

THESIS

AGRICULTURAL MANUFACTURING LOCATION DECISIONS IN COLORADO:
IMPLICATIONS FOR RURAL ECONOMIC DEVELOPMENT POLICY

Submitted by

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ABSTRACT

AGRICULTURAL MANUFACTURING LOCATION DECISIONS IN COLORADO: IMPLICATIONS FOR RURAL ECONOMIC DEVELOPMENT POLICY

Many rural areas face unique challenges that put them at a competitive disadvantage relative to urban areas. State and Federal policies in the U.S. promote opportunities for value-added agriculture (manufacturing) as a means to create and retain wealth in rural places. In order to inform policies that might attract agricultural manufacturing firms to rural locations, this research explores agricultural firm location decisions using a case study of Colorado. First, this research creates a unique dataset of agricultural manufacturing firms in the State of Colorado and uses these data to assess if the traditional factors associated with neoclassical firm location theory (such as wages, tax rates and population) are correlated with agricultural manufacturing firm locations. Second, we conduct in-depth interviews with selected food manufacturing firms located in Colorado's heterogenous Western Slope. Results suggest a behavioral framework (where assets other than profit increase welfare) may better explain how agricultural manufacturing firms choose to locate in rural places. We recommend bottom-up policies that allow communities to promote entrepreneurship and take advantage of location-based comparative advantages as a means to attract agricultural manufacturing firms to rural Colorado.

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Chapter 1: Introduction

Many rural areas face unique challenges that put them at a competitive disadvantage relative to urban areas. Populations in rural Colorado are shrinking for the first time on record, rural job growth is well below urban rates, and deep and persistent poverty has become characteristic of some of Colorado's rural counties (Cromartie, 2017). Traditional economic development strategies to counter the poverty of rural places have focused on attracting capital resources to create more jobs and increase wages to grow an economy, but these policies are often too costly for communities (Shaffer et al, 2006; Pender et al, 2012). Additionally, top-down approaches to rural development have been hampered by the heterogeneity of rural economies (Honadle, 1993).

These challenges shifted the focus of rural development from the accumulation of financial assets and economic growth to wealth creation and community development. Wealth refers to the cumulative, diverse and durable assets that contribute to the well-being of a community. Wealth includes physical goods and financial assets, but also considers human, social, intellectual, natural, cultural and political capital. Measuring the value of non-marketable assets can be difficult. However, their inclusion in the consideration of what contributes to community well-being strengthens our ability to address the challenges of rural poverty (Pender et al, 2012). The creation of wealth has been shown to increase community well-being and is therefore an essential element to economic development (Arrow et al, 2013).

This thesis investigates opportunities to support rural economic development through agricultural manufacturing. Rural communities are endowed with natural, agricultural, recreational and tourism-based resources that make their economies diverse in competitive advantages. The heterogeneity of rural communities makes implementing a state-wide comprehensive rural development policy challenging. Recent federal policies have promoted cluster-based development strategies, encouraging competitive advantages of regions to promote productivity and innovation in industry sectors (Deller, 2009). These policies align closely with targeted regional development strategies, by capitalizing on and growing wealth assets beyond fiscal indicators of well-being.

Given the history of extraction-based economies in Colorado, such as mining, farming and ranching, modern rural development strategies can focus on adding value to these existing sectors. Manufacturing, for example, can create high-paying jobs off the farm, which may help to stabilize population bases in rural places (Capps et al, 1988). Additionally, value-added products expand opportunity for innovation among small entrepreneurial businesses (Vilsack, 2017).

Supporting opportunities for agricultural manufacturing in rural communities is important to rural economic development. Accordingly, it is critical to understand how agricultural manufacturing firms make location decisions. Firm location theory provides a framework for understanding these decisions and a substantial body of literature explores the spatial aspects of firm investments (e.g., Arauzo-Carod et al., 2010). However, literature regarding agricultural manufacturing location decisions specifically is sparse.

This research explores what characteristics influence the location decisions of agricultural manufacturing firms across the state of Colorado? This thesis aims to understand the qualities of a region that attract this particular industry. The research uses a mixed methods approach to answer the question, utilizing a unique dataset and econometric model for state-wide analysis in addition to a targeted regional case study of ten counties on Colorado's Western Slope. In using a mixed-methods approach, we can better identify communities' intrinsic assets as well as guide local policies to support the growth of value-added manufacturing in rural Colorado.

One contribution of the research is the creation of a unique data set of aggregated food manufacturers across the state. It allows insight into an aspect of the local food system that has not been researched to date. Firm location theory indicates that different industries have different cost structures and input requirements, so they will be attracted to different mixture of place-based characteristics (Deller, 2009; Connor et al, 1997); this makes a study in food processing firm location in this region novel in its findings and relevant to formulating targeted regional economic development strategies. Finally, research into firm location decisions and the economic benefits that arise from the growth of industry clusters has been primarily analyzed using econometric methods. Our results suggest that understanding the locational qualities that both represent community wealth and serve to further wealth creation may be improved by an integration of both qualitative and quantitative methods.

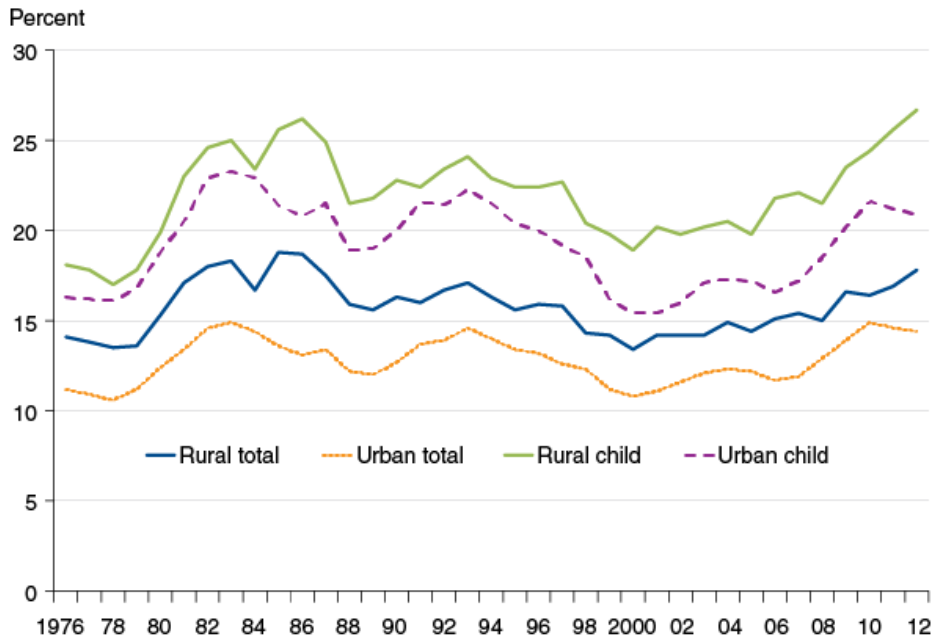
Following this introduction, a background of rural economic development, wealth creation and firm location theory will be presented. This section reviews relevant literature and implications for this research question. Chapter 2 presents an econometric model of agricultural manufacturing firm location across the state. Two count models are compared, one using neoclassical indicators and the other integrating measures of wealth and community's capital assets. The results are compared with prior expectations from the literature, and a discussion explains the significant and important factors. Chapter 3 details the methodology, data and results of a targeted regional case study of food manufacturers located on Colorado's Western Slope. Survey answers are analyzed both quantitatively and qualitatively to highlight some location-based assets that influence location decisions, which were not included in the econometric model due to the availability of secondary data. The discussion weaves together the results from the econometric model and the survey responses in Chapter 4. The findings lead us to recommend strategies for rural economic development. Finally, Chapter 5 offers a conclusion to summarize findings.

Overview of Rural Poverty

Many rural places across America are faring worse than their urban counterparts. Higher incidences of poverty occur in the least populated areas of this country. While the last few decades saw a decline in overall poverty in the United States, the gap between rural and urban poverty persists (See **Figure 1**). The rate of rural children living in deep poverty is

increasing, with some of the highest rates of persistent and deep poverty¹ in American occurring in the Southwest region of the country (See **Figure 2**) (Farrigan et al 2017).

Rural child poverty has increased the most since 2008



Note: Rural and urban are defined by metropolitan area definitions.
 Source: USDA, Economic Research Service using Current Population Survey Data.

Figure 1: Rural and Urban Total and Childhood Poverty Rates, 1978-2012
 (Farrigan et al, 2017)

¹ Deep poverty is defined as having cash income below half of the individual or family’s poverty threshold. Counties are persistently poor if more than 20 percent of the population has been living in poverty for the last 30 years (Farrigan et al, 2017).

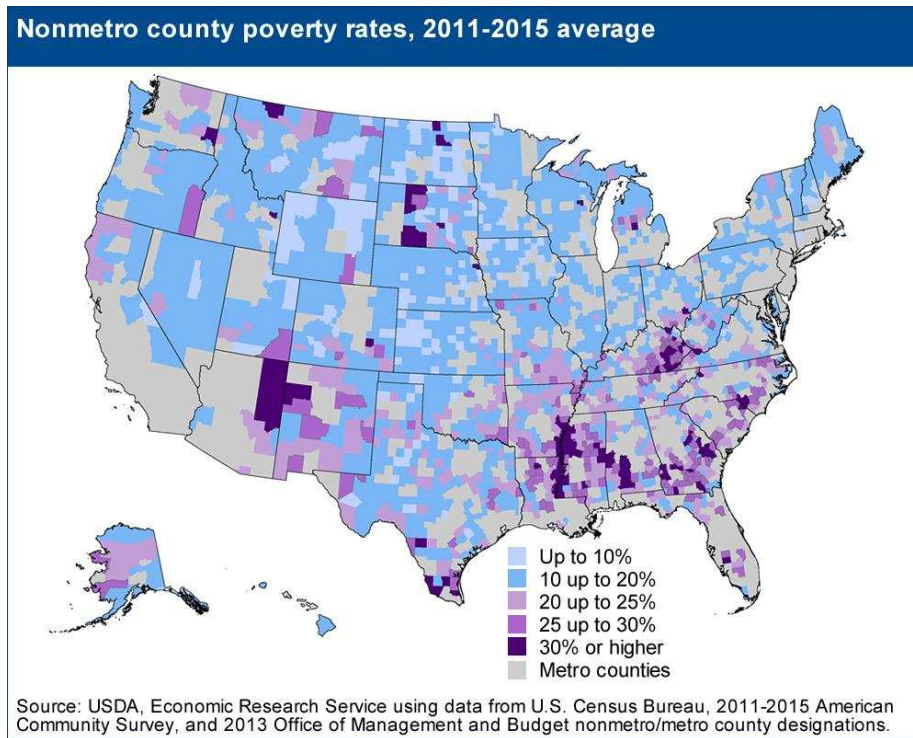


Figure 2: Non-Metro County Poverty Rates for United States, 2011-2015 Averages (Farrigan, 2017)

Poverty is defined as having an income below a federally determined threshold deemed necessary to meet basic needs, based on family size. These thresholds were developed in the 1960s and updated annually with inflation. Poverty rates do not change based on cost of living in different areas, account for ages of individuals in a family, or include access to other public goods such as health care, schooling, transportation or communication networks (Farrigan et al, 2017). As a result, much research calls into question whether or not poverty is an adequate measure of the well-being and resiliency of communities.

What is Wealth

Some of the economic development literature has shifted away from traditional measures of productivity and prosperity, such as income, to advocate for a more comprehensive

understanding of human well-being in the form of wealth (Pender et al, 2012). A generally accepted definition of wealth is the cumulative and diverse assets that can contribute to the well-being of people. Assets can be financial or physical (as measured by poverty thresholds and regarded in traditional economic growth theory), other natural, human, or social capitals or even ‘intangible’ assets. Wealth is a stock value that can be accumulated or depleted through investment and consumption; investment is necessary in multiple assets to promote sustainable long term development (Pender et al, 2012; Arrow et al, 2013; Marre, 2014; Ratner et al, 2014).

Income vs. Wealth

The relationship between wealth and income is misleading. Income is a flow, and traditional economic theory and government policy measures well-being of communities based on these flows. For example, the federal poverty threshold discussed above is based solely on household incomes. Wealth is considered a stock: it is measured as an accumulation of assets at a given time. Income can contribute to increased wealth over time, and wealth can generate income (Pender et al, 2012). The Recession of 2008 highlighted the importance of net worth and wealth creation because so many people saw the value of their assets decline substantially while income changed less (Marre, 2014).

Wealth is even more unevenly distributed than income in the United States, yet it is thought to be critical to achieving long-term reductions in poverty (Arrow et al, 2013). However, most social policies address poverty via subsidies or increased income, rather than by building wealth. As a result, the US has among the most unequal net worth

distributions relative to other industrialized countries that gather wealth distribution data (Pender et al, 2014). Rural areas in particular struggle to build assets and create sustainable long-term wealth in their communities: the earning gap between urban and rural workers is growing, the people who could contribute to rural wealth are migrating to urban areas, and the extraction-based rural economies are losing ground (Marre, 2014; Ratner et al, 2014).

Wealth and Economic Development

Investment in wealth, particularly in diversifying the types of assets that together constitute a community's wealth, is necessary for sustainable economic development (Pender et al, 2009). Yet, economists have historically focused on growth rather than development. Economic growth can be thought of as more factories, more jobs, accumulating more natural resources and doing more of what is already being done (Shaffer et al, 2006). However, natural resources are depleted over time, and diminishing returns to capital means that growth of this kind will eventually stagnate (Solo, 1956). Alternatively, economic development implies long-term structural change that increases the capacity for innovation and creation within an economy. Development leads to competitive advantages of production and stable, resilient communities (Shaffer et al, 2006). As a result, federal policy makers in the US have begun to incorporate wealth as a component of achieving long-term development and prosperity in rural America (Pender et al, 2009).

Characterizing Rural Economies

The perception that rural economies thrive solely on extractive sectors is inaccurate and misleading. Agriculture and mining combined provide less than 5% of jobs in rural areas, while manufacturing provides 15% of rural jobs, and service industries account for over half of rural employment as of 2015 (Cromartie, 2017; Honadle, 2001).

The immense diversity of the rural landscape in the United States poses challenges to creating comprehensive development policy. The operational definition for many rural for federal programs is anything “nonmetropolitan”² which is problematic because it defines rural by what it is not (i.e. not urban) and not what rural areas may have in common (which is very little) (Honadle, 2001). This heterogeneity must be considered when implementing development strategies.

One of the most striking characteristics of rural economies is the net population decline over the last decade – the first time this has occurred on record in the US (see **Figure 3**). The number of people living in non-metropolitan counties declined by nearly 200,000 between 2010 and 2016 (Cromartie, 2017). This has contributed to the ‘brain drain’ of educated workers moving from rural to urban areas: not only are wages higher in urban areas but rural workers see their wages increase more rapidly in urban settings. The wage dynamic between rural and urban places results in lower net worth for rural households, exacerbating rural poverty (Marre, 2014).

² Metropolitan counties are defined as having densely settled urban area with 50,000 or more people. Nonmetropolitan counties are the counties are all those that do not meet the definition of metropolitan (Cromartie, 2017).

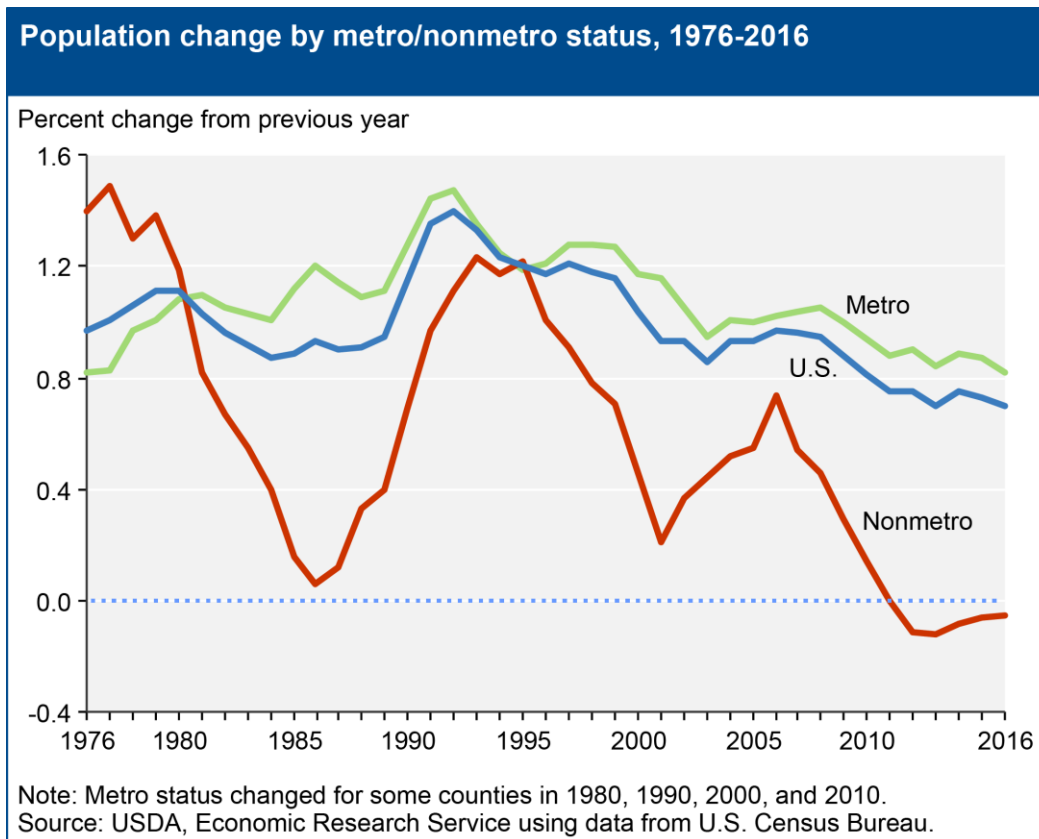


Figure 3: Population change by Metro and Non-Metro Counties, 1976-2016 (Cromartie, 2017)

Opportunities in Agricultural Manufacturing

Manufacturing provides a larger portion of jobs and earnings in rural areas than urban areas. Although the share of total rural employment in manufacturing is shrinking relative to service-sector jobs, median earnings are higher in manufacturing and therefore make it more valuable to rural economies overall (Low, 2017). The manufacturing industry holds promise for rural communities to provide more lucrative employment and slow the rapid emigration from rural to urban places.

Although it is clear that rural economies are no longer based entirely in agricultural ventures, there are opportunities for agricultural manufacturing to improve the economic

conditions of rural communities. Since the late 1980's, value-added food manufacturing has been promoted by federal and state governments as a source of rural economic development, job creation and population stabilization (Capps et al, 1988). These policies likely resulted in food manufacturing contributing to more than 18 percent of rural manufacturing employment in 2015 (Low, 2017). There are cost-minimization advantages to locating food processing firms near raw agricultural inputs, providing a competitive advantage for rural agricultural regions in this sector (Connor et al, 1997). Additionally, agricultural manufacturing has been shown to contribute to economic development rurally (DeVuyst et al, 2005).

Policy Overview

In an effort to support rural development, Federal and state governments have created policies to promote technological innovation and value-added manufacturing over the last several decades. Economic theory and current trends in rural development policy shed light on some solutions to the rural urban poverty gap.

Federal Rural Development Policy

Federal rural development policies in the US have been fragmented. This is due in part to the vague mandate of the Rural Development Act of 1972 that tasked each President to form a national policy for rural development and charged the USDA with implementing the President's policy (Deller, 2009). Additionally, the diversity of rural places has and continues to present substantial challenges to implementing coherent and successful

national rural policy. Accordingly, each subsequent Administration has taken different approaches to address rural development.

The Bush Administration initiated the National Rural Development Partnerships. The goals of these Partnerships, administered at the state level and including public and private members, aimed higher than just job and income creation to include health, transportation and environmental issues. This perspective captures the creative innovation and collaborative partnerships that wealth creation requires (Shaffer, 2001).

President Obama created the White House Rural Council to “expand access to capital..., promote innovation, improve access to health care and education and expand outdoor recreational activities on public lands” (Obama, 2011). Again, the themes of wealth creation are present, and the value of innovation promoted by economic clusters is highlighted. Included in the Council’s priorities were promoting opportunities for rural manufacturers and value-added producers to expand access to new markets (White House Rural Council, 2011).

Most recently, the Trump Administration’s Agriculture and Rural Prosperity Task Force issued a report in late 2017 outlining key indicators of rural prosperity (e-Connectivity, quality of life, rural workforce, technological innovation and economic development) that demonstrate a comprehensive multidisciplinary understanding of community development (Perdue, 2017). This administration is reorganizing the USDA in a way that they state elevates rural development as a priority for the Department, but also restructures the

federal rural leadership in a novel way (USDA, 2017). Some agricultural producers have welcomed the changes, while other advocates for rural development are concerned with vacant leadership posts and the confusion caused by abrupt and rapid restructuring (Douglas, 2017).

Wealth Creation Concepts

Creation of wealth requires savings and investment in assets. This means policy makers must be able to identify and implement strategic investments while continually understanding and adapting to the changing dynamics of their unique communities (Pender et al, 2012). The difficulty with implementing a comprehensive top-down rural development policy stems from the heterogeneity of rural communities: no two communities have the same base-level wealth, the same comparative advantages, nor a shared vision of what constitutes a 'successful' future. Deller (2014) outlines two broad ways to approach strategies for modern rural development:

(1) Increasing available resources: this could be through federal grant dollars, by increasing social capital through cultural fairs, or investing in human capital by creating a new branch of a community college.

(2) Using existing resources differently: instead of harvesting a forest, develop a trail system, or designate a higher share of public funds to support small businesses.

Value-added agricultural manufacturing: a source of economic development?

For rural economies that have traditionally been based in extraction industries, one source of their competitive advantage is exactly that they are close to resources worth extracting.

While it is clear that not all rural economies are agricultural, some economies may have an advantage in agricultural processing. Value-added agricultural manufacturing is one way to move rural communities from extraction to sustainable economies (Vilsack, 2017).

Food processing is a part of local food systems, and expansion of local food systems has been shown to be a driver for rural economic development through income and employment growth, import substitution, and the local circulation of money (Martinez et al, 2010). This industry sector represents an opportunity to embrace both aspects of the broad strategies to develop economies.

Firm Location Theory and Agricultural Manufacturing

Economic development inherently poses a spatial question. Communities are not homogenous, nor is the topography that separates the communities. Differing human capital, as well as diverse locational attributes, shape the distribution of industry location and thus levels of development within a given region (Deller, 2009). **Table 1** outlines the economic perspectives on firm location theory: neoclassical profit maximization, behavioral, institutional and industry clusters; as well as the measurable indicators, (the expected influence on firm location), and literature sources associated with the theories.

Table 1: Firm Location Theory Summary			
Theory	Description	Measurable Indicators (Expected sign)	Sources
<i>Neoclassical Profit Maximization</i>	Firms are seek to minimize costs and maximize revenues through access to market demand	Population size (+) Wages (-) Education attainment (+/-) Unemployment (+) Size of input markets (+) Energy costs (-) Income (+) Transportation infrastructure (+) Property tax rates (+/-)	Carlton (1983); Duranton et al (2011); Hanson et al (2010); List (2001); Guimaraes (2003); Davis et al (2005); Goetz (1997); Henderson et al (2000); Bhat et al (2014)
<i>Behavioral</i>	Individuals maximize utility: minimal profit threshold with welfare increased through other channels	Natural amenities index (+) Social capital index (+) Public land access (+)	McGranahan et al (2017)*; Throsby (1999)*
<i>Institutional</i>	Structure of relations, rules and laws that set parameters for business-government negotiations	Corporate tax rates (-) Subsidies (+) Regulations (+/-)	Goetz (1997); Carlton (1983); List (2001); Henderson et al (2000)
<i>Industry Clusters</i>	Spatial array of linked industries affect innovation, productivity and competitive advantage	Agglomeration/Location Quotients (+) Entrepreneurial culture (+) (proprietary owned businesses)	List (2001); Guimaraes et al (2003); Davis et al (2005); Goetz (1997); Henderson et al (2000); Bhat et al (2014)
* Articles are not firm location literature, but address the effect of the indicators on economic development			

A large number of empirical studies have attempted to quantify the driving forces behind firm location and investment decisions. Advances in econometric modeling as well as enhanced access to and quality of data available have facilitated better understanding of firm location theory and economic development (Arauzo-Carod et al, 2010). Within economic literature, the focus on different determinants and use of different modeling approaches result in substantial variety of conclusions among published works. As such, comparisons across studies are challenging, and determining the importance of individual factors on location decision has been elusive.

Neoclassical Profit Maximization Theory assumes firms are driven by profit maximization and will make a locational decision that minimizes total costs while maximizing total revenue (Shaffer, 1989). Costs include wages, transportation, proximity to inputs, energy, water, and land: any increase to these costs would likely result in a decrease in firm location or investment (Arauzo-Carod et al, 2010). Maximizing revenue often means access to markets, indicated by population size or density and incomes. Human capital can also be a source of increased revenue, measured by unemployment and educational attainment levels. Connor and Sheick (1997) give reason to believe that agricultural manufacturing firms locate with particular attention to cost structure: if transporting inputs is expensive or time sensitive, firms will locate close to major agricultural zones; if the costs of distributing the final product is larger, then firms will locate closer to urbanized areas with bigger markets for their products.

Behavioral Theory suggests that firms, like individuals, do not function as perfectly informed optimizers. Instead locational decision makers choose to maximize utility, which includes a combination of monetary and personal factors. Acceptable risk perception differs among individuals, which can affect where a firm chooses to locate. There is also imperfect information about the future of suppliers and markets, and the infrequencies of the decision to locate in a place leads to the location of firms in 'irrational' places if judged solely by profit maximization theory (Shaffer, 1989; Deller, 2009). It is more likely that the chosen site merely meets some minimal profit threshold, and the welfare or satisfaction of the decision maker is increased through other channels. It is at once more realistic because it limits the range of possible locations to those considered by the firm, and also more

complex because optimizing utility often includes noneconomic criteria (Shaffer, 1989). Some of the noneconomic criteria include social capital, access to public land and natural amenities. Previous literature shows that these would have a positive correlation to firm location decision (Rupasingha et al, 2006; Arrow et al, 2013). However, assessing and quantifying these 'other channels' of noneconomic criteria that increase utility remain challenging.

The *Institutional Approach* analyzes the institutions that structure private-public relationships that influence a firm's decision to locate. Decision makers weigh a network of economic relations that affect revenue and costs, and these relations determine how firms make location decisions (Aruzo-Carod et al, 2010). These relationships can also be thought of as the rules and laws that set parameters for negotiations between governments and firms. Corporate tax rates, subsidies and industry regulations imposed in a given place would be expected to influence how firms make location decisions. This is type of relationship dynamic the institutional approach examines to understand the context of firms' location choices (Deller, 2009).

Porter's (1998, 2000) *cluster economics* pervade modern regional development policy nationally and locally (Woodward et al, 2001). Clusters are more than just agglomeration of a single industry, but rather are all industries, businesses and institutions in a single sector or field located in a geographically proximate area. The spatial array of these sector linkages serve to increase productivity, expand competitive advantages and promote innovation, all of which contribute to the creation of wealth and economic development in

communities (Porter, 2000; Woodward et al, 2009). The existence of clusters has been shown to benefit local economic vitality, although contributions vary by industry and impacts are often challenging to quantify (Gabe, 2003). The indicators of cluster economies, agglomeration and entrepreneurial culture, would be expected to increase firm location decisions (Arauzo-Carod et al, 2010). The ideas put forth by Porter (1998, 2000) link economic growth theory, regional development theory, and location theory: cluster economies are not a theory themselves, but rather a complimentary observation drawn across these theories. Porter is critiqued for having little theoretical context for these observations. Due to the prevalence of support for cluster strategies to economic development among national institutions (Goetz et al, 2009), often firm location theory is now treated equivalently with cluster economics.

Critiques of Firm Location Theory

Despite its prominence in the literature, there are many critiques of location theory. First, measuring the existence of clusters is akin to measuring industry agglomeration, which was discussed in more depth in the previous segment on Location Quotients. McCann (1995) points out a salient issue regarding modern location theory, noting that many firms have few or no trading links with other local firms in the same industry, or even in the same geographical region regardless of the presence of a cluster. He argues there is no proof that information flows more within a particular space (especially in a highly digitalized age), or that relationship links are formed. Deller (2009) lists a plethora of definitions for clusters, highlighting the lack of convergence of understanding. The

behavioral perspective to firm location theory has not received as much attention precisely because it is deductive and difficult to test rigorously (Shaffer, 1989; Deller, 2009).

Agricultural Manufacturing

While a large body of literature examines firm location theory, there is a dearth of research specifically focused on agricultural manufacturing. The research that does exist finds that these firms' decisions are largely driven by cost structures. Connor and Schiek (1997) identify three types of food industries: supply-oriented, demand-oriented, and footloose. Supply-oriented industries locate close to input sources because inputs are expensive, heavy, or perishable. Demand-oriented industries have high costs of distributing final products relative to the sales, so these firms concentrate near retail outlets or consumer bases. Footloose industries utilize a variety of inputs and distribute over a broad region, so these firms' location decisions are harder to predict (Capps et al, 1988; Connor et al, 1997).

If we accept that agricultural firms are cost minimizers, what are the most important factors that influence their location decisions? Large population bases, low wages, agglomeration economies of scale and labor force heterogeneity are found to be the most important factors that influence new business development in the agricultural manufacturing sector (Goetz, 1997; Henderson et al, 2000; Davis et al, 2005). These findings indicate that rural communities would be at a disadvantage to attracting firms in this sector, due to lower populations and relatively homogenous labor forces. Davis et al (2005) supports that manufacturing firms are less likely to locate in rural than in urban places.

There are only two studies that focus on location decisions of agricultural manufacturing plants in rural communities. Henderson and McNamara (2000) analyzed the relationship between local attributes and food plant investments in the Corn Belt counties between 1987 and 1995. This paper relates firm location decision to agricultural manufacturing, and examines the influential neoclassical factors of locational theory. They found that manufacturing investments were dependent on the type of industry: supply-oriented firms made location decisions associated with higher access to inputs, while demand-oriented firms' location correlated with developed transportation systems and access to markets.

DeVuyst, Leistritz and Schepp (2005) examine the socioeconomic impacts of new agricultural processing plants locating in rural communities in North Dakota during the 1990s. This paper supports the concept of rural wealth creation and ties agricultural manufacturing to community economic development. They found evidence of improved job opportunities and enhanced incomes in rural towns with new agricultural processing plant establishments, which stabilized the local population. This had spillover effects in creating demand for infrastructure improvements and services, such as daycare. This study does not address the more modern concepts of social, cultural or 'intangible' assets and how the growth of agricultural manufacturing affected overall community development.

The rest of this thesis proposes a mixed methods approach to analyzing agricultural firm location decision in the state of Colorado. First, an econometric model examines the factors that influence firm location decision, including neoclassical indicators as well as measures of human, social and natural capital. Then findings from a targeted regional case study of

surveyed food manufacturers on Colorado's Western Slope will be presented. The survey examines the factors informed by prior literature and the econometric model that are correlated with firm location decisions. Weaving the two analyses together provides a more nuanced understanding of the reasons agricultural businesses are choosing to locate rurally. Thoughtful consideration with regards to these reasons results in poignant policy recommendations for ways to promote value-added manufacturing as a source of rural economic development in Colorado.

Chapter 2: Modeling Firm Location Decision

The issue of regional development is context and place-specific (Hondale, 1993; Pender et al, 2014), and the location determinants of manufacturing are often sector-specific (Connor et al, 1997; Arauzo-Carod et al, 2010). Examining agricultural manufacturing firm location across Colorado allows unique insight into this industry. Here, a negative binomial model is used to analyze the location of agricultural manufacturing firms based on county- and ZIP code-level characteristics.

Model Specification

Firm location decisions are often estimated through discrete response regression models that address non-negative integer responses (Hilbe, 2007). Our model seeks to measure the likelihood of firms locating in an area given a set of characteristics specific to that area. This allows analysis of the relevant and significant characteristics of locations that correlate with firms' location. Following the methodology of Arauzo-Carod and Viladecans-Marsal (2009), Gabe (2003), Guimarães and Woodward (2003), List (2001) and Bhat and Singh (2014), we employ a count model in this analysis. Count models are generally analyzed with Poisson or negative binomial regressions (Hilbe, 2007).

Count Regression Model

Count models examine which characteristics of a territory affect the average number of firm establishments located there. The unit of analysis is the geographic territory; the data

analyzed are the characteristics of that territory (Arauzo-Carod et al, 2010). For this study, very little data describing firm characteristics were available, while data on county and ZIP code level characteristics are widely available for public use. Knowing more about place-based characteristics than individual firm characteristics suggests a count model is most appropriate for analysis. The count model approach allows for a high number of spatial alternative choices where firms can choose to locate, and accounts for all characteristics of all territorial units in location choice analysis (Guimaraes et al, 2003). For this reason, more recent studies in firm location decision have utilized count models (Bhat et al 2014).

The Poisson estimation has been used in the past to model the count of firms located in a given area (Carlton, 1983; List 2001; Guimaraes et al, 2004). This model assumes that the mean of the distribution of expected count equals the variance of the observed count, which rarely holds in reality (Hilbe, 2007). When examining the data of firms in Colorado, a large degree of variance was evident in the count of firms per ZIP, and about half the ZIP codes did not have a firm located in them. This indicated that the assumptions of the Poisson distribution may not hold for this data set (Coxe et al, 2009).

Negative Binomial Model

Researchers have utilized less restrictive models such as the negative binomial model to more accurately reflect the distribution of firms across space (Arauzo et al, 2009; Gabe, 2004). The negative binomial model derives the conditional expected number of firms located in a given area:

$$\Pr(y_i|x_i) = \frac{\Gamma(y_i + \alpha^{-1})}{y_i! \Gamma(\alpha^{-1})} \left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu_i} \right)^{-\alpha} \left(\frac{\mu_i}{\alpha^{-1} + \mu_i} \right)^y$$

Where y is the observed count, and the probability of an observed count is conditioned on the x -variables associated with the area. μ is the expected count of firms:

$$\mu_i = E(y_i|x_i) = \exp(x_i\beta + \epsilon_i)$$

The parameter α determines the degree of dispersion in the predictions, measures how much the variance diverges from the mean. The $\exp(\epsilon_i)$ is assumed to be drawn from gamma distribution = Γ . The gamma distribution of the expected value of the error terms introduced with the degree of dispersion, α , is what allows the negative binomial regression to relax the assumption of equidispersion. When $\alpha = 0$, dispersion is not significantly different than zero and the variance is equal to the mean; thus, the negative binomial model reduces to the Poisson model (Long, 2006).

If the actual variance of firms located in a defined area is greater than the estimated mean variance, then the negative binomial model will provide more accurate estimations for count data (Arauzo-Carod et al, 2010). The works of Mota and Brandão (2013), Davis and Schluter (2005), Arauzo-Carod and Viladecans-Marsal (2009), and Gabe and Bell (2004) have utilized the negative binomial model to analyze firm location decisions. For our data, α was determined to be significantly different from zero and the negative binomial model was utilized.

Data

In order to create a list of manufacturing and processing firms in Colorado, we began with the agencies that regulate food and agriculture in the state.³ Agency officials informed which permits, certificates and licenses (hereafter, just ‘permits’) businesses are required to possess for a wide variety of food- and agricultural-related activities. For this study, we decided to focus on businesses that were involved with the handling, distribution, processing or manufacturing of food across the state. Detailed consultation with the agencies that regulate these businesses helped distinguish between those business permits that were specific to businesses that grow, raise or otherwise cultivate food and other types of establishments.

The permit/licensure programs outlined below were determined to be the most relevant for the purposes of this thesis, based on agency advice⁴ and the research question. All lists compiled are the most accurate records the responsible government agencies had of active permit holders as of March 2016.⁵

- Food Manufacturing and Processing Permit from the Colorado Department of Public Health and the Environment: Required for any business that manufactures,

³ Agencies include Colorado Department of Agriculture, Colorado Department of Public Health and the Environment, and US Department of Agriculture Food and Safety Inspection

⁴ Agencies listed above

⁵ When verifying addresses for businesses, it became clear that a number of firms had ceased to be in business. The database of firms was not edited or modified in any way to reflect this, and are accepted as the best records of supervising agencies available at time of request.

warehouses, repacks, stores grains or participates in industrial hemp operations with annual sales greater than \$5,000.

- Grade A Dairy Plant Permits from the Colorado Department of Public Health and the Environment: Applies to any manufacturing business that uses milk or milk products in final output.
- Colorado Farm Product Handler and Commodity Dealer Licenses from the Colorado Department of Agriculture: For anyone or any company that is purchasing more than \$20,000 in Colorado farm products for the purpose of resale or processing.
- Custom Exempt Meat Processing from the Colorado Department of Agriculture: This permit is for businesses that sell direct to consumer and includes wild game and domestic processing (usually small local butcheries).
- Meat and Poultry Product Inspection License from the USDA Food and Safety Inspection Service: Any establishments that produce meat, poultry and/or egg products for sale to any other industry or retail (usually large slaughterhouses).

To our knowledge, this permit list is the first of its kind compiled, making any analysis done with respect to this list unique. Knowing where firms are located gives insight into the dispersion of food processing across a heterogeneous landscape with varying endowments of physical, human, social and natural capitals. The permit lists only provide the name and address of firms, so no analysis regarding firm characteristics or firm location decision over time is available. Additionally, there is concern that not all manufacturers have the required permits. To the extent a business is not permitted, they would not show up in this

database. Therefore, the list of food manufacturers is likely non-exhaustive of all Colorado agricultural processing businesses

Once the lists of permits were compiled, they were cross referenced to determine overlap of permit list and firm name. Of the 2,620 total permits collected, 105 firms (4% of all firms) possessed multiple permits. Each of these multiple-permit holders were assigned to a single permit based on their primary activity. This step ensured that no firm was double counted. For example, a dairy manufacturing plant that possessed both a Food Processing permit and Dairy Plant permit was designated a “Dairy Plant” permit only, so as to not be counted twice. The distribution of permits is outlined in **Table 2**. The large majority of permits are for Food Manufacturing (76%).

	Food Manufacturing	Dairy Plant	Farm Product Handler	Commodity Dealer	Custom Exempt Meat Processing	Meat and Poultry Processing	Total Permits
Count of Non-duplicated permits	1903	41	84	291	83	113	2515
Percent of Total Permits	76%	2%	3%	12%	3%	4%	100%

After compiling the locations of permitted agricultural manufacturing firms across the state, it was necessary to examine the characteristics of Colorado ZIP codes and counties. These characteristics give insight into the qualities of a defined area that could make it attractive to firms to locate there.

The intention was to analyze firm location decision based on the ZIP code level characteristics to attempt to account for small-scale variations across Colorado. In some cases, this most granular level of detail for the desired variables was only available at the county-level. Of the 662 ZIP codes in Colorado, 142 were associated with PO Boxes or were defined as ‘Unique’⁶ ZIP codes. As no data for these ZIP codes were available, they were omitted from the analysis.⁷

A total of 516 ZIP codes were analyzed in this model, 355 of which (69%) have at least one permitted food manufacturing business located within their boundaries. Data were gathered from a variety of sources (detailed below) and matched to the corresponding ZIP codes. Where ZIP code level data were unavailable, county-level measurements were used.

Table 3 summarizes the measurements of place-based characteristics used in this model.

⁶ ‘Unique’ ZIP codes are associated with institutions, such as universities, that get large amounts of mail and are designated their own ZIP code by the US Postal Service. ‘PO Box’ ZIP codes are boxes located at a postal office and therefore do not associate with a physical zone.

⁷ In the database of firm addresses, only six firms of the 2,515 use PO Box addresses. These firms’ physical locations were determined and they were grouped in with the closest associated ZIP code that had a physical designation.

Table 3: Summary statistics

VARIABLE	SYMBOL	DESCRIPTION	CTY/ZIP	MEAN	STD DEV	MIN	MAX	Expected Sign
Firms	F	Is there a firm in the ZIP?	ZIP	0.675	0.47	0	1	-----
Count	N	How many?	ZIP	4.86	10.63	0	120	-----
Tax Rate	TAX	2017 county mill levy (1 mill = \$1 per \$1000 of property value)	CTY	11.74	5.35	3.17	25.9	(+) or (-)
Manufacturing location quotient	LQ	Location quotient for food manufacturing establishments in the state of CO	CTY	1.69	2.43	0	10.43	(+)
Market Value of Ag Products Sold	AGV	2012 market value in \$10,000,000 sold	CTY	19.99	46.04	0	186.07	(+)
Rural Urban Continuum Code	RUCC	2013 Index classifying based on population and metro-adjacency from 1=urban to 9=rural	CTY	4.1	2.98	1	9	(-)
Population	POP	Total population 2015, in hundreds	ZIP	102.18	141.2	0	723.48	(+)
Highway	HWY	Population-weighted distance to nearest highway on-ramp or intersection (x/1000)	CTY	38.4	47.85	18.5	202.68	(+)
Unemployment rates	UNEMP	Estimate of unemployment rate (20-64 yo)	ZIP	6.42	6.54	0	74.4	(+) or (-)
Average wages	WAGE	2015 average weekly pay (in \$100) in all industries	CTY	8.31	1.97	4.66	12.53	(-)
Income	INC	Mean household income in \$1000	ZIP	73.48	27.04	0	186.68	(-)
Educational Attainment	ED	Percent population with Bachelor's degree or higher (25-64 yo)	ZIP	28.4	17.8	0	100	(+)
Natural Amenities Index	NA	Scale of climate, topography and water area that enhance a location as a place to live	CTY	5.09	1.01	3	7	(+)
Entrepreneurial business culture	EC	Proportion of proprietary-owned businesses (x100,000)	CTY	3.27	1.04	1.54	5.81	(+)
Public land	PLAND	Percent of public land per zip (x100)	ZIP	70.18	164.89	0	1415.53	(+)
Social Capital index	SOK	Principal component analysis of social, political, recreational and religious activities of population (x10)	CTY	0.52	10.31	-13.52	91.49	(+)

Tax Rate: Taxes represent a cost to firms, but rates vary by location and local government policy (Arauzo-Carod et al, 2010). Empirical studies examining the effects of tax rates have found that taxes are significant factors in determining firm location decisions. However, there is no prior intuition about the effect of taxes. On one hand, lower taxes would lower costs to firms. On the other hand, higher taxes may indicate improved public infrastructure in the area where the firm will do business, higher quality of life attributes such as better funding for school and public spaces, and the enhanced ability of governments' to afford tax breaks to businesses (Arauzo-Carod et al, 2010; Duranton et al, 2011; Hanson et al, 2011). Although the ideal measure would be corporate tax rate by county, these data were unavailable. The closest proxy data for corporate tax available are county mill levies. Mill levy data were gathered from the Colorado Department of Local Affairs report on Property Tax Entities by County, where 1 mill = \$1 per \$1000 of property value at the county level.

Location Quotient: Agglomeration of firms within the same industry give rise to cost-saving economics of scale and enhance the potential for information spillovers that increase productivity (Porter, 2000; Henderson et al 2000). The Location Quotient (LQ) is a measurement of agglomeration that measures the density of food manufacturing establishments in Colorado. The location quotient for industry i in region j is calculated by:

$$LQ_i = \frac{E_{ij}/E_{in}}{E_j/E_n}$$

where E indicates employment and n designates national levels. A location quotient greater than one indicates the region has a higher concentration of employment in the industry than the nation as a whole (Woodward et al, 2009). There are potential cost-reducing

economies of scale for firms locating in areas with higher concentrations of an industry, so this measurement helps us understand where these potential economies of scale exist. There is evidence of the positive benefits of agglomeration (Gabe, 2003) and a tenuously positive correlation between agglomeration and new business location (List, 2001; Arauzo-Carod et al, 2010; Henderson et al, 2000). In this research we use the Bureau of Labor Statistics Quarterly Census on Wages and Employment 2015 Annual NAICS-Based Data Files report LQs for food manufacturing industry at the county level.

Market Value of Agricultural Products: Transporting heavy agricultural inputs to a manufacturing plant poses a cost burden on agricultural manufacturing firms. Firms that are more heavily influenced by the costs of input procurement could reduce transportation costs by locating near input suppliers (Connor et al, 1997). Henderson and McNamara's research (2000) shows that larger food manufacturing investments are positively correlated with the value of agricultural commodities produced in the same county. Accordingly, we use data from the US Department of Agriculture's National Agricultural Statistics Service (USDA NASS) 2012 Census of Agriculture for Colorado counties. We used the data on market value of agricultural products sold per county in \$10,000,000s.

Access to markets: Urbanization, population, and transportation infrastructure are expected to have positive effects on firm location decision. They represent access to markets, which is of particular importance to 'demand oriented' agricultural manufacturing firms. These firms have low input procurement costs relative to the cost of transporting the

final product, and so desire to locate closer to large populations or in urban areas (Connor et al, 1997.)

The USDA Economic Research Service developed the Rural-Urban Continuum Code (RUCC) to classify counties by degree of urbanization, population, and adjacency to a metro area. Each county is assigned one of nine codes, with one being urban and nine being rural. Urban areas represent large consumer market bases and can be sources of economies of scale (Cader et al, 2009; Arauzo-Carod et al, 2010; List, 2001). The distance to markets also affects cost of transportation (Connor et al, 1997; Henderson et al, 2000). We would therefore expect a positive correlation between urbanized economies and firm location decision. The mutually exclusive categories of RUCCs require a 'base' category to compare the relative effects of all other RUCCs as dummy variables so as to avoid perfect multicollinearity. The RUCC equal to 'one' was designated as the base to measure the gradient effects of the continuum relative to the urban core.

ZIP-code level populations provided by the US Census Bureau 2011-2015 American Community Survey 5-Year Estimates estimate total population scaled to 100s of people. Higher populations indicate larger markets and would therefore have similar positive effects on firm location as noted above.

Transportation infrastructure provides access to markets and decreases costs to businesses, which encourages firm location (Henderson et al, 2000; List, 2001). In 2011, the USDA Economic Research Service developed a highway-access measurement of

population-weighted distance to the closest limited-access highway ramp or major non-limited access highway intersection for one-kilometer grid cells summed to the county-level (Dickens et al, 2011). This variable was used to measure transportation infrastructure at the county level.

Human Capital: Regions with higher measures of human capital are correlated with clusters due to their competitive advantage in finding and retaining skilled workers (Porter, 2000). Of the potential measures of human capital, wages, education and unemployment have been most explored (Arauzo-Carod et al, 2010). Wages are costs to firms and previous literature has found there to be a negative correlation between higher wages and firm location (Goetz, 1997; Henderson et al, 2000; Arauzo-Carod et al 2010). The Bureau of Labor Statistics Quarterly Wages and Employment Census 2015 Annual report on county-level wages across all industries was used, scaled to the average weekly wage paid in \$100s. Income data were available at the ZIP-code level and were used as a proxy for wages on a smaller scale with the goal of understanding smaller variations in the data. Income is measured as mean household income in \$1000s.

Areas with higher levels of education in the working-age population are more attractive to firms (Woodward, 1992; Goetz, 1997; Arauzo-Carod et al, 2010). Previous studies often used high school graduation rates, but increases in educational attainment have resulted in relatively homogenous high school completion across the state of Colorado. This would make variations in the effects of educated working population harder to decipher. Instead,

this study used the percent of people ages 25-64 that have a bachelor's degree or higher at the ZIP code level.

Unemployment rates are used as a measurement of labor availability. One might think that agricultural manufacturing firms would favor areas with available work force, however evidence is ambiguous and inconclusive. Goetz (1997) found higher unemployment rates correlate to an increase in meat processing, but no other manufacturing sectors. Other research has found unemployment to be statistically insignificant in determining firm locations (Henderson et al 2000; Leatherman et al, 2009).

Education, income and unemployment measurements used in this model were derived from the US Census Bureau's 2011-2015 Community Survey 5-year estimates for the state of Colorado at the ZIP-code level.

Intangible Assets: Current research on rural wealth creation includes considerations of different forms of capital assets that influence economic development (Pender et al, 2012). This study contributes to traditional firm location literature models by attempting to capture non-financial assets of the geographical areas that may entice manufacturing firms to locate there. We would expect areas with more positive attributes to have more firms located in their boundaries.

The Natural Amenities Index developed by the USDA Economic Research Service in 1999 scales climate, topography and water area that enhances a location as a place to live

measured at the county level. Entrepreneurial business culture, measured by the proportion of proprietary-owned business employment relative to total nonfarm employment in each county, was created by the Bureau of Economic Analysis' Regional Economic Information System. We are including this variable as Porter (2000) emphasized business culture and its importance in promoting new firm creation within an economic cluster. Percent of land area that is public per ZIP code was derived by multiplying the percent of public land per county by the land area per ZIP code (Goldbach, 2012). This variable attempts to capture the recreational benefits associated with access to public lands. Finally, we use the Social Capital Index developed by the Northeast Regional Center for Rural Development in 2014. This index includes measures of social, political, recreational and religious activities of populations and is widely used in research. Higher social capital could be considered an asset that contributes to community wealth creation, and is measured at the county-level ((Rupasingha et al, 2006).

Results

To determine the relationship between firm locations and the independent variables outlined above, two variations of the negative binomial model were tested. The first model included only the neoclassical determinants of firm location. The second model includes measures of human, social and natural capital that could be considered attributes that contribute to wealth creation, provide an avenue for sustainable development, or enhance a community's resiliency. In both models, the measure of dispersion, α , is significantly different than zero, which justifies the use of the negative binomial regression over

Poisson. **Table 4** reports the coefficient, standard errors and statistical significance associated with each variable for both models as well as the measures of fit.

Model 1: *WAGE* and *POP* are both positively correlated to firm location decisions and their coefficients are statistically significant at the 1% level. This tells us there is a higher likelihood of a food processing plant being located in areas with higher wages and larger populations. *TAX* is negatively correlated with firm location decision and the coefficient for this variable is significant at the 10% level, supporting expectations that higher taxes will reduce the likelihood of agricultural manufacturing establishments. The coefficient for *LQ* is also significant at the 10% level, but positively correlated with firm location, suggesting that a firm is more likely to be located where other agricultural manufacturing firms are also located. *ED* coefficient is statistically insignificant but negatively correlated with firms' locations. All the *RUCCs* coefficients are significant and positive, except that of *RUCC8*, which is negative and insignificant.

Model 2: *POP* has a positive coefficient very similar to the coefficient in **Model 1**. This tells us that a larger population is an important indicator of likelihood of a food processing firm location. Coefficients for *WAGE* and *PLAND* are positively correlated with manufacturing firm locations and statistically significant at the 1% level. The correlation of higher wages to firm location is a surprising result, but perhaps also indicates a higher skill level. The positive coefficient on public land supports the hypothesis that public land offers location-based attributes attractive to food processing firms. Interestingly, the inclusion of additional variables seems to have reduced the significance of important variables from

Model 1. The *RUCC* variables all positively influence firm location, except *RUCC 8*, with the coefficients for *RUCCs 2, 3, 5, and 6* being statistically significant. The effects of urbanization seem to be varied and will be considered more in the following section.

Testing the joint statistical significance of the coefficients for *Agricultural Market Value, Highway, Unemployment, Income, Natural Amenities, Public Lands, Entrepreneurial Culture, and Social Capital* indicated their effect on this model was not statistically different from zero. This tells us that the two models tested are not significantly different from each other. **Model 2** has fewer variables with significant coefficients making conclusions more difficult to draw from this model. These results could possibly be driven by endogeneity caused by unobserved correlated factors influencing the measures of human, natural and social capital included in **Model 2**.

Table 4: Negative-Binomial Regression Models – Estimated Parameters

	MODEL 1		MODEL 2	
	Coefficient	Std. Error	Coefficient	Std. Error
Constant	-1.106***	0.425	-0.112	1.028
TAX	-0.036*	0.211	-0.020	0.024
LQ	0.560*	0.318	0.052	0.033
WAGE	0.180***	0.053	0.173*	0.066
AV	--	--	-0.002	0.002
HWY	--	--	-0.0001	0.002
POP	0.007***	0.001	0.006***	0.006
ED	-0.005	0.004	-0.001	0.006
UNEMP	--	--	0.002	0.0143
INC	--	--	-0.006	0.0005
NA	--	--	-0.120	0.091
EC	--	--	-0.012	0.099
PLAND	--	--	0.001*	0.0005
SOK	--	--	0.014	0.012
RUCC2	0.653***	0.199	0.729***	0.261
RUCC3	0.823***	0.280	0.639*	0.340
RUCC4	0.562*	0.341	0.354	0.403
RUCC5	1.090***	0.331	0.870**	0.367
RUCC6	1.194***	0.283	0.995***	0.370
RUCC7	0.813***	0.228	0.483	0.387
RUCC8	-0.050	0.521	-0.438	0.582
RUCC9	0.735***	0.273	0.339	0.404
<hr/>				
LR χ^2		212.21***		222.96***
Pseudo-R^2		0.0818		0.0859
Significance	*** $p < 0.01$	** $p < 0.05$	* $p < 0.1$	

Discussion

Mostly striking, both models report wages as having a positive correlation with agricultural manufacturing establishments. Traditional location theory predicts that firms would choose to locate in areas with lower wages to minimize costs (Deller, 2009; Arauzo-Carod et al, 2010). However, perhaps the fact that population is positive and significant across both models provides additional insight. Our expectation for population is that larger populations equate to a larger immediate consumer base, giving firms access to improved markets in which to sell their goods (Cader et al, 2009; Arauzo-Carod et al, 2010; List, 2001). One possible explanation for wages having an opposite correlation than expected is that the benefits to firms of having access to markets in places with larger populations outweigh the costs of higher wages in those areas. Wages in populated urban areas are on average much higher than rural places (Marre, 2014) but if the firm is able to sell more products, perhaps the cost of higher wages is offset by the advantages of access to a larger market.

Another parallel between the models is the mostly positive influence and statistical significance of the rural-urban continuum codes. Our expectation prior to modeling was that increased urbanization (i.e. RUCC 1-3) would have a positive effect on firm location due to the benefits of market access and enhanced transportation infrastructure, and more rural places (i.e. RUCC 4-8) would have a negative correlation (Connor et al, 1997; Henderson et al, 2000). Recall that $RUCC = 1$ was excluded to avoid perfect collinearity among the categorical codes, so interpretation is relative to this base category. Every RUCC

(with the exception of RUCC8) had a positive and significant coefficient. Holding all else constant, the model predicts that firms are more likely to be located in more rural areas compared to the urban core. This finding supports what theory on food manufacturing hypothesized: supply-oriented industries locate close to input sources because inputs are expensive, heavy, or perishable; demand-oriented industries have high costs of distributing final products relative to the sales, so these firms concentrate near retail outlets or consumer bases (Connor et al, 1997). For agricultural manufacturing businesses, the importance of urbanization depends on the cost-structure of manufacturing, so it makes sense that the more rural RUCCs have positive coefficients relative to the most urban RUCC.

Interestingly, the coefficients for human capital factors that prior literature indicated may be influential in firm location decision were insignificant in this model. Income and education are negatively correlated with food manufacturing establishments. Previous literature has hypothesized that human capital required for manufacturing doesn't require a higher education (Henderson et al, 2000), so measuring the rate of people with a Bachelor's degree or higher would be less important to food processing than other sectors.

Finally, the new measures included in **Model 2** of natural amenities, entrepreneurial culture, public land and social capital provided insight into the relative unimportance of these measures in econometric terms. Amount of public land is statistically significant and positive, but suggests only a very small influence on agricultural processing firm location. These variables were included to capture the non-financial assets that promote rural wealth development, as informed by the USDA's rural development policy (Pender et al,

2012). The findings in this econometric model do not support the USDA focuses on rural wealth creation, which warrants further investigation through improved modeling and alternative methodology.

Chapter 3: Regional Case Study of Colorado's Western Slope

The econometric model uses secondary unique dataset along with secondary data informed by the literature, but the analysis is limited by a lack of data about the firms themselves.

While data on county and ZIP code area characteristics are readily available, it is evidence that some of the key criterion upon which firms are making location decisions remains elusive. Accordingly, a targeted regional case study of Colorado's Western Slope is used to complement the statewide analysis. Survey responses help bridge the gap between rural wealth development and the econometric modeling results.

Methodology

Colorado's Western Slope is an ideal region for a targeted case study due to the diversity of characteristics within the region. **Table 5** highlights the county-level characteristics of the ten counties included in this analysis.

Table 5: Western Slope County Characteristics

County	Firm Count	Tax per \$1000	Weekly Wages	LQ	Ag Value	RUCC	HWY	NatAm	EntCult (x10,000)	UnEmp	SocCap
Montrose	49	8.77	\$706	1.46	\$103m	4	80.67	5	0.341	8.6%	-0.29
Gunnison	24	10.74	\$673	0.66	\$13m	7	106.18	6	0.321	7.1%	10.15
Delta	58	7.33	\$638	1.74	\$55.6m	6	52.77	5	0.414	9.2%	9.61
La Plata	52	8.4	\$644	0.85	\$25m	6	31.75	7	0.316	4.8%	3.06
Montezuma	49	7.17	\$669	1.32	\$46m	6	188.91	5	0.351	6.5%	-3.91
Mesa	96	10.25	\$796	1.01	\$84.5m	3	4.48	4	0.268	8.7%	-6.51
Ouray	3	14.77	\$685	1.16	\$4m	9	121.17	6	0.482	6.4%	21.27
Dolores	9	6.06	\$1048	1.51	\$10m	9	143.48	5	0.420	3.6%	1.36
San Miguel	11	12.76	\$767	0.59	\$4.7m	9	132.93	6	0.380	4.3%	10.03
San Juan	0	9.54	\$466	0.38	\$0	9	157.81	7	0.460	10.3%	41.24

Targeting the Western Slope

The Western Slope epitomizes rural heterogeneity. Within a 200-mile stretch of land west of the Rocky Mountains, there are micropolitan counties ($RUCC \leq 3$) and extremely rural zones ($RUCC = 9$). Montrose County produces over \$103 million worth of agricultural products while two counties south, San Juan County has no commercial agricultural output. Unemployment ranges from below the national average in counties such as Dolores, San Miguel and La Plata, to double digits in San Juan County. County wages and taxes vary widely, with average weekly wages more than twice as high in Dolores County compared to neighboring San Juan County. The density of the food manufacturing industry (as measured by its location quotient) ranges from almost double the national average in Delta County to less than half that of the national average in San Juan County. Some counties have high counts of permitted food processing activities while others have no permitted agricultural manufacturing in their borders. This diversity in county characteristics within a relatively

small radius allows for a great natural experiment as to which of these qualities are most attractive to food manufacturing firms.

Though there is substantial heterogeneity in the region, overall, the Western Slope is known for its vibrant and diverse agricultural economy. Over the last decade, the agricultural sector was responsible for the second-largest increase in the number of jobs in Region 10⁸, adding nearly 600 jobs at a growth rate of 24%. The same Region has included value-added agricultural manufacturing as a tenant of the economic development strategic plan (State Demography Office, 2017). Another indicator of a strong agricultural sector is the growth of agritourism in the American West. This sector has helped farmers diversify and grow their income from farm-related activities. Colorado has the second largest number of farms engaged in agritourism activities in the country, and the Western Slope is a hot spot of agritourism (Van Sandt et al, 2016). The importance of agriculture and the growth within this industry indicate that this region might be more inclined to embrace food manufacturing as a source of economic development.

The Western Slope is highly entrepreneurial, as measured by the ratio of proprietary owned businesses to total businesses in an area (Low et al, 2005). There is a high level of entrepreneurship in Delta, Ouray and Dolores Counties, some of the more rural Counties in this region. This entrepreneurship may be correlated with the ‘creative class’ in the rural counties of the Western Slope that drives creativity and innovation needed to be economically competitive (Wojan et al, 2016). In affirmation of this trend, county

⁸ Region 10 includes Delta, Gunnison, Hinsdale, Montrose, Ouray and San Miguel Counties

governments in Region 9⁹ piloted a program to build entrepreneurial infrastructure that has helped grow small locally-owned businesses (State Demography Office, 2017). The entrepreneurial culture and creative job market indicate that this region may already be developing economically.

Outside interest supports and further justifies a targeted case study of these ten counties. In order to support opportunities for economic development, a number of outside governmental and nonprofit agencies were interested in better understanding drivers for agricultural firm location decisions. Research into food processing is a natural extension of the Colorado Blueprint for Food and Agriculture, implemented by Colorado State University and supported by the Governor's Food Systems Advisory Council and the Colorado Department of Agriculture. Agricultural sector-led development is a means of pursuing economic resiliency, and is of particular interest to the Regional Economic Development Institute at Colorado State University. Additionally, The Nature Conservancy is invested in examining market opportunities of viable crops to promote sustainable development and water conservation in this region.

Food Manufacturing on the Western Slope

We used the database described in chapter two to compile a list of permits. From this list we identified businesses in each of the West Slope counties including Gunnison, Delta, Mesa, Montrose, San Juan, San Miguel, Dolores, Ouray, La Plata and Montezuma. Any

⁹ Region 9 includes Archuleta, Dolores, La Plata, Montezuma and San Juan counties.

business located in these counties was eligible to be included in this targeting regional case study. Figure 4 provides a map of the identified food manufacturing businesses.

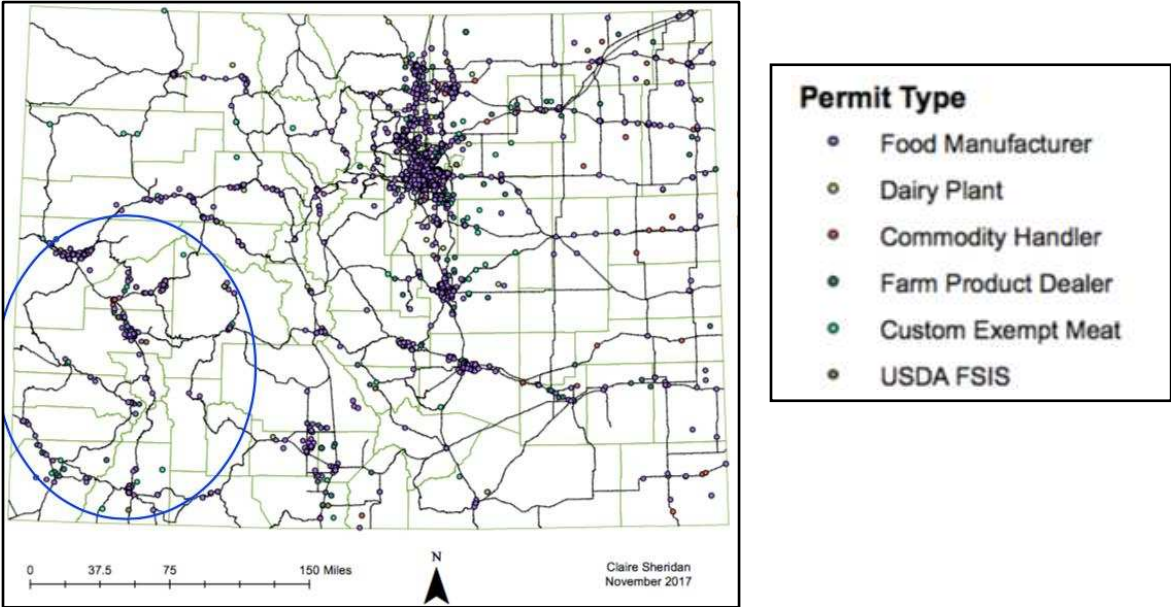


Figure 4: Food Manufacturing Establishments in Colorado, 2016

Interview protocol

We designed a survey to enhance understanding about firm location decisions.¹⁰ Questions were formulated to try to get at the relative importance of the variables that theory and past literature indicate influence firm location decision. **Table 6** shows the survey protocol divided into factors motivated by the literature, including neoclassical profit maximization theory, institutional factors, industry clusters, and behavioral and wealth assets.

¹⁰ Survey and methodology protocol was submitted to Institutional Review Board (IRB) prior to implementation; study was determined exempt since the subjects are businesses. The survey is available upon request.

In addition, there were several open-ended questions to capture items not explicitly cited in the previous literature.

Table 6: Theory, Indicators and Survey Questions Aligned		
Theory	Measurable Indicators (Expected sign)	Survey Questions
<i>Neoclassical Profit Maximization</i>	Population size (+) Wages (-) Education attainment (+/-) Unemployment (+) Size of input markets (+) Energy costs (-) Income (+) Transportation infrastructure (+) Property tax rates (+/-)	<ul style="list-style-type: none"> • Full time/part time/seasonal employees • Importance of availability of labor • Importance of access to inputs • Importance of cost of inputs • Importance of proximity to transportation • Where are inputs purchased from • Where is final product distribution hub • Gross sales of business
<i>Institutional</i>	Corporate tax rates (-) Subsidies (+) Regulations (+/-)	<ul style="list-style-type: none"> • Did business receive government support? How much? • In considering expansion, is the business decision influenced by state or local regulations? • Importance of local tax rates • Importance of pro-industry regulatory environment
<i>Industry Clusters</i>	Agglomeration/Location Quotients (+) Entrepreneurial culture (+) (proprietary owned businesses)	<ul style="list-style-type: none"> • Importance of proximity of similar businesses • Importance of community support of small businesses • Do products command a price premium for being made in Colorado
<i>Behavioral and Wealth Assets</i>	Natural amenities index (+) Social capital index (+) Public land access (+)	<ul style="list-style-type: none"> • Benefits and challenges of current business location • Importance or quality of life attributes • Importance of growing up in the county • Importance of 'Other: _____'

Neoclassical Profit Maximization Theory includes questions that examine how the costs of running a business influence a business' location. If a firm is large and requires a large number of employees, then we would assume that the availability of labor is important and that they will need to be located closer to a large population center. The proximity to inputs would influence agricultural manufacturing firms that are supply-oriented and reduce transportation costs of input procurement (Connor et al, 1997). The importance and cost of

inputs, transportation infrastructure and distance to the final distribution hub all provide insight into a firm's cost structure that influence location choice. Gross sales of the firm give a sense of amount of output: larger gross sales may be indicative of need to locate closer to a market for the output, or access to transportation to transport the final product.

Institutional Factors capture the power of local governments to negotiate with manufacturing firms and offer incentives to entice firms to locate in their region. Understanding whether a business received local government support or whether the decision-makers considered tax rates before locating gives a better sense of how government policies influence agricultural manufacturing establishments. We also questioned whether pro-business regulatory environments influenced business' decisions to locate or expand.

Agglomeration and entrepreneurial culture are indicative of the presence of *Industry Clusters* that contribute to economic development. If firm decision-makers are considering the proximity of other manufacturing establishments with similar needs, then this would support the cluster theory as an explanation for firm location. Porter states that "the existence of clusters signals an opportunity" (2000, p. 26) to new firms, including lower barriers to entry, existence of local customers, established relationships and the presence of other successful firms, that make local entrepreneurs likely to enter a cluster. Additionally, entrepreneurial culture could also indicate strong cultural capital, an asset that contributes to community wealth.

Business Selection

Key community stakeholders were identified in each county, including CSU Extension agents, local government officials, county economic development agencies, and regional nonprofit organizations. These stakeholders were asked to review the list of agricultural manufacturing firms located in their county and prioritize the interview list. Based on these recommendations, identified firms were contacted by phone and an in-person interview was requested. Interviews were conducted over a six-week period from June to August 2017. **Table 7** displays a per-county chart of phone calls and response rates.

Table 7: Firm distribution, response rate and interviews by County											
	Gunnison	Delta	Mesa	Montrose	San Juan	San Miguel	Ouray	Dolores	La Plata	Montezuma	Total
Total firms	24	58	96	49	0	11	3	9	52	24	326
Contacted	5	12	14	14	0	3	1	3	9	6	67
Interviewed	2	5	4	5	0	0	0	0	5	3	24

Twenty-four firms were surveyed through in-person interviews in a ten-county region. Firms range in size from small operations with two employees and gross sales of \$175,000 to large plant branches of international companies with over 400 employees and gross sales of \$20 million. Some businesses have been processing agricultural products for over a century, while others are in nascent stages of operation. Firms’ activities include growing or raising, processing, purchasing/distributing and packing/shipping agricultural products. This diversity even within a small sample size allowed for great variety in perspectives and opinions regarding each firms’ decision to locate on the Western Slope.

Additionally, we conducted 17 meetings with stakeholders to gain additional insight into agricultural firm location decisions (see **Figure 5**).

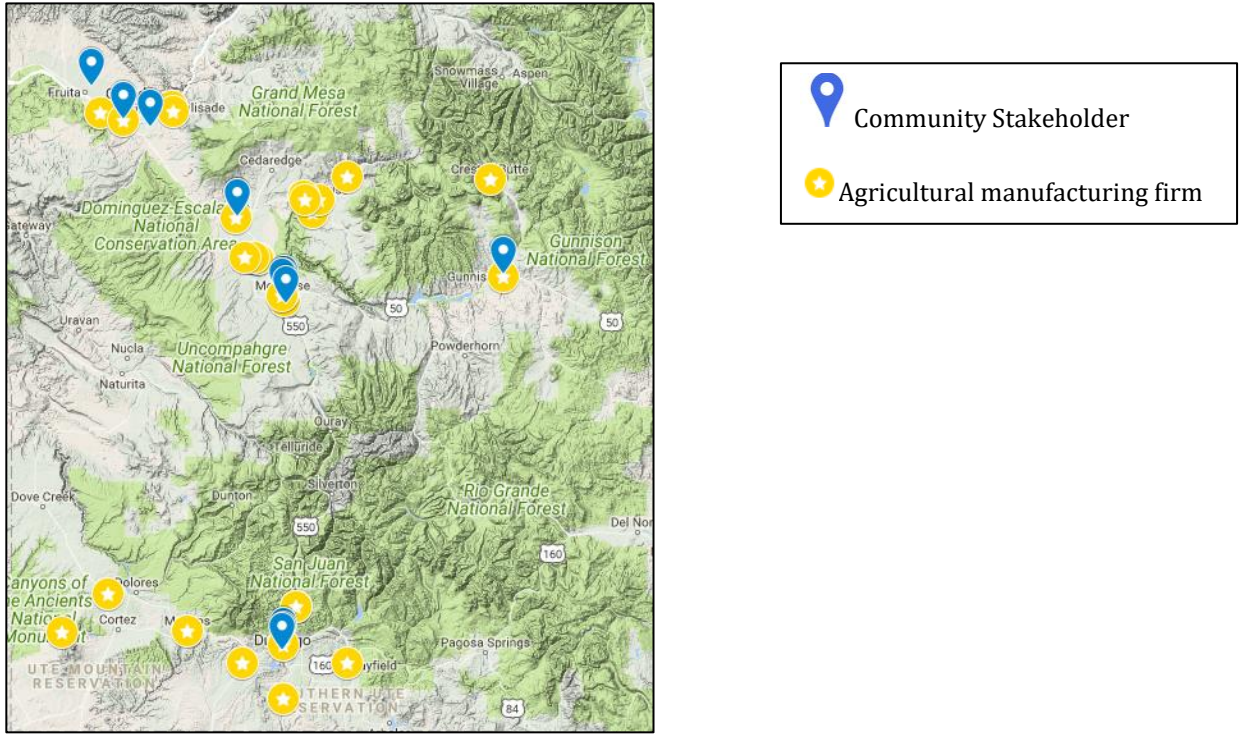


Figure 5: Map of Surveyed Businesses and Stakeholder Interviews

Results

Quantitative results from these surveys will first be examined statistically in **Table 8**, and then a qualitative analysis on themes that emerged from the interviews will be presented.

Table 8: Summary of Quantitative Survey Questions				
Question		Mean	Min	Max
Employees	Full Time	32.38	2	400
	Part time	29.29	0	175
Years in business		29.7	1	107
Local government financial investment	Received = 1, Not received = 0	0.23	0	1
	If Yes, how much?	\$2,927.571	\$0	\$50,000
Importance of... (Likert Scale: 1 = Not at all important 5 = Extremely important)	Access to inputs	3.41	1	5
	Water	2.6	1	5
	Proximity of businesses with similar needs	2.71	1	5
	Local tax rates	1.5	1	4
	Availability of Labor	1.75	1	4
	Quality of life or Natural Amenities	3.8	1	5
	Transportation infrastructure	2.6	1	5
	Community Support for business	1.6	1	5
	Pro-Industry Regulatory Environment	1.42	1	4
	Born and raised in county, wanted to stay	2.42	1	5
	“Other: _____”	4.93	4	5
	Regularly purchasing CO grown/raised inputs (1 = yes, 0 = no)		0.92	0
Do you receive a price Premium for Colorado-processed product (1 = yes, 0 = no)		0.667	0	1
Estimated Gross Sales for 2016		\$5,128,846	\$175,000	\$20,000,000
Likelihood of business expansion (-2 = very unlikely, 2 = very likely)		0.54	-1	2

Summary of Quantitative Results

When evaluating the importance of various factors on the decision to locate in a given area, firms were presented with a Likert scale ranging from 1, indicating not important, to 5, indicating extremely important. Of these options, 15 firms self-reported an “Other” option where they identified reasons why they chose their location other than the listed factors.

These were ranked by respondents as the most important factors in selecting their location. The answers are included in the analysis of the qualitative results section. Quality of life or natural amenities factors were the next highest ranked factors, followed closely by access to inputs. Quality of life factors align with the behavioral approach to firm location decision, as these attributes could contribute to the utility of a location decision maker. Having access to local inputs minimizes firms' transportation costs for input procurement. Other studies have demonstrated positive correlation between establishment growth and proximity to raw material inputs (Goetz, 1997; Henderson et al, 2000), which supports the neoclassical firm location hypothesis.

Similar to findings in the literature (Gabe et al, 2004; Hanson et al, 2014), taxes, regulations and packages to incentivize firm location did not have a strong impact on many firms. This is counter to neoclassical profit maximization and institutional theories about firm location, which predict more firms would locate where costs are minimized. Less than a quarter of all surveyed firms received financial incentives from local governments to locate in the area, with every firm reporting that the incentives did not sway their decision to locate and was little more than a nice gesture on behalf of local governments. Local tax rates and pro-industry regulatory environment were ranked the lowest mean importance scores. Only one business reported receiving a generous tax subsidy for locating in their county about 80 years ago, a negotiation that is no longer in effect. This suggests that a given firm's location decision has a long-run time horizon that is less influenced by temporary incentive policies.

The survey revealed evidence of backwards linkages in the supply chain and opportunities for growth in the agricultural sector. These linkages are important because they are a potential source of positive impacts on rural economic development (Martinez et al, 2010). One of the things we were unable to do with the data gathered for the econometric model was determine which businesses were purchasing raw agricultural inputs that were grown and raised by Colorado farmers and ranchers. Results from the interviews confirm that these backwards linkages in local supply chains exist. Over 92% of firms interviewed reported sometimes or always purchasing Colorado grown or raised raw agricultural products for their inputs. Additionally, two-thirds of firms reported that they received a price premium for their Colorado-processed products. As thirteen of these firms also reported interest in expanding their business, we would expect that demand for local inputs is likely to grow.

Summary of Qualitative Results

Qualitative results offer a different perspective that supports enhanced understanding of the environment where people, firms and governments operate. These alternative perspectives can help to fill in gaps between theory, econometric modeling and the reality of our experiences (Chamlee-Wright, 2010). The qualitative responses were captured in open ended questions, such as: "Describe how you (or someone from your company) chose the location of your current business." Firms were also invited to share important factors that influenced their location choice that we may have missed, referenced earlier as the "Other" responses. Accordingly, four main themes emerged from the interviews with agricultural manufacturing firms on the Western Slope. These themes provide insight into

the decision makers' perspective when establishing their food processing facility in rural Colorado.

Theme 1: Growing climate

This theme refers to the physical climate where raw agricultural products grow.

Interestingly, nine of the manufacturers, or one-third of all firms interviewed, also grew crops that they used in their own processing. Processing or distributing these raw products was a secondary location consideration to how well the raw inputs would grow. As an example, the owner of Peach Street Distillery stated, "...the point of locating in Palisade was to be *here*, in the fruit growing region. No one can catch us on that." This theme suggests that the Western Slope has a competitive advantage in processing the agricultural products that grow best in this region.

Theme 2: Opportunity

The idea of economic opportunity was echoed by many firm decision-makers interviewed.

This opportunity was often seen as an open niche. As an example, Kinikin Processing became the only USDA certified slaughter house in the five-county region surrounded by public land and filled with cattle operations. The owner reported that USDA certification appeals to local ranchers that pay to have their animals slaughtered, and that customers have a higher willingness to pay for USDA-certified products. The West Slope also offers some unique branding opportunities for highly differentiated agricultural products. Tuxedo Corn, for example, patented Olathe Sweet Sweet Corn based on the perceived "pristineness"

of Colorado mountains, and serves as a local distributor for all farmers growing this product.

Theme 3: Contributing to Community

Many interviewees described having made their location decision out of a desire to invest in their local community. Sutcliffe Vineyards located sixteen miles from the closest town of Cortez, down a winding canyon near the border of the Navajo Nation, to be close enough to provide jobs for Navajo people and have substantial impact on the people living rurally in the canyon. Tailwind Nutrition rents a manufacturing plant in Bayfield, Colorado because the owners of the sports drink company “wanted to help this rural community grow.” Many other firms cited community support for small businesses and the supportive culture of other entrepreneurs in rural places that made their location attractive.

Theme 4: Quality of Life

This theme can be thought of as the assets of a place that improve one’s life experience. Colorado’s Western Slope offers very high levels of natural amenities, access to public parks, recreational pursuits and strong community engagement. When asked why the location for Two Rivers Winery was chosen, the owner gestured broadly and enthusiastically and instructed, “Just take a look around!” Alternatively, the owners of Montana Distillers moved from one small mountain town to another a few counties over because the school system was better for their children. The broadness of this factor makes it difficult to measure, but awareness of a location’s assets could help rural places attract new investment in manufacturing.

Discussion

Drawing across both the qualitative and quantitative survey responses, we can connect the county-level characteristics to firm location theory to identify the most influential factors that determine agricultural manufacturing location that emerged from this case study.

Firms that grow their own inputs, or identified strongly with the theme of growing climate, were exclusively located in the neighboring counties of Delta, Mesa and Montrose. These counties have the highest market value of agricultural products. Additionally, these counties are less rural than other counties in this region. Neoclassical firm location theory suggests that in strong growing climate, we would expect a higher concentration of food manufacturers processing locally grown products due to the reduced costs of input procurement. Additionally, this theory says that urbanization, proximity to larger populations, and access to markets are factors that contribute to profit maximization.

The desire to contribute to local community was repeated by firms located in the more rural counties of La Plata, Montezuma and Gunnison. The concepts of commitment to community and engaging in the integrated social fabric of rural places are behavior-based elements of firm location theory, and could explain why many firms are located in highly rural areas that may seem uneconomic or illogical from a neoclassical perspective.

Examining the Social Capital Index scores for these counties, this expressed desire to contribute to community was not clearly reflected in their scores. While Gunnison has a

fairly high level of social capital, Montezuma has one of the lowest scores in the region. Perhaps the Social Capital Index is not the most appropriate way to measure this theme.

Instead, we can examine the entrepreneurial culture. Porter's theory of cluster economies suggests that the existence of a cluster signals an opportunity to new firms, and clusters are quick to innovate and respond to these opportunities (Porter, 2000). Rural areas support a breadth of entrepreneurial ventures born of local demand (Lowe et al, 2005), which suggests that businesses are likely to be more responsive to rural needs. The theme of opportunity was repeated by firms across the entire region. While the rates of entrepreneurship in these counties are relatively uniform¹¹ between counties, the region has high breadth of entrepreneurial ventures relative to other parts of the state. These findings indicate that the answer to the question of rural development could be within the rural communities themselves. Perhaps community members are best able to identify the opportunities within their own communities, and promoting entrepreneurship will empower them to add value to their local economy (Lowe et al, 2005).

The theme of quality of life was repeated in all counties where firms were interviewed, except Delta. The behavioral perspective on firm location suggests that there are factors outside of profit that a firm takes into consideration when making a location decision. As an example, in this region every county has very high Natural Amenities scores. Though there is not a lot of discernable variation in this characteristic, all of these counties have higher

¹¹ Recall that Entrepreneurial culture is measured in the proportion of proprietary owned business employment relative to total nonfarm employment times 10,000, so the variations presented in **Table 5** are relatively small

mill levy taxes on property relative to other counties in this region (greater than \$8.50 per \$1000 of property value). Firm location literature has suggested that the positive relationship often observed with taxes could be attributed to the higher quality infrastructure, schools, public parks that local taxes support (Arauzo-Carod et al, 2010). Higher tax rates in these areas could be a proxy measure of quality of life indicators cited by interviewed firms.

The survey results seem to be based more in behavioral firm location theory. The responses vary substantially from the results of the econometric model, which primarily supported traditional thinking regarding neoclassical factors. The differences between these two models suggest that we may need to consider a different framework when examining rural development and agricultural manufacturing firm locations.

Chapter 4: Cross-Methods Discussion

Our expectation prior to surveying agricultural manufacturing firms was that the variables deemed important and significant in the econometric model would be reported as influential by businesses when they made locational decisions for their establishments. However, the interview results yielded some surprising insights into why firms chose their location that were not highlighted in the results from the econometric models. Both results sections can be synthesized to increase understanding about the drivers of firm location decisions of the agricultural manufacturing sector.

Comparison of Results

Recall in the econometric **Model 1**, location quotients, taxes and population had statistically significant and positive impacts on firm locations. In the survey results described above, quality of life/natural amenities and access to inputs were most often cited by firms as being important in choosing their location. **Table 9** compares the econometric modeling data with the survey responses. From the survey, Likert scale scores of 4 or 5 were considered “Important,” while scores of 1, 2 or 3 were considered “Not important.”

Table 9: Survey and Econometric Data Comparison							
Proximity of similar businesses	Location Quotient of Food Manufacturing per County						
		LQ >1		LQ < 1		Totals	
	Important	7	29%	2	8%	9 38%	
	Not Important	10	42%	5	21%	15 63%	
	Totals	17	71%	7	29%	24 100%	
Access to Inputs	Market Value of Agriculture in County						
		<50,000,000		>50,000,000		Total	
	Important	7	29%	9	38%	16 67%	
	Not Important	4	17%	4	17%	8 33%	
	Total	11	46%	13	54%	24 100%	
Quality of Life	Social Capital Index						
		>0		<0		Totals	
	Important	9	38%	8	33%	17 71%	
	Not Important	2	8%	5	21%	7 29%	
		Totals	11	46%	13	54%	24 100%
	Estimated Public Land per ZIP						
		>1.5 acres		<1.5 acres		Totals	
	Important	10	42%	7	29%	17 71%	
	Not Important	4	17%	3	13%	7 29%	
		Totals	14	58%	10	42%	24 100%
Natural Amenities Index							
	NA ≥ 5		NA <5		Totals		
Important	15	63%	2	8%	17 71%		
Not Important	5	21%	2	8%	7 29%		
	Totals	20	83%	4	17%	24 100%	
Access to Labor	Population by ZIP code						
		Pop <10000		Pop >10000		Total	
	Important	2	8%	1	4%	3 13%	
	Not Important	12	50%	9	38%	21 88%	
	Total	14	58%	10	42%	24 100%	
Tax Rate	Tax Rate of County						
		< 8.5%		>8.5%		Totals	
	Important	0	0%	1	4%	1 4%	
	Not Important	12	50%	11	46%	23 96%	
	Totals	12	50%	12	50%	24 100%	

Location Quotients (LQ) are a measure of business agglomeration and potentially indicate the existence of a cluster economy (Deller, 2009). If a county has an LQ greater than 1, that indicates an agglomeration of agricultural manufacturing businesses in that area. While the majority of firms reported that the location of other businesses with similar needs was not an important determinant in their own firms' location, nearly three quarters of the

firms interviewed are located in counties with agglomerations of agricultural manufacturing. There are a few possible explanations for this discrepancy between the qualitative and quantitative responses. As discussed previously, LQs may not be the best proxy for clusters because they are based on NAICS codes and therefore miss the 'clustering' of all types of firms associated with that industry (Woodward et al, 2009). Perhaps firms are not aware of the spillover benefits from being located next to other food processing businesses, with some arguing that there is no evidence these benefits even exist (McCann, 1995). Since many of these firms also grow their own inputs, it seems likely that the access to inputs is a larger driver of agricultural manufacturing locations in this region.

Access to inputs was measured in the econometric model as the market value of agricultural products produced per county in 2015. This was not statistically significant in any of the modeling variations tested. This finding was surprising as in other studies this factor was a significant driver (Goetz, 1997; Henderson et al, 2000). Further, over two-thirds of businesses interviewed reported that having access to inputs was an important factor in deciding where to locate their manufacturing facility. This discrepancy between the econometric model and the survey results could be due to the inadequacy of the measure of market value. Perhaps the model could be improved by separating produce sales and livestock sales, as was done by Henderson and McNamara (2000).

One theme that emerged from the qualitative portion of the survey was the prominence of quality of life factors. These factors reflect the assets that contribute to resilient communities and sustainable economic development in rural places. The econometric

model utilized the social capital index, acres of public land per ZIP, and natural amenities index to attempt to capture these place-based assets. Although the econometric model, **Model 2**, that included these measures was not statistically different than **Model 1**, over 70% of survey respondents said the quality of life and natural amenities were a significant influence on their decision to locate in the region. Interestingly, over 80% of businesses interviewed were located in areas with very high natural amenities. Public lands and social capital are less compelling measures based on the quantitative county-level measures and econometric modeling results. It is also possible there are endogeneity issues within the econometric model that are masking the true correlation between firm locations and these measures of quality of life, and more work can be done to bridge the measurement of wealth assets to the economic drivers of firm location decisions.

Across both econometric models, *Population* data had coefficients that were statistically significant and strongly correlated to a firm's location decision. This measurement was intended to represent neoclassical firm location theory: higher populations would indicate higher access to markets, and a larger labor pool. A large majority of the firms surveyed did not report labor being important in their decision, and the business locations are split evenly between larger and smaller population areas. This indicates that agricultural manufacturers motivated to locate in rural areas may not be as heavily influenced by population as the econometric model would lead us to believe. Additionally, many rural firms interviewed shared that online sales represent an increasing share of revenue, which further negates the need for a large population base to serve as a market for their products.

Finally, the themes of economic opportunity and contribution to community are not easily measured in an econometric model and are often discounted for the very reason that adequate measurements do not exist. The shift in focus by some federal agencies and local governments towards a rural wealth creation framework is reflective of the understanding that financial indicators are not sufficient indicators of the stock of place-based assets that support sustainable development (Pender et al, 2012). The synthesis of traditional modeling in combination with surveying manufacturers provides important insights into how regions can engage agricultural processing as a driver for sustainable development in rural places.

Policy Implications

Traditional policies of industrial recruitment remain popular in rural areas (Pender et al, 2012). Agricultural manufacturing has the potential to support rural economic development and wealth creation by offering jobs with higher wages, indirect economic impacts through the purchase of local inputs and contributing to local tax revenues (Pender et al, 2012). The comparative advantage revealed in survey results for agricultural manufacturing in this region comes from a unique growing climate and the availability of Colorado-grown and raised agricultural inputs. Industrial recruitment could exploit these natural comparative advantages. However, this strategy has been criticized as being too costly for local governments or ineffectual in fostering economic development (Deller, 2014). While the econometric model results suggest that tax rates are an influential factor

that determine firm location decision, there may be more effective ways for local governments to attract agricultural manufacturing on the Western Slope.

Successful economic development strategies for rural places include identifying and advertising economic niches where their location has a distinctive competitive advantage (Reeder, 2006). This strategy relates to industry recruitment in that it focuses on the potential competitive advantages for firms locating near Colorado-grown inputs. Many surveyed firms reported choosing the Western Slope exactly for this reason, with over two-thirds of interviewed firms reporting receiving a price premium for their Colorado-made products. This comparative advantage serves to promote industry agglomeration, which was determined to be significant in the econometric model. The call for place-specific development strategies (Honadle, 1993) also suggests that local governments identify where their competitive advantage lies and leverage these factors to attract firms.

The prevalence and success of entrepreneurial ventures in rural Colorado are a source of diversification that can help to stabilize small economies in times of fluctuation (Low et al, 2005; Reeder, 2006). Entrepreneurs locate their business where they live, retaining profits locally and supporting communities (Pender et al, 2012). While the entrepreneurial culture of a county was not a significant determinant of firm location in the economic model, the survey responses indicated that reciprocal community support influenced their location decision. Strategies that promote entrepreneurialism are industry-neutral and can contribute to the innovation and creativity that cluster strategies suggest are important for development (Porter, 2000). Colorado Economic Region 9, which includes counties in the

southwest corner of the state, has embraced this strategy through an entrepreneur accelerator program that has created 60 jobs through fifteen businesses over a four-year period (State Demography Office, 2017).

The heterogeneity of rural places even within this small region suggests that a comprehensive top-down rural development policy would be challenging. The findings of this research suggest that opportunities for rural development may be within the communities themselves. The European Union implemented the LEADER program over the last 25 years, which allowed local strategies to be designed by local actors to address the challenges of rural development in their own region. This approach designates local action groups to small, homogenous and socially cohesive areas that serve to prioritize the needs of their own communities, facilitate innovation, strategize for development at a local level and network with national and regional agencies. This program has been widely adopted across Europe, with over 2500 local action groups across 77% of rural EU territory (European Commission, 2006). This bottom-up approach to policy supports economic theory of cluster-based development through promotion of innovation and competitive advantages. Policy implementation is more likely to be effective when considering the diversified needs of rural places. The themes emerging from the survey results demonstrated a willingness for local businesses to contribute to community economic development, and policies that embrace this enthusiasm could serve to expand rural wealth.

Chapter 5: Conclusion

The goal of this research was to understand the characteristics of places that influence the location decisions of agricultural manufacturing firms. Enhanced understanding of these location decisions can help to inform policies, programs and initiatives that can support rural economic development.

This thesis included a mixed methods analysis of factors that influence firm location decision across Colorado. First, we worked with several state agencies to develop a unique dataset of agricultural manufacturing firms. To understand how different factors affect the dispersion of these firms, a negative binomial model was utilized to estimate firm count in a region given a defined set of characteristics. Two version of this model compared the influence of traditional neoclassical location-decision factors to variables indicative of agricultural output, social capital, natural amenities and other quality of life measures. The results from the econometric analysis align with traditional firm location literature. Wages, population, industry agglomeration, taxes and urbanization are all important and significant indicators of firm location decision (Arauzo-Cardo et al, 2010).

Second, we conducted interviews in a targeted regional case study of Colorado's Western Slope. This area was chosen for its unique agricultural landscape, diverse economic and demographic setting and the expressed interest from state and nonprofit agencies. We used the database of agricultural manufacturing firms to determine potential businesses to be included. Qualitative survey results indicate that access to inputs, quality of life, and other

community assets were the most important factors for firms choosing their location. Quantitative answers reflected non-financial resources that attracted firms, such as economic opportunity, support for entrepreneurial small businesses, an engaged local community and natural and public amenities.

Synthesizing the results of the econometric model and survey responses provide unique insight into development strategies. Access to inputs provides a comparative advantage in this region, which suggests 'niche' development strategies may be effective for promoting agricultural manufacturing. This comparative advantage may be the reason for the high location quotients for food processing on the Western Slope, a finding supported by the econometric model results that indicate LQs are an important indicator for firm locations. The positive and significant influence of urbanization suggest that the creativity in rural places, and the access to diversified Colorado products, allow businesses to thrive outside of the urban core. The success of entrepreneurs in rural places demonstrates the reciprocal and advantageous commitment to community expressed in the survey findings. Combined, these factors suggest bottom-up policies based on supporting entrepreneurs and marketing a region's comparative advantage will be most effective in developing Colorado's rural places.

Limitations

This research was limited to firms located in Colorado. There are a number of things about Colorado that make it unique, including the fact that it's the second fastest growing state in

the U.S., and that it has tremendous endowment of natural amenities. This research could be improved by taking a more regional approach, as Henderson and McNamara (2000) did in their analysis of the Corn Belt Counties. Though our dataset did not allow for the broader analysis, perhaps inclusion of the entire Rocky Mountain region would be more appropriate, as food manufacturing could potentially serve to bolster the tourism industry. Inclusion of state-level policies across a larger region may highlight a relationship between firm locations and the differing regulations that this study did not include.

Further, analysis of firm location decisions for agricultural manufacturing in Colorado was limited by the available data. The list firms included in the database contained no information about the firms themselves outside of a name, address, and type of permit possessed. There was no way to decipher the type of food processing, the scale of production, the size of the firm, or where the firm purchased inputs. This limited the type of modeling that could be done. Additionally, the Colorado Department of Public Health and the Environment estimate there are somewhere between 50 and 300 food manufacturers operating in Colorado without the proper license.¹² This suggests that the list of agricultural manufacturing firms in the state that we aggregated is likely non-exhaustive. Any analysis done on incomplete data skews the results towards the data that is available, limiting the holistic perspective this research hoped to present.

¹² Cited from conversations with Chad DeVolin, Program Manager of the Environmental Agriculture Program in the Colorado Department of Public Health and the Environment in February 2017

Though we were able to obtain more in-depth information in the survey, we were limited by sample size, and results may not be representative given our approach. Food processing literature indicates that different types of manufacturing have diverse cost structures that drive their location choices (Connor et al, 1997). While we were able to interview eight businesses that manufacture wine, beer and spirits, we were unable to interview a single dairy plant owner/manager. This would bias the results of our survey towards the type of food manufacturing firms that were interviewed by excluding the perspective of those types of firms that are not represented.

Future Research

The LEADER program implemented across the European Union to support bottom-up, integrative, and locally-designed development strategies may serve as a good example for Colorado to model when considering rural development policy. Establishing an effective regional program like this has taken a quarter century (European Commission, 2006). Implementing a program like this would be a massive undertaking at the federal, state and local levels. Some challenges with the implementation warrant further research. For example, less than half of the businesses interviewed reported utilizing local organizational support, such as Colorado State University Extension, Agricultural Experiment Station's research stations, economic development agencies, or other nonprofit entities. Even if local action groups were to be supported by a state or federal policy, we would need to understand how those groups can effectively coordinate within a region to promote rural economic development.

One consideration worth more attention is the *relative* economic impact agricultural manufacturing could have on different communities in rural Colorado. A firm choosing to locate in Durango might have a smaller overall effect on economic indicators for that town because it already has a thriving manufacturing base than if it were to locate in neighboring Mancos, which recently lost its only manufacturing plant to a fire. The survey results revealed that many firm decision makers are utility maximizers and desire to contribute to community by providing high-paying, benefitted full-time jobs for local residents. Future research could examine where the largest potential economic impact could be for a plant looking to locate in a given area that also desired to positively influence the local economy.

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