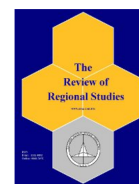




The Review of Regional Studies

The Official Journal of the Southern Regional Science Association



Place-Based Factors and the Performance of Farm-Level Entrepreneurship: A Spatial Interaction Model of Agritourism in the U.S.*

Anders Van Sandt,^a Sarah Low,^b Becca B.R. Jablonski,^c and Stephan Weiler^c

^a *Department of Agricultural Economics, Texas A&M University, USA*

^b *Department of Agricultural Economics, University of Missouri, USA*

^c *Department of Economics, Colorado State University, USA*

Abstract: We apply farm-level data to a two-stage model to explore how three different theories of comparative advantage influence the propensity of a farm or ranch to adopt an agritourism enterprise and the level of economic activity tied to that enterprise. Findings suggest that a county's entrepreneurial spirit and scenic byways increase the propensity to adopt agritourism, but natural endowments and agglomeration are the primary drivers of agritourism economic activity. Results should assist policy makers as well as rural economic development researchers in leveraging community strengths to increase economic activity in the agritourism industry and its surrounding rural economies.

Keywords: entrepreneurship, Heckman 2-stage, agritourism, agritourism revenue, Heckscher-Ohlin, agglomeration

JEL Codes: L26, Q15, O13

*The authors appreciate helpful comments received from seminar attendees at the 2016 North American Regional Science Council meetings in Minneapolis, MN. This work was supported by the Agriculture and Food Research Initiative under Grant 2014-68006-21824. This research was completed while the primary author was an intern at USDA Economic Research Service and the second author was an employee of USDA Economic Research Service. The findings and conclusions in this publication are those of the authors and should not be construed to represent any official USDA or U.S. Government determination policy.

Anders Van Sandt is a Postdoctoral Associate of Agricultural Economics at Texas A&M University. Sarah A. Low is an Associate Professor of Regional Economics, Fred V. Heinkel Chair in Agriculture, and Director of Extension Community Economic and Entrepreneurial Development program the University of Missouri. Becca B.R. Jablonski is an Assistant Professor at Colorado State University. Stephan Weiler is Professor of Economics and Director of Regional Economic Development Institute (REDI@CSU) at Colorado State University. *Corresponding Author:* Anders Van Sandt, e-mail: anders.vansandt@gmail.com

1. INTRODUCTION

Innovation and entrepreneurship are two central drivers of industry growth across regions and markets, but their determinants likely differ depending on the industry. As the agricultural sector becomes increasingly competitive, U.S. farms and ranches, particularly those of small- to medium-scale, have sought out diversification strategies by tapping into new niche markets and developing value-added products (Bauman et al., 2015; Low et al., 2015). One such diversification strategy, agritourism, has received particular attention from agricultural operators and policy makers concerned with rural economic development due to its perceived ability to complement multiple agricultural production activities while increasing revenue, as well as to act as a catalyst for rural economic development (Skuras et al., 2006; Thilmany et al., 2007; Das and Rainey, 2010; Cromartie, 2017).

Agritourism is most commonly defined as any revenue generating enterprise that takes place on a working farm or ranch and provides some service or recreation to visitors for a monetary fee (Arroyo et al., 2013). The drivers of innovation and entrepreneurship in agritourism are difficult to identify due to this broad definition and the heterogeneity across agritourism activities, which also makes identifying options to grow this sector elusive. As an example, the factors motivating an operator to start an agritourism enterprise, including the degree of economic activity generated by the site, may be different for a winery operator in California than for a rancher in Wyoming. Nonetheless, identifying the firm and locational factors that influence participation and affect performance can assist agricultural operators and economic development professionals in recognizing and leveraging firm- and location-specific attributes to mitigate market pressures and stimulate innovative growth in their local economies.

This analysis fills a gap in the literature by exploring the following research questions with establishment-level data: How do operational characteristics and place-based factors, such as natural amenities, population, and transportation infrastructure relate to the propensity to adopt an agritourism enterprise? And, moreover, how does agritourism revenue generated, a proxy for its economic activity, vary by these factors? We explore these questions by comparing three different trade theories that describe how natural endowments (Heckscher-Ohlin factor advantages), farm and operator characteristics (Ricardian productive efficiencies), and agritourism clusters (agglomeration scale and scope advantages) act as pull-factors within the U.S. agritourism industry.

Over the past few decades, increasing market pressures, growing consumer interest in differentiated food products, and attention to new models of rural development have motivated a growing number of agritourism studies. Most of the existing agritourism literature has focused on identifying operators' motivations to adopt, implications for rural development, or estimating the demand for agritourism activities. However, the existing literature falls short in exploring the complex drivers and interdependency between firm location and market potential to support the viability of individual or clusters of agritourism establishments. For example, some operators may be compelled to adopt an agritourism enterprise in order to take advantage of an emerging market and reduce their financial pressures from urban sprawl, while more rural operators may develop an agritourism business to create economic opportunities where there otherwise were none (Nickerson et al., 2001; McGehee and

Kim, 2004; Barbieri and Mahoney, 2009; Tew and Barbieri, 2012; Barbieri, 2013). Understanding how a producer's location influences the decision to adopt such an enterprise, and further, the expected revenues from their agritourism operation will provide researchers with a more general framework in which to view these previous case studies focused on operator motivations.

Another branch of literature of particular interest to rural development practitioners is the role of agritourism as an engine of rural economic growth. As the farmscape of the U.S. continues to evolve, it is becoming increasingly difficult for small- and medium-sized farms and ranches that cannot take advantage of economies of scale to succeed in more competitive agricultural commodity markets (Che et al., 2005; Hoppe and MacDonald, 2013). As a tourism enterprise, agritourism can act as a local export industry bringing dollars into rural communities where multiplier effects stimulate economic growth across sectors (Skuras et al., 2006; Thilmany et al., 2007; Das and Rainey, 2010). Identifying place-based factors associated with increased agritourism activity may assist in leveraging community strengths to increase agritourism traffic in their local communities.

Conceptualizing a theoretical framework building on the traditional gravity model, farm-level data from the U.S. Department of Agriculture (USDA) Census of Agriculture from 2012 are applied to a two-stage Heckman model to empirically test several hypotheses surrounding firm location and economic activity. This approach lends itself to exploring the potential role of three regional trade theories (Heckscher-Ohlin, Ricardian, and agglomeration) in the context of the locational aspects of the agritourism sector, while controlling for potential selection bias. Results from the empirical analysis suggest that agritourism generally benefits from tourism-oriented industry clusters and that the revenue generated from an operation is also dependent on the type of agricultural products produced on the farm or ranch, both of which serve as a potential pull to visitors.

2. LITERATURE REVIEW

The development of virtually all industries is marked by the continuous cycle of consolidations, new niche players, and unique value-added products (for an exploration of innovation throughout the lifecycle of industries, see Audretsch and Feldman (1996)). Such developments also have substantive implications for regional development. While some businesses may benefit from consolidating with larger firms through cost reductions, product branding, or more efficient distribution, other businesses may continue to grow independently through innovation or by tapping into emerging markets. In perfectly competitive markets, innovation is a central driver of short-run economic profits, and an essential factor for long-run business growth. In addition to these firm-based benefits, the greater economic activity generated through innovation leads to greater local employment growth and significantly contributes to the general economic prosperity of the local economy (Duranton, 2007).

A significant body of literature is dedicated to identifying drivers of innovation and entrepreneurship and their regional economic implications. While some innovation is born out of greater technological efficiencies or advancements, other sources of innovation and entrepreneurship include comparative advantages in natural endowments or industry agglomeration. For example, while the invention of the moving assembly line reduced Ford Motor

Company's automobile operating costs, allowing more vehicles to be sold at a lower price, the proximity of the automobile hub to factor endowments and forward- and backward-linkages also played a significant role in establishing Detroit as the historic automobile capital of the U.S. (Klein and Crafts, 2012).

Similar to many other industries, the evolution of the agricultural sector is a story of consolidation, new niche markets, and value-added products. Between 1950 and 2012, the number of farms in the U.S. decreased by 61 percent, the average farm size doubled, and the total real value of production¹ increased 75 percent (USDA, 2014a). While much of the growth in the value of this industry is due to technological advancements, a set of these agricultural businesses have evolved through product differentiation (e.g., organic certification, selling through local markets, or diversifying into value-added products such as salsa, jams, or leather crafts).

As is consistent with other entrepreneurs (van der Zwan et al., 2016), farmers and ranchers may be innovating and entering these alternative markets out of necessity or opportunity (Low et al., 2005; de Silva and Kodithuwakku, 2011). USDA Economic Research Service data show that small-scale operations are more likely to have a 'high risk' operating profit margin, indicating that agricultural production size may motivate to adopt out of necessity (USDA Economic Research Service, 2018). These producers are likely less able to take full advantage of new production technologies due to their scale, and may increasingly need to innovate by exploring new niche-markets and value-added products to ensure higher value production (Bauman et al., 2015; Low et al., 2015; Bauman et al., 2018).

In addition to producers' motivations for adopting various diversification strategies, some alternative marketing efforts have received significant attention from policy makers and researchers in recent years due to their potential to create wealth in rural communities (Schmit et al., 2017). By most measures, the economies of rural America have fared worse than their urban counterparts. For example, the average median income for rural counties is roughly 25 percent below that of urban areas and rural America has yet to recover from its pre-recession employment levels (Cromartie, 2017; USDA Economic Research Service, 2018).

Compared to other economic diversification strategies with the potential to establish rural-urban linkages, agritourism has been found to be relatively more successful at increasing farm profitability (Barbieri, 2013), particularly for mid-scale farms and ranches (Schilling et al., 2012), and has led to higher per capita income in some regions (Brown et al., 2014). Unlike other diversification strategies, agritourism acts as an export industry by physically bringing-in tourists from outside the community, leading to spillover benefits and a multiplier effect that can stimulate other related sectors in the local rural economy (Skuras et al., 2006; Thilmany et al., 2007).

Between 2002 and 2012, the number of farms and ranches with agritourism operations grew over 18 percent and real average agritourism revenue per agritourism establishment increased by 130 percent (USDA, 2014a). However, the share of farms and ranches with agritourism operations is still relatively small, with only 1.5 percent of farms and ranches operating an agritourism enterprise in 2012 (Appendix Figure 1), indicating room for growth

¹Total real value of production includes the value of crop and animal production as well as farm related income adjusted for inflation.

in the industry (Bagi and Reeder, 2012).

Agritourism is important entrepreneurial activity, and research shows that regional economies with greater levels of entrepreneurship tend to grow faster. Using county level data, Brown et al. (2014) analyze the economic development role of agritourism and find that while agritourism plays an insignificant role in increasing personal incomes at a national level, it did lead to increased personal income in some regions of the U.S. While other literature indicates that agritourism can support regional economic development, these studies have shown that benefits are not consistent across all regions and communities, necessitating further exploration into how these entrepreneurs choose to adopt an agritourism enterprise, and what regional or operational characteristics influence the performance, or revenue-generation, of that enterprise.

2.1. Identifying Sources of Comparative Advantage

Different regions may have comparative advantages in certain types of tourism activities compared to other regions. There are multiple trade theories that seek to explain comparative advantages within more traditional economic industries (e.g., manufacturing, agriculture). These trade theories have also been applied to understanding the comparative advantages in the tourism industry. Zhang and Jensen (2007) outline several of these trade theories in the context of tourism including the Heckscher-Ohlin, Ricardian, and agglomeration trade theories. These theories can be used to describe different sources of comparative advantage specific to tourism in certain regions based on natural endowments (Heckscher-Ohlin), relative productive and technological efficiency (Ricardian), and gains from the surrounding area's infrastructure and externalities (agglomeration) (Zhang and Jensen, 2007). As pointed out by Gray (1989), no single trade theory can explain every type of trade flows singularly. Accordingly, this research incorporates different aspects of the potential types of comparative advantage in agritourism from the three trade theories mentioned above.

The Heckscher-Ohlin theory of comparative advantage asserts that a region will export goods/services that are produced using factors that are relatively abundant in that region. Examples that might provide evidence of this theory in the agritourism industry include: outdoor recreation activities on farms and ranches, farm stands/stores near urban areas and busy transportation corridors, a microclimate that allows for unique agricultural products, and production methods that are conducive to human interactions. This theory has particular importance in the tourism sector, which requires physically attracting visitors to a specific location (Carreras Verdaguer, 1995; Urtasun and Gutiérrez, 2006). Previous research shows that some regions have a comparative advantage in attracting visitors. Carpio et al. (2008) and Hill et al. (2014) both find more agritourism trips are taken to areas with high natural amenities, indicating that agricultural operators in these natural amenity rich areas are more likely to generate more economic activity from adopting an agritourism enterprise. Similarly, farms and ranches near population centers are more likely to adopt an agritourism enterprise, perhaps due to their proximity to urban buying dollars (Che et al., 2005; Veeck et al., 2006; Bagi and Reeder, 2012).

The Ricardian theory of comparative advantage identifies a region's relative productive and technical efficiency as the primary driver of which goods/services that region exports.

However, this classical economic standard also indirectly supports our inclusion of the firms' contexts and incentives as reinforcing complements to the regional productive efficiencies. Such efficiencies are most likely to manifest within the firm's labor (i.e. principal operator's age and years in operation), size (i.e. total value of production), related business activities (i.e. participation in other diversification strategies), and associated networks. In their survey of farms and ranches in Texas, Barbieri and Mahoney (2009) find that nearly three quarters of respondents had multiple diversification strategies. This finding may provide evidence of possible synergies between diversification strategies such as reduced marketing costs, shared capital requirements, and other cost reducing or revenue generating interactions.

Agglomeration economies occur when a local industry benefits more from the addition of a new firm locating in the cluster than if that firm had located outside of the cluster. There are two sources of economies of agglomeration presented in the literature. The first, identified by Jacobs (1969), argues that economies of agglomeration occur when that additional firm is from a diverse industry, spurring experimentation and innovation through inter-industry knowledge transfers. The second, developed by Marshall (1890); Arrow (1962); Romer (1986), but formalized by Glaeser et al. (1992), argues that the benefits from agglomeration occur when the additional firm is from the same industry, creating a concentration of specialized firms that benefit from sharing similar infrastructure, labor skills, and industry specific knowledge (van der Panne, 2004).

While there is empirical evidence to support both agglomeration theories in different settings and depending on the nature of the industry in question, agritourism firms likely benefit from the Marshall-Arrow-Romer theory by locating in clusters of similar firms in the tourism industry. Although not explicitly labeled 'agglomeration,' Che et al. (2005) find evidence of 'value webs' in the Michigan agritourism industry, where individual agritourism establishments benefit from coordinating with surrounding agritourism businesses. Two other reasons agglomeration might exist in the agritourism industry are: 1) agritourism clusters are more attractive for multi-destination travelers looking to partake in multiple experiences (Van Sandt et al., 2018), and 2) agritourism clusters reduce search costs for consumers (Stahl, 1982; Urtasun and Gutiérrez, 2006).

The presence of agglomeration can also have economic development implications, particularly in the tourism sector. In a Spanish case study by Urtasun and Gutiérrez (2006), the presence of a vibrant tourism sector was found to increase per capita income in regions with less economic development in other sectors. Furthermore, as was previously mentioned, many small establishments lead to greater employment growth relative to fewer larger establishments (Chatterji et al., 2014). However, it should be noted that agglomeration economies experienced by small firms are more sensitive to distance decay due to smaller firms' greater reliance on external knowledge (van der Panne, 2004).

3. DATA & METHODS

While the gravity model was historically used to measure international trade flows driven by countries' comparative advantages, the literature also shows its successful application in estimating tourism flows, arguably a form of trade (Keum, 2010; Morley and Santana-Gallego, 2014). Early attempts to apply the gravity model to tourism flows were challenged

due to unrealistic assumptions and a lack of a theoretical foundation (Morley and Santana-Gallego, 2014). In the past decade, however, the linking of the gravity equation to individual utility theory and empirical support has made the gravity model a more widely accepted tool and an empirically-validated approach to assessing both international goods and tourism flows (Kimura and Lee, 2006; Keum, 2010; Morley and Santana-Gallego, 2014).

We use farm-level data (1.3 million observations) from the USDA's 2012 Census of Agriculture in this study. Data were accessed in a confidential National Agricultural Statistics Service (NASS) data lab in Washington, D.C. and all results were cleared by NASS statisticians. Due to disclosure concerns we were prohibited from releasing summary statistics, but Appendix Figures 1 and 2 contain summary statistics and county-level maps of the agritourism farm share and average agritourism revenue using the publicly-released Census of Agriculture data.

We use a two-stage Heckman model to explore the performance of agritourism enterprises (measured by gross revenue) in the context of the gravity model. The first stage, or the selection equation, corrects for endogeneity resulting from nonrandom self-selection bias using a probit model to estimate what factors influence the decision by a farm or ranch to adopt agritourism enterprises or not. The second stage outcome equation utilizes the inverse Mills ratio from the probit model in its estimation of farm-level agritourism revenue (a proxy for the relative economic activity generated by the site).²

The independent variables of the gravity model can be broken down into two categories, which are derived from Isaac Newton's original equation describing gravitation attraction: mass and distance (Equation 1). For the application of the gravity model in this study, 'Mass' has two different forces: push- and pull-factors. Push-factors are those causing consumers to actively seek out agritourism activities and can be thought of as factors of demand and may include more intrinsic traits such as a desire for social interaction, prestige, relaxation, health, escape, and adventure (Uysal and Jurovski, 1994; Prayag and Ryan, 2011). Pull-factors represent what causes agritourism to perform well in a particular area and commonly include the physical features of the area, the number of clustered agritourism sites, or the types of activities offered. Herein we focus our attention on pull-factors as our purview is farms and revealed demand models have previously explored some of the push-factors for agritourism such as personal income, travel expenses, and preferences (Carpio et al., 2008; Hill et al., 2014).

Focusing on the pull-factors offers an important contribution to the literature in that it provides producers with valuable information about the potential draw of their location and effective managerial decisions. Additionally, insight into pull-factors provides a complement to the existing consumer choice literature. While we necessarily exclude push factors due to data limitations, which arguably introduces potential omitted variable bias, including push factors could lead to different results, particularly for variables that may represent both push- and pull-factors. Keeping this contextual constraint in mind, it is important to interpret results with the caveat that there may also be underlying push factors influencing the sign and magnitude of a particular variable of interest.

²Several of the county level variables used in this modeling process were graciously generated by the GIS team at the USDA's Economic Research Service using raster level data, while the other county level variables came from secondary sources (National Park Service, 2014; USDA, 2014a,b).

$$Measure\ of\ Attraction_i = \frac{Mass_i^\beta}{Distance_i^\alpha} \quad (1)$$

While motivated by theory, applying the traditional gravity model may not be the best modeling approach, as a significant share of agritourism trips are reported to be made by multi-destination travelers (Hill et al., 2014). Due to the nature of multi-destination travelers visiting multiple sites on a single trip, including a distance term would give an incorrect measure of friction that an agritourist may experience in visiting a site since it does not account for the additional benefits of visiting complementary sites that the tourist takes into account when making travel plans.

Due to the shortcomings of the traditional gravity model in the present context, we stay true to its theoretical intuitions while empirically estimating what could more accurately be called a ‘unilateral spatial interaction model,’ given the focus on pull-factors to agritourism locations. This generalized form still considers the complementarity of demand and supply, competing opportunities from substitutes, and the transferability of travelers, preserving the spatial interactions underlying the gravity model. This approach enables the empirical results to be interpreted as key pull-factors, which contribute to an agritourism sites degree of attraction independent of consumer demand (push-factors) and distance traveled.

The unilateral spatial interactions model (Equation 4) is unique from the traditional gravity model, which usually compares the attraction between two regions, in that this study only seeks to measure the attraction of random agents (agritourists) to a specific set of points (agritourism sites). Essentially there is a two-dimensional plane (the contiguous U.S.) with random particles (agritourists) traveling across it in various directions. However, these particles are not completely random since the majority of them tend to locate in large groupings (cities) and most frequently travel between these groupings. Moreover, when they are in motion, they are bound to designated paths (travel infrastructure), each with varying degrees of activity. The purpose of this model is to distinguish what pull factors attract these particles to particular points that may lie on less traveled paths and in areas with notably less persistent traveler activity. In the context of agritourism, the model attempts to distinguish what factors pull visitors to agritourism operations, and what factors create resistance to this attraction.

While the traditional gravity model in tourism uses the number of visitors to a location as the measure of attraction, these data are not available at a large scale and at the level of individual farms and ranches. Thus, agritourism revenue per farm or ranch (\mathbf{Y} in Equation 4) is used as a proxy. This is a fitting metric because if the variation in price caused by the types of activities and regional differences can be reasonably controlled for by integrating types of crops grown and regional dummy variables, then the proposed metric can be thought of as an agritourist’s ‘footprint.’

The Heckman two-stage model begins with a probit model (Equation 2) to predict what influences a farm or ranch to adopt, or select into, an agritourism enterprise:

$$Prob(A = 1 \mid \bar{Z}) = \Phi(\bar{Z}\theta) \quad (2)$$

where, A is an $n \times 1$ vector with entries equaling one if the agricultural business has an

agritourism enterprise and zero if otherwise, \bar{Z} is an $n \times m$ matrix of independent variables related to participation in agritourism, Φ is the normal cumulative distribution function, and θ is an $m \times 1$ vector of coefficients. Using the predicted coefficients from this model, the inverse Mills ratio is calculated for each observation (Equation 3):

$$\eta(\bar{Z}\hat{\theta}) = \frac{\phi(\bar{Z}\hat{\theta})}{\Phi(\bar{Z}\hat{\theta})}, \quad \text{where } \eta \sim N(\mu, \sigma^2) \quad (3)$$

where, η is an $n \times 1$ vector of inverse Mills ratios and ϕ is the probit probability function. Including the inverse Mills ratio in the spatial interactions model (Equation 4) corrects for the specification bias resulting from the anticipated endogeneity of the nonrandom self-selection and the inclusion of the agglomeration variables in the outcome equation. If the coefficient of the inverse Mills ratio, λ , is significant then the $cov(\bar{X}, \epsilon) \neq 0$ and the hypothesis of endogeneity is supported, justifying the use of the two-stage Heckman model.

$$E(Y \mid \bar{X}, A = 1) = \alpha_0 + \sum_{k=1}^K \bar{X}_k \beta_k + \eta \lambda + \epsilon \quad (4)$$

where, Y is an $n \times 1$ vector of agritourism revenue, \bar{X} is an $n \times k$ matrix of friction, push, and pull factors, β is a $k \times 1$ vector of coefficients, λ is a scalar parameter of unknown variance, and ϵ is an $n \times 1$ vector of normally distributed random error terms.

Two other types of models that correct for the self-selection bias were considered as alternatives to the Limited Information Maximum Likelihood (LIML) two-stage Heckman model: Full Information Maximum Likelihood (FIML) and the subsample OLS (two-part model). Given the exclusion restrictions in the selection equation (total value of production and operator demographics), the large sample size, and precedence set by the literature, the efficiency gains from computationally more complex alternative models appear negligible (Nelson, 1984; Little and Rubin, 1987; Puhani, 2000).

The strength of this exclusion restriction is dependent on there not being discrimination based on the operator's demographics, which could affect the performance of the agritourism establishment and thus introduce potential selection bias. If discrimination were present, this would lead to inflated standard errors in the outcome equation, due to collinearity between the repressors and inverse Mills ratio (Bushway et al., 2007), alongside an unrepresentative sample due to external constraints systematically limiting the broader pool. In that vein, we limit our conclusions to reflect that sampling reality. In general, given the large overall sample size and significance of the core regressors in the outcome equation results, even accounting for this potential bias, the interpretation of results should be consistent and sound. This perspective is reinforced by the inverse Mills ratio's insignificance. Inevitable collinearity may have minor impacts on estimator efficiency, but the correction for the more serious selection bias allow for at least reasonably concrete bases for the interpretation of results.

Independent variables are broken down and categorized into the three major trade theories, which each may partially explain why agritourism operations perform relatively better in some locations (Table 1). Including variables that appeal to the Heckscher-Ohlin, Ricar-

Table 1: Measures of Attraction

| Trade Theory | Independent Variables |
|--|---|
| Heckscher-Ohlin (Natural Endowments) | Crops, livestock, natural amenities index ^{*ψ} , travel time to NPS attraction ^{*ψ} , forest products, travel time to city of $\geq 10k$ people ^{*ψ} |
| Ricardian (Productive and Technological Efficiency) | Age, farming as primary occupation ^{ψ} , years in operation ^{ψ} , direct to consumer ^{ψ} , direct to retailer ^{ψ} , value-added products ^{ψ} , on site packaging facility, organic certified, total value of production ^{ψ} , entrepreneurship breadth ^{\dagger^*} , patents per capita ^{\dagger^*} |
| Agglomeration (Infrastructure and Externalities) | Byways [*] , interstates [*] , agritourism revenue per sq. farm mile ^{*ψ} |
| Demographics | Female ^{\dagger} , race ^{\dagger} , retired ^{\dagger} , job off farm ^{\dagger} , income per capita [*] , population [*] , farm-dependent [*] , recreation-dependent [*] |

* Indicates that the variable is at the county level

\dagger Indicates the variable is only in the selection equation

ψ Indicates the variable is only in the outcome equation

dian, and agglomeration theories of trade overcomes the criticisms of Gray (1989) by not limiting the model's explanatory power for describing the place-based drivers of comparative advantage across farms and ranches. The following subsections break down the variables and their hypothesized signs based on the trade theory to which they most closely connect.

3.1. Heckscher-Ohlin

Fourteen crop and livestock variables were included in both models to determine which types of agricultural operations are conducive to having an agritourism enterprise, and to explore the intensity of economic activity catalyzed within agritourism operations³. Principal operators are able to make some management decisions, but the broader production categories included in the model are limited to the natural endowment of various locales. Since value-added products are directly controlled for, crops and livestock that are relatively unique or ready-to-eat without processing (i.e., vegetables, fruit and nuts, grapes, and specialty livestock⁴) are hypothesized to lead to greater participation in agritourism and an agritourism site's level of economic activity. This hypothesis will be supported if these more unique or *conducive to human interaction* livestock and crop variables are positive and significant in both estimation stages of the model.

Higher natural amenities and the proximity to a National Park Service (NPS) attraction are both hypothesized to encourage higher adoption rates and greater economic activity tied

³Note that the USDA classifies a farm's primary commodity based on the enterprise from which they derive the majority of sales, so a vegetable operation might also include fruit sales, for example.

⁴Specialty livestock are defined by the USDA to include bison, deer in captivity, elk in captivity, alpacas, llamas, mink, rabbits, and other livestock not specified in the 2012 Census of Agriculture.

to agritourism; the outdoor recreation opportunities they represent may be compliments to agritourism activities. The proximity to a city of at least 10,000 people, proximity to a NPS attraction and the county population of an agritourism site are expected to lead to greater agritourism adoption and economic activity tied to agritourism. These variables represent the agricultural business' access to markets, complementary markets, and the potential market size for agritourism.

3.2. Ricardian

Total value of production is hypothesized to be negative, reflecting the need to reallocate resources toward the agritourism enterprise. The natural log function of this variable is meant to capture the diminishing marginal value of production of resources as they are reallocated between enterprises. *Days worked off farm* and *Farming as a primary occupation* reflect the principal operator's allocation of labor between on-farm and off-farm economic endeavors, and are thus expected to display negative and positive coefficients, respectively. Finally, the operator's *Years of experience* is hypothesized to be positive and significant, reflecting the value of work experience.

Five product differentiation variables are included in both stages to capture any possible synergies between agritourism and these other alternative production or marketing strategies. These variables include whether the agricultural business is *Organic certified*, has an *On farm packaging facility*, produces *Value added products*, or participates in *Direct to consumer* or *Direct to retailer* marketing channels. Participating in alternative markets may imply the primary operator has more experience with initiating and operating different enterprises and managing diverse revenue streams, leading them to be both more likely to adopt agritourism as well as generate more economic activity tied to the agritourism operation.

3.3. Agglomeration

As discussed, agritourism firms likely benefit from within-industry agglomeration. This hypothesis will be supported if *Agritourism revenue per square farm mile* is positive and significant in the estimated model, implying that additional economic activity tied to agritourism in a specific agritourism site's county leads to positive externalities for that specific agritourism site. Since agglomeration can arise for multiple reasons, including natural and geographic advantages, several variables act to control for these other sources of agglomeration including: natural amenities, region, local population size, a farm-dependent economy, a recreation-dependent economy, and concentration of travel infrastructure in the county. While *Agritourism revenue per square farm mile* would be endogenous in a single equation model, the two-step nature of the Heckman model and the inclusion of the inverse Mills ratio preserves the independence between this measure of agglomeration and the error term in the second stage.

4. EMPIRICAL RESULTS AND DISCUSSION

We estimate three separate models on two different subsets of the data to provide robustness checks for farm size and farm type. The first model includes all farms and ranches, regardless of their total value of production, the second model includes only farms and ranches with more than \$350,000 in total value of production in 2012⁵, and the third model replicates the first model, but also includes in the second stage an interaction term between agritourism businesses with at least \$350,000 in total value of production and participation in *local food operations* (i.e. farms that participate in direct to consumer or direct to retailer markets, are certified organic, have an on farm packaging facility, or produce value added products). We include this interaction term as we are interested in whether larger farms with *local food operations* behave differently from small farms using local food markets. The first model likely provides the most policy relevant results as it includes all agritourism operations. However, comparing model one's results to those of models two and three may provide perspective into whether pull-factors vary depending on the size of the agricultural businesses, as well as how the relationship between *local food operations* and agritourism differs depending on the size of the agricultural business.

The West was chosen as the reference group for the Census Regions due to its significant agritourism activity relative to the other regions. The results in the first stage (Table 2) should be interpreted as the change in the z-score for a one-unit change in the independent variable. However, most of this study's primary research questions revolve around the second stage results (Table 3), which are more straightforward and can be interpreted as the change in agritourism revenue measured in dollars from a one-unit change in the independent variable.⁶ Potential heteroskedasticity was controlled for using White's robust standard errors.

Table 2: Heckman Selection Equation – Probit model

| <i>Dependent variable: 1 if Agritourism, 0 otherwise</i> | | | | |
|--|----------------------|------------------------------------|--------------------------------------|--|
| Coefficients | | | | |
| Variable | | Model 1: All Farms & Ranches | Model 2: Large Farms & Ranches | Model 3: (Local Foods × Large) Interaction |
| <i>Farm Level</i> | Intercept | -2.2416*** | -2.1237*** | -2.2416*** |
| | Female | 0.0402*** | 0.1652*** | 0.0402*** |
| | Black | -0.0833*** | -0.0357 | -0.0833*** |
| | Asian | 0.0748* | -0.011 | 0.0748* |
| | Hawaiian | 0.1666 | 0.2279 | 0.1666 |
| | American Indian | -0.1700*** | -0.0128 | -0.1700*** |
| | Retired | -0.1919*** | -0.0348 | -0.1919*** |
| | Age | 0.0038*** | 0.0046*** | 0.0038*** |
| | Days worked off farm | -0.0427*** | -0.007 | -0.0427*** |

Continued on next page

⁵The gross cash farm income greater than \$350,000, comes from USDA Economic Research (Hoppe and MacDonald, 2013).

⁶Since variable means may be backed out from marginal effects, we are unable to present the marginal effects of the first stage due to disclosure concerns.

Table 2: *continued from previous page*

| | | Coefficients | | |
|------------------------------|---|------------------------------------|--------------------------------------|--|
| Variable | | Model 1: All Farms & Ranches | Model 2: Large Farms & Ranches | Model 3: (Local Foods × Large) Interaction |
| <i>Crops and Livestock</i> | | | | |
| <i>Farm Level</i> | Hay and grains | 0.0379*** | -0.0053 | 0.0379*** |
| | Christmas trees | 0.3964*** | 0.4440*** | 0.3964*** |
| | Maple products | -0.0825** | -0.2212* | -0.0825** |
| | Bee products | 0.0887*** | 0.1879*** | 0.0887*** |
| | Vegetables | 0.2609*** | 0.1697*** | 0.2609*** |
| | Fruit and Nuts | 0.2663*** | 0.1832*** | 0.2663*** |
| | Berries | 0.1746*** | 0.3433*** | 0.1746*** |
| | Grapes | 0.4697*** | 0.3418*** | 0.4697*** |
| | Cattle | 0.0665*** | 0.1472*** | 0.0665*** |
| | Horses | 0.1526*** | 0.3120*** | 0.1526*** |
| | Sheep and goats | 0.1848*** | 0.2059*** | 0.1848*** |
| | Pigs | 0.0516*** | -0.1249*** | 0.0516*** |
| | Poultry | -0.0489*** | -0.2236*** | -0.0489*** |
| | Specialty livestock | 0.4130*** | 0.4961*** | 0.4130*** |
| | Forest products | 0.3197*** | 0.5663*** | 0.3197*** |
| | Value added products | 0.2302*** | 0.3515*** | 0.2302*** |
| | Direct to consumer | 0.1497*** | 0.3860*** | 0.1497*** |
| | Direct to retailer | 0.3312*** | 0.3265*** | 0.3312*** |
| | Organic certified | 0.034 | -0.0278 | 0.034 |
| | On-farm packaging facility | 0.0607*** | 0.0837* | 0.0607*** |
| <i>Spatial</i> | | | | |
| <i>County Level</i> | South | 0.0733*** | 0.0004 | 0.0733*** |
| | Midwest | -0.2282*** | -0.3788*** | -0.2282*** |
| | Northeast | 0.0704*** | -0.0546* | 0.0704*** |
| | Miles of Byways/100 sq. mi. | 0.0172*** | 0.0176*** | 0.0172*** |
| | (Miles of Byways/100 sq. mi.) ² | -0.0008*** | -0.0006* | -0.0008*** |
| | Miles of interstates/100 sq. mi. | -0.0025 | 0.0038 | -0.0025 |
| | (Miles of interstates/100 sq. mi.) ² | -0.0006 | -0.0007 | -0.0006 |
| | Ln(population) | -0.0442*** | -0.0636*** | -0.0442*** |
| | Farm-dependent | 0.0868*** | 0.0920*** | 0.0868*** |
| | Recreation-dependent | 0.0377*** | 0.0246 | 0.0377*** |
| <i>Entrepreneurship</i> | | | | |
| | Breadth | 0.6051*** | 0.7265*** | 0.6051*** |
| | Patents per 1,000 people | 0.0062*** | 0.0112*** | 0.0062*** |
| * Significant at 1% level | | | | |
| ** Significant at 5% level | | | | |
| *** Significant at 10% level | | | | |

4.1. Propensity to Adopt Agritourism

Ricardian theory of trade posits comparative advantages arise out of a farm operator's core production enterprise, specialization, and experience. To assess this, we examine the first-stage results, keeping in-mind that the large N (approximately 1.3 million) leads to very small standard errors.

Across all three models – independent of agritourism enterprise size – older operators

were consistently more likely to adopt an agritourism enterprise. However, retired principle operators were less likely to participate in agritourism, so these variables may offset one another to some degree and the status an operator reports (retired vs. actively managing) matters greatly. Rounding out operator demographics, all three models support previous findings that female principle operators are more likely to adopt an agritourism enterprise.

The propensity to adopt an agritourism enterprise was greater for farms processing or selling food for human consumption (i.e., value-added agricultural products, direct to consumer sales of food, and direct to retailer sales of food). In line with previous research (Barbieri and Mahoney, 2009), these results may be reflective of enterprises requiring similar physical and human capital. Direct to consumer and direct to retailer sales allow for additional communication lines with the public, thus potentially providing additional marketing through word of mouth or point of purchase. The coefficient on organic certification was insignificant, potentially reflecting the more conventional supply chains through which these products generally move.

Several types of production systems are associated with a greater propensity to adopt an agritourism enterprise. *Cattle*, for example, has a significant and positive impact on the decision to adopt an agritourism enterprise, but the z-score coefficient is over twice as large for larger farms and ranches (model two), suggesting larger livestock operations are more likely to see value in adopting agritourism practices to diversify incomes they generate from their key assets (lands and herds/flocks). Similarly, *Horses* have a greater impact on the propensity to adopt agritourism, particularly among higher value agricultural operations (model two). This is likely due to horses playing a more central role in some higher value enterprises, like dude ranches.

The negative signs on *Poultry* and *Maple Products* illustrate that not all agricultural production processes are conducive to agritourism activities. While the sign on *Poultry* makes sense given that chickens may seem common to many people, the negative sign on *Maple Products* is somewhat unexpected, but may be due to nearly half of the U.S.'s maple production taking place in rural Vermont. This negative result for *Maple Products* should be studied further to identify potential opportunities or barriers to agritourism in the maple industry.

Farms and ranches in the Midwest have a lower propensity to adopt agritourism relative to the West in all three models. When including smaller establishments, farms in the Northeast and South had a higher likelihood of participating in agritourism. However, the West dominates all regions when only considering those agritourism operations with the highest total values of production (model two). These differences across regions and farm sizes may be attributable to certain regions' relatively more well-established promotional programs, agritourism collaboratives, and community organizations, as well as differences in natural endowments such as climate, high supply of undeveloped land, and regionally-specific community assets.

The coefficient on the natural log of population indicates that as the location of an agricultural business increases in rurality, they are more likely to adopt agritourism. This is especially true for larger operations. Additionally, farms and ranches in farm-dependent and recreation-dependent counties, as well as those in counties with scenic byways, seem to have greater propensities to adopt an agritourism enterprise. Results suggest some locations

may provide greater opportunities in adopting an agritourism enterprise based on regional assets, related sectors, and travel infrastructure.

Finally, it appears that the entrepreneurial spirit of a county is a significant motivator in adopting an agritourism enterprise, suggesting network or cohort effects may be relevant. Both the breadth of entrepreneurship (the share of non-farm proprietors in the local labor force) and patents per capita are positive and significant at the one percent level in each model. These entrepreneurship variable coefficient signs and significance mirror McGranahan et al. (2010) who found that entrepreneurial spirit, creative class, and their interaction, had a significant and positive impact on job and establishment growth in rural counties for a broad set of sectors. Entrepreneurial ventures, and the evidence found here of a snow-ball effect, play particularly important roles in transitioning rural economies due to their ability to generate long-term employment opportunities.

Table 3: Heckman Outcome Equation – Ordinary Least Squares

| <i>Dependent variable: Agritourism Revenue (Dollars)</i> | | | | |
|--|-------------------------------|------------------------------------|--------------------------------------|--|
| Coefficients | | | | |
| Variable | | Model 1: All Farms & Ranches | Model 2: Large Farms & Ranches | Model 3: (Local Foods × Large) Interaction |
| <i>Farm Level</i> | Intercept | 28,947.00 | -329.54 | 27,735.00 |
| | Total value of production | 0.0012** | 0.001 | 0.0012** |
| | Retired | -7,992.43*** | -14,534.00 | -8,027.72*** |
| | Acres | 2.59*** | 3.60*** | 2.58*** |
| | Age | -122.49 | 315.5 | -119.54 |
| | Farming as primary occupation | 394.36 | -23,968.00*** | 345.7 |
| | Years in operation | 131.09** | -119.45 | 133.18** |
| <i>Crops and Livestock</i> | | | | |
| <i>Farm Level</i> | Hay and grains | -1,330.04 | 13,680.00* | -1,250.82 |
| | Christmas trees | -8,850.48 | 21,639.00 | -9,087.68 |
| | Maple products | -10,093.00 | -2,462.92 | -9,404.78 |
| | Bees | -10,165.00*** | -6,236.70 | -10,069.00*** |
| | Vegetables | 3,604.44 | 30,636.00** | 3,771.58 |
| | Fruit and Nuts | 24,458.00*** | 40,456.00*** | 23,928.00*** |
| | Berries | -6,481.13* | 15,457.00 | -5,525.87 |
| | Grapes | 58,208.00*** | 133,681.00*** | 56,447.00*** |

Continued on next page

Table 3: *continued from previous page*

| | | Coefficients | | |
|------------------------------|---|------------------------------------|--------------------------------------|--|
| Variable | | Model 1: All Farms & Ranches | Model 2: Large Farms & Ranches | Model 3: (Local Foods × Large) Interaction |
| <i>Farm Level</i> | Cattle | -9,281.75*** | -31,967.00*** | -9,163.53*** |
| | Horses | 2,706.40 | 4,712.59 | 2,822.73 |
| | Sheep and goats | -4,736.58* | -4,056.10 | -4,695.30* |
| | Pigs | 5,326.93 | 4,259.80 | 5,706.95* |
| | Poultry | -2445.7 | 15,291.00 | -2,571.90 |
| | Specialty livestock | 21,054.00*** | 153,442.00*** | 20,926.00*** |
| | Forest products | -7,636.37** | -14,876.00 | -7,856.01** |
| | Large Local | — | — | 15,419.00*** |
| | Value added products | 9,732.77*** | 8,555.47 | 8,059.10** |
| | Direct to consumer | -11,726.00*** | 3,119.71 | -23,487.00*** |
| | Direct to retailer | 3,776.75 | -24,281.00 | -1,271.58 |
| | Organic certified | -19,911.00*** | -26,328.00 | -22,797.00*** |
| | On-farm packaging facility | 1,000.12 | 6,835.80 | 1,218.85 |
| <i>Spatial</i> | | | | |
| <i>County Level</i> | South | 150.73 | -2,623.01 | 536.3 |
| | Midwest | 6,426.78 | -10,870.00 | 6,554.25 |
| | Northeast | 11,897.00*** | -34,818.00** | 12,152.00*** |
| | Natural amenities scale | 1,076.57*** | -2,451.33 | 1,080.61** |
| | Minutes to pop. of ≥ 10,000 people | 3.58 | -128.34 | 3.74 |
| | Hours to NPS attraction | -2,149.99** | -280.05 | -2,091.35** |
| | Miles of Byways/100 sq. mi. | -475.76 | 616.16 | -458.55 |
| | (Miles of Byways/100 sq. mi.) ² | -8.49 | -58.13 | -9.79 |
| | Miles of interstates/100 sq. mi. | -310.56 | -4,291.66 | -328.53 |
| | (Miles of interstates/100 sq. mi.) ² | -22.83 | 622.36 | -22.67 |
| | Agritourism revenue per sq. farm mi. | 0.11*** | 12.11*** | 0.11*** |
| | Per capita income | 0.19** | -0.62** | 0.19** |
| | Ln(population) | 2,325.97*** | 2,463.25 | 2,264.38*** |
| | Farm-dependent | -2,767.98 | -9,159.77 | -2,652.03 |
| | Recreation-dependent | 804.31 | 20,207.00** | 757.78 |
| | Inverse Mills ratio | -13,422.00 | 15,210.00 | -13,116.00 |
| | Adjusted R ² | 0.0809 | 0.268 | 0.0814 |
| * Significant at 1% level | | | | |
| ** Significant at 5% level | | | | |
| *** Significant at 10% level | | | | |

4.2. Agritourism Establishment Pull-factors

We now turn to the main results, those from the outcome equations, to understand how the three theories of comparative advantage apply to the economic activity generated by an agritourism enterprise. The inverse Mills ratio is insignificant in all three models despite the exclusion restrictions: operator demographics and total value of production. The selection correction term's insignificance is likely a result of its collinearity with other independent variables rather than evidence of no sample selection bias. Including the selection correction term may lead to an increased probability of committing a type two error for other variables, but given the general significance of variables of interest, we have kept the inverse Mills ratio to avoid potential endogeneity issues. Across all three models, it appears that

the Heckscher-Ohlin theory of comparative advantage drives the economic performance of agritourism businesses. Grapes are the leading driver of agritourism revenue, presumably because they are commonly linked to wineries – a high-value system of production and agritourism activity. Specialty livestock is also an important contributor to agritourism revenue, particularly for agritourism sites with higher total values of production (model two), while most other livestock coefficients are negative or insignificant. This specialty livestock result is linked to outdoor recreation and educational activities and is in line with prior research. For example, Frosch et al. (2008) estimated the direct impact from deer farm hunters in Texas (considered specialty livestock), excluding all other operations, to be \$73.2 million. Specialty livestock is also a significant pull-factor when including the lower value farms and ranches (model one), which may be due to these agritourism farms and ranches tapping into consumer curiosity and offering activities, such as petting zoos, where the public can interact with or learn about unique animals. In general, it appears that types of production that are unique or conducive to human interactions generate greater agritourism revenues.

Agritourism enterprises in the Northeast generate more agritourism revenue, *ceteris paribus*, relative to the other regions analyzed. This may be due to the fact that the Northeast has the most well-established state networks supporting agritourism operations (Veeck et al., 2006). Also, the Northeast has higher population density, necessitating agricultural operators seek entrepreneurial responses to urbanization pressures more quickly than other U.S. regions. In model 2, agritourism revenue is highest in the West while in model 1, it is highest in the Northeast, possibly because agritourism establishments in the Northeast are unable to take advantage of economies of size and scale compared to those in the West, and thus they generate less revenue. This size disparity between farms in the Northeast and the West leads to the Northeast intercept shifter differing greatly across the subsamples.

The natural log of county population is positive and significant in models one (*All Farms & Ranches*) and three (*(Local Foods × Large)* Interaction), suggesting that while agritourism establishments in less populated areas are more likely to adopt agritourism (Table 2, models 1, 2, and 3), those in more populated counties earn more revenue (Table 3, models 1 and 2). This may be due to intervening marketing opportunities for farms and ranches in more populated areas, whereas those in more rural counties may be adopting agritourism due to a perception of relatively few other viable diversification strategies.

One pull-factor revealed in the model that could help offset the lower agritourism revenues for farms and ranches in rural areas is leveraging their access to natural amenities. On average, an hour *closer* to a National Park Service (NPS) asset translates to \$2,150 more in agritourism revenue (model one). This supports the narrative that agritourism may be a complement to other types of outdoor recreation. Whether the NPS assets are pulling greater numbers of agritourists to the area, or whether they are pushing visitors out from their attractions to explore activities to supplement their NPS experience, it appears there are opportunities for co-promotion and development partnerships between the NPS and agritourism establishments.

Agritourism farms and ranches in counties with high agritourism activity benefit from industry concentration, though it is unclear if this is due to information sharing, business referrals, purchasing linkages, or regional reputation. When including all agritourism establishments, the gains from agglomeration are \$0.11/dollar of total agritourism revenue in the

county (model 1). These gains increase dramatically to \$12.11/dollar of agritourism revenues for high value agritourism establishments (model 2). These substantial benefits from agglomeration in model two are less likely due to information sharing and more likely a result of a well-established regional reputation, such as the renowned wine regions previously discussed. The other potential sources of agglomeration revolving around travel infrastructure were mostly insignificant in the second stage results.

In contrast to the findings of Barbieri and Mahoney (2009), the negative coefficients on *direct to consumer* and *direct to retailer sales* indicates that there are generally not positive spillovers or efficiency gains to the agritourism enterprise from partaking in these additional diversification strategies. Given this result, a third model with an interaction term for agritourism establishments with over \$350,000 in total value of production and at least one local foods activity, *Large Local*, was estimated as a robustness check. The coefficient on *Large Local* shows that larger operations actually benefit from positive spillovers between some diversification strategies and agritourism (model 3). This may be due to the different set of resources required to develop both an agritourism experience and the logistics to prepare and deliver agricultural products directly to market being too great for smaller operations to operate efficiently. Instead, evidence suggests they may want to make a choice between one diversification strategy and the other. In contrast, larger operations that have more labor and access to capital may have greater flexibility to take advantage of the synergies between agritourism and other diversification strategies, and see it as a way to diversify the cash flows needed to sustain their larger operations.

5. CONCLUSIONS AND FUTURE RESEARCH

This study investigates how natural amenities, populations, infrastructure, and farm/ranch characteristics affect the decision of an agricultural operator to adopt an agritourism enterprise, as well as whether these factors lead to comparative advantages in agritourism. The Heckscher-Ohlin, Ricardian, and agglomeration theories of comparative advantage are explored by applying farm-level data to a unilateral spatial interactions model framework – a derivative of the gravity model.

Empirical findings suggest that while all three trade theories had some significant factors, the Heckscher-Ohlin theory provided the most evidence for sources of comparative advantages in the agritourism industry. Natural endowments, such as natural amenities, distance to complementary outdoor activities, existing crops and livestock, and population, were all significant drivers in determining an agritourism site's level of economic activity tied to agritourism. Specifically, unique agricultural production types conducive to human interactions, such as grapes (i.e., wineries), fruit and nuts (i.e., pick-your-own), and specialty livestock (i.e., petting zoos), are significant pull-factors for economic activity tied to agritourism. This finding may be encouraging for agricultural businesses producing these products, especially in regions where such agricultural production types are likely to stand out against the nearly ubiquitous production of more conventional crops. However, the impact of a particular natural endowment on agritourism's economic activity is dependent on the size of the agritourism business.

The advantages from productive and technological efficiency described by the Ricardian

theory seem to differ across the adoption and outcome equations as well as across the agricultural firm size. In the first stage, older principal operators were more likely to start agritourism businesses, but the second stage results show that while more experienced operators earn more, active managers earn more than retired operators. Similarly, while value-added, direct to consumer sales, direct to retailer sales, and on-site packaging facilities corresponded to a greater likelihood of operating an agritourism enterprise, only larger agricultural operations appear to generate additional revenue from it. For both the Hecksher-Ohlin and Ricardian empirical analyses, we fully acknowledge the potential for limited selection bias, but have addressed these concerns as fully as possible given data constraints.

Finally, strong evidence of positive externalities resulting from industry concentration was found in each model. The significantly higher industry concentration benefits in the second model, focusing on agritourism sites with greater total value of production, provides some evidence of different levels or sources of economies of agglomeration throughout the agritourism industry.

Given the increasing share of farms and ranches with agritourism enterprises and the increasing market pressures on small- and medium-sized farms and ranches, understanding the role location plays in the propensity to adopt, and the performance of an agritourism operation is of increasing importance. In order to fully understand the spatial relationships of agritourism and its potential role as a rural development driver, future research should explore: 1) the interplay between pull- and push-factors that motivate an agritourist to participate; 2) case studies on regions with unexpectedly low/high agritourism revenues relative to their comparative advantages to identify best practices, keys to success, or barriers to growth; 3) the spatial dimensions of possible intra- or inter-industry spillover benefits by integrating NPS activity into at least one of the case studies and tourist demand studies; and 4) how the benefits of agglomeration vary depending on the flavor of agritourism and how these benefits of agglomeration may relate to positive spillovers for other local industries in rural communities.

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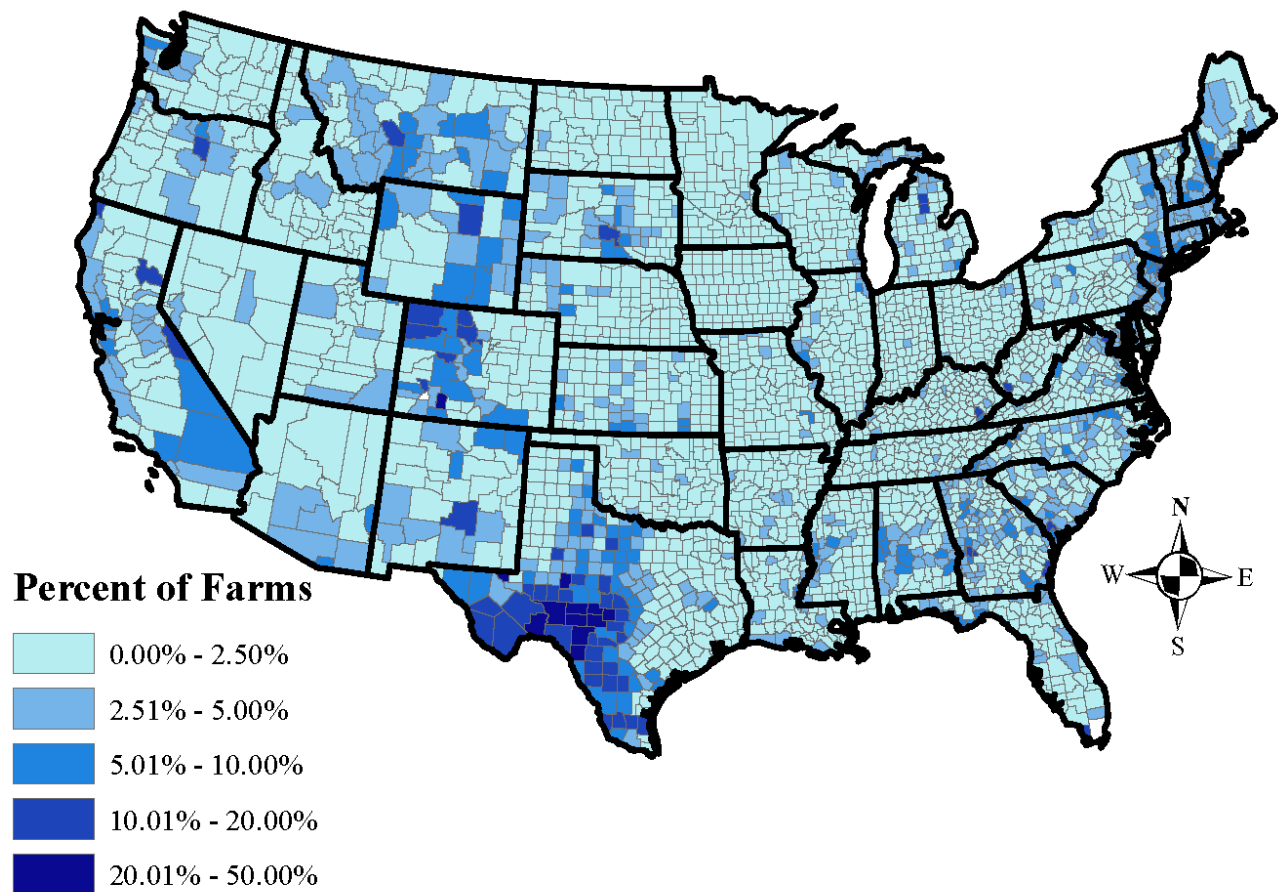
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APPENDIX

County-level maps and summary statistics

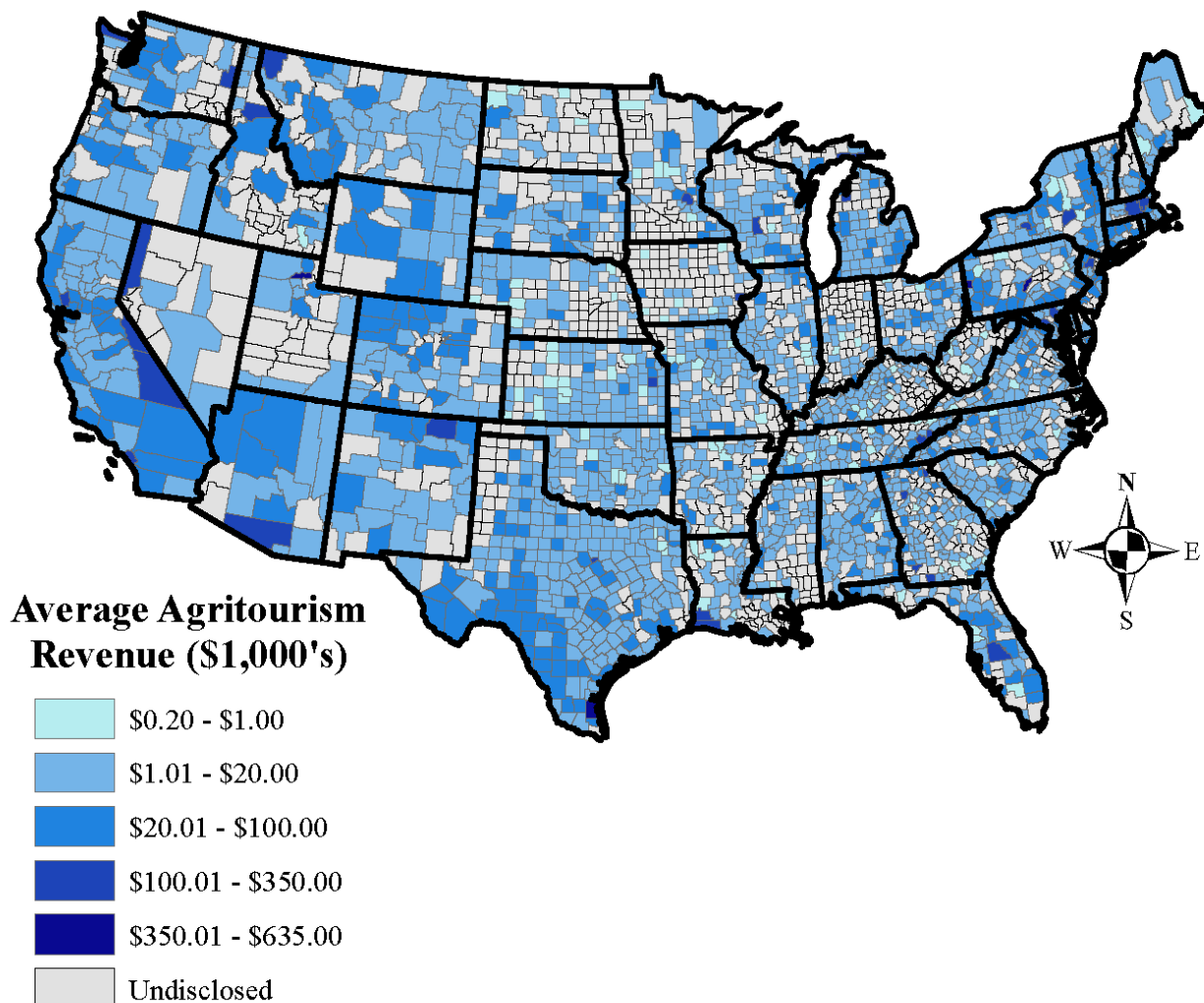
We mapped two key measures closely related to our dependent variables: the share of farms and ranches with agritourism revenue and average farm agritourism revenue. These maps provide some information about the regional variation in agritourism. For example, we see spatial concentration of agritourism enterprises in the Intermountain West (e.g. dude ranches) and parts of the Great Plains (e.g., hunting-related tourism) but average revenue is more even across regions of the U.S. For an in-depth discussion about clusters of agritourism in the U.S., see Van Sandt et al. (2018).

Figure 1: Percent of Farms with Agritourism Revenue, 2012



Source: *USDA Census of Agriculture, 2012*

Figure 2: Agritourism Farm Agritourism Revenue, Average per County, 2012



Source: USDA Census of Agriculture, 2012

Note: Grey counties have missing or undisclosed data

Summary statistics of publicly available variables from the 2012 Census of Agriculture and other secondary data sources are in Table 4. Not all variables were available publicly at the county-level, but we hope this addition helps the reader better understand the variables used in our model. USDA did not allow us to remove variables means used in the regressions from the confidential data lab. Despite this shortcoming, we think the value of using farm-level microdata on agritourism outweighs the disadvantages presented by not having summary statistics for the microdata used in the regressions.

Table 4: Appendix – Summary Statistics

| Variable (2012) | Value | Percent |
|--|---------------|---------|
| Agritourism Farms | 33,161 | 1.57 |
| Agritourism Revenue | \$704,038,000 | – |
| Farming as Primary Occupation | 1,007,904 | 47.78 |
| Years in operation | | |
| 1: 2 years or less | 47,782 | 2.27 |
| 2: 3 or 4 years | 82,324 | 3.9 |
| 3: 5 to 9 years | 252,290 | 11.96 |
| 4: 10 years or more | 1,726,907 | 81.87 |
| Days worked off farm | | |
| 1: None | 823,659 | 39.05 |
| 2: 1 to 49 days | 169,761 | 8.05 |
| 3: 50 to 99 days | 92,876 | 4.4 |
| 4: 100 to 199 days | 180,407 | 8.55 |
| 5: 200 days or more | 842,600 | 39.95 |
| Acres (mean) | 433.57 | – |
| Female Principal Operators | 288,264 | 13.67 |
| White Principal Operators | 2,012,652 | 95.42 |
| Black Principal Operators | 33,371 | 1.58 |
| Asian Principal Operators | 13,669 | 0.65 |
| Native Hawaiian Principal Operators | 1,468 | 0.07 |
| American Indian Principal Operators | 37,851 | 1.79 |
| Principle Operator Age (mean) | 58.3 | – |
| Hay | 781,899 | 37.07 |
| Christmas Trees | 15,494 | 0.73 |
| Maple Products | 8,261 | 0.39 |
| Bees | 38,261 | 1.81 |
| Vegetables | 72,045 | 3.42 |
| Fruit and Nuts | 118,590 | 5.62 |
| Berries | 30,538 | 1.45 |
| Grapes | 27,878 | 1.32 |
| Cattle | 913,246 | 43.3 |
| Horses | 504,795 | 23.93 |
| Sheep and/or Goats | 216,794 | 10.28 |
| Hogs | 63,246 | 3 |
| Poultry | 198,272 | 9.4 |
| Specialty Livestock | 41,602 | 1.97 |
| Direct to Consumer Sales | 144,530 | 6.85 |
| Organic | 14,326 | 0.68 |
| Farm Dependent (2003, USDA) | – | 13.78 |
| Recreation Dependent (2004, USDA) | – | 10.63 |
| Scenic Byways Per 100 sq. miles (mean) | 1.93 miles | – |

Continued on next page

Table 4: *continued from previous page*

| Variable (2012) | Value | Percent |
|--|---------------|---------|
| Interstate Per 100 sq. miles (mean) | 1.75 miles | – |
| Hours to National Park (mean) | 1.64 | – |
| Time to Town of 10,000 People (mean) | 41.42 minutes | – |
| Patents per 1,000 people (2007, USPTO) | 1.21 | – |
| Breadth (Proprietors/Total Employment) (2006 mean, BEA) | – | 24.7 |
| Per Capita Income (2006, BEA) | \$50,895.61 | – |
| <i>Source: Census of Agriculture, 2012, unless otherwise noted</i> | | |