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Farm business financial performance in local foods value chains

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Abstract

Purpose – The purpose of this paper is to identify the factors associated with farm financial success for those farms known to produce for local supply chains. The analysis considers alternative measures of farm financial performance and considers the role of the local foods supply chain in the choice to market locally.
Design/methodology/approach – The paper uses a two-stage Heckman approach which addresses the possibility of sample selection bias. In the first stage, the choice model to engage in direct marketing is estimated. In the second stage, the authors estimate a model of the financial performance of those in the sample that direct marketed which includes an IMR term calculated from the parameters of the first stage equation. The analysis uses national farm-level data from the Agricultural and Resource Management Survey of the US Department of Agriculture and combines data from 2009 to 2012 to overcome the constraint of small samples.
Findings – Indicators of the development of a local foods supply were positively related to the choice to engage in direct marketing. Factors affecting farm financial performance varied significantly between a short-term and a long-term measure. The results emphasize the importance of considering multiple outcome measures, developing local supply chains and provide implications about beginning farms.
Originality/value – If a local foods system is going to thrive, the farms that market the agricultural products in the local food system must attain a certain level of profitability. The value of the analysis is an improved understanding of the financial performance of farms producing for a small, but growing segment of the food supply chain.

Keywords Beginning farmers, Farm financial performance, Local foods, Local foods supply chain, Local marketing channels

Paper type Research paper

An aspect of contemporary agricultural supply chains is the development of value chains that meet consumer demands for products with distinct attributes, including those associated with its production, processing and marketing (Armbruster and Knutson, 2013). One of those value chains is for local foods, which has experienced a growing interest among American consumers (Federal Reserve Bank of St Louis, 2017). Commonly cited evidence for this trend includes a rapid increase in the number of farmers markets and farm-to-school programs as well as the marketing of local foods by major retailers, like Walmart and Target, and institutional food services, like Sodexo (Federal Reserve Bank of St Louis, 2017; Tropp, 2016). Although there has always been a market for local foods, including through the use of barter, the contemporary local foods movement has only garnered widespread attention in about the last decade. Perhaps its beginning is associated with the Slow Foods Movement (Gaytan, 2004) and popularized by Michael Pollan (2006).

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Benefits most often cited by proponents of local food systems include: health and nutrition, local economic development, environmental (such as food miles), food security, and market opportunities for small and mid-sized farmers (US Department of Agriculture, 2009; Duram and Oberholtzer, 2010; Low *et al.*, 2015). The potential and diversity of benefits of local food systems motivated the US Department of Agriculture (USDA) to establish an interagency initiative to coordinate their activities and knowledge, Know Your Farmer, Know Your Food Initiative (US Department of Agriculture, 2009). The last two major pieces of farm legislation (in 2008 and 2014) have included a focus on building the local foods infrastructure. Since 2009, the USDA has invested more than $1 billion in local and regional[1] food systems projects (Federal Reserve Bank of St Louis, 2017).

Because of the popular interest in local foods and the purported benefits of local food systems, there has been a recent focus on the general topic in the literature. Most of the economics literature on local foods has focused on local foods consumer characteristics and willingness-to-pay (Martinez *et al.*, 2010) and, more recently, local economic development benefits (Hughes and Boys, 2015; O'Hara and Pirog, 2013). A much sparser literature exists on the farm-level analysis of farmers who produce for local food markets. This is an important void in the literature. If a local foods system is going to live up to its popular expectations of delivering a variety of benefits, including to the sustainability of small and mid-sized farms, the farms that market the agricultural products in the local food system must attain a certain level of profitability (Brown and Miller, 2008)[2]. Lev and Gwin (2010) argue that improved knowledge will be of value in developing and delivering technical assistance to local food farms and helpful in designing relevant public policies. This improved knowledge includes an understanding of the factors that contribute to survivability of the farm business.

In light of the growing consumer interest in local food systems and the development of the local foods infrastructure by Federal, State and local governments[3], an obvious question remains as to the profitability of local food production at the farm level. Profitability at the farm-level remains an essential element of a local foods supply chain. The overall contribution of this paper is to identify the factors associated with farm financial success for those farms known to market in local supply chains, including characteristics of the local supply chain. To address this question, we use national USDA-Agricultural and Resource Management Survey (ARMS) data from 2009-2012 to estimate a two-stage model. The first stage estimates the probability that a producer has chosen to direct market. From the first stage, an Inverse Mills Ratio (IMR) is estimated and included in the second stage that uses an OLS to determine the farm and farmer level characteristics that affect farm profitability measured as gross cash farm income (GCFI) and return on assets (ROA). We consider why factors explaining measures of farm financial performance may differ for alternative measures. We also consider the role of the local foods supply chain in the choice to market locally. We overcome some of the prior data constraints of low sample sizes identified as problematic in the literature by collapsing multiple years of farm-level data. After describing some unique challenges associated with measuring local food production, we review the relevant literature pertaining to financial performance of local food farms, describe our framework, and a description of our data sources. This is followed by a description of our empirical findings and, finally, we conclude with policy implications. The results emphasize the importance of considering multiple outcome measures, developing local supply chains and provide implications about beginning farms.

Measurement issues associated with local food production

"Local" food lacks a consistent definition across the country complicating its metrics (Martinez *et al.*, 2010; Darby *et al.*, 2008). The 2008 Food, Conservation, and Energy Act provided a definition of local foods, for a limited set of programs, as those that are consumed

within an area that is less than 400 miles from where it is produced, or within the State in which it is produced. Because of extensive regional variation, the USDA as an agency has not adopted a single definition of local foods. Although there is no firm definition of local foods, most would agree that food commodities sold directly to consumers (DTC) are considered local. DTC sales include those at farmers markets, on-farm stores, road-side stands, community supported agriculture (CSAs), and online sales[4]. Local farm commodities have also come to include those that are sold through other marketing channels with a short supply chain, such as other local retail markets (such as restaurants), institutional sales (such as schools), and intermediate markets (such as food hubs).

How local foods are defined for applied research purposes is constrained by the availability of data. Two national farm-level data sources are USDA's Census of Agriculture and the ARMS. The Census of Agriculture, conducted by the National Agricultural Statistics Service, USDA (NASS), is generally available every five years. Since 1978, the Census of Agriculture has collected information on the number of farms and their value of direct sales to individuals for human consumption (excluding sales of nonfood agricultural products, like Christmas trees or hay). In some years, the Census of Agriculture also included various YES/NO questions about related marketing practices, such as selling value-added products, like jams. In 2012, the Census of Agriculture included a YES/NO item on direct sales to retail and other intermediaries.

The ARMS collected information on the direct sales to individuals in various years; in some years the direct sales included nonfood items, like hay, complicating any trend analysis and local foods analysis. In addition, in various years, the ARMS question regarding direct sales to consumers was a simple YES/NO item, without collecting the value of those sales. In 1996, ARMS first included a YES/NO item on direct sales to intermediaries, and in later years the value of those sales. In summary, the national data sources have varied over time in terms of: whether nonfood commodities were excluded; whether the value of direct sales were collected; and whether direct marketing channels, other than direct to consumer, were considered[5].

In light of the increased popular interest in local food systems, many researchers and analysts were eagerly anticipating the release of the 2012 Census of Agriculture to quantify how recent trends would impact the farm sector and the number of farms selling DTC and selling through other local retail marketing channels. The 2012 Census of Agriculture referred to those local retail markets, other than DTC, as intermediary markets. Although, the 2012 Census of Agriculture asked farmers if they marketed their product through intermediary markets, the value of those sales was not collected. To address this and other data gaps relating to local food production, USDA conducted a more extensive farm survey of local food marketing with a reference year of 2015, released in 2016 (US Department of Agriculture, 2016).

Between 2002 and 2012, the number of farms selling DTC increased by 24 percent, while the total number of US farms stayed fairly constant, only declining by less than 1 percent (Table I). While the new 2015 survey showed a 21 percent decline from the 2012 Census of Agriculture in the number of farms producing for direct sales to consumers, it showed a large increase in the sales from these farms. More specifically, the value of sales of agricultural products sold DTC increased by more than 60 percent from 2002 to 2012, totaling $1.3 billion, and then increased another 130 percent from 2012-2015 to $3.1 billion[6].

In addition to the 144,530 farms reporting that they sold DTC in 2012, 49,043 farms reported selling to intermediaries (such as local schools or restaurants) who sold DTC. The number of farms reported selling locally to retail markets, institutions, and intermediate markets increased by 2015 to 83,535, with sales through these channels of $5.8 billion. Therefore, the total value of local sales (direct to consumer and other local marketings) in 2015 was $8.7 billion, which compares to the constructed estimate made by Low *et al.* (2015) for 2012 of $6.1 billion.

Census year	No. farms with direct sales	Value of direct sales, $1,000	% of farms with direct sales	Direct sales as a % of all US farm sales
1978	139,969	392,322	5.65	0.36
1982	143,353	498,162	6.40	0.38
1992	86,432	404,056	4.49	0.25
1997	93,140	550,947	4.20	0.28
2002	116,733	812,204	5.48	0.40
2007	136,817	1,211,270	6.21	0.41
2012	144,530	1,309,827	6.85	0.33
2015	114,801	3,026,677	5.55*	0.82*

Note: *The 2015 Local Marketing Practices Survey did not report total farms or sales
Sources: USDA, NASS, Censuses of Agriculture, various years. Alternative estimates are available from other NASS sources to compute ratios

Table I.
Trends in farms selling directly to consumers

Most US farms produce more than one commodity and data on sales of individual commodities are available. Increasingly, information on farm-level marketing strategies is also available from a whole farm perspective. However, due to the increased respondent burden, the value of sales of individual commodities through local supply chains is generally not available at the farm level. Local foods represent a small share of what is produced on US farms, but there is a wide diversity of farm commodities marketed through local channels. Of the farms which market through local channels, the most common commodity sold is beef products. Perhaps this is not surprising since more farms, in all regions, produce cattle than any other commodity. Fruits and nuts are the second most common commodity group marketed through local channels, closely followed by vegetables. A variety of other livestock products and crops, and even grains, are marketed through local channels (US Department of Agriculture, 2016).

It is important to consider the local marketing transactions in the context of the larger agricultural markets. Again, there is no trend data on the value of sales to intermediaries, so trend data can only be considered for the sales made by farmers DTC, for example, at farmers markets. Direct sales have been a small share of the output of the agricultural sector for many decades and never exceeded more than 1 percent. However, direct sales as a share of all agricultural sales decreased during the decade of 2002-2012, before more than doubling between 2012 and 2015. These trends raise questions about why farm sales of locally produced and marketed products remain a small share of total farm sales.

Part of the explanation likely lies in the expansion of sales to intermediaries. But, part of the explanation for the low share of DTC sales of total farm sales is also due to its inherent constraints. While some conclude that more food could be grown in local foodsheds (Horst and Gaolach, 2014), others argue that most US foodsheds cannot economically, climatically and/or ecologically (Born and Purcell, 2006) produce all of their local food needs. For example, in considering 28 fruits and vegetables produced in the fertile Midwest, Swenson (2010) found that the region could meet its needs for only about one-third of the year. This result relied on the extreme assumptions of a region redirecting its land away from conventional agriculture and establishing the necessary processing capabilities. In contrast, organic production can be produced in many regions and shipped anywhere with developed supply chains, a model which is consistent with the conventional supply chain and one that can benefit from the well-established economies of scale in agricultural production.

Literature on farm performance of farms producing for local markets

Some analysis of farmer production choices and characteristics has relied on county or state-level data (Brooker and Taylor, 1977; Thilmany *et al.*, 2012; Timmons and Wang, 2010).

Other studies have relied on surveys of farmers participating in farmers markets, case study analysis, or small area data (Monson *et al.*, 2008). While these analyses are generally illustrative and especially useful for tracking the development of the marketing channel, analysis of aggregated data or farmers market participants fails to provide insight into farmers' choices to engage in direct marketing and, especially, financial outcomes of marketing locally. Further, analysis of small area or case studies fails to provide an understanding of the extent that the results can be generalized to all US farms and the role played by different types of local infrastructure for US local food farms. The farm-level literature of interest here addresses the factors affecting the decision to adopt direct marketing, and for those farms that adopt direct marketing, the factors leading to financial success. We briefly summarize the most relevant studies focusing on their research question, geographic area of interest, and major conclusion.

Govindasamy *et al.* (1999) used a logit model to identify the types of marketing activities, including direct retailing, that contributed to the probability of attaining high farm incomes, measured as gross farm income per acre above the median level for 455 New Jersey farms in 1992. In their study, direct retailing was defined as DTC. They also considered sales at garden centers, but did not consider sales through other retail or institutional outlets. The authors found that those farmers who engaged in direct retailing were more likely to attain high gross incomes per acre than those farms who did not engage in these types of enterprises because they were able to benefit from the lack of a "middleman" in the supply chain. Existence of price premiums have also been reported in King *et al.* (2010), although work by Valpiani *et al.* (2016) found direct-retail pricing competitive.

Detre *et al.* (2011), using USDA's 2002 national survey of farms, the ARMS, investigated the decision to use direct marketing and its impact on gross sales. In 2002, the ARMS was integrated with the Census of Agriculture and the value of DTC sales was collected. Using a double-hurdle model, they found that large farms were less likely to adopt direct marketing. Consistent with other studies, they also found location of the farm had a significant impact on whether a farmer adopted direct marketing strategies.

Uematsu and Mishra (2011) identified factors affecting the total number of direct marketing strategies adopted by farmers and measured the impact of the intensity of adoption of direct marketing strategies on GCFI using 2008 USDA ARMS data. Out of the 4,629 farms in their sample, only 378 implemented at least one direct marketing strategy. Direct marketing strategies were considered to be the different types of direct marketing channels identified in the 2008 ARMS, such as through farmers markets or CSAs, and direct sales through intermediaries were also considered. Their analysis employed a count data analysis and a quantile regression model. They found that the intensity of adoption, or the use of multiple channels, had no significant impact on GCFI and that participation in farmers markets, in particular, was negatively correlated with GCFI. They hypothesized that a major reason they did not find the relationship they expected between direct marketing strategies and GCFI is due to the small sample sizes; they reported that only 20 observations had four or more direct marketing strategies in the 2008 ARMS. They also found that region of the country and distance from the farm to a large town was significant in explaining whether farms engaged in direct marketing, perhaps suggesting the importance of the local supply chain.

Like Uematsu and Mishra (2011), Ahearn and Sterns (2013) only focused on farms that engaged in direct marketing, but considered two alternative measures of financial performance, a short run and a long run measure. They focused on the Southeast which has the highest proportion of small farms and a climate highly suitable for fruit and vegetable production – commodities more commonly marketed through direct marketing. They estimated a logit model to consider the factors which determined whether or not farms which engaged in direct marketing, including marketing to intermediaries, had relatively

high net cash farm income and relatively high returns to farm assets with a sample of 564 farms from a combined 2009 and 2010 ARMS data set. Note that these measures are alternative profit measures, in contrast to the gross measures considered in other studies. Rather than regional dummies, they had a more refined set of county-level indicators of the local supply chain in their model and found that the growth in the number of farmers markets, the share of farms in the county using direct sales, and the access of the population to food stores all impacted the profitability of farms which direct marketed.

Park *et al.* (2014) used the 2008 ARMS[7] to consider the role of marketing and management skills in marketing options for those farms that engaged in direct marketing. They classified the 340 sample farms into three different groups of direct marketing – direct to consumer, sales to intermediaries, and sales to both consumers and intermediaries – and estimated a multinomial logit model. They measured marketing skills by whether or not a farmer employed a series of seven practices identified on the survey, such as whether they use on-farm storage or use the futures market. They measured management skills through the use of 5 practices, such as using farm advisors and shopping for the best input prices. Like Uematsu and Mishra (2011), they found that management skills were a significant factor in explaining the choice to engage in intermediary marketing and that their indicator of marketing skills was significant in explaining the gross value of farm sales.

Farm performance measurement

There is a long literature on measures of farm financial performance. Historically, the agricultural economic sources of the literature were extension programs at land grant universities with a purpose of advising farmers and, at the national level, the USDA's Economic Research Service with a purpose of advising policy makers and others with an interest in farm sector performance. However, the farm financial crisis of the 1980s brought a renewed focus on performance measurement (Lins *et al.*, 1987). The annual USDA publication on farm income and balance sheet statistics extended its reporting of financial ratios beyond ROA and equity to include an assortment of performance measures tailored to specific purposes (US Department of Agriculture, 1986). The expansion of, and access to, national farm-level data also allowed for the development of indicators of financial vulnerability among the farm population (Baum and Johnson, 1986).

Depending on the goal, there are many ways to measure farm financial performance (Farm Financial Standards Council, 2013). The FFSC categorizes financial performance measures into liquidity, solvency, profitability, and repayment capacity measures. Gross farm returns are an important part of the income statement and measures of profitability. A variety of factors are known to affect farm performance, depending in large part on the farm population and the performance measures. Fox *et al.* (1993) provided a useful summary of those factors. Examples of more recent analysis using national data from the ARMS to examine performance include (Ahrendsen *et al.*, 2007; El-Osta and Johnson, 1998; Kropp and Katchova, 2011; McBride and El-Osta, 2002; Mishra and Morehart, 2001).

A general finding of the literature is the importance of both operator characteristics and farm characteristics. In particular, variables that capture the operator's level of human capital have consistently been found to have a positive and significant effect on farm performance. These include measures of age, education, and operator experience. The literature also supports a positive association with farm size and various good management practices. For example, engagement in activities that are associated with risk management are positively associated with farm performance. This includes participation in government programs (Kropp and Katchova, 2011) and various marketing options, such as contracting (McBride and Key, 2013). Diversification in production is another risk management strategy, both in terms of the numbers of commodities produced and the characteristics of those commodities, including organic.

Conceptual framework and estimation approach

Our approach to modeling the farm performance of local-food farms is similar in some respects to Park *et al.* (2014) and Ahearn and Sterns (2013). Like Park *et al.* (2014), we use a two-stage approach to address sample selection bias that may be at play in the choice of marketing channel. Like Ahearn and Sterns (2013), we consider two different measures of returns and consider the role of the local supply chain. A farm business faces many decisions in the process of profit maximization. Given the growing demand for local foods, one of those choices is whether or not to produce for local supply chains. Marketing in local supply chains may have the benefit of earning a premium price over conventional supply chains. However, marketing in local supply chains can also affect production costs for a variety of inputs, for example, the additional labor associated with marketing locally (Hardesty and Leff, 2010). The primary motivation of farmers choosing to market in local supply chains is their perception that marketing locally will result in higher profits.

Estimating the profitability of choosing to market locally could potentially result in selection bias. Selection bias poses a challenge in estimating the effects of farmers' decisions because their decisions are non-random and the outcomes of their choices not made are not observable. The method used in this paper to address possible selection bias, as proposed by Heckman (1979), assumes a joint normal distribution between the errors of a selection equation and treatment equations. In our analysis, we first examine the factors associated with the choice to engage in direct marketing and then separately examine the financial performance of farms that choose to market through direct marketing channels. This two-stage approach first estimates the choice model in stage one by the ith farmer ($i = 1, \ldots, n$) of whether, or not, to engage in direct marketing for the full sample as in Greene (2008, pp. 884-885):

$$\begin{aligned} Z_i^* &= X_i'\alpha + u_i, \quad u_i \approx N(0,1), \\ Z_i &= 1 \text{ if } Z_i^* > 0 \text{ (operator markets locally)} \\ &= 0 \text{ if } Z_i^* \leqslant 0 \text{ (otherwise).} \end{aligned} \tag{1}$$

The parameters of the first stage also provide for an estimate of the IMR. In the second stage of the model, or outcome equation, profitability is the primary equation of interest. In this stage, after the sample-selection correction term, IMR, is added, the outcome OLS regression equation can be expressed as:

$$Y_i = x_i'\beta + \gamma\lambda_i + \varepsilon_i, \tag{2}$$

where x is a subset of the explanatory variables in (1), and where λ is a random variable, representing the IMR, and is estimated from the parameters from the probit regression in (1) for the purpose of testing and/or correcting for the possible presence of sample-selection:

$$\lambda_i = \frac{\varphi(Z_i)}{\Phi(Z_i)} \quad \text{if } Z_i = 1$$

$$\lambda_i = -\frac{\varphi(Z_i)}{[1-\Phi(Z_i)]} \quad \text{if } Z_i = 0,$$

Data

The farm-level data used in this study are from the USDA's ARMS. The ARMS is conducted annually by the Economic Research Service and the NASS (US Department of Agriculture, 2018). The survey collects data to measure the financial condition (farm income, expenses, assets, and debts) and operating characteristics of farm businesses, the cost of producing agricultural commodities, and the well-being of farm operator households.

The target population of the survey is principal operators of farm businesses representing agricultural production in the 48 contiguous states. In the USA, since the mid-1970s, a farm is defined as an establishment that sold or normally would have sold at least $1,000 of agricultural products during the year. Note that this definition means that some places are classified as farms even though they did not have farm sales in any particular year. Data are collected from one operator per farm, the principal farm operator. A principal farm operator is the operator who makes most of the day-to-day management decisions.

For the purpose of this study, those operator households organized as nonfamily farms were excluded. Nonfamily farms are defined as those where less than half of the farm assets are owned by the principal operator and his or her extended family, whether they reside in the same household or not. Nonfamily farms are 2 percent of all farms and are a very diverse group, including farms organized as trusts with hired managers. In addition, the ARMS does not collect demographic information of interest from operators of nonfamily farms.

In defining our sample of interest, we also excluded those farms that reported that they did not produce any agricultural commodities. In a typical year, approximately one-quarter of farms are in that category. This is likely a reflection of many factors, but mainly because many farms are lifestyle farms. They are not of interest in this study and have little relevance for farm policy purposes.

The ARMS collects a core set of information from farms annually, but a subset of items are collected sporadically. This is the case for DTC sales, which was first collected as a separate item on the ARMS in 1998 and later in 2006-2012. However, in 1998, 2006, and 2008, direct sales were defined to include those of nonfood items, like Christmas trees and hay. Since 2009, direct sales are defined to exclude nonfood items, making it consistent with the Census of Agriculture's concept[8].

We define our population of interest-local food farms-based on: what they market; and where they market. Our definition of local food farms are those that produce farm products for human consumption and market those products DTC and/or those that indicated that they marketed products for human consumption to local retail and other intermediaries. We recognize that we use the term "local" with a specific definition in our analysis, even though there is no official definition of what local means and other studies may employ different definitions depending on their data source and year of collection[9].

The ARMS data are designed to be representative of the US population of farms for the 48 contiguous states and for major regions and some states. However, because farms engaged in direct sales are a relatively small share of all US farms, we pool data from the 2009, 2010, 2011, and the 2012 ARMS. The small ARMS sample of farms using direct marketing has been cited as a constraint by previous ARMS researchers using a single year of data. All monetary variables are expressed in constant 2012 values and the models include dummies for years.

The ARMS data include a geospatial county identifier, the FIPS code, so we are able to link county-level characteristics that are relevant to the local marketing environment. In addition to the farm-level data of ARMS, we include county-level variables from the Food Environment Atlas to capture the local marketing environment. The Food Environment Atlas is a county and state database of variables compiled from a variety of sources that relate to food issues in general (US Department of Agriculture, 2015b).

The ARMS data have a complex survey design with a multiphase sampling scheme and any inference based on estimated parameters from classical statistical algorithms become suspect. Hence, to assure reliable statistical inference, we employ the delete-a-group jackknife variance-estimation method for both the summary statistics and regression analysis using the 30 replicate weights developed for each observation by the NASS, USDA. The jackknife variance estimate measures how much the replicate estimates differ from the full sample estimate. The jackknife is a method suitable for estimating standard errors when the data set has a complex survey design (Kott, 1997; Dubman, 2000).

Empirical model

We focus on two measures, GCFI and ROA. GCFI is a short-run measure of gross returns, calculated before operating and ownership expenses. This measure of financial performance is similar to measures employed by others in the literature (Uematsu and Mishra, 2011). In addition, we consider a common measure of profitability, ROA. ROA is calculated as net farm income less an estimate of unpaid labor and management and before payments for interest divided by the value of farm assets. The estimate of unpaid labor and management is based on reported hours worked and state-level wage rates; interest payments and the value of farm assets are reported by the respondent on the survey. The net farm income estimate in this calculation includes all cash and noncash items. The importance of using the ROA measure also comes from the inclusion of the costs associated with unpaid labor and management, because direct marketing is known to require additional time spent marketing compared with other marketing options (Hardesty and Leff, 2010). Both measures of returns are used in logarithmic form.

Table II presents the model variables, definitions, and summary statistics. Variables included in the models are those known to generally be significant in explaining production and marketing decisions and farm financial performance, as well as those specific to the relative sparse literature on the financial performance of farms engaged in local marketing. These include the characteristics of farmers and farm families, characteristics of the farms they operate, characteristics of the local supply chain, as well as dummies for the data years, 2009 to 2012.

Farmer and household characteristics

Age (AGE, AGE2) and education (EDUC), but also marital status (MARRY) and gender (GENDER) of the principal operator and whether or not the principal operator is considered to be a beginning farmer (BEGIN) are important characteristics of farmers and their families. Increased educational attainment and age, as a measure of experience, are standard variables used as proxies for human capital and expected to be positively related to marketing locally due to the greater knowledge requirements of understanding dynamic market conditions. The presence of a spouse may indicate an additional resource to meet labor and management requirements; the gender of the principal operator may be negatively related to direct marketing because women operators have special child-bearing responsibilities that may compete with farm management and labor demands. On the other hand, direct marketing may provide more time flexibility for managing multiple commitments in production and marketing. Beginning farms are hypothesized to be positively associated with farm returns since there is evidence that beginning farms are more likely than established farms to choose to engage in local marketing (Ahearn, 2013) and their greater interest may lead to higher returns.

Farm characteristics

Another category of variables hypothesized to affect farm returns are production specific variables: including farm size (GSLSPY), diversification (NCOMM), organic practices (ORGANIC), the use of high speed internet (INTERNET), participation in government programs (GOVT) or contracting (CONTRACT), hours the operator works on the farm (OPHRS) and the hours of unpaid labor (UNPAID). Following Detre *et al.* (2011), the relationship between farm size and the choice to engage in local marketing is expected to be inversely related to direct marketing, in part due to the greater labor intensity of marketing locally compared to selling more conventionally in bulk. Small farms are also more likely to produce multiple commodities. Traditional retail outlets often do not offer consumers a wide variety of farm commodities compared to what might be offered at local marketing outlets. Hence, the number of commodities a farm produces may be positively related to direct marketing. Organically produce commodities, in particular, demand a price premium and are a larger share of commodities marketed through local channels (Carlson, 2016).

Variable	Definition	Mean	SD[c]
GCFI	Gross cash farm income, $1,000 (used in logarithm)	129.822	6.707
ROA	Return on assets (used in logarithm)	3.383	0.044
AGE	Age of the principal operator	58.167	0.157
AGE2	Age of principal operator squared	3561.784	17.435
EDUC	Education of principal operator, years	13.476	0.030
MARRY	Dummy, = 1 if principal operator is married	0.826	0.004
GENDER	Dummy, = 1 if principal operator is male	0.920	0.003
BEGIN	Dummy, = 1 if operators have farmed for 10 years or less	0.167	0.004
GSLSPY	Gross farm sales, $1,000, previous year, farm size measure	150.828	2.927
NCOMM	Number of commodities produced	2.042	0.014
ORGANIC	Dummy, = 1 if produces certified organic	0.006	0.001
INTERNET	Dummy, = 1 if uses high speed internet	0.567	0.006
CONTRACT	Dummy, = 1 if uses production or marketing contracts	0.160	0.004
GOVT	Dummy, = 1 if participates in government farm programs	0.372	0.005
OPHRS	Hours principal operator works on farm, 1,000	0.751	0.006
UNPAID	Hours of unpaid workers on farm, 1,000	0.296	0.007
VEGFRT	Acres of fresh vegetables and orchards per 1,000 population, in county	44.527	1.630
FMRKT	Number of farmers markets in county, 2009	1.835	0.027
CH_FMRKT	% change in the number of farmers markets in county, 2009-2012	24.406	1.020
METRO	Dummy, = 1 if metro or adjacent to metro	0.661	0.005
POVRATE	Poverty rate in county	16.482	0.076
NE[e]	Dummy, = 1 if region is Northeast (South is omitted region)[d]	0.051	0.001
MW[f]	Dummy, = 1 if region is Midwest (South is omitted region)[d]	0.376	0.008
WE[g]	Dummy, = 1 if region is West (South is omitted region)[d]	0.126	0.002
YEAR10	Dummy, = 1 if year is 2010 (2009 is omitted year)	0.248	0.010
YEAR11	Dummy, = 1 if year is 2011 (2009 is omitted year)	0.257	0.004
YEAR12	Dummy, = 1 if year is 2012 (2009 is omitted year)	0.248	0.004

	Sample size	Expanded population
Entire sample, 2009-2012	36,517	1,600,892
Only those using direct marketing, 2009-2012	3,560	214,294

Notes: [a]Excludes farms that reported no production in survey year; [b]Dollar values are in 2012 dollars, deflated by the prices received index; [c]standard deviations are calculated with jackknife procedure; [d]the South includes: Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Tennessee, Virginia, District of Columbia, and West Virginia; [e]the Northeast includes: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania. Rhode Island, and Vermont; [f]the Midwest includes: Illinois, Iowa, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; [g]the West includes: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
Sources: USDA, ARMS, 2009-2012

Table II.
Variable definitions and weighted summary statistics, 2009-2012[a, b]

Farm use of the internet is hypothesized to be positively related to direct marketing and performance since it contributes to market information for both producers and consumers. Practices which contribute to risk management may be negatively related to the choice to use direct marketing due to the resource commitments associated with those risk management strategies. This includes participation in government programs and marketing and/or production contracting. Engagement in government programs is expected to be negatively related to returns for local food producers because the large share of the government program payments are focused on traditional grains, sold through conventional markets.

Local food marketing environment

Another set of variables which characterize the local marketing infrastructure of an area are included in the first stage equation of the choice to engage in local marketing because they

characterize the opportunities available to a farmer. These include the extent of fruit and vegetable production (VEGFRT), the number-and recent growth in the number-of farmer's markets (FMRKT and CH_FMRKT), adjacency to a metropolitan area (METRO), poverty rate (POVRATE), and region (South, NE, MW, WE. While it is not totally clear how the local fruit and vegetable production and income status of the local population affect the financial performance of local food farms, they are known to be important variables in characterizing the local foods marketplace. Uematsu and Mishra (2011) characterized the local marketing infrastructure using the distance to the nearest metropolitan area. In addition, the first and second stage equations of the model include dummies for the data year.

Results and discussion

The results will be discussed in two parts. The first part will discuss the factors affecting the choice to be engaged in local marketing. The second part will discuss the results of the financial performance of farms engaged in local marketing, using two financial measures.

Stage 1-factors affecting the direct marketing choice

Binomial probit parameter estimates for the direct marketing choice are presented in Table III. The full sample of 36,517, representing 1.6 million farms was used in the estimation. McFadden's R^2 was 0.12. Most of the variables hypothesized to affect the choice to engage in direct marketing were significant. Surprisingly, AGE and AGE2 were not significant. Perhaps this is because direct marketing is used as a transition strategy in agriculture, where the very

Variable	Estimate	SE
Intercept	−2.479***	0.456
AGE	0.015	0.018
AGE2	−0.00014	−0.00016
EDUC	0.0262**	0.0110
MARRY	0.1708**	0.0768
GENDER	−0.1906***	0.0622
BEGIN	0.1742***	0.0642
GSLSPY	−0.0002***	0.00005
NCOMM	0.1070**	0.0430
ORGANIC	0.703***	0.257
INTERNET	0.1706***	0.0774
CONTRACT	−0.653***	0.068
GOVT	−0.308**	0.1277
OPHRS	−0.0062	0.053
UNPAID	0.171***	0.034
VEGFRT	−0.00037***	0.00011
FMRKT	0.0142***	0.0025
CH_FMRKT	0.0009***	0.0002
METRO	0.189***	0.0617
POVRATE	0.0112***	0.00429
NE	0.778***	0.094
MW	0.254***	0.068
WE	0.467***	0.073
YEAR10	−0.1197	0.081
YEAR11	−0.385***	0.079
YEAR12	−0.363***	0.0647
McFadden's R^2	0.12	
Sample size	36,517	

Note: **,***Significant at 5 and 1 percent levels, respectively

Table III.
Stage 1: binomial probit maximum likelihood estimates: choice of direct marketing, 2009-2012

young, generally with higher educational attainment, use it to transition into agriculture as part of the process of learning production techniques and the market opportunities, and elderly farmers use it as they transition out of agriculture production. Having a spouse increased the likelihood of marketing locally, perhaps because of the intensity of the labor and management requirements involved in marketing locally. Having a woman principal operator and being a new entrant increased the likelihood of marketing locally, perhaps indicating a new marketing niche for women and new entrants into farming.

Most of the variables characterizing the farm were significant. As expected, farm size was negatively related to the choice to use direct marketing and the number of commodities produced and producing organically were both positively related to direct marketing. Having high speed internet was positively related to the choice of direct marketing, as expected, and is consistent with the increase in internet tools available to match producers and consumers in direct marketing. An advantage of direct marketing is the flexibility it can bring, except in the case where a producer has a contract to deliver products. Consistent with that explanation, we found that having a production or marketing contract was negatively related to being engaged in direct marketing. Producers with a contract to deliver output are focused on meeting the terms of that contract and have less time, output, and flexibility to participate in direct marketing. We also found that receiving government payments was negatively related to being engaged in direct marketing. Like contracting, participating in government programs is a risk management tool. These risk management strategies are less likely to be available to producers of commodities often marketed directly. Although the number of farm hours worked by the operator was not significant in the stage 1 model, the number of unpaid hours was positive and significant.

Because of the unevenness of the development of local food markets across the country – in some cases characterized as "missing" markets – we were especially interested in the third set of factors that characterized the local foods environment[10]. We found a negative relationship between the choice to engage in direct marketing and the acres of fruit and vegetable production per capita in a county. Perhaps this is because regions with significant fruit and vegetable production are already geared up to market through national and global supply chains, leaving less available for local markets. These could also be regions where the local population is accustomed to producing their own fruits and vegetables, in favorable climatic conditions, reducing local demand through typical local marketing channels.

The number of farmers markets and percent change in farmers markets over the study period were both positively related to the farmers' choice to engage in direct marketing. As mentioned these are key indicators of the development of a local foods supply chain. Given the importance of having marketing outlet alternatives, the positive relationship between these variables and the choice to engage in direct marketing was as expected. Similarly, being in or adjacent to a metropolitan county and being outside of the Southern region were positively related to the choice to market through direct channels. Poverty rate of an area was significant and positively related to the choice to market locally. Many urban and rural counties experience high poverty rates and perhaps this finding is indicative of direct marketing activity in both settings.

Stage 2-farm financial outcome measures of direct marketing

Results for the second stage (OLS) of the Heckman two-step model are shown in Table IV. The sample size for this stage of the analysis was 3,560, representing 214,294 farms engaged in direct marketing. The model was significant as measured by the *F*-value. The two farm financial outcomes considered, GCFI and return on farm assets (ROA), were both measured in logarithmic form. The second stage incorporates the IMR. We found a difference in the significance of the IMR for the two models. The sample selectivity variable, λ, was found to

Variable	Gross cash farm income model estimates Estimate	*t*-value	Return on farm assets model estimates Estimate	*t*-value
Intercept	8.224***	9.58	5.864***	7.19
AGE	−0.054*	−1.89	−0.042	−1.62
AGE2	0.0004*	1.74	0.0002	1.04
EDUC	0.059**	2.13	−0.030**	−2.04
MARRY	−0.179	−1.16	−0.102	−1.14
GENDER	0.40**	2.05	−0.557	−0.36
BEGIN	−0.443***	−3.07	0.311***	2.98
GSLSPY	0.001***	5.48	−0.0006***	−5.07
NCOMM	0.086**	2.84	−0.070**	−2.32
ORGANIC	0.293	1.10	0.348*	1.71
INTERNET	0.079	0.47	−0.219**	−2.72
CONTRACT	0.896***	4.83	−0.424***	−3.43
GOVT	1.074***	7.08	−0.599***	−4.16
OPHRS	1.383***	13.04	−0.371***	−6.62
UNPAID	0.100	1.63	−0.009	−0.22
YEAR10	−0.003	−0.02	0.011	0.14
YEAR11	−0.186	−1.26	0.007	0.10
YEAR12	−0.134	−0.77	−0.034	−0.48
λ	−0.035	−0.17	0.293**	2.52
R^2	0.5152		0.3139	
Weighted sample	214,294		214,294	
Sample size	3,560		3,560	
F-value	29.848***		30.06***	

Note: *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table IV.
Stage two: regression estimates of financial outcomes (in logarithm) from direct marketing, 2009-2012

be significant in the ROA model, but not the GCFI model. The GCFI model had a better fit than the ROA model, with R^2 of 0.52 and 0.31, respectively.

GCFI. For the short-term outcome measure, GCFI, AGE was negatively related and EDUC was positively related with the outcome. In other words, being young and well-educated was positively related to short-term financial performance. The negative sign of AGE coupled with the positive sign of AGE2 indicates the classical inverted U-shaped curve often observed for differing subpopulations of farmers in various farm performance models. Being a beginning farmer was negatively related to GCFI. Many of the farm characteristics hypothesized to be related to GCFI were significant. Not surprising, farm size and the number of hours operators worked on the farm were positively related to returns. Participating in contracting and government programs, two risk management strategies, were significant and positive in explaining GCFI. Another risk management strategy, diversification or NCOMM, as measured by the number of commodities produced, was positively related to GCFI. Engaging in organic production is another way to diversify, but it was not significant in the GCFI model.

ROA. In considering the ROA model, many of the farmer characteristics were not significant in the model. Educational attainment was significant, but negative, and being a beginning farmer was significant, but positive in the ROA model. All of the farm characteristics hypothesized to affect performance were significant in the ROA model, with the exception of UNPAID, unpaid labor hours. However, the sign of the farm characteristics explaining ROA for local food farmers were largely not as expected. For example, farm size and hours the operators worked on the farm, both had negative signs. As indicated, it is not surprising that farm size is positively related to gross returns, but a priori it is less clear of the role of farm size in explaining a financial performance outcome when expenses are considered, as they are in ROA. The risk management strategies of contracting and

participation in government programs were also negatively related to the ROA. In the ROA model, the diversification of the farm (as measured by the number of commodities, NCOMM) was significant and negative, supporting the argument of economies in specialization.

Discussion. There are very clear differences in which factors are most important in explaining differing measures of farm returns. We considered both a short-term and a long-term measure of farm returns. A short-term measure does not account for opportunity costs of owned inputs, such as an operator's time, while the long-term measure does; for example, the hours worked by the farm operator has an opposite effect on returns in the two models. The majority of farm households rely on their off-farm jobs for most of their cash income and benefits, like health insurance. Cash from off-farm work also often provides the needed cash to grow farm businesses. Hence, while operator hours can go "unpaid" in the short-run, the opportunity costs of operator time are very significant to the farm and the household in the long-run (El-Osta *et al.*, 2004).

In comparing the two outcome models, it is striking that, when they were significant, the relationships of the right-hand-side variables to the two outcome measures had the opposite signs. This underscores the importance of considering multiple indicators of performance before drawing conclusions about the returns from engaging in direct marketing. In particular, this emphasizes the need to consider the production expenses associated with marketing locally. Recall that our first outcome measure was simply gross cash sales (GCFI) and did not consider costs of inputs, whether owned or purchased, capital or operating. This is similar to the case for organic production for which there is evidence which shows that organic producers do indeed receive a price premium but also incur disproportionately larger costs of production, relative to conventional production. This underscores the need for extension programs directed at advising the farm population marketing through local channels. The needed extension programs seem traditional in nature, but they call for more targeted analysis for farms engaged, or considering being engaged, in direct marketing. Moreover, given the lack of data on production costs and returns for many of the commodities marketed through local chains, local extension expertise needs to be further supported and developed.

In the short-run, producers are likely to be concerned with increasing gross returns to ensure immediate cash flow to meet any potential loan obligations and to otherwise cover cash expenses. In a long-run perspective, however, producers are more focused on returns to assets. Many of the factors contributing to short-term returns were negatively related to the long-term measure of ROA. For example, farm size was positively related to GCFI, but negatively related to ROA, which considers the costs of all inputs, owned and purchased. If local food producers intend to expand their operation, they will likely need to expand their marketing channels outside of local channels, if they are to maintain positive ROA. Alternatively, to the extent that local food supply chains continue to be enhanced, greater local market opportunities may support larger farm sizes.

In the short-term, being a beginning farmer is negatively related to GCFI, but positively related to the long-term performance measure of ROA. Perhaps the short-run finding can be explained by their lower asset accumulation over a shorter work life in farming, hindering their ability to generate significant sales. Regarding the finding on a long-term performance measure, recall that ROA is the residual from returns, after all other inputs are paid, accruing to farm assets. For a given residual income, ROA would be higher if assets are lower, as is the case for beginning farmers as a group. Local foods farming may be a useful strategy for establishing a business, but farms seeking to expand their business may need to diversify their marketing strategies. This is especially true for farms seeking to expand their business through asset accumulation. Access to affordable farmland, in particular, is consistently listed by new entrants as a barrier to their long-term success (Ackoff *et al.*, 2017).

Conclusions and implications

A persistent claim of those in the local foods movement is that marketing of local foods supports both the farms that supply to the local supply chain and the communities in the local foodshed through positive economic development outcomes. Quantitative evidence about the community impacts is just beginning to be amassed as the movement continues to grow, as measured by the number of farmers markets and food hubs. Many US farms engaged in agricultural production lose money on a net cash basis consistently, but they earn returns through tax and capital gains benefits. Our focus here is on the returns to farming for those engaged in marketing through local supply chains. In particular, the major purpose of this research was to provide a better understanding of the factors that affect the ability of farms to make a profit supplying to the local food supply chain. We found that a variety of factors affect the financial outcomes of farms that produce for local markets, however, these factors affect short-term outcomes differently than long-term measures of performance. This is not unrelated to the life-cycle stage of the farm family and of relevance to sound farm management planning. To the extent that many local food farming families are new to farming and lack historical roots in agriculture, there is an important role for extension to assist farmers in managing for a successful long run outcome.

If local foods systems are going to develop to meet local demands, structural changes in agriculture and local supply chains must occur in many foodsheds. We found that the fundamental demand and supply conditions, such as access to farmer's markets and recent growth in farmer's markets, were critical in the producer choice to engage in local food production. This underscores the value of the relatively recent USDA investment in developing local "missing" or underdeveloped supply chains. Coordination of programs, as was done in the Know Your Farmer, Know Your Food initiative, are likely to be especially important to new entrants for whom success in the short run is vital to their survival. Relative to other US regions, farmers in the Southern region are less likely to market locally. The South is also one of the regions where the local food supply chains are relatively less developed, even though many counties have large acreage in fruit and vegetable production. Given that the South has a large share of small farms and that farms supplying to local food systems are generally small farms, investment in local food supply chains in the South, in particular, is warranted. The last two farm bills have provided modest support for local food farming, through support of farmers and local supply chain development. These comprehensive pieces of legislation have also provided targeted support for beginning farmers. Development of the next farm bill has begun and it remains to be seen if this support for local food systems will continue into the future.

Notes

1. Local and regional are used interchangeably in the literature, in part, because they lack specific geographic boundary definitions in the context of food systems.
2. Peterson *et al.* (2012) consider issues other than profitability that may be motivating the organic producer community that may be relevant to producers marketing through local food supply chains. These include lifestyle and the environment.
3. While supply chains are private markets, there is a role for government in maintaining the efficiency, nutrition, and safety of our food supply regardless of scale, for example, through the 1946 Agricultural Marketing Act and subsequent legislation (Tropp, 2016).
4. USDA, Agricultural Marketing Service's national directory indicates that, as of 2016, there were 8,527 farmers markets, 668 Community Supported Agriculture arrangements, 153 food hubs, and 1,313 on-farm markets (Tropp, 2016).

5. The importance of direct marketing channels, other than direct to consumer, was discussed at the annual ARMS "schools" where State and national statisticians and economists meet to discuss the current year survey. Subsequently, it was discussed extensively at USDA's Know Your Farmer, Know Your Food effort.
6. Note that the 2012-2015 increase should be viewed with caution. There was a significant change in the data collection approach for the value of direct sales between 2012 and 2015 and the 2015 value includes value-added products, such as jams and jellies, while the 2012 does not.
7. Note that the two studies using 2008 ARMS data (Uematsu and Mishra, 2011; Park *et al.*, 2014) included nonfood items, such as Christmas trees and hay, in direct sales:

$$\lambda_i = \frac{\varphi(Z_i)}{\Phi(Z_i)} \quad \text{if } Z_i = 1$$

$$\lambda_i = -\frac{\varphi(Z_i)}{[1-\Phi(Z_i)]} \quad \text{if } Z_i = 0,$$

   and where ϕ and Φ are, respectively, the standard probability density and the standard cumulative distribution function of the probability distribution obtained from (1).
8. This definitional change can have a major impact on the composition of the farms marketing directly. For example, the 2007 ARMS and 2007 Census of Agriculture which both excluded nonfood items from the definition found that 6 percent of farms reported direct sales, compared to the more than 18 percent of farms which reported direct sales in 2008 when nonfood items were included.
9. It should also be noted that identification of local food farms has special challenges for another reason. Farmers contacted through surveys and censuses do not always know where their production is marketed. For example, while the Census of Agriculture reports that approximately 50,000 farms reported in 2012 that they sold to intermediaries who sold directly to consumers, it is likely that more of the total 2.1 million farms are having their output sold locally, but are not aware of the final distribution of their products to consumers. And the farms selling to intermediaries of local food sales, both known and unknown, are likely to have experienced a growth in numbers and output during the past decade. Secondary evidence of this is the growth in food hubs (Barham *et al.*, 2012; Matson *et al.*, 2013) and farm-to-school programs (US Department of Agriculture, 2015a).
10. "Missing markets," a concept often applied to food systems in developing countries (Barrett *et al.*, 2010; Mottaleb *et al.*, 2014), is also a relevant concept for the local foods supply chain for some regions of the USA.

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