and marketing opportunities. Results of our county-level and commuting zone-level models supported the regional analysis of 2008 ARMS data and also provided additional evidence of the patterns detected in the ARMS data. Model results enabled us to draw more data-driven conclusions than the ARMS data alone would have yielded due to geography and the number of observations in the Census of Agriculture that cannot be matched in the ARMS.

Data

Most studies on the determinants of local foods use survey data (e.g., Morgan and Alipoe, 2001; Lyson and Guptill, 2004; Brown et al., 2007), and a few have used secondary data (Thilmany and Watson, 2004; Brown et al., 2006). We attempted to model local food sales using 2008 ARMS data, but the sample size was too small to generate a statistically significant regression, precluding testing of the hypotheses. Using ARMS would offer a better understanding of intermediated sales. Due to data limitations, however, we can only model direct-to-consumer sales. Until additional years' ARMS data are available and we can pool surveys, we use data on direct-to-consumer sales to test the location hypothesis, to understand the drivers of local food supply and demand, and to provide additional support for our conclusions.

The dependent variable—direct-to-consumer sales of agricultural products for *human consumption*—comes from the 2007 Census of Agriculture. Explanatory variables were drawn from the 2002 Census of Agriculture, the 2000 U.S. decennial Census, and other publicly available county-level data sources. All variable descriptions, sources, and summary statistics are available in appendix table 2 for the county-level model and appendix table 4 for the commuting zone model.

Variables for the commuting zone model differ only for the purposes of aggregating county-level data up to the commuting-zone level. We used Tolbert and Sizer's (1996) commuting zones (CZ)—the most recent available—because they represent an alternative areal unit (or zonal objects) that might be large enough to capture most direct sales transactions (i.e., production and consumption occur within the same areal unit). As a plausible

spatial representation of commuting and commerce, commuting zones are an improvement over labor market areas because all U.S. counties, including the most rural, are included in a CZ. Additionally, the CZ may be a useful observation unit because, according to the 2008 ARMS, many farm households with direct sales have one member commuting to an off-farm job—84.8 percent of small direct sale farms and 59.5 percent of all direct sale food farms had at least one member commuting to an off-farm job.

The Model

Our maps and descriptive analysis revealed that substantial variation exists in direct sales across the United States. We used regression analysis to better understand how location factors are correlated with direct sales, while controlling for theoretically appropriate variables. Since data to estimate structural supply and demand equations were not available, we estimated a reduced-form equation that included supply- and demand-side variables. We used dependent and explanatory variables found in Brown et al. (2006), changing variables to expand the model from West Virginia to the United States. Due to limitations of available data, we cannot include in our models all the factors that theory suggests would affect direct sales. The models assume market equilibrium exists—that supply equals demand.[1] We used county-level data as a proxy for local markets and assumed that most consumers shop for groceries locally and producers prefer to sell locally due to increasing travel costs for both. We expected, however, that some producers and consumers traveled outside the county or commuting zone to purchase food directly from farmers. To account for this county-to-county or CZ-to-CZ spillover, we utilized a spatial econometric model to control for any spatial autocorrelation detected in the reduced-form linear (Ordinary Least Squares or OLS) regression.

[1]Unlike many other markets, quantity supplied and quantity demanded are uneven at different points in the calendar year and in different locales. In North America, supply of local food tends to be high mid-summer to autumn, while supply is almost zero at other times of the year, whereas demand tends to be more constant. By examining *annual* direct sales levels, we skirt seasonality issues. Another unique aspect to local foods is the "local" nature of supply. Using county-level variables enables us to equate local supply with local demand, an improvement over State or multi-State units of observation. The spatial econometric model specification also controls for spatial spillovers between neighboring counties.

Hypotheses and Variables

The supply of locally produced food is determined by producers, but we know little about producers' motivation (Martinez et al., 2010). From existing literature and ARMS data, we know that local food producers are most likely to produce fruits and vegetables and be located in or around an urban area (Gale, 1997; Martinez et al., 2010). We hypothesized that:

1. Supply will be higher where there are adequate inputs for production but also ample marketing outlets, *ceteris paribus*.

We tested this hypothesis with production variables included in the reduced-form equations.

Percentage of cropland in the county (*PctCropLand*) affects supply, particularly in urbanized counties where the cost of farmland may be high due to development pressure. Percentage of farms with direct sales (*DSFarms*), or having neighbors who participate in direct sales, is tied to direct sales levels via neighboring local food farms. The share of agricultural sales from fruits and vegetables (*FruitVeg*) suggests how amenable the area is to fruit and vegetable production, which is important because fruits and vegetables represent most directly sold food. The number of farmers' markets (*FmrMkt*) represents marketing outlets for producers. We expected all these production-oriented test variables to have a positive relationship with direct sales.

We controlled for environmental factors that affect local food supply. Temperature (*JulyTemp*) affects the length of the growing season and the crops that can be grown locally. Topography (*Topog*) can also affect the crops being grown locally and the feasible scale of agriculture found in the areal unit. For example, modern large-scale agriculture is easiest where more relatively flat land is available for cultivation. Thus, we might expect local food production to occur in more marginalized lands that are not as attractive for large-scale agriculture. Finally, two variables—access to interstate highways (*Hwy*) and high-speed Internet (*Internet*)—were used to control for built infrastructure, which may affect the supply and marketability of local foods.

More research on local food consumers' characteristics is available than on producer characteristics (Brown, 2002; Brown et al., 2006). A body of literature posits that local food consumers do not share a particular demographic, but instead are motivated to purchase local foods for the improved taste, quality, variety, environmental benefits, and/or to support local farmers (Brown, 2002; Martinez et al., 2010).

Spatial analysis suggests urbanization may be associated with high levels of direct sales. We hypothesized that:

2. Local foods sales are higher in metropolitan areas than rural because there are more consumers.

Since county-level consumer data for the United States are not available, we used county-level averages of supply-side factors[2] to test this urbanization hypothesis, assuming that the supply of local food will equal demand. We included dummy variables for metropolitan counties (*Metro*) and nonmetropolitan counties adjacent to metropolitan counties (*AdjMetro*) with nonmetro, nonadjacent counties as the omitted condition. We also included dummies for regions because exploratory spatial data analysis found regional heterogeneity in direct sales; we included Pacific, Mountain, Midwest, and Northeast while the South served as the omitted condition. We included population density (*PopLand*) to control for cross-county population heterogeneity without distortion. Despite a debate in the existing literature on whether wealth and income affects local food consumption, we cannot test whether demographics or motive affect an individual's desire to purchase local foods using county-level means. Rather, we controlled for wealth and income to the extent possible by using county-level average wage and salary income (*AveWS*) and median home value (*MedHomeValue*). Due to the nature of commuting zone data (i.e., its aggregation from county-level data), we instead used per capita income and the maximum of the median home value for commuting zones.

[2]Regressors are represented by average county-wide values so that each county proxies for the average characteristic of the pool of local producers and local consumers.

Empirical Methods

We first estimated the models with OLS regression. As is common with these models, heteroskedasticity was apparent in the initial results (not shown, but available upon request). After applying the White-Huber correction and re-estimating the standard errors, we obtained results that remained consistent despite the correction. Multicollinearity was not problematic in the model; the variance inflation factors for the explanatory variables were

less than five. Endogeneity commonly exists in simple, reduced-form estimations like ours, so we used lagged explanatory variables where possible to reduce this effect. Nevertheless, this endogeneity persists and can cause biased, but consistent, parameter estimates, possibly affecting the p-values of our hypothesis tests. Endogeneity should not alter coefficient signs, and we interpreted our results with due caution.

Given the spatial patterns exhibited as we mapped U.S. direct sales, we tested the OLS regression for the presence of spatial processes using the Lagrange Multiplier (LM) test. Controlling for spatial processes can reduce statistical problems, such as unstable parameters and unreliable significance tests. Spatial error processes, or nuisance errors, can occur if spatially correlated variables are omitted or the value of adjacent observations move together due to common or correlated unobservable variables. Spatial lag processes occurred due to some systematic interaction among neighbor areal units. We tested for the presence of spatial processes in both the county and CZ model.

Conducting the LM test requires that an appropriate spatial weights matrix be selected, and there is very little formal guidance when choosing the optimal spatial weights matrix. We used a first-order queen contiguity weights matrix due to the nature of spatial dependence and its suitability for use with irregular polygons. The weights matrix is row-standardized to facilitate interpretation and ease computational expense.

For the county model, we found both the lag and error LM tests were significant, so we conducted robust LM tests, according to Anselin (1988). The robust LM tests showed preference for the spatial autoregressive (SAR) model, suggesting that some sort of systematic county-to-county spatial processes exist. When spatial lag processes are unaccounted for in a model, the coefficients can be biased and inconsistent, leading to the wrong sign on coefficients and invalid hypothesis testing. Spatial dependence of this type is most frequently incorporated into models using the spatial autoregressive (SAR) lag model:

$$(1) \qquad Y = \rho \mathbf{W} Y + \beta Y + \varepsilon,$$

where $\varepsilon \sim$ i.i.d., $\mathbf{W}$ is an n x n matrix defining spatial unit interaction, and the spatial lag process is accounted for using the spatially-weighted dependent variable, $\mathbf{W}Y$ (Anselin, 1988).

We repeated the LM test for the CZ regression model and expected different results due to the alternate areal unit. The CZ is a larger areal unit that may capture county-to-county sales because producers are more likely to market within a region that includes their place of work, church, school, etc. Results of the LM tests showed that both the lag and error tests were significantly different from zero, necessitating robust LM tests. The robust tests showed preference for the spatial error model in equation 2. That is, there was no systematic spatial pattern, rather nuisance errors and/or omitted variables caused the spatial processes exhibited in the CZ model. The theory behind the spatial error process is admittedly vague; developing a theory behind implementation of the spatial error model is difficult because the errors are not due to an underlying process, but rather to a host of micro processes.

(2) $Y = \beta X + \varepsilon$,

where, $\varepsilon = \lambda \mathbf{W}\varepsilon + \mu$ and μ ~i.i.d.

We estimated the county-level model with equation 1 using generalized methods of moments. We estimated the CZ model with equation 2 using maximum likelihood estimation.

Results

Econometric model results suggest that location factors dominate direct sales. The coefficient on metropolitan (*Metro*) counties was large and significant in the county-level model (appendix table 3), and the coefficient on nonmetro counties adjacent to metro counties (*AdjMetro*) was positive, but smaller, and not statistically different from zero. Results indicate metro county *direct sales* were higher than nonmetro direct sales. Population density (*PopLand*) had a negative and significant coefficient, which taken together with the positive coefficient on *Metro*, suggests that direct sales were highest in metropolitan counties with enough open space for producers, as opposed to the most densely populated metro areas. Direct sales' difference among U.S. regions was also evident in the results. Coefficients on Pacific and Northeast regions were large in magnitude and statistically significant in both models, while controlling for metropolitan and population density. The South was the omitted condition, and coefficients on the Midwest and Mountain census regions were not statistically different from the South.

Supply-side factors exhibited a significant relationship with direct sales. In addition to the urbanization variables, proximity to other direct sales farms (*DSFarms*) and others' sales of fruits and vegetables (*FruitVeg*) were significant, suggesting neighborhood characteristics drive direct sales, *ceteris paribus*. The coefficient on the share of cropland (*PctCropLand*) had a positive sign, suggesting that the availability of tillable land is a driver of direct sales. The number of local farmers' markets (*FmrMkt*) had a positive and statistically significant coefficient. We cannot speak to the direction of the relationship between direct sales and number of farmers' markets, however.

Similar to the findings from other studies, demand-side factors in our model exhibited mixed results. The coefficient on average wage and salary income (*AveWS*) was insignificant. Median home value, a proxy for wealth, had a positive and significant coefficient that was very small. These findings affirm Brown (2002) and Martinez et al. (2010), suggesting that consumers who buy local foods do not fit a demographic, but rather are motivated by ideals and preferences—variables we cannot capture with aggregated data.

The county-level model exhibited a systematic spatial bias, which could be caused by several things—most likely either the areal unit or the spatial weights matrix were inappropriate. Several spatial weights matrices were tested to assess the robustness of the first-order queen-contiguity matrix, but a systematic (lag) process remained, suggesting that a different areal unit might yield better results. LM tests on the CZ model found that using CZs eliminated the presence of a robust spatial lag process but detected the presence of a robust spatial error process. Thus, the CZ may be a more appro-

priate areal unit of observation for direct-to-consumer sales. Some variables, however, exhibited a neighborhood effect rather than a regional effect; thus, each model has its own merits.[3]

Results from the CZ model generally affirmed county model results, although coefficients on the neighborhood variables were weaker (appendix table 5). For example, the coefficient on *DSFarms* lost statistical significance in the CZ model, likely due to less interaction among farms across a CZ than across a county and more within unit heterogeneity. Accordingly, we concluded that the influence of neighboring farmers participating in direct sales was a highly localized neighborhood effect. The coefficient on the share of farm sales from fruit and vegetable sales (*FruitVeg*) was significantly positive in both models, suggesting that the decision to grow fruits and/or vegetables was based on regional factors, such as climate, topography, and processing infrastructure, not on what their neighbors were doing. We found the square of farmers' markets has a large positive coefficient, as expected, suggesting that access to markets also drives direct sales in CZs.

As we found in the county-level model, the CZ model suggests that producers on the West Coast and in the Northeast were more likely to participate in direct sales than producers in other parts of the country. Metropolitan dummy variables were not included in the CZ model because they cannot be aggregated up to CZs, so we substituted rural-urban commuting area codes for the most urban of the CZs (USDA ERS, 2005). These variables were insignificant due to the lack of variance across CZs. For commuting zones, we found that population density (*PopLand*) and the presence of tillable land (*PctCropLand*) was less important statistically, since this areal unit was more likely to include farmland and urban places. Income and wealth proxies were insignificant in the CZ model, in line with previous research results (Martinez et al., 2010).

Much remains to be understood about the affect of production and consumption choices on direct sales, *ceteris paribus*. This study did not address causality, but looked at the characteristics and place/space associated with direct sales. Future research with more complete micro data is needed to avoid ecological fallacy issues that can arise when using aggregated county-level (or CZ level) data to test hypotheses about individuals' behavior. Finally, this econometric analysis was conducted with Census of Agriculture data on direct-to-consumer sales, which does not include direct-to-retailer or intermediated sales.

[3]This assumption likely holds for some regions of the United States, but not the country as a whole.

Appendix table 2

County variable description and summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum	Description
DS	433.8	1550.5	0	42065	Direct sales to individuals for human consumption, 2007 (in $1,000s)
DSFarms	0.064	0.063	0	1	Farms with direct sales over total farms, 2002
PctCropLand	0.305	0.258	0.00003	1	Acres cropland over total acres[1]
Internet	0.097	0.296	0	1	Counties with three or more high-speed internet providers[2]
JulyTemp	-0.002	1.007	-2.86	6.5	Mean July temperature, Z score[3]
Topog	-0.003	1.000	-1.19	1.84	Topography, Z score[3]
Hwy	0.432	0.496	0	1	Dummy, counties containing a portion of interstate highway
FmrMkt	1.723	4.624	0	94	Number of farmers' markets[4]
FruitVeg	0.054	0.130	0	0.98	Fruit, nut, and vegetable sales over total sales[5]
AveWS	20.7	5.719	5.98	68.89	Average wage and salary income (in $1,000s)[6]
PopLand	223.7	1513.7	0.04	54127	Population density: Persons per square mile[7]
MedHomeValue	80922	42110	12500	583500	Median home value in constant 2000 dollars[7]
Metro	0.328	0.470	0	1	Beale code 0,1,2,3, 2003
AdjMetro	0.324	0.468	0	1	Beale code 4,6,8: Counties adjacent to metropolitan counties
Pacific	0.053	0.225	0	1	CA, OR, WA, AK, HI
Mountain	0.091	0.288	0	1	ID, MT, WY, NV, UT, CO, AZ, NM
Midwest	0.341	0.474	0	1	ND, SD, NE, KS, MN, IA, MO, WI, IL, IN, MI, OH
Northeast	0.07	0.256	0	1	ME, NH, VT, MA, RI, NY, PA, CT

[1] 2002 Census of Agriculture data.
[2] 1999 Federal Communications Commission data.
[3] USDA's Natural Amenities Scale.
[4] USDA, Economic Research Service Food Environment Atlas.
[5] 2007 Census of Agriculture data.
[6] Bureau of Environmental Analysis, Regional Economic Information System.
[7] 2000 U.S. Census data.
Source: USDA, Economic Research Service estimates.

Appendix table 3

County regression results

	Y=Direct-to-consumer sales			
Variable	*Coefficient*	Standard error	Z-value	
DSFarms	2000.4	356.240	5.615	***
PctCropLand	374.7	80.023	4.683	***
Internet	258.4	59.428	4.348	***
JulyTemp	-102.1	20.591	-4.960	***
Topog	33.342	17.314	1.926	*
Hwy	76.590	31.540	2.428	**
FmrMkt	58.103	4.392	13.230	***
FruitVeg	1274.7	122.052	10.444	***
AveWS	1.287	3.234	0.398	
PopLand	-0.107	0.011	-10.111	***
MedHomeValue	0.002	0.001	3.159	**
Metro	170.6	42.525	4.012	***
AdjMetro	7.759	35.326	0.220	
Pacific	844.3	97.838	8.630	***
Mountain	70.9	56.513	1.255	
Midwest	-55.3	40.280	-1.372	
Northeast	502.6	74.961	6.705	***
W_DS	0.187	0.026	7.152	***
constant	-176.7	74.146	-2.383	**
N=2961				
Pseudo R-squared 0.422		Log likelihood -23788.7		

*= Statistically significant at the 10-percent level.
**= Statistically significant at the 5-percent level.
***= Statistically significant at the 1-percent level.
Source: USDA, Economic Research Service estimates.

Appendix table 4

Commuting zone variable description and summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum	Description
DS	1564.06	3448	0	31054	Direct sales to individuals for human consumption, 2007 (in $1,000s)
DSFarms	0.053	0.043	0	0.349	Farms with direct sales over all farms, 2002
PctCropLand	0.29571	0.24836	0.00002	1	Acres cropland over total acres[1]
Internet	0.61081	0.4879	0	1	Counties with three or more high-speed internet providers[2]
JulyTemp	0.29137	1.25562	-2.530	6.501	Maximum of mean July temperature, Z score[3]
Topog	0.34092	1.03461	-1.194	1.839	Maximum of topography, Z score[3]
Hwy	0.61081	0.4879	0	1	Dummy for interstate highway within CZ
FmrMkt	6.9973	14.9871	0	142	Number of farmers markets[4]
FruitVeg	1.95723	1.78069	0	11.916	Fruit, nut, and vegetable sales as percent of total sales[5]
PCI	23858.1	4294.22	12432	47104	Per capita income[6]
PopLand	101.567	270.888	0.082	5482.17	Population density: Persons per square mile[7]
MedHomeValue	78562.1	42044	23825	583500	Average of median home value in constant 2000 dollars[7]
Pacific	0.08243	0.27521	0	1	CA, OR, WA
Mountain	0.12973	0.33623	0	1	ID, MT, WY, NV, UT, CO, AZ, NM
Midwest	0.33784	0.47329	0	1	ND, SD, NE, KS, MN, IA, MO, WI, IL, IN, MI, OH
Northeast	0.05946	0.237	0	1	ME, NH, VT, MA, RI, NY, PA, CT
Midwest	0.341	0.474	0	1	ND, SD, NE, KS, MN, IA, MO, WI, IL, IN, MI, OH
Northeast	0.07	0.256	0	1	ME, NH, VT, MA, RI, NY, PA, CT

[1] 2002 Census of Agriculture data.
[2] 1999 Federal Communications Commission data.
[3] USDA's Natural Amenities Scale.
[4] USDA, Economic Research Service Food Environment Atlas.
[5] 2007 Census of Agriculture data.
[6] Bureau of Environmental Analysis, Regional Economic Information System.
[7] 2000 U.S. Census data.
Source: USDA, Economic Research Service estimates.

Appendix table 5

Commuting zone regression results

	Y=Direct-to-consumer sales			
Variable	*Coefficient*	Standard error	Z-value	
DSFarms	4747.2	3959.1	1.199	
PctCropLand	990.6	639.5	1.549	
Internet	946.2	266.4	3.552	***
JulyTemp	-399.3	119.8	-3.334	***
Topog	120.9	117.7	1.027	
Hwy	45.1	198.0	0.228	
FmrMkt^(1/2)	1165.6	80.6	14.5	***
FruitVeg	3332.0	739.4	4.5	***
PCI	-0.026	0.044	-0.595	
PopLand	-0.824	0.420	-1.96	**
MedHomeValue	0.0	0.0	0.16	
MinOfBeale	39.405	54.354	0.73	
Pacific	2815.7	528.3	5.330	***
Mountain	345.7	366.7	0.94	
Midwest	-291.6	304.2	-0.959	
Northeast	2289.7	585.9	3.908	***
lambda	0.2		13.70	***
constant	-1495.5	756.56	-1.9767	
N=720				
AIC: 13139		Log likelihood -6550.611		

**=Statistically significant at the 5-percent level.
***=Statistically significant at the 1-percent level.
AIC=Akaike Information Criterion.
Source: USDA, Economic Research Service estimates.