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**An Exploratory Analysis of Women Farmers and  
Rural Economic Growth and Development**

By

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# **AN EXPLORATORY ANALYSIS OF WOMEN FARMERS AND RURAL ECONOMIC GROWTH AND DEVELOPMENT**

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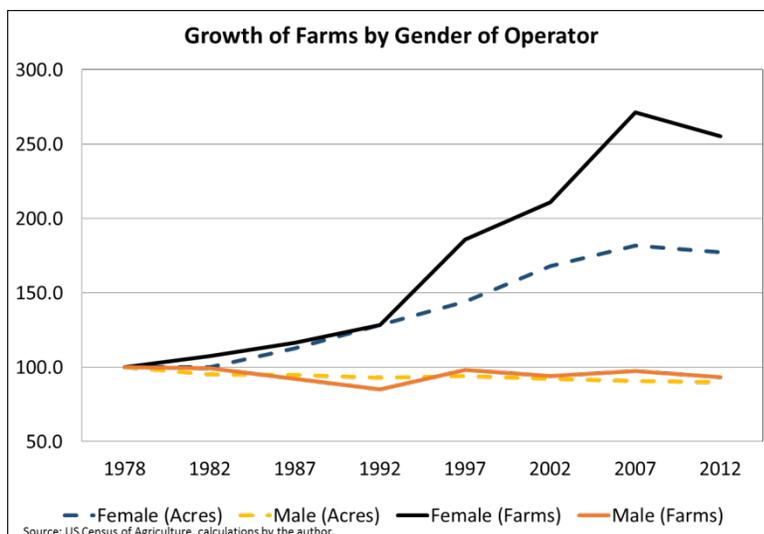
## Abstract

This exploratory research seeks to better understand the changing role of women farmers in rural US economic growth and development. Within the US the number of farms operated by women has grown from five percent of all farms in 1978 to almost 14% in 2012. Over the 1978-2012 time-frame nearly all the growth in number of farms and acres farmed has been from women farmers. It is unclear how this shift in farming across the US impacts the economic performance of rural communities. We explore temporal and spatial patterns of women owned farms using Census of Agriculture data then use an expanded Carlino-Mills partial adjustment growth framework to model how concentrations of women farmers in 2007 influence growth patterns over the 2007 to 2013 period. We find higher concentrations of women farmers do not influence employment or population growth but do have a negative association with income growth.

## AN EXPLORATORY ANALYSIS OF WOMEN FARMERS AND RURAL ECONOMIC GROWTH AND DEVELOPMENT

### Introduction

In a detailed analysis of Census of Agriculture and Agricultural Resource Management Survey (ARMS) data Hoppe and Korb (2013) found that much of the growth in farming, particularly in the number of farmers, over the past 30 years has come from women farmers. From 1978 to 2012 the number of farms operated by women grew by over 150 percent while the number of farms operated by men declined by slightly less than ten percent. Over the same period the acreage operated by women farmers increased by about 75 percent while the acreage operated by male farmers declined again by slightly less than ten percent. The growth trend in women farmers is most evident in the period 1992 to 2007 with a reversal of the general trend from 2007 to 2012. It is not clear if this reversal reflects a permanent deviation from the prior growth patterns or a temporary change due to the difficulties of the Great Recession. Hoppe

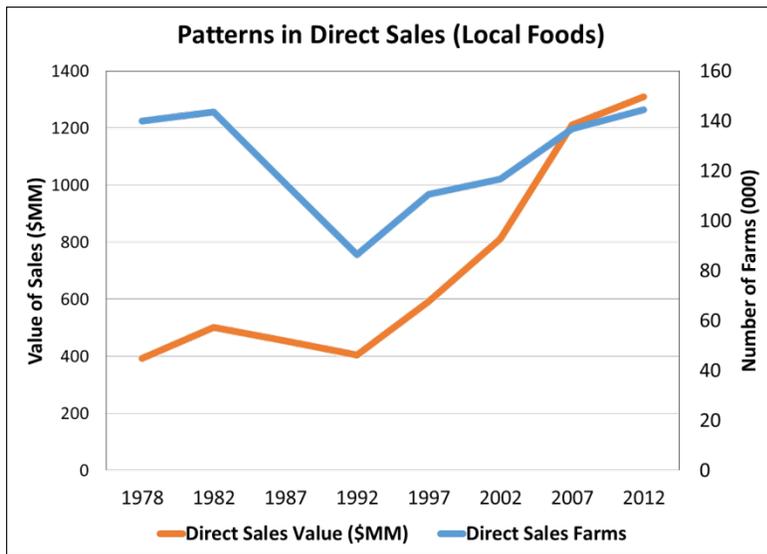


and Korb (2013) go on to observe from the 2007 Census of Agriculture that the majority (about three quarters) of women operated farms had sales less than \$10,000 and only a small share (five percent) had sales over \$100,000. As noted by Beach (2013), as well as Key and Roberts (2007), the growth in women farmers complements the growing bimodal distribution of farms in the US.

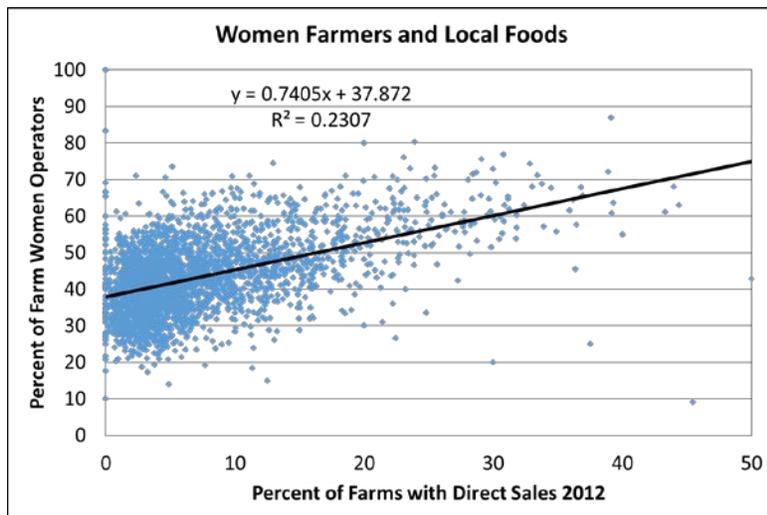
In Wisconsin, of the 69,754 farms (2012 Census of Agriculture), 7,346 or just over one in ten, are operated by women and those farms account for 4.6% of acreage. In 1997 women farmers accounted for only 7.3% of all Wisconsin farms and 4.3% of acreage. Between 1997 and 2012 the number of women farmers increased by 28.3%. During the same period, the total number of farms in Wisconsin declined by 12.3%. While the growth in the number of women farms in Wisconsin was not sufficient to entirely off-set the decrease in the total number of farms, it slowed the rate of decline. Indeed, women farmers are a source of growth for Wisconsin agriculture.

Analysis by Trauger (2004) and Trauger and colleagues (2010) note that the rapid growth in women farmers corresponds to the rapid growth in local foods activity. In comparing the growth in the number of women farmers and the number of farms with direct sales for human consumption (the single best measures of local foods from the Census of Agriculture), there is a noticeably similar “take-off” period starting in 1992 and slow down over the period of the Great Recession. As further evidence of the relationship, simple scatter plot of the percent of farms with direct sales for human consumption and percent of farms that are operated by women shows a remarkably strong positive correlation.

In their studies of women farmers in Pennsylvania, Trauger and her colleagues found that women strongly embraced the notion of civic agriculture where the objective of the farm has more dimensions than simple profit maximization. They conclude that (2010, p53) “[w]omen in this study redefined successful farming in terms of providing services to their community, as



well as in terms of profit and productivity.” These observations are important because they speak to how women generally think about business and in particular agriculture and food markets. As noted by Barbercheck et al (2009) and Kiernan et al (2012) this later observation raises the question if current programs aimed at promoting agriculture, such as Extension educational programs, are flexible enough to meet the needs of women farmers who, in addition to having a profitable farm, would like to provide services to their communities.



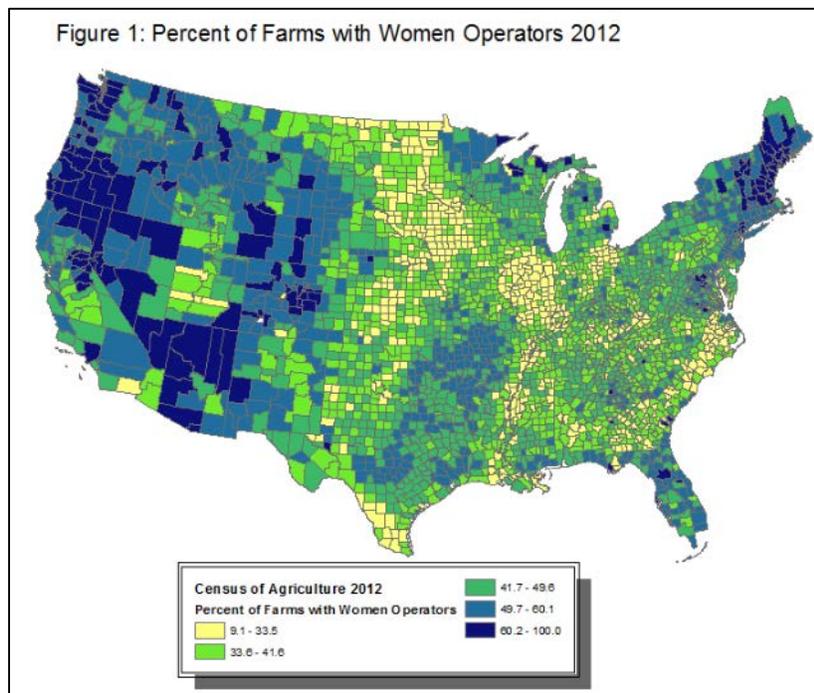
The growing number of women farmers raises questions concerning the impact on broader community economic performance and well-being. Specifically, does the growth in the number of women farmers represent an opportunity or a risk

to local communities? If the growth in women farmers is highly linked to growth in the local foods movement there is rigorous research evidence of a risk to local communities (e.g., Deller and Brown 2011; Deller et al 2014; Stickel 2015). In essence, for most rural communities the markets are too thin to impact the local economy in any measurable way and the profitability is sufficiently low that it may be a drag on the local economy. It is not clear, however, if applying the lessons learned from studying local foods and community economic growth and development is transferable to the growth in women farmers.

This exploratory analysis proceeds in four ways. First we provide a temporal and spatial descriptive analysis of women farmers followed by a summary review of the prevailing lines of literature which explores women farmers. Third, we offer a simple empirical growth model where we identify how concentrations of women farmers impact three metrics of economic growth over the 2005/7 to 2013 time period. We use a Spatial Durbin specification with heteroscedastic errors.

### Patterns of Women Farmers<sup>1</sup>

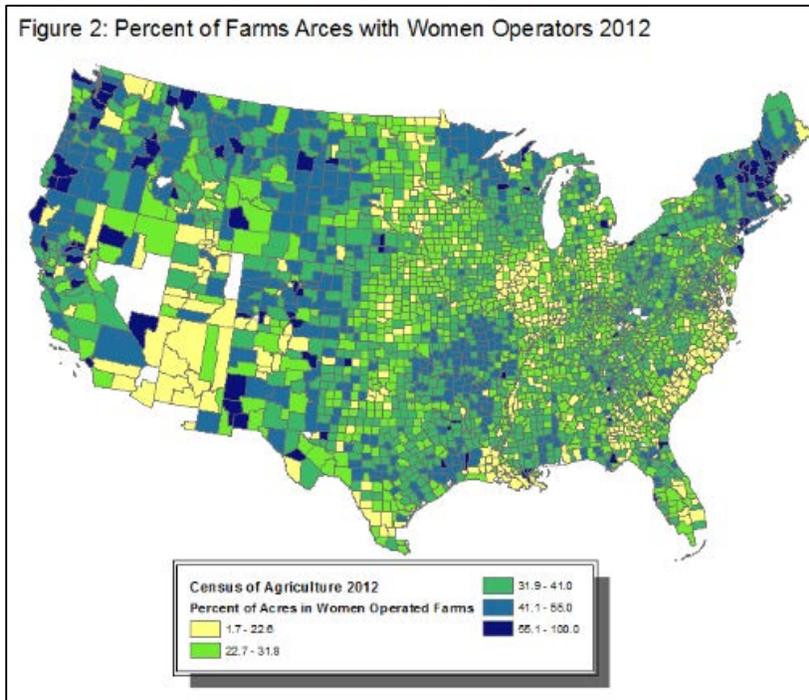
As we noted in the introductory comments, there has been significant growth in both the number of women farmers and the number of acres that are operated by women farmers over the past three decades. If we explore current concentration patterns across the US we can see



clusters of women farmers in the New England region and large parts of the Western states, particularly a band from the Seattle area south through northern California, Nevada and Arizona (Figure 1). There are also pockets around Denver heading northwest, the very northern reaches of the Upper Midwest, parts of Florida and to a lesser extent in the Missouri-Arkansas region. But if we look at the percentage of land (acres) that are controlled by women

<sup>1</sup> For an in-depth analysis see Hoppe and Korb (2013). In the simple descriptive analysis here we are interested in laying a foundational baseline for discussion.

Figure 2: Percent of Farms Acres with Women Operators 2012

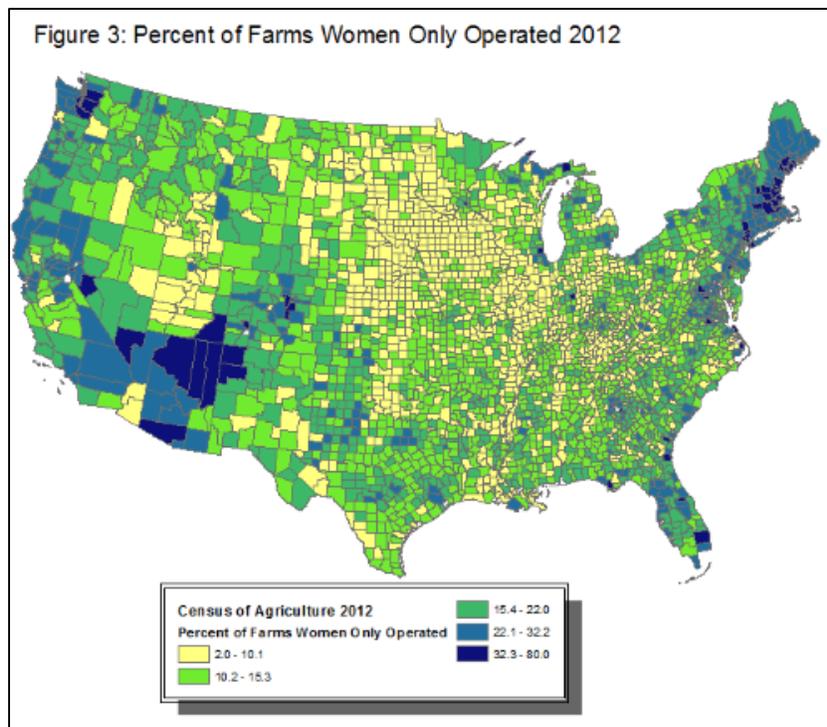


farmers a slightly different pattern emerges (Figure 2).

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from the Seattle area south through northern California, Nevada and Arizona (Figure 1). There are also pockets around Denver heading northwest, the very northern reaches of the Upper Midwest, parts of Florida and to a lesser extent in the Missouri-Arkansas region. But if we look at the percentage of land (acres) that are controlled by women farmers a slightly different pattern emerges (Figure 2). The spatial patterns revealed in Figure 2 mimic those in Figure 1, but the levels of intensity is much lower. Taken together, coupled with the work of Hoppe and Korb (2013), one can conclude that many of the women operated farms tend to be smaller in scale than those operated by their male counterparts. This also complements the speculative observation that women farmers tend to focus on local food markets and those farmers, in turn, tend to be of smaller scale than traditional commercial farmers.

If we use a more narrow definition of women farmers and explore the percent of farms where the only operator is a woman, the concentrations look much smaller spatially (Figure 3). In Figure 1, the definition of women farmers includes farm partnerships where the woman has a spouse, family member or another partner who could or could not be a male. But women only operated is akin to a sole proprietorship with the woman as the sole farm operator. The spatial pattern in New England, along the Pacific coast, the “Four Corners” area in the southwest and the region around Denver remains but at a much lower level of concentration. In addition the area in the central US disappears. From this simple analysis it appears that the growth in women farmers is coming from them assuming a larger role in farm partnerships.



Clearly, this spatial analysis of women farmers is only scratching the surface of a much larger phenomena. Indeed, in our econometric modeling reported below there are several ways in which to measure and proxy the structure of women farmers. But we can draw some generalities from the analysis presented up to now: (1) if it were not for the strong growth in the number of women farmers over the past several years the absolute number of farms in the US

would have declined significantly; (2) many of the women operated farms tend to be smaller in scale and/or producing products that require less land; (3) the concentration of women farmers and local food market activity overlap to a large extent.

The question that we are interested in exploring in this study is if this growth in the concentration of women operated farms influences the economic well-being of the communities where these farms are located. Does the presence of a higher concentration of women farmers positively, or negatively, impact the local economy? To help gain insights into this relatively straightforward question we first explore what the available literature tells us about women farmers, we then outline a widely used partial equilibrium adjustment growth model, followed by the empirical results. We close this exploratory analysis with an outline of future research steps.

The Women Farmer Literature

The academic literature focusing on women farmers in the US is dominated by ethnographic sociology studies with a strong feminist perspective (e.g., Beach 2013; Keller 2014; O’Hara 1998; Sachs 1983, 1996; Trauger 2004). This large literature is focused on better understanding the roles that women play within farm enterprises and families. In other words, what does it mean to be a “farm wife”? In O’Hara’s (1998) study of Irish farm women she identified four classifications or roles: farm helper; farm homemaker; working for the farm; and farm women

in paid work. In her framework, the women assume the role of a “supportive wife” who may or may not be a full partner in the farm enterprise. The strong feminist perspective in much of this literature contextualizes the farm wife as being less than an equal partner and implicates the institutional barriers to becoming a full partner.

Brandth (2002) does note that these classifications may not really correspond to the actual working relationship within the farm and family. In a study of farms in Georgia and Ohio, Barlett, Lobao and Meyer (1999) find that the roles of women in farming is changing as attitudes about women in the workplace are changing. Yet, these changes vary across communities as well as age. They find, for example, that the farm wife assumes more traditional roles amongst older farmers in the south but are seen as equal partners both in the family and the farm itself amongst younger farmers in the Midwest. A farmer that identifies more with the “industrial marital model” where the farm is a business tends to see women as full partners in the enterprise and family. Whereas farmers that identify more with the “agrarian marital model” where the farm is more of a way of life tend to view wife as partners in a more conservative or traditional light.

A second line of work examining the role of women in farming looks at the economics behind the roles through time use modeling (e.g; Brick 2005; Corsi and Findeis 2000). Here farmers and farm wives are making time allocation decisions across alternative uses of time: working on the farm, working off the farm, or leisure. For farm women a fourth choice includes work related to the family or household. In a study of farm women in the US, Bharadwaj, Findeis and Chintawar (2013) find that the financial needs of both the household and farm enterprise is predominate in time allocation decisions. This results in many farm wives electing to work off-farm in order to support the family and take financial pressures off the farm enterprise itself, reducing certain elements of family economic risk and instability. They also find that the allocation of time, and more importantly, the factors that drive those decisions, vary significantly across farm women, particular over age. Older farm wives find that working off the farm provides more intangible benefits beyond income such as networking and social interaction with others.

But the extant literature, while helpful in understanding the gender dynamics within farm enterprises and families, does not address the growing number of women that are the farm operators. Historically the farm is operated by the male spouse and the woman plays a supportive role. Although Barlett, Lobao and Meyer (1999) find that amongst younger farmers women are viewed more as full partners in the farm operation, the literature looking at women farmers, as in the principal operator, is much less developed. What limited literature that is available, that is beyond descriptive analysis such as that of Hoppe and Korb (2013), such as the work of Trauger (2004), Trauger and colleagues (2010), Barbercheck and colleagues (2012) and

Keller (2014), seeks to better understand the motivations behind women becoming the principal operator of a farm. There are no rigorous studies available that seek to better understand how the growth in women farmers impacts the larger community.

The research exploring why women enter farming as a principal operator and their farm practices does draw attention to important characteristics of women farmers when considering their impacts on the larger community. Within the broader women entrepreneurship literature, it is becoming increasingly obvious that women business owners have more complex utility functions than their male counterparts (e.g., Akerloff 2000; Conroy and Weiler 2015; Lewis 2006). Nelson (1995) and Mellor (1997) find that women entrepreneurs, when compared to males, disproportionately engage in alternative economic practices that emphasize community, family and innovative businesses and while profitability is important it is often secondary to other considerations.

Lee-Gosselin and Grise (1990), for example, find that women prefer business models that emphasize smaller scale, greater stability, and a stronger environment for work-life balance. Matsa and Miller (2014) find that during an economic downturn, among privately held-firms in the U.S., those that were women-owned were less likely to reduce their workforces than those owned by men. Further, women-owned firms were less likely to hire temporary or leased workers or increase labor intensity (e.g., forced over-time) after the previous recession. In an ecological study of regional economies in the US, Deller, Conroy and Watson (2015) found that counties with a higher percentage of businesses that were owned by women tended to experience greater stability through the Great Recession. In addition, some research finds that women can be more altruistic (Andreoni and Vesterlund 2001), as well as more risk and competition averse (Jianakoplos and Bernasek 2001; Niederle and Vesterlund 2007). Experimental research shows women are less likely than men to lie to gain monetary payoff (Dreber and Johannesson 2008), but more likely than men to choose a large (or preferable) but delayed rewards over a small immediate reward (Silverman 2003).

These differences between women and men business owners also play out in farming. Trauger and colleagues (2010) find that women farmers in Pennsylvania are much more interested in sustainability practices and multi-functionality of farms. This observation coincides with Keller's (2014) ethnographic study of women dairy farmers in Wisconsin. Indeed, Trauger's (2004) initial work with women farmers in Pennsylvania led her to argue that because women farmers are often focused on broader outcomes than efficiency, yield, and profit, they often times did not "fit into" the traditional farming institutions including but not limited to financial, educational, and technical support institutions, and the broader agricultural community. If we place the multi-objective function of women farmers next to the stated outcomes of civic agriculture as defined by Lyson (2004) the overlap is significant. Trauger and colleagues (2010

p53) concluded that “[w]omen in this study redefined successful farming in terms of providing services to their community, as well as in terms of profit and productivity.” Women farmers are more likely to adopt a “triple bottom line” approach to their business model where economic (profit) goals overlap with social or community and environmental goals.

While the broader literature looking at how women entrepreneurs and small business owners impact the larger community or regional economy is just starting to come into its infancy, there are no available studies looking at women farmers and the larger community or regional economy. If women farmers are more interested in the notion of civic agriculture and less interested in growing the farm business beyond some minimum necessary threshold, how does this impact the larger regional economy?

### Modeling Framework

The basic structure of the empirical work takes the general form:

$$Well - Being = f(Soc, Demo, Pol, Econ, WOF)$$

Here *Well – Being* includes a range of community level metrics including traditional growth metrics (population, employment and income) along with broader well-being metrics such as income equality and poverty. Other metrics of well-being such as changes in social capital will be explored. The block of variables in *Soc, Demo, Pol, Econ* are control variables for social, demographic, political, and economic characteristics.

This work faces two additional difficulties beyond developing metrics to capture *Well – Being*. First, how do we develop measures of women-owned and operated farms (*WOF*)? Second, how do we address issues of endogeneity in the relationship between women farmers and community well-being? For example, in our work on local foods and community well-being we have found strong relationships between the supply of local foods and public health (Deller, Canto and Brown 2015). Others have found similar results but have incorrectly jumped to the conclusion that higher access to local foods leads to higher levels of public health. We cannot tell if local foods feeds into better health or people with better health demand local foods. Similarly, in this research, it will be difficult if strong communities support the growth of women-owned farms or if women-owned farms facilitate strong communities.

To address the measurement of women farmers (*WOF*) we are limited to the data available from the Census of Agriculture but, as documented in Hoppe and Korb (2013), there are a range of ways in which the USDA has defined and measured women farmers. For this exploratory analysis we use:

- Share All Farms Operated by Women
- Share of Total Farm Sales by Women Operated Farms
- Share of All Farms Women Principal Operator
- Share of All Farms Women Full Owners
- Share of All Acres by Women Operator
- Share of All Acres by Women Principal Operator
- Share of All Acres Women Full Owners
- Share of All Acres by Women Operator Harvested Crop Land
- Share of All Farms Women Operator Harvested Crop Land

Note that there are three variations on operator structure: women as a partner in the farm enterprise, women as the primary or principal operator, and women as the sole operator. These reflect the various ownership-operator structures that are possible with farm enterprises. We also look at the size of the farm enterprise across all acres and harvested crop land. If women farmers are predominately entering farming in terms of small scale production targeting local foods markets, then we would expect acres and crops to be less reflective of women farmers.

This exploratory analysis of women farmers on community economic performance builds on the classic Carlino and Mills (1987) model of employment and population growth. We expand the traditional two equation model by including income (Deller, et al 2001). This expanded version has been well accepted in the literature.

$$\Delta E_{t \rightarrow t+1} = \alpha_{E1}E_t + \alpha_{E2}P_t + \alpha_{E3}I_t + \alpha_{E4}\Delta E_{t-1 \rightarrow t} + \alpha_{E5}\Delta P_{t-1 \rightarrow t} + \alpha_{E6}\Delta I_{t-1 \rightarrow t} + \theta X_t + \beta WOF + \epsilon$$

$$\Delta P_{t \rightarrow t+1} = \alpha_{P1}E_t + \alpha_{P2}P_t + \alpha_{P3}I_t + \alpha_{P4}\Delta E_{t-1 \rightarrow t} + \alpha_{P5}\Delta P_{t-1 \rightarrow t} + \alpha_{P6}\Delta I_{t-1 \rightarrow t} + \theta X_t + \beta WOF + \epsilon$$

$$\Delta I_{t \rightarrow t+1} = \alpha_{I1}E_t + \alpha_{I2}P_t + \alpha_{I3}I_t + \alpha_{I4}\Delta E_{t-1 \rightarrow t} + \alpha_{I5}\Delta P_{t-1 \rightarrow t} + \alpha_{I6}\Delta I_{t-1 \rightarrow t} + \theta X_t + \beta WOF + \epsilon$$

Here  $t=2007$ ,  $t+1=2013$ ,  $t-1=1997$ ,  $E$  is employment,  $P$  is population, and  $I$  is per capital income,  $X$  is a set of control variables, and  $WOF$  is a set of measures of women owned and operated farms as described above from the Census of Agriculture. All data are for U.S. nonmetro (rural) counties, after losing some to missing data the sample size is 1,464. Each model is estimated separately.

Note that in these preliminary modeling efforts we use a heteroscedastic errors Spatial Durbin Model with Bayesian estimates rather than classical least squares. This is because of the spatial

clustering of women farmers in certain parts of the US (Figure 1). Following LeSage and Pace (2009) the heteroskedastic Spatial Durbin Model (SDM) model can be expressed as:

$$y = \rho W y + X \beta + \theta L F + \varepsilon$$

$$\begin{aligned} \varepsilon &\sim N(0, \sigma^2 V) \quad V = \text{diag}(v_1, \dots, v_n) \\ \pi(\beta, \theta) &\sim N(c, N) \\ \pi(r / v_i) &\sim \text{IID } \chi^2(r) \\ \pi(1/\sigma^2) &\sim \Gamma(d, v) \\ \pi(\rho) &\sim U[0,1] \end{aligned}$$

The set of variance scalars ( $v_1, v_2, \dots, v_n$ ) are unknown parameters that need to be estimated. The prior distribution for the  $v_i$  terms takes the form of an independent  $\chi^2(r)/r$  distribution where  $\chi^2$  is a single parameter distribution with  $r$  as the parameter. By adding the single parameter  $r$  this allows the estimation of the  $n$  parameters  $v_i$ . The prior distributions are indicated using ( $\pi$ ), a normal-gamma conjugate prior for  $\sigma$  and a uniform prior for  $\rho$ . To implement the model we use the Gibbs sampling procedure which must be repeated until the values of the estimates converge. For this study we use 50,000 draws with the first 2,000 draws removed in effect acting as a "burn-in" to minimize the likelihood of poor starting values.<sup>2</sup>

The control variables in our exploratory growth model include six categories including: (1) base year levels for the dependent growth variables; (2) deep lags of the dependent variables to minimally address issues of endogeneity; (3) economic structure; (4) demographic characteristics; (5) income characteristics; and (6) social structure. Specific variables include:

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<sup>2</sup> Consider the general form of the spatial Durbin model which can be expressed as  $y = \rho W y + \beta X + \delta W X + e$  and in reduced form as  $y = (I - \rho W)^{-1} \beta X + (I - \rho W)^{-1} \delta W X + (I - \rho W)^{-1} e$ . Let  $V(W) = (I - \rho W)^{-1}$  then write the reduced form as  $y = V(W) \beta X + V(W) \delta W X + V(W) e$ . Because  $V(W)$  is a matrix and not a scalar, the common approach of using point estimates to test the hypothesis as to whether or not spatial spillovers exist can lead to erroneous conclusions (LeSage and Pace 2009, p.74). Instead we need to use the partial derivatives to properly interpret the impact of changes to the variables. Specifically,  $\frac{\partial y}{\partial x} = V(W) \beta + V(W) \delta W$  or  $\frac{\partial y}{\partial x} = \text{direct} + \text{indirect} = \text{total}$ . Here the direct effect is the impact within the county and the indirect is the impact across counties, or the neighborhood effect. For reporting purposes LeSage and Pace (2009) suggest the using the averages of the diagonal element of  $V(W) \beta$  for the direct effects, or within geographical unit effects, as well as the averages of the sum of the columns or rows (the symmetric nature of the matrix makes it irrelevant if one used the columns or rows) of the  $V(W) \delta W$  for the indirect effects, or across geographical unit effects.

#### Base Year

Population Base Year 2007  
Per Capita Income Base Year 2007  
Employment Base Year 2007

#### Deep Lags

Change in Population 1997 to 2007  
Change in Per Capita Income 1997 to 2007  
Change in Employment 1997 to 2007

#### Economic Structure

Index of Industrial Diversification  
Share of Employment in Goods Producing (Non-Agriculture)  
Share of Employment in Service Producing  
Share of Employment in Government

#### Demographic

Percent of the Population Under Age 18  
Percent of the Population Over Age 65  
Percent of the Population African-American  
Percent of those Over Age 25 with Some College Education, No Degree  
Percent of the Population Foreign Born

#### Income Characteristics

Percent of Households with Income over \$150K  
Gini Coefficient of Income Equality  
Per Capita Income from Transfer Payments  
Per Capita Income from Dividends, Interest and Rent

#### Social Structure

Commuting to Adjacent Metro Counties  
Percent of Persons in Same House 2000-1995  
Social Capital Index

Most of the variables are self-explanatory and are drawn from a range of studies that seek to understand the growth patterns of rural US counties (e.g., Deller, et al. 2001; Deller and Lledo 2007; Deller, Lledo and Marcouiller 2008; Isserman, Feser and Warren 2009; McGranahan and Wojan 2007). Most of the data are drawn from the US Census Bureau and the Bureau of Economic Analysis Regional Economic Information System. The economic diversity index is drawn from Deller and Watson (2015) and is a simple Herfindahl index of the distribution of the

number of firms across the three digit NAISC classification. The social capital metric is drawn from the work of Rupasingha and Goetz (2008).

### Empirical Results

The results of the base models are provided in Tables 1, 2 and 3 and in these specifications of the three models none of the women farmer variables are included. We proceed by entering each of the women farmer metrics into the based models one at a time, for a total of 27 separate models being estimated. Before turning to the variables of interest, women farmers, consider the insights we gain on rural growth over the 2007 to 2013 time period from the base models. Consider first the employment model (Table 1), then per capita income (Table 2), then finally population (Table 3). For brevity consider the total effects only which combine within county effects (direct) and the cross county effects (indirect) (see footnote 2 for details).

For the employment growth model (Table 1) neither base year population or employment appear to influence growth yet rural counties that had a higher per capita income in 2007 appears to have higher employment growth rates over the 2007 to 2013 period. The deep lag variables appear to have little overall or total impact on employment growth but there is some evidence for direct impacts within the county. Here faster growth in population and per capital income within a county appears to positively influence growth, but lagged employment growth has a dampening effect. Somewhat surprisingly, higher shares of employment in nonagricultural goods producing, services and government have a negative impact on rural employment growth. Higher levels of income inequality appear to be associated with higher levels of rural employment growth. Given the nature of the Great Recession, higher levels of income from dividends, interest, and rent is associated with lower employment growth. Also, a higher concentration of African-Americans is associated with lower employment growth. Residential stability, a higher share of the population that is foreign born along with higher levels of social capital have positive direct impacts on employment growth, but no indirect effects which dominates the total effects.

The base year variables have no impact on rural income growth (Table 2) but lagged population and income growth is associated with slower income growth and lagged employment growth is associated with higher levels of income growth. Lagged growth in employment is tied to higher rates of subsequent income growth. A higher share of people commuting to an adjacent metro county is linked to higher income growth in rural areas. A more diversified rural economy is linked to lower income growth. As with the employment growth model, higher shares of total employment in non-agricultural goods producing, service producing and government is linked to slower income growth. Again similar to the employment model, higher levels of income

from dividends, interest and rent is linked to lower income growth. Finally, higher levels of residential stability, percent of the population foreign born and higher levels of social capital are each linked to higher rates of rural income growth.

Rural counties that had higher levels of per capita income in the base year of 2007 as well as faster rates of lagged income growth tended to have faster rates of population growth (Table 3). In addition, rural counties that experienced faster growth over the 1997 to 2007 period tended to see those higher rates of growth continue over the 2007 to 2013 period.

Surprisingly, higher rates of commuting to adjacent metropolitan counties are actually associated with lower population growth rates. More diversified counties in terms of business mix tended to experience slower growth rates. Counties with an older population also experienced slower growth. As with employment and income, higher share of employment in non-agricultural goods producing, service producing and government employment have lower population growth rates. Wealthier rural counties, measured by higher share of households with high income, tended to experience slower population growth and counties with higher levels of income inequality see faster population growth. Higher levels of income from transfer payments are associated with lower population growth. Finally, rural counties with a higher share of African-Americans experienced slower population growth.

While we do not spend much attention to discussing the direct (within county) and indirect (across counties) effects across the control variables, there are some patterns that warrant consideration. First, there are several variables that have strong direct (indirect) effects but weak indirect (direct) effects and in essence cancel each other out in estimating the total effect. Second, we also see some cases where the direct and indirect effects move in opposite direction, again cancelling each other out in terms of the total effect. The implication is twofold: (1) spatial patterns are important in understanding rural economic growth and development processes and (2) policies aimed at fostering rural economic growth and development must take a regional perspective as individual rural communities (counties) are intimately linked to neighboring communities (counties).

Consider now the variables of interest, specifically the different metrics of women farmers. Recall that each of these variables are entered into each of the growth models independently; to include all the women farmer metrics into the same model would yield serious collinearity problems. When considering the totality of the results it is clear that women farmers do not seem to influence either employment or population growth, but does have negative impact on income growth. If the growth in the number and production of women farmers are indeed tied to the growth in local foods then we can draw insights from the local foods literature in helping understand these results. In essence, the markets are too small to impact either employment or population in any meaningful manner but the wages supported by these markets are

sufficiently weak to dampen income growth. Alternative, the shocks of the Great Recession are simply masking the true impact of women farmers. The strong results on income, however, does suggest that women farmers are playing a role and further analysis is called for.

### Conclusions

The growth of women farmers in the US has been sufficiently strong to off-set the general decline in farms overall. There is evidence to suggest that many of these women operated farms are of a smaller scale targeting local markets and as a result generate limited revenues to the farm or income to the women operator. While there is a respectable ethnographic literature exploring women farmers, or more directly, the role of women in farming, there is no available research seeking to better understand how the growth in women farmers impacts the larger rural communities they are located within. This exploratory study aims to begin exploring this latter question.

We use a widely accepted partial equilibrium growth model based on the original work of Carlino and Mills (1987) and expanded by Deller, et al (2001) and model growth in employment, population and per capita income from 2007 to 2013. We use a heterogeneous Bayesian Spatial Durbin Model to capture the spatial interrelationship between neighboring counties. We test nine different measures of the size of women farmer to explore the sensitivity of our results.

The results on women farmers are consistent across nearly all our measures of women farmers: higher concentration of women farmers in 2007 has no influence on either employment or population growth over the 2007 to 2013 period. There is, however, consistent evidence that a higher concentration of women farmers has a negative impact on per capita income growth rates. Building on the cursory analysis linking women farmers to the local foods market we could draw on the results of that literature to help can insights into our exploratory analysis: the size of the market, or the concentration of women farmers, is not sufficiently large to impact employment or population growth, but the scale of operations is small enough and the associated wages low enough to place a drag on income growth.

Clearly, this is an exploratory study and we have really only scratched the surface of a longer term research question. For example, how much of the results are driven by the lingering effects of the Great Recession? Should a static metric of women farmer concentrations in 2007 be set aside in favor of a lagged growth rates in women farmers? Could it be that the spatial global parameters estimated across the rural US be masking important regional variations? For example, could the influence of women farmers be fundamentally different in New England, for example, when compared to the Great Plains? Does aggregating across these distinct regions

(i.e., a global parameter model) mask important regional differences? Is it possible that what the relevant “answer” to the basic question is different for different parts of the US? Our work is laid out for us.

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Table 1: Base Model Rural Employment Growth 2007 to 2013

	Direct	Indirect	Total
Population Base Year 2007	-0.00072 ** (0.0178)	0.00043 (0.5878)	-0.00029 (0.7422)
Per Capita Income Base Year 2007	0.00088 (0.2942)	0.00268 (0.1470)	0.00356 * (0.0621)
Employment Base Year 2007	0.00135 ** (0.0159)	-0.00081 (0.5950)	0.00055 (0.7471)
Change in Population 1997 to 2007	0.16136 *** (0.0001)	-0.22240 ** (0.0054)	-0.06104 (0.4623)
Change in Per Capita Income 1997 to 2007	0.03581 ** (0.0482)	0.03201 (0.4273)	0.06782 (0.1122)
Change in Employment 1997 to 2007	-0.04561 ** (0.0100)	0.08121 (0.1181)	0.03560 (0.5487)
Commuting to Adjacent Metro Counties	0.00005 (0.7990)	0.00049 (0.3561)	0.00054 (0.3064)
Index of Industrial Diversification	1.80811 *** (0.0001)	-0.73964 (0.2635)	1.06847 (0.1500)
Percent of the Population Under Age 18	0.03616 (0.7018)	-0.10596 (0.6323)	-0.06980 (0.7522)
Percent of the Population Over Age 65	0.07167 (0.5037)	-0.27649 (0.2081)	-0.20482 (0.3590)
Share of Employment in Goods Producing (Non-Agriculture)	-0.34234 *** (0.0001)	-0.20276 ** (0.0294)	-0.54510 *** (0.0001)
Share of Employment in Service Producing	-0.24437 *** (0.0001)	-0.24523 ** (0.0133)	-0.48960 *** (0.0001)
Share of Employment in Government	-0.15048 ** (0.0002)	-0.25585 ** (0.0191)	-0.40633 ** (0.0006)
Percent of Households with Income over \$150K	0.18724 (0.5936)	-0.61396 (0.4910)	-0.42672 (0.6528)
Gini Coefficient of Income Equality	-0.01563 (0.8636)	0.48107 ** (0.0263)	0.46544 ** (0.0439)
Per Capita Income from Transfer Payments	-0.00738 ** (0.0127)	-0.00404 (0.5590)	-0.01141 (0.1117)
Per Capita Income from Dividends, Interest and Rent	-0.00208 (0.2643)	-0.00675 (0.1303)	-0.00883 * (0.0606)
Percent of the Population African-American	0.01685 (0.5771)	-0.11709 ** (0.0050)	-0.10024 ** (0.0011)
Percent of those Over Age 25 with Some College Education, No Degree	0.06117 (0.4747)	-0.12540 (0.3592)	-0.06423 (0.5869)
Percent of Persons in Same House 2000-1995	0.10671 ** (0.0269)	0.04558 (0.6432)	0.15229 (0.1134)
Percent of the Population Foreign Born	0.25323 ** (0.0012)	-0.02025 (0.9014)	0.23298 (0.1332)
Social Capital Index	0.00383 * (0.0612)	-0.00054 (0.9134)	0.00330 (0.5326)
Spatial Lag $\rho$	0.31529 *** (0.0001)		
$R^2$	0.3197		

\*\*\*: Significant at the 99.9 percent level.

\*\*: Significant at the 95.0 percent level.

\*: Significant at the 90.0 percent level.

Values in parentheses are the marginal significance levels or p-values.

Table 2: Base Model Rural Per Capita Income Growth 2007 to 2013

	Direct	Indirect	Total
Population Base Year 2007	-0.00021 (0.5658)	-0.00029 (0.7916)	-0.00051 (0.6777)
Per Capita Income Base Year 2007	0.00110 (0.3173)	0.00296 (0.2684)	0.00406 (0.1426)
Employment Base Year 2007	-0.00058 (0.4060)	-0.00016 (0.9381)	-0.00074 (0.7517)
Change in Population 1997 to 2007	-0.18831 *** (0.0001)	-0.27738 ** (0.0139)	-0.46569 *** (0.0001)
Change in Per Capita Income 1997 to 2007	-0.03024 (0.2115)	-0.07243 (0.1864)	-0.10268 * (0.0755)
Change in Employment 1997 to 2007	0.05265 ** (0.0197)	0.14178 ** (0.0485)	0.19443 ** (0.0178)
Commuting to Adjacent Metro Counties	0.00001 (0.9878)	0.00151 ** (0.0369)	0.00152 ** (0.0359)
Index of Industrial Diversification	0.07923 (0.8041)	-2.06397 ** (0.0434)	-1.98475 * (0.0765)
Percent of the Population Under Age 18	-0.08542 (0.4533)	0.03695 (0.9047)	-0.04846 (0.8742)
Percent of the Population Over Age 65	0.33561 ** (0.0133)	-0.10558 (0.7257)	0.23003 (0.4544)
Share of Employment in Goods Producing (Non-Agriculture)	-0.33757 *** (0.0001)	-0.27578 ** (0.0246)	-0.61335 *** (0.0001)
Share of Employment in Service Producing	-0.27171 *** (0.0001)	-0.01460 (0.9092)	-0.28631 ** (0.0407)
Share of Employment in Government	-0.21706 *** (0.0001)	-0.08045 (0.5886)	-0.29752 * (0.0637)
Percent of Households with Income over \$150K	0.29616 (0.5080)	-1.40659 (0.2489)	-1.11043 (0.4008)
Gini Coefficient of Income Equality	0.01634 (0.8849)	0.25001 (0.4047)	0.26635 (0.4139)
Per Capita Income from Transfer Payments	-0.01556 *** (0.0001)	0.00158 (0.8635)	-0.01397 (0.1494)
Per Capita Income from Dividends, Interest and Rent	-0.01086 *** (0.0001)	-0.00246 (0.6835)	-0.01332 ** (0.0388)
Percent of the Population African-American	0.09682 ** (0.0063)	-0.11465 ** (0.0308)	-0.01783 (0.6638)
Percent of those Over Age 25 with Some College Education, No Degree	-0.06349 (0.5561)	0.21803 (0.2356)	0.15453 (0.3497)
Percent of Persons in Same House 2000-1995	0.17354 ** (0.0039)	0.21004 (0.1149)	0.38358 ** (0.0042)
Percent of the Population Foreign Born	-0.05200 (0.6182)	0.54068 ** (0.0171)	0.48868 ** (0.0289)
Social Capital Index	0.00723 ** (0.0068)	0.00508 (0.4410)	0.01230 * (0.0867)
Spatial Lag $\rho$	0.37181 *** (0.0001)		
$R^2$	0.3424		

\*\*\*: Significant at the 99.9 percent level.

\*\*: Significant at the 95.0 percent level.

\*: Significant at the 90.0 percent level.

Values in parentheses are the marginal significance levels or p-values.

Table 3: Base Model Rural Population Growth 2007 to 2013

	Direct	Indirect	Total
Population Base Year 2007	-0.00023 *	0.00022	-0.00001
	(0.0569)	(0.5293)	(0.9787)
Per Capita Income Base Year 2007	0.00073	0.00111	0.00184 **
	(0.0265) **	(0.1548)	(0.0263)
Employment Base Year 2007	0.00069 **	-0.00019	0.00050
	(0.0021)	(0.7806)	(0.5038)
Change in Population 1997 to 2007	0.20270 ***	0.03554	0.23824 ***
	(0.0001)	(0.3603)	(0.0001)
Change in Per Capita Income 1997 to 2007	0.00020	0.03160 *	0.03180 *
	(0.9776)	(0.0744)	(0.0922)
Change in Employment 1997 to 2007	-0.00029	-0.01118	-0.01147
	(0.9662)	(0.6292)	(0.6621)
Commuting to Adjacent Metro Counties	-0.00022 **	-0.00020	-0.00042 *
	(0.0069)	(0.3880)	(0.0682)
Index of Industrial Diversification	-0.20653 *	-0.38516	-0.59168 *
	(0.0773)	(0.2078)	(0.0984)
Percent of the Population Under Age 18	0.05691	-0.14283	-0.08592
	(0.1222)	(0.1247)	(0.3611)
Percent of the Population Over Age 65	-0.20076 ***	-0.14212	-0.34289 **
	(0.0001)	(0.1444)	(0.0005)
Share of Employment in Goods Producing (Non-Agriculture)	-0.01509	-0.15987 ***	-0.17496 ***
	(0.2610)	(0.0001)	(0.0001)
Share of Employment in Service Producing	0.01127	-0.24767 ***	-0.23639 ***
	(0.4556)	(0.0001)	(0.0001)
Share of Employment in Government	0.03663 **	-0.19411 ***	-0.15748 **
	(0.0213)	(0.0001)	(0.0021)
Percent of Households with Income over \$150K	-0.13052	-0.75495 **	-0.88547 **
	(0.3495)	(0.0488)	(0.0316)
Gini Coefficient of Income Equality	0.02401	0.22486 **	0.24888 **
	(0.5106)	(0.0160)	(0.0137)
Per Capita Income from Transfer Payments	-0.00367 **	-0.00281	-0.00648 **
	(0.0015)	(0.3326)	(0.0337)
Per Capita Income from Dividends, Interest and Rent	0.00082	0.00079	0.00161
	(0.2718)	(0.6788)	(0.4313)
Percent of the Population African-American	-0.09277 ***	0.04633 **	-0.04644 **
	(0.0001)	(0.0083)	(0.0005)
Percent of those Over Age 25 with Some College Education, No Degree	0.02601	0.01739	0.04340
	(0.4468)	(0.7688)	(0.4071)
Percent of Persons in Same House 2000-1995	-0.01878	0.07464 *	0.05586
	(0.3173)	(0.0709)	(0.1811)
Percent of the Population Foreign Born	0.01884	-0.03905	-0.02021
	(0.5678)	(0.5755)	(0.7622)
Social Capital Index	0.00076	-0.00152	-0.00076
	(0.3334)	(0.4560)	(0.7336)
Spaital Lag $\rho$	0.38171 ***		
	(0.0001)		
$R^2$	0.48460		

\*\*\*: Significant at the 99.9 percent level.

\*\*: Significant at the 95.0 percent level.

\*: Significant at the 90.0 percent level.

Values in parentheses are the marginal significance levels or p-values.

Table 4: Woman Farm Augmented Rural Employment Growth 2007 to 2013

	Direct	Indirect	Total
Share All Farms Operated by Women	-0.02725 (0.3839)	0.03379 (0.5169)	0.00654 (0.8863)
Share of Total Farm Sales by Women Operated Farms	0.02296 (0.5326)	-0.16201 * (0.0900)	-0.13905 (0.1814)
Share of All Farms Women Principal Operator	-0.00953 (0.8473)	-0.05548 (0.5737)	-0.06501 (0.4988)
Share of All Farms Women Full Owners	-0.01722 (0.7456)	-0.08746 (0.4308)	-0.10468 (0.3355)
Share of All Acres by Women Operator	-0.00800 (0.7268)	-0.01645 (0.7192)	-0.02445 (0.5737)
Share of All Acres by Women Principal Operator	0.00028 (0.9956)	0.04955 (0.6678)	0.04984 (0.6784)
Share of All Acres Women Full Owners	-0.00389 (0.9477)	-0.06041 (0.6600)	-0.06430 (0.6508)
Share of All Acres by Women Operator Harvested Crop Land	-0.04542 (0.4034)	-0.12670 (0.3058)	-0.17212 (0.1926)
Share of All Farms Women Operator Harvested Crop Land	0.02637 (0.1060)	-0.04465 (0.1774)	-0.01828 (0.5726)

\*\*\*: Significant at the 99.9 percent level.

\*\* : Significant at the 95.0 percent level.

\*: Significant at the 90.0 percent level.

Values in parentheses are the marginal significance levels or p-values.

Table 5: Woman Farm Augmented Rural Per Capita Income Growth 2007 to 2013

	Direct	Indirect	Total
Share All Farms Operated by Women	-0.06787 *	-0.15647 **	-0.22434 **
	(0.0635)	(0.0217)	(0.0004)
Share of Total Farm Sales by Women Operated Farms	-0.02611	-0.23445 **	-0.26057 **
	(0.5543)	(0.0484)	(0.0480)
Share of All Farms Women Principal Operator	-0.10895 *	-0.34377 **	-0.45272 **
	(0.0702)	(0.0103)	(0.0008)
Share of All Farms Women Full Owners	-0.12054 *	-0.40376 **	-0.52430 **
	(0.0601)	(0.0065)	(0.0004)
Share of All Acres by Women Operator	-0.03897	-0.16393 **	-0.20290 **
	(0.1566)	(0.0062)	(0.0006)
Share of All Acres by Women Principal Operator	-0.13053 **	-0.33366 **	-0.46418 **
	(0.0320)	(0.0305)	(0.0040)
Share of All Acres Women Full Owners	-0.15854 **	-0.44181 **	-0.60035 **
	(0.0269)	(0.0151)	(0.0014)
Share of All Acres by Women Operator Harvested Crop Land	-0.09946	-0.32176 **	-0.42122 **
	(0.1074)	(0.0456)	(0.0137)
Share of All Farms Women Operator Harvested Crop Land	-0.01740	-0.00264	-0.02003
	(0.3816)	(0.9506)	(0.6237)

\*\*\*: Significant at the 99.9 percent level.

\*\* : Significant at the 95.0 percent level.

\*: Significant at the 90.0 percent level.

Values in parentheses are the marginal significance levels or p-values.

Table 6: Woman Farm Augmented Rural Population Growth 2007 to 2013

	Direct	Indirect	Total
Share All Farms Operated by Women	-0.00519 (0.6529)	0.00137 (0.9494)	-0.00381 (0.8485)
Share of Total Farm Sales by Women Operated Farms	-0.00857 (0.5225)	-0.00631 (0.8694)	-0.01488 (0.7257)
Share of All Farms Women Principal Operator	-0.00459 (0.7968)	-0.00257 (0.9516)	-0.00715 (0.8689)
Share of All Farms Women Full Owners	-0.01232 (0.5162)	-0.00044 (0.9925)	-0.01275 (0.7895)
Share of All Acres by Women Operator	-0.00515 (0.5642)	-0.00451 (0.8099)	-0.00967 (0.5999)
Share of All Acres by Women Principal Operator	-0.00236 (0.9059)	0.02493 (0.6209)	0.02257 (0.6679)
Share of All Acres Women Full Owners	-0.00296 (0.8981)	-0.01611 (0.7866)	-0.01907 (0.7588)
Share of All Acres by Women Operator Harvested Crop Land	-0.02605 (0.2116)	-0.05176 (0.3354)	-0.07781 (0.1672)
Share of All Farms Women Operator Harvested Crop Land	-0.00707 (0.1899)	-0.01325 (0.3352)	-0.02032 (0.1272)

\*\*\*: Significant at the 99.9 percent level.

\*\* : Significant at the 95.0 percent level.

\*: Significant at the 90.0 percent level.

Values in parentheses are the marginal significance levels or p-values.