Multifunctional Agriculture and Farm Viability in the United States

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Abstract

Multifunctionality of agriculture is being heralded as a way to achieve food and fiber production while simultaneously providing ecological services and promoting rural development through the establishment of new enterprises. However, in order for multifunctional agriculture to achieve these objectives it must be viable. To date there have been no empirical studies assessing the current regional distribution of multifunctional activities in the U.S. Using the 2002 and 2007 Census of Agriculture we use regional econometric models to estimate the impact of county-level measures of multifunctional activities on farm viability as measured by the change in the number of farms. Results indicate that direct sales for human consumption were associated with increases in the number of farms only in New England. An increase in income from agritourism and recreational services within a county was associated with *reduced* farm viability nationally and in three regions. In three of the eight regions results confirm previous findings that off-farm labor income is a means of diversifying and potentially stabilizing total income of farm households, and that it may also serve as a financial platform for new entrants into farming.

Keywords: multifunctional agriculture, farm viability, direct sales, agritourism income, regions
JEL Codes: Q11, Q13, R11

1. Introduction

Multifunctionality in agriculture has received increased attention in certain academic and policy arenas (Libby, 2002; Randall, 2002; Vatn, 2002; Batie, 2003; Moon and Griffith, 2011). Some authors have suggested that it can serve as a framework for viewing agriculture's changing role in developed countries in the 21st century from a limited foundation of food production to a more holistic role that incorporates environmental and cultural management as well as rural development (Potter, 2002; Dobbs and Pretty, 2004). Multifunctional agriculture is purported to enable farmers to profit from production of both agricultural commodities and a variety of ecological services through the development of new enterprises (Wilson, 2007; Jordan and Warner, 2010).

One factor influencing the potential usefulness of multifunctionality as a framework in the U.S. is the ongoing structural change within agriculture. On the one hand, the number of U.S.

farms remained remarkably stable at around 2 million between 1978, when the current farm definition was adopted, and 2007. On the other hand, this relative stability in farm numbers masks a great deal of structural change in the size distribution and productivity of farms. The 2007 Agricultural Census showed an increase in the number of farms in the U.S., although only at the very lowest and highest ends of the size distribution. The Census also showed the continuing concentration of farm production on the largest farms. Some research has suggested that diversifying agriculture on actively farmed land could provide environmental, social, and economic benefits (Boody et al., 2005), which seems at odds with the general trend of increased concentration in U.S. agriculture production on larger farms. However, small and medium sized farmers may seek to diversify their income portfolio by engaging in multifunctional operations such as agri-tourism, value added production, direct sales, and off farm jobs as a way of consumption smoothing. Anecdotally, there is support that multifunctional activities may improve long term farm profitability and economic opportunities for some rural communities. For instance, the case of Hardwick, VT has been heralded as the "town that food saved" (Hewitt, 2009). Despite this type of evidence and the importance that multifunctional farms may have for the economic wellbeing of entire regions, there has been a lack of empirical research examining the regional distribution of multifunctional activities in U.S. agriculture and their impacts on farm viability. Over time if these activities are profitable and sustainable the net number of farms is expected to increase in regions where multifunctional agriculture is more abundant.

The purpose of this study is to help fill this gap in the literature. Regional econometric analysis is used to better understand how county-level farm viability is impacted by the prevalence of multifunctional activity and county farm and agricultural structure, more broadly. Multifunctional activities are measured from information taken from the 2002 and 2007 Census of Agriculture. We examine how initial (2002) period direct sales to consumers, agri-tourism and recreation income, custom harvesting and agricultural services income, and off-farm labor participation of farm operators impact the change in the number of farms in the county. Results confirm that impacts of multifunctional agriculture on farm viability vary across regions likely due to differences in prevailing types of agricultural production and consumer preferences, and these impacts are not always positive. Direct sales were associated with increases in the number of farms in the New England region, and the marginal impacts were substantial. More intensive off-farm labor was associated with increases in the number of farms across three U.S. regions. This result suggests that at least in these regions off-farm labor continues to be a stabilizing factor in U.S. agriculture for existing farmers, but may also be a vehicle by which new operators can begin farming.

2. Multifunctional Agriculture in the U.S.

Multifunctionality in the United States has largely been addressed at the macroeconomic level when considering trade issues (e.g., Bohman, et al. 1999). In the EU, the multifunctional agriculture (MFA) concept has emerged as a key notion in scientific and policy debates on the future of agriculture and rural development among European countries (Renting, et al. 2009; Brouwer and van der Heide, 2009). Broadly speaking, MFA refers to agricultural activities beyond the traditional role of producing food and fiber, such as renewable resource management, landscape and biodiversity conservation, and contribution to the socio-economic viability of rural communities (Renting, et al. 2009, Hajnalka and Alajos, 2009; Van Huylenbroeck and Durand, 2003).

Figure 1 describes the conceptual framework of multifunctional farm operations developed by Liang et al. (2011) following the triangular relationship described by Van der Ploeg and Roep (2003) of *Broadening*, *Deepening*, and *Regrounding* activities. *Broadening* involves a farming operation diversifying its enterprises to include the production of new goods and services that encourage the linking of farm production, visitors to rural areas, and amenities of their local communities. Agritourism and specialty food sectors in the New England region are clear examples of broadening activities. *Deepening* involves refocusing agricultural production to better meet the demands of consumers and sometimes requires advancements in the agricultural supply chain. Direct local sales to consumers are examples of deepening activities. Finally, *Regrounding* activities involve the total refocusing of farm household resources, such as to activities outside of farming and off-farm work of farm household members.

<< Insert Figure 1 around here >>

Agritourism and specialty food sectors are growing as forms of agricultural diversification and integration in rural communities which may generate higher margins and additional income for farmers (Hughes, Kennedy, and Ortego, 1999; McGehee, 2007). Several studies have discussed agritourism systems as including farm families, Destination Marketing Organizations, and agri-tourists to address each of these three stakeholder group's unique motivations and needs for participating in an agritourism system (McGehee, 2007). Other researchers have analyzed specific marketing strategies adapted by farmers such as direct farm-to-table food marketing, roadside stands, web-based sales, community supported agriculture, small producer marketing cooperatives, pick-your-own fresh produce, and farmer's markets (Kinsey and Senauer, 1996; Roth, 1999; Tippins, Rassuli and Hollander, 2002; Hansen, 2003; White, 1996; White, 1997; White and Manning, 1998). Most of these studies touched on the issues and importance of developing more innovative and integrated marketing strategies for Specialty Food and Agritourism producers. They also point out the need to examine the impact of the competitiveness of Specialty Food and Agritourism sectors in rural areas as new opportunities for agricultural producers are explored, which is directly related to the viability of such activities. Moon and Griffith (2011) found that consumers in aggregate valued the multifunctional roles of U.S. agriculture at $105 billion. Nevertheless, little is known about the viability of farm operations which participate in multifunctional activities across different regions of the country.

3. Farm Viability

Recent research has investigated the benefits of diversification for multi-product firms (Chavas and Kim, 2010; Chavas and DiFalco, 2012; Chavas et al., 2012). The general findings of this work are that the economies of diversification are determined by complementarity between activities, economies of scale, and convexity (in outputs) of the cost function, which can lead to partial or complete specialization. As a result, these factors influence the mixing of different activities and are expected to impact farm viability by providing multiple ways of generating income and possibly spreading fixed operating costs over multiple activities. For example, dairy farmers may decide to start agritourism activities by charging visitors a small fee in order to tour their farm, and/or directly sell butter or cheese to visitors derived from their milk. In this way multifunctional activities can positively contribute to the viability of the farm and with significant adoption also reveal regional impacts on the net change in farms over time.

We assume that the decision-making process of participating in multifunctional activities is similar to the decision to work off-farm by farm operators (Mishra and Goodwin, 1997; Goetz and Debertin, 2001; Mishra and Holthausen, 2002). Following Goetz and Debertin (2001), suppose that a farm proprietor's utility is a function of consumption ($\boldsymbol{c}$), leisure time (t_L), non-monetary benefits of engaging in farming and multifunctional activities ($\boldsymbol{s}_U$), and exogenous shifters (λ):

(1) $U = U(\boldsymbol{c}, t_L, \boldsymbol{s}_U; \lambda).$

Utility is maximized subject to budget and time constraints, as well as the production technology used in farming, broadening, and deepening activities:

(2) $\sum_{O=F,B,D} p_O Q_O(K, t_{F,B,D}; \theta) + g - p_I K + R(w_R t_R) - f(C) = 0,$

(3) $T - t_L - t_{F,B,D} - t_R = 0,$

(4) $Q_O(K, t_{F,B,D}; \theta) = 0,$

(5) $c, K, t_L, t_{F,B,D}, t_R \geq 0,$

where p is the output price, $Q(\cdot)$ is a multi-product production function of output (O) from farming (F), broadening (B), and deepening (D) activities, K represents the quantity non-labor inputs, $t_{F,B,D}$ represents time spent on farming, and farm related broadening, and deepening activities, t_R is time spent on regrounding activities such as off-farm work, θ is a vector of farm characteristics, g is government payments, p_I is a vector of input prices, R is income from regrounding activities which is determined by the wage or implicit wage (w_R) and time (t_R) spent on the same. Regrounding activities are assumed to incur transaction costs $f(C)$ determined by fixed (C_R) and variable ($t_R \times \phi$) costs, where ϕ represents a per-unit of time cost. Farm proprietors evaluate the present value of expected future utility received from farming and multifunctional activities versus suspending on-farm operations:

$$(6)\ V_t = \int U_t(\boldsymbol{c}, t_L, \boldsymbol{s}_U; \lambda) e^{-\delta t} dt,$$

where δ is the discount factor and $\boldsymbol{s}_U = 0$ if all farm-related operations cease. In order to see the intertemporal budget constraint, let B_0 equal the value of (2) at some initial time period and y_t represent total income net of production and transaction costs $f(C)$. For any t

$$(7)\ B_{t+1} = (1+\delta)^{t+1} B_0 + \sum_{s=0}^{t} (1+\delta)^{t-s} \left(y_s - c_s\right).$$

Dividing through by the common factor $(1+\delta)^t$, evaluating at $t = T$, and rearranging gives the intertemporal budget constraint,

$$(8)\ \sum_{t=0}^{T} \left(\frac{1}{1+\delta}\right)^t c_t + \sum_{t=0}^{T} \left(\frac{1}{1+\delta}\right)^T B_{T+1} = (1+\delta) B_0 + \sum_{t=0}^{T} \left(\frac{1}{1+\delta}\right)^t y_t .$$

The farm operator's problem is to choose a consumption vector $\boldsymbol{c}$ and farming and multifunctional activities $\boldsymbol{s}_U$ over time to maximize their discounted sum of utility subject to the budget constraint, the production function, and time constraints in each period. Farming and multifunctional activities will cease when $V_t(\boldsymbol{s}_{U\neq 0}) < V_t(\boldsymbol{s}_{U=0})$ and continue if $V_t(\boldsymbol{s}_{U\neq 0}) \geq V_t(\boldsymbol{s}_{U=0})$. New operators begin farming when utility from farming and multifunctional activities net of production and transaction costs exceeds not entering, $V_t(\boldsymbol{s}_{U\neq 0}) > V_t(\boldsymbol{s}_{U=0})$. Similar to Kimhi and Bollman (1999) and Goetz and Debertin (2001), we assume that these conditions can be captured in reduced form equations that contain exogenous factors explaining current and future income from farming and multifunctional activities.

4. Empirical Model and Data

We begin by discussing the change in the net number of farms in the U.S. between 2002 and 2007, which is used to measure farm viability at the county level in this study.[1] Figure 2 illustrates parts of the country that experienced net gains and losses in the number of farms. However, most of the increase in farms can be attributed to very small farms (farms reporting less than $2,500 of value of sales). Table 1 shows the change between the two time periods by the different sales-class sizes reported in the Census of Agriculture. The net number of farms increased in the smallest and largest sales-class sizes, but decreased in every other category. The large increase in the number of farms with less than $2,500 in sales may partially be a result of greater efforts of the USDA to measure small farms in the 2007 Census of Agriculture (Hoppe et al., 2010). These small farms contribute little to total agricultural production (less than 5% nationally) and tend to represent life-style farms, i.e., those that wish to live on a farm (Hoppe et

[1] The aggregate data published by USDA does not report the number of farm entrants and exits. As a result, looking at changes in the number of farms over time only reveals net increases or decreases in the number of farms.

al., 2007). Since farm viability is of interest in the present study, we exclude those farms with less than $2,500 in sales when determining the change in the number of farms in a county.[2]

<< Insert Figure 2 around here >>

<< Insert Table 1 around here >>

A regional econometric model is used to determine how county-level farm viability is impacted by the initial level of farms, multifunctional activities and county farm and agricultural structure, more broadly. Multifunctional activities are expected to improve farm viability measured by the growth in the number of farms. The model is specified as:

$$(9)\ ln\,(\text{farms}_{07i,r} / \text{farms}_{02i,r}) \;=\; f\,(\text{farms}_{02i,r}, B_{i,r}, D_{i,r}, R_{i,r}, S_{i,r}) + \varepsilon_{i,r},$$

where *i*,*r* index county and region, broadening (*B*), deepening (*D*), and regrounding (*R*) activities as well as farm structure (*S*) are measured during the initial period (2002), and ε is an error term. Broadening, deepening, and regrounding activities are measured by farm-related income from agritourism and recreation, direct sales for human consumption, and the number of farm operators working 200 days or more off-farm. Increases in these activities are expected to positively impact farm viability. We exclude from our analysis local sales by farmers to retailers and end-users other than direct consumers because these numbers are not reported in the Census;

[2] Public use data from the 2002 and 2007 Census of Agriculture do not provide tabulations on various income sources by sales-class of farms. As a result, we were unable to subtract the smallest sales-class size's contribution to other county-level measures.

according to ARMS data they are four times as large as direct sales to consumers (Low and Vogel, 2012).

Following previous studies, we include control factors that may also impact the utility of farming, which explicitly impacts farm viability. Opportunity cost of assets utilized in farming, farming experience, and risk and uncertainty play a role in the decision making process of farm operators (Mishra and Goodwin, 1997; Goetz and Debertin, 2001; Mishra and Holthausen, 2002). The value of land and buildings per acre and a natural amenities index are used to measure the opportunity cost of using these assets in farming or farm-related multifunctional activities. Increases in the value of land and buildings are expected to be negatively associated with farm viability as it represents higher opportunity costs of those assets. On average, areas with higher natural amenities have higher farm real estate values (Nickerson et al., 2012). Other amenities can come directly from farm land, which are typically not captured in land values, including habitat provision, groundwater recharge, and open-space benefits (Hellerstein et al., 2002; Irwin et al., 2003). As a result, the impact of natural amenities on farm viability is unclear. The average age of farm operators is used to proxy experience and is believed to positively impact farm viability.

Risk often arises from unknown future crop yields and prices at the time that input decisions are made. There are several means of truncating this down-side risk. Inherently there are different types of risk associated with crop versus livestock production. Livestock production is also relatively more concentrated in the U.S. (O'Donoghue et al., 2011). The share of livestock sales to total agriculture sales in a county is used to account for these issues. Uncertainty of rainfall is controlled for by using the share of irrigated acres in a county. Farmers may also choose to take marginal land out of production and enroll it in the Conservation Reserve

Program (CRP) or enroll their production acres in subsidized crop insurance programs. Additionally, farmers can receive government payments from federal programs, such as direct, counter cyclical, or loan deficiency payments, depending upon the crops and livestock they produce, their yield, and price received. These factors are accounted for in the model by including the share of acres in a county enrolled in CRP or a crop insurance program and the average total government payments received per farm. Increases in these factors are expected to be positively related to farm viability to the extent that they help farmers manage risk.

To capture additional region-specific fixed effects associated with geography, climate, general economic conditions, and differences in consumer preference we use the Bureau of Economic Analysis Regions to determine if farm viability is affected differently across the U.S. (see Figure 3). As an example, the prevalence of direct sales for human consumption is strongest in the New England, Great Lakes, and Far West regions (see Figure 4). We also include measures of travel time to population centers of 25,000, 250,000, and 1,000,000 people based upon population levels from 2000. These measures control for access to demand centers for agricultural products, but they also reflect pressure associated with urban sprawl in the different regions. Equation (9) is estimated separately for each region.

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5. Results

Changes in the number of farms by region of the U.S. between 2002 and 2007 are shown in Table 2. On average counties in New England experienced the largest increase (in absolute and percentage terms) in the number of farms, while counties in the Plains region had the largest decrease. Summary statistics for the variables used in the regressions are reported in Table 3. The total sample size is *N* = 3,069 counties from the lower 48 states. Results from the OLS models are reported by region in Table 4. The sample size by region ranges from *n* = 67 to 1,028. Overall, the regional models perform reasonably well with adjusted R^2 values between 0.089 and 0.319.

<< Insert Table 2 around here >>

<< Insert Table 3 around here >>

Broadening Multifunctional Activities

Farm related income from agritourism and recreation was used to measure broadening multifunctional activities. Higher levels of this type of income were related to statistically significant net *reductions* in the number of farms in the overall sample (all U.S. counties), as well as in the Southeast, Southwest and Rocky Mountain regions; alternatively, counties where this activity was less important were more successful at maintaining or even raising farm numbers (perhaps because farmers there instead focused on producing major commodities such as peanuts and cotton). Thus, contrary to expectation but confirming the findings of Bagi and Reeder (2012) who use ARMS data, counties in which farms earn more from agritourism and recreation are not characterized as having a more viable agricultural sector, at least not based on the definitions, measures and specifications used here. This lack of statistical significance is perhaps especially surprising for the New England region, where agritourism is commonly perceived to be an important sector of the rural economy. The effect of these changes can be calculated as follows. The mean for the dependent variable *ln* ($farms_{07i,r}$ / $farms_{02i,r}$) is 0.00670, so that exp(0.00670) = 1.0067, indicating that the number of farms nation-wide with sales of over $2,500 increased by nearly seven-tenths of a percent (0.67%) between 2002 and 2007. A doubling of agritourism and recreation income nationally from the mean of $3,330 per farm in 2002 would have led to a reduction in the number farms by 1.0067 – 0.9693 = 0.037% (because exp{-0.000974 * 3.33} = exp{-0.0312} = 0.9693). In other words, instead of experiencing 0.6% growth, the number of farms would have declined by 3.07%, which is not trivial.

To illustrate the sensitivity of these results we also calculated selected regional effects. In the Southeast, the average number of farms fell by exp(-0.012649) = 0.98743 (or 0.0125695=) 1.257%. If average agritourism income per farm in that region were to double, by $2,945, then the change in farm numbers would have declined even more, by -0.004446 or an additional 0.44%. In the Southwest region, the number of farms expanded by exp(0.0453) = 1.0464 or 4.6% between 2002 and 2007. If agritourism income there had doubled from the mean of $5,826.88 then the number of farms would instead have changed by 0.9784, or been 6.8 percentage points lower, for a net loss of farms of (4.6-6.8=) 1.8%.

Farm-related income from custom harvesting and agricultural services was also used as a measure of broadening activities. Higher levels of custom harvesting and agricultural services had a statistically positive effect only in the Plains region, and the effect was negative in the entire U.S., the Southwest, and the Rocky Mountain region. In the latter two regions and the U.S. it appears that *less* reliance on these activities translates into more viable farms, which own their harvesting equipment rather than having to hire other farmers to perform fieldwork. In the Plains region, higher levels of these services likely not only helped the farms providing the service but perhaps also those potential new entrants who were not able to afford to buy the kind of equipment needed to operate the typical large farm in that region. On the other hand, in the two other regions, counties with higher levels of these activities were unable to stem the ongoing reductions in farm numbers. A doubling of custom harvest and agricultural services income nationally from the mean of $8,630 per farm in 2002 would have led to 1.2% fewer farms nationally. In the Plains, where the number of farms declined by 4.34% between 2002 and 2007, a doubling of average custom income per farm by $9,587 would have led to an increase in the number of farms of 6.95% for a net gain over the five year period of 2.61% (= 6.95-4.34) which, again, is not trivial.

<< Insert Table 4 around here >>

Deepening Multifunctional Activities

Deepening activities measured by direct sales to consumers were associated with increases in the number of farms only in New England. Here the number of farms increased by 23% over the five years, but if direct sales had doubled from the actual average of $13,529 per farm (which is a proxy for greater demand for local foods), then the number of farms would have more than doubled (by 104%) over and above the 22%. At first glance this seems unrealistic. However, Bagi and Reeder (2012) found that farms involved in direct marketing were smaller in size and had lower net worth and household income. This suggests that barriers to entry for new farmers via direct sales are relatively lower. With this in mind, a doubling of the demand for direct sales from population centers in New England could lead to large increases in the number of farms within the region. As noted earlier, this measure from the Census is estimated to capture only about one-quarter of the food that enters local marketing channels through so-called "intermediated" markets including sales to retailers or distributors and restaurants (Low and

Vogel, 2012). In the New England states close proximity to large numbers of high-income consumers likely helps to maintain a viable local agricultural economy, that also encourages new entrants into farming (despite a relative scarcity of land). In the other regions this effect is likely to be too diffuse when averaged across the entire region, and in future work it may be useful to include a measure of proximity to consumer income (e.g., around San Francisco; note that we control for distance from or travel time to population centers, but not income levels).

Regrounding Multifunctional Activities

Intensive off-farm labor was used to measure regrounding activities. The share of farm operators who worked off-farm 200 days or more of the year had a positive and statistically significant effect only in the Rocky Mountain and Far West regions. Other than direct sales in New England, it represents the most robust (positive) multifunctional activity in our findings. The results confirm previous findings in the literature that off-farm labor is often a stabilizer of total income of farm households (Mishra and El-Osta, 2001; Goodwin and Mishra, 2004), although Goetz and Debertin (2001) argue that it also has the effect of easing farmers' transition off the farm by reducing transactions costs associated with job searches, etc.

Farm Structure and Other Variables

The impact of risk management on farm viability similarly varied across regions. Nation-wide, statistically significant effects are found only for acreage under CRP or crop insurance (negative effect) and livestock sales as a percent of total (positive effect). Across the different regions, enrolled acreage had a statistically significant positive effect on farm viability only in New England, and the effect was negative in the Great Lakes, Southwest and Rocky Mountain regions. Livestock sales, in contrast, had a positive effect in the two regions where the effect differed statistically from zero: Plains and Southeast. The effect of irrigated acres as a share of the cropland was statistically different from zero, and *negative*, only in the Great Plains regions. Instead of representing a stabilizing force, it is possible that this measure is capturing increasing scarcity of irrigation water in that part of the country, all else equal. For government payments, positive effects were observed only in the Plains and Rocky Mountain regions.

Counties that are home to older farmers may be expected to experience more farm exits over time as those farmers retire. This is consistent with the results in Table 4 for the U.S. as a whole. However, for the Plains and for the Far West the opposite is true: counties with older farmers on average are more viable as measured by increases in farms over time. Especially for the Plains this result is unexpected, given the decade-long exodus of residents from the region. Given that the negative result is obtained only for the nation as a whole, this has to be interpreted with caution.

A higher opportunity cost of farming, as measured by the value of land and buildings per acre, is as expected associated with lower farm viability in New England and the Southeast (possibly due to increased pressures associated with urban sprawl) but, surprisingly, in the Far West the effect is positive. Here individuals are starting new farming operations despite high entry costs. At the same counties nationwide with more amenities are seeing new farming operations emerge, and the same is true in the Mideast, Southwest and Rocky Mountain region. In the Plains, which tend to rank very low on the amenity score, *lower* amenities are associated with more farm entry, perhaps because in those places that do have some natural amenities the barriers to entry into farming are prohibitive.

Our last three covariates capture the amount of travel time in minutes to successively larger population centers, which measures access to markets and consumers. The underlying hypothesis is that greater distance is associated with less market access and thus reduced viability; at the same time, greater distance also provides some protection from sprawling development. Across the nation, greater distance from smaller population centers is associated with greater farm viability. This may be related to the cost of farm land, independent of the value of land and buildings. Perhaps unsurprisingly, the effect of each of the three distances is statistically different from zero only in the Plains, with greater distance from both the smallest and the largest population centers reducing the viability of farms. At the same time, greater distance from population centers of 250,000 people is associated with *more* farm viability. The only other instance where greater distance (from the medium size-city) leads to more net exits from agriculture occurs in the Great Lakes region. In this region (1mn population), as well as in the Southeast (250,000 pop) and the Rocky Mountains (25,000 pop), greater distance is associated with greater farm viability.

6. Conclusions and Future Research

This study supports some but raises questions about other common perceptions about the determinants of farm viability or changes over time in the number of operations. Interesting differences emerge across the eight BEA regions in terms of the factors influencing farm viability. Perhaps most importantly, direct sales to consumers have a statistically significant effect only in the New England region, with its proximity to major population centers. In each of the seven other regions the effect does not differ statistically from zero. Nation-wide, income from both custom operations and agritourism and recreation activities were associated with reduced farm viability, or net reductions in the number of farms. Income from custom operations had a positive effect on farm viability only in the Plains region. Government program payments and livestock sales had positive effects in three of the regions.

These results are conditional on our measures of viability used as well as the specification (functional form) chosen. Preliminary specification tests that explore interactions or non-linear effects of selected regressors did not yield consistent or robust results. In future work we will elaborate on the reduced form models estimated here and investigate simultaneous equations as well as simple difference models, and also test for potential spatial dependence bias.

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Table 1. Change from 2002 to 2007 in the Number of U.S. Farms

Farms (number)	Change (2002 to 2007)
Farms by value of sales \ Less than $2,500	73,769
Farms by value of sales \ $2,500 to $4,999	-13,024
Farms by value of sales \ $5,000 to $9,999	-4,637
Farms by value of sales \ $10,000 to $24,999	-7,872
Farms by value of sales \ $25,000 to $49,999	-3,174
Farms by value of sales \ $50,000 to $99,999	-15,023
Farms by value of sales \ $100,000 or more	45,771
Total change (all farms)	75,810

Source: 2002 and 2007 Census of Agriculture, USDA NASS

Table 2. County Average Change in the Number of Farms by Region (2002 to 2007)[1]

Region	Avg. Change	Avg. % Change
New England	50.43	23.10
Mideast	21.74	6.87
Great Lakes	0.78	1.07
Plains	-18.78	-3.87
Southeast	-6.60	-0.53
Southwest	18.87	9.94
Rocky Mountain	20.19	10.26
Far West	4.77	3.12

[1] Source: 2002 and 2007 Census of Agriculture USDA, NASS.
Excludes farms with less than $2,500 in value of sales.

Table 3. Descriptive Statistics (N = 3,069)

Variable	Label	Mean	St.Dev.
ln (farms 2007 / farms 2002), farms with $2,500 or more in sales[1]	$lnfarms_{07/02}$	0.01	0.18
farms with $2,500 or more in sales in 2002[1]	$farms_{02}$	422.95	353.97
direct sales for human consumption in 2002 ($1,000 per farm) [1]	dirsales	4.87	6.83
custom harvesting and ag. services income in 2002 ($1,000 per farm) [1]	custinc	8.63	9.87
agritourism and recreation income in 2002 ($1,000 per farm) [1]	agtourinc	3.33	6.50
share of farm operators working 200+ days off-farm in 2002[1]	opoff200	0.26	0.06
share of cropland acres irrigated in 2002 [1]	irrig	0.18	0.24
share of acres enrolled in CRP or crop insurance in 2002 [1]	consac	0.03	0.04
total government payments in 2002 ($1,000 per farm) [1]	govpay	8.52	8.01
livestock share of total sales in 2002[1]	lstksales	0.53	0.30
average age of farm operators in 2002[1]	opage	55.44	2.55
value of land and buildings per acre ($1,000/ac) [1]	lbvaulepa	2.33	4.08
natural amenity index[2]	nascale	0.06	2.29
travel time to population center of 25,000 people (min)[3]	dt25k	76.42	65.03
travel time to population center of 250,000 people (min)[3]	dt250k	148.86	135.08
travel time to population center of 1,000,000 people (min)[3]	dt1000k	230.67	167.66

Source: [1] 2002 and 2007 Census of Agriculture; [2] USDA ERS http://www.ers.usda.gov/Data/NaturalAmenities/
[3] Calculated by USDA ERS

Table 4. Multifunctional Activity Impacts on Farm Viability by BEA Region

	Entire U.S.		New England		Mideast		Great Lakes		Plains	
	Coeff.[1]	R.S.E.[2]	Coeff.	R.S.E.	Coeff.	R.S.E.	Coeff.	R.S.E.	Coeff.	R.S.E.
$farms_{02}$	-0.00004***	0.00001	-0.0002***	0.0001	-0.00004**	0.00002	-0.0001**	0.00003	0.00002	0.00002
dirsales	0.0009	0.0006	0.0034**	0.0016	-0.00002	0.0019	-0.0006	0.0013	0.0005	0.0007
custinc	-0.0006*	0.0004	-0.0003	0.0025	0.0006	0.0014	-0.0017	0.0016	0.0027***	0.0010
agtourinc	-0.0010***	0.0005	-0.0014	0.0013	-0.0018	0.0012	-0.0007	0.0010	-0.0003	0.0012
opoff200	0.0873	0.1354	0.4544	0.4208	1.0111	0.6620	-0.1176	0.2337	-0.0002	0.1233
irrig	-0.0374	0.0240	0.0088	0.1317	-0.3516	0.2673	0.0916	0.0610	-0.0588***	0.0205
consac	-0.2766***	0.0828	2.6297*	1.4015	-0.3789	0.7554	-0.4328*	0.2566	-0.1595	0.1238
govpay	0.0007	0.0006	-0.0037	0.0026	0.0075	0.0059	0.0043	0.0031	0.0063**	0.0031
lstksales	0.0377**	0.0166	0.0673	0.0778	-0.0626	0.0698	0.1237**	0.0542	0.0756*	0.0430
opage	-0.0044**	0.0024	0.0116	0.0091	-0.0086	0.0055	-0.0043	0.0052	0.0073*	0.0041
lbvaulepa	-0.0003	0.0015	-0.0060**	0.0024	0.0019	0.0019	-0.0103	0.0064	-0.0001	0.0036
nascale	0.0123***	0.0015	0.0108	0.0169	0.0374***	0.0144	-0.0028	0.0073	-0.0143**	0.0071
dt25k	0.0001	0.0001	-0.0002	0.0006	-0.0003	0.0007	-0.0001	0.0003	-0.0002*	0.0001
dt250k	-0.00002	0.00005	-0.0005	0.0005	0.0001	0.0005	-0.0004*	0.0002	0.0002***	0.0001
dt1000k	-0.000002	0.00004	0.0001	0.0005	-0.0003	0.0002	0.0005***	0.0002	-0.0003***	0.0001
constant	0.2374*	0.1350	-0.4560	0.5171	0.3683	0.2396	0.2559	0.3346	-0.5285*	0.2776
	n= 3,069		n = 67		n = 176		n = 437		n = 617	
	F = 7.60***		F = 4.99***		F = 1.85**		F = 4.41***		F = 4.10***	
	Adj. R^2 = 0.042		Adj. R^2 = 0.319		Adj. R^2 = 0.182		Adj. R^2 = 0.103		Adj. R^2 = 0.110	

[1] Statistical significance at the 99th, 95th, and 90th percentiles is represented by ***, **, and *. [2] Robust standard errors.

Table 4 Continued. Multifunctional Activity Impacts on Farm Viability by BEA Region

	Southeast		Southwest		Rocky Mountain		Far West	
	Coeff.[1]	R.S.E.[2]	Coeff.	R.S.E.	Coeff.	R.S.E.	Coeff.	R.S.E.
$farms_{02}$	-0.0001***	0.00002	-0.00003	0.00004	0.000004	0.00004	-0.00002	0.00002
dirsales	-0.0012	0.0012	-0.0004	0.0037	0.00001	0.0015	0.0002	0.0006
custinc	0.0010	0.0007	-0.0027*	0.0014	-0.0034***	0.0013	0.0003	0.0006
agtourinc	-0.0015*	0.0009	-0.0037*	0.0019	-0.0041**	0.0018	-0.0001	0.0015
opoff200	-0.1723	0.2701	0.0679	0.5582	0.7898***	0.2531	1.2649***	0.5366
irrig	0.0123	0.0410	0.0754	0.1325	-0.0123	0.0449	-0.0778	0.0821
consac	-0.1951	0.2153	-0.9810**	0.4660	-0.4838*	0.2841	-0.3912	0.5064
govpay	-0.0014	0.0009	-0.0024	0.0021	0.0044**	0.0022	-0.0007	0.0019
lstksales	0.0874***	0.0249	-0.0090	0.0811	0.0016	0.0477	-0.0261	0.0702
opage	0.0033	0.0051	-0.0187	0.0137	0.0208	0.0147	0.0304*	0.0159
lbvaulepa	-0.0119**	0.0047	-0.0019	0.0235	-0.0029	0.0116	0.0139*	0.0079
nascale	0.0051	0.0046	0.0223**	0.0092	0.0198***	0.0063	-0.0043	0.0074
dt25k	-0.0005	0.0003	0.0008	0.0005	0.0004**	0.0002	0.0002	0.0003
dt250k	0.0004***	0.0001	0.0003	0.0003	-0.0001	0.0001	0.0003	0.0003
dt1000k	0.0001	0.0001	-0.0001	0.0001	-0.0001	0.0001	0.00002	0.0003
constant	-0.1529	0.3282	1.0785	0.8307	-1.2681	0.7701	-1.9868**	0.9607
	n = 1,028		n = 379		n = 215		n = 150	
	F = 5.14***		F = 2.32***		F = 6.14***		F = 2.62***	
	Adj. R^2 = 0.089		Adj. R^2 = 0.111		Adj. R^2 = 0.224		Adj. R^2 = 0.216	

[1] Statistical significance at the 99th, 95th, and 90th percentiles is represented by ***, **, and *. [2] Robust standard errors.

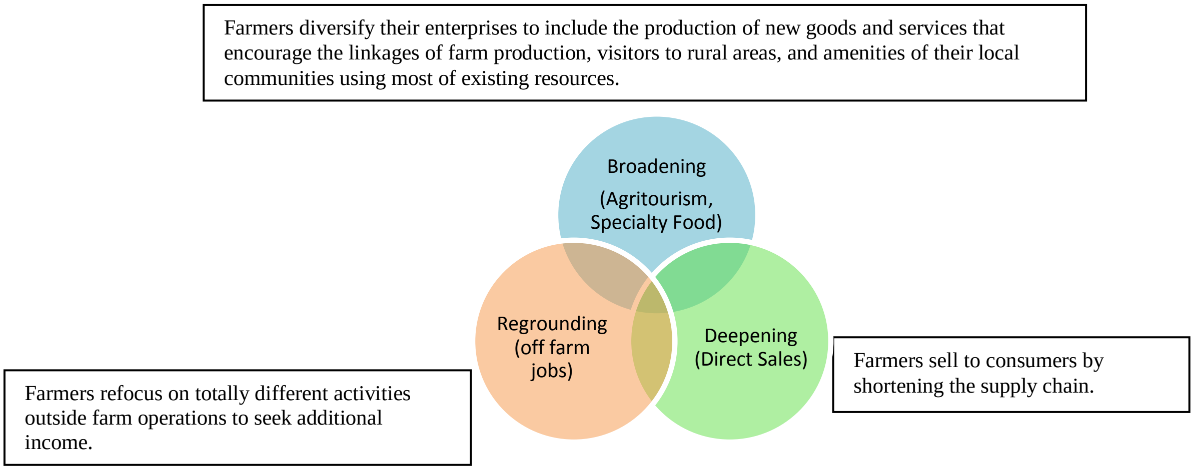

Figure 1. Three Aspects of Multifunctional Farm Operations and the Linkages to People, Place, and Prosperity (source: Liang et al., 2011)

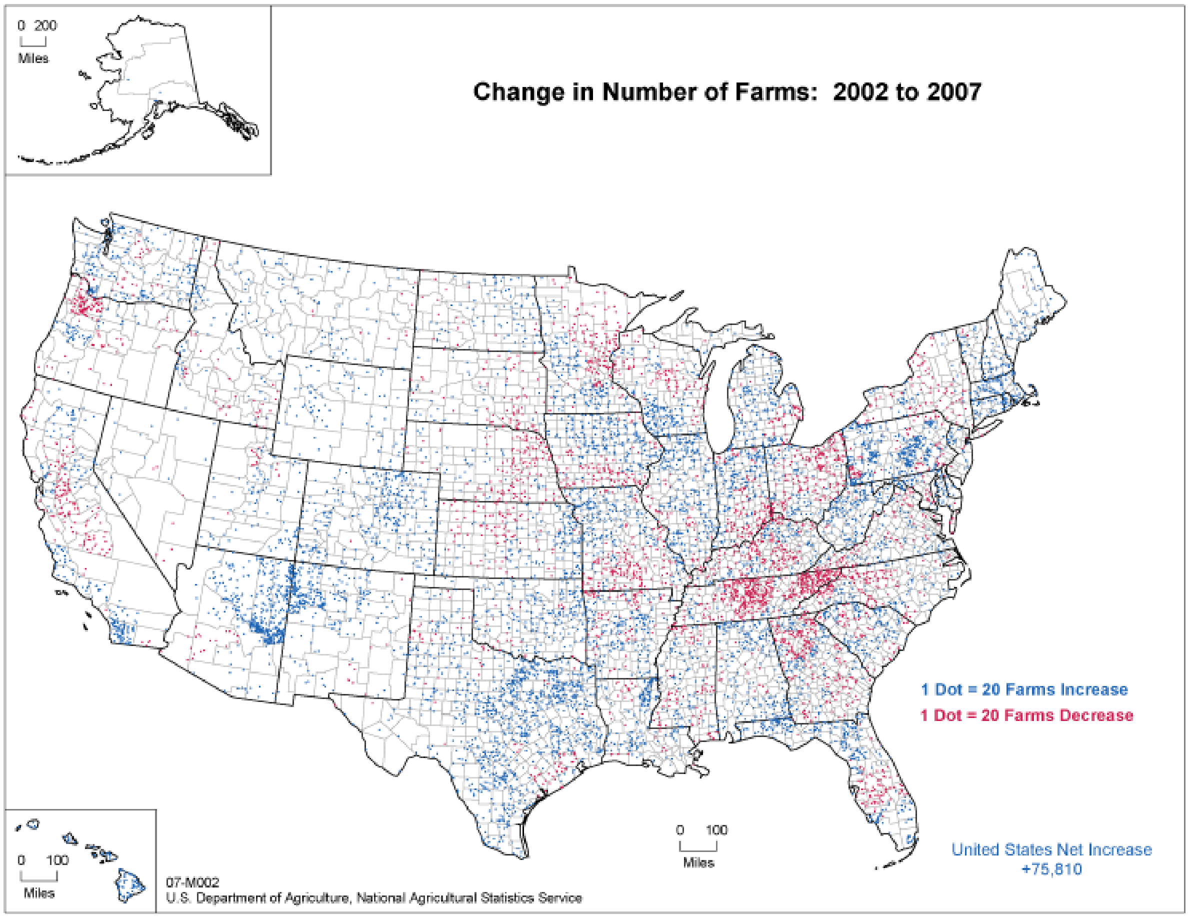

Figure 2. Change in the Number of Farms
(Source: http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Ag_Atlas_Maps/Economics/)

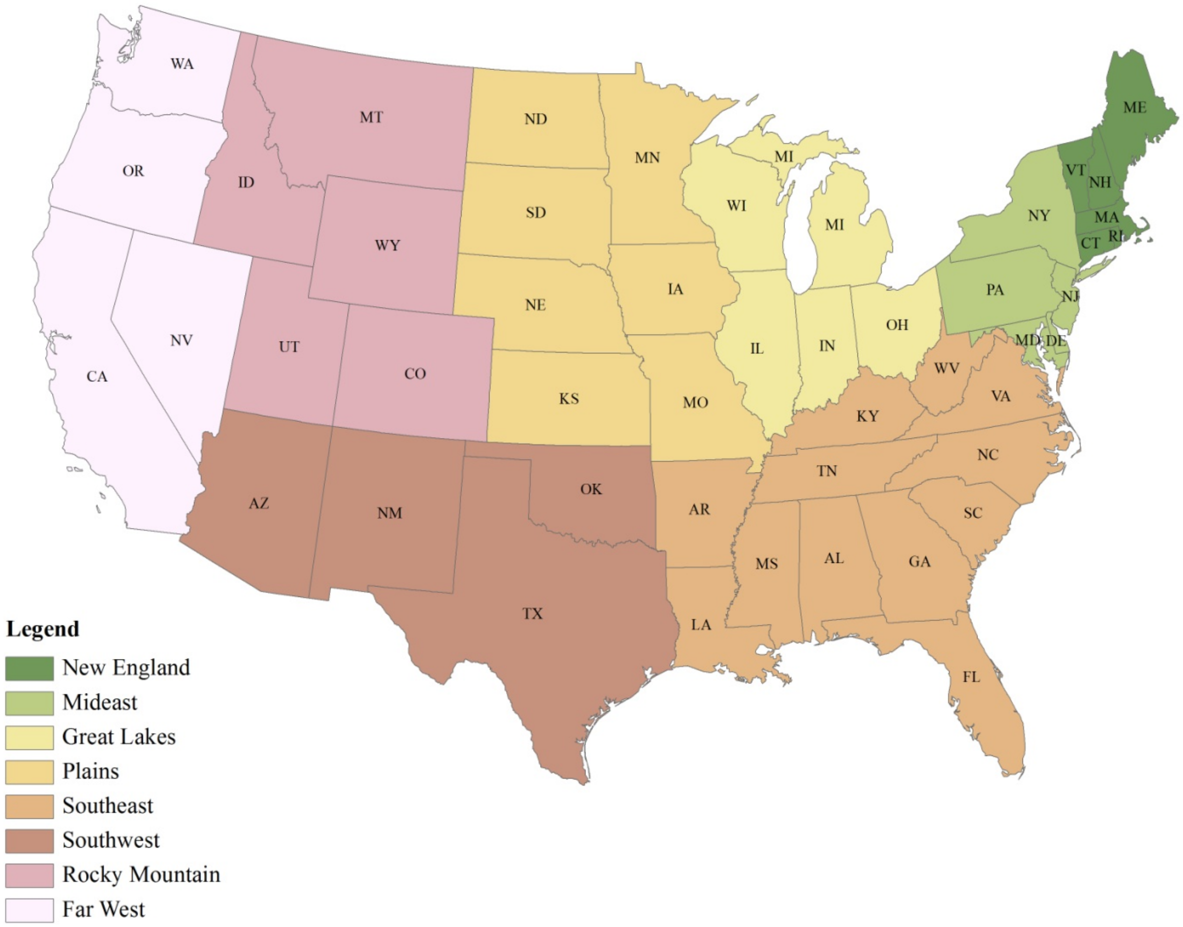

Figure 3. Economic Regions – Bureau of Economic Analysis
(Source: Constructed by authors)

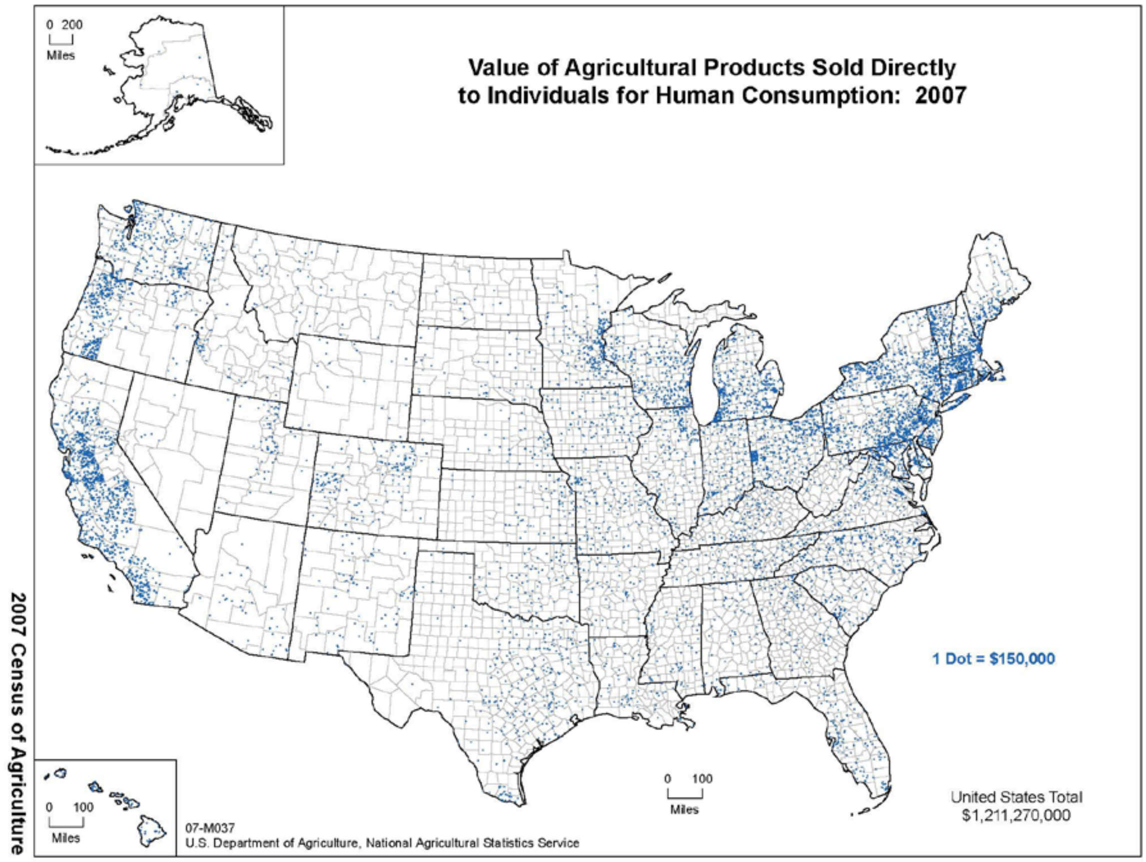

Figure 4. Direct Sales for Human Consumption
(Source: http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Ag_Atlas_Maps/Economics/)