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Agriculture and Rural Economic Growth

Steven C. Deller, Brian W. Gould, and Bruce Jones

The role of farm dependency and size on rural economic growth is examined with data from 2,240 nonmetropolitan U.S. counties for the period 1990–1995. A simple neoclassical model of regional economic growth is set forth with a central question relating to the role of agriculture on rural economic convergence. Traditional neoclassical theory predicts that poor rural areas should grow proportionally faster than rich areas. As interpreted in the academic literature and popular press, a preponderance of small family farms should enhance growth. Results suggest that a higher level of local dependence on production agriculture could lower growth rates.

Key Words: economic growth, production agriculture, rural development

JEL Classifications: O47, O51, Q18, R11

For decades, the notion of a healthy rural economy has been equated with a strong family-based agricultural sector (NCSF). Current research on the structure of the rural economy in the United States, however, documents that structural changes in the U.S. economy, and rural America in particular, have reduced the role of production agriculture (e.g., Drabenstott; Johnson; Walzer and Deller). Significant concerns have been expressed about the transition from small-scale "family-based" agriculture to larger "industrial-scale" farming (Ikerd 2000, 2001; NCSF).

Writing more than 50 years ago, Goldschmidt (1947, 1978) popularized the idea that the demise of the family farm and rise of corporate farms diminish the quality of life in rural America. Goldschmidt originally focused on the concept of large absentee-owner farms in California, the outflow of profits from local communities, low pay for farm laborers, and weaker production ties to the local community. Today, however, the notion of Goldschmidt has been greatly expanded and somewhat distorted within the literature to attack the trend in production agriculture away from the stereotypical family farm (Barnes and Blevins). In particular, farm structure and the theoretical relationships so explicit in Goldschmidt's original hypothesis have been blurred and misrepresented within the literature (Buttel; Gilles et al.; Green).

The argument widely expressed in the popular press, and to some extent in the academic literature, is that the "demise" of agriculture and traditional farming will greatly hinder the economic, social, and political vitality of rural America. Gebremedhin and Christy (p. 65) conclude:

> The survival of small farms is important because of their social and economic role in

Steven C. Deller and Bruce Jones are professors, Department of Agricultural and Applied Economics, University of Wisconsin–Madison, WI. Brian W. Gould is a senior research scientist, Department of Agricultural and Applied Economics and the Wisconsin Center for Dairy Research, University of Wisconsin–Madison, WI.

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> the rural community. Small farms constitute the majority of farm enterprises in the country. Their survival implies more viable rural communities and a potential demand for public and private goods and services which have been overlooked over the years.

Ikerd (2000, p. 4) argues that the very soul of the rural community is dependent on the family farm.

> As (farm) families were forced off the land, there were fewer people to buy groceries, clothes, and hardware in town, fewer people to go to schools and church, fewer people to serve in local government, join civic organizations, and rural communities withered and died.

The recent return to previous commodity price (income) support programs embodied in the 2002 Farm Bill with explicit caps on payments to individual farms was influenced by this logic. Arguments that commodity price support programs will help ensure a strong and healthy rural economy were commonly made in both the popular press and the halls of Congress. Again, a strong rural economy was equated with family farms.

In contrast, other researchers have argued that if farming is to generate sufficient levels of income to entice younger operators to remain in agriculture, the farm enterprise must adapt to changing times (Gardner). Throughout most of the 20th century, U.S. agriculture has generated lower than average incomes and a higher percentage of families living in poverty than nonfarm families. Gardner argues that improvements in technology and changes in the economic structure of farms have significantly improved the economic status of family farms. For example, in 1999, the average income of farm households was $64,347 compared to $54,842 for the average U.S. household. Despite the arguments of scholars such as Ikerd, a majority of the members of Congress, and much of the popular press, the data paint a vastly different picture.

Perhaps more compelling is that almost 90% of household income for the typical farmer comes from off-farm sources, suggesting that agricultural restructuring is allowing greater farm household flexibility to pursue alternatives for household income (USDA/ERS). This simple but startling statistic suggests that the commonly held belief that a healthy farming economy translates into a strong rural economy has been turned on its head; rather, a strong rural economy is a necessary condition for robust farm household income. If farm household income is significant and stable from off-farm sources, then farm enterprises have a greater ability to survive turbulence in farm markets.

The intent of this research is to contribute to the limited but growing literature concerning the relationship between the farm and rural economies and overall economic performance. This research pays particular attention to the role of agricultural dependency and structure on overall economic growth. With data for 2,249 nonmetropolitan U.S. counties for 1990 and 1995, a neoclassical model of regional economic growth is presented. Particular attention is paid to the effect of farm structure and dependency on overall regional growth.

This article is divided into four sections. In the following section, we provide a descriptive discussion of rural economic growth and the role of agriculture in such growth. Next, a brief review of the theoretical and empirical models are presented, followed by the empirical results. The article closes with a review of the issues and empirical results and suggests future research directions.

Overview of Rural Growth and Farming

The rural economy over the past 30 years could be described as a roller coaster. For much of the 1970s and 1990s, rural areas experienced relatively strong growth in employment, but in the late 1970s and much of the 1980s, the rural economy could best be described as stagnant. When compared to metropolitan areas during the Carter/Reagan recession, rural areas experienced employment stagnation and a weak recovery through much of the 1980s. Yet, the recession of the early 1990s appears to have largely by-passed rural America, at least as measured by growth in employment. This begs the question: What, if anything, has changed in the structure of the

rural economy to explain this inconsistent pattern of rural economic performance relative to the overall economy?

A popular hypothesis advanced for the weakness of the rural economy during 1980 is the farm "crisis" and the subsequent restructuring of agriculture when farm employment declined rapidly over the 1983–1993 period. This latter trend corresponds to the overall performance of the rural economy as measured by employment. Indeed, the stabilizing and slight recovery of farm employment during the mid- to late 1990s also corresponds to the relative strength of the overall rural economy. In a purely descriptive sense, these aggregate employment data seem to lend credence to the notion that a strong rural economy requires a strong farm economy.

If we broaden the analysis to examine rural economic growth beyond aggregate employment levels, a slightly different picture is painted. Comparing simple growth indices for total employment, farm employment, nonfarm employment and number of farm proprietors (a proxy for number of farms), the link between a declining farm sector and rural economic growth becomes blurred. Specifically, if the broader notion of dependency on agriculture were correct, one would expect parallel trends in farm employment coupled with number of farm proprietors and nonfarm employment. For the past 30 years, the farm and nonfarm rural economy appear to have moved in opposite directions, at least in terms of employment growth. This divergence is most apparent and persistent from about 1983 to today. From a purely descriptive perspective, the widely held belief that a healthy rural economy depends on a healthy farm economy does not appear to hold. Indeed, farm income as a percentage of total rural income has dropped from a high of 12% in 1975 to only 2% today.[1] Despite the weakness of the farm economy, the rural economy seems to be robust and growing.

Two questions that arise are: 1) Is a healthy farm economy a necessary condition for a healthy rural economy; and 2) Does the movement to fewer but larger farms negatively affect rural economies? The literature aimed at addressing these questions is mixed at best. Although some studies support the widely held popular belief linking farming to healthy rural economies, such as MacCannell, there are numerous studies refuting this premise. For example, Green examined rural Missouri and found little statistical relationship between several measures of farm structure and most measures of economic well-being. Similarly, Skees and Swanson found a lack of such a relationship in the rural South. Flora and Flora, Barnes and Blevins, and Lobao could not find a relationship between farm structure and the well-being of the rural economy. Harris and Gilbert; van Es, Chicoine, and Flotow; and Gilles and Dalecki actually found that bigger farms meant healthier economies at the community level.

Henry et al. imply that from a macroperspective, the reallocation of inefficiently used resources from smaller to larger farms improved the overall performance/efficiency of the larger economy. Henry and his colleagues argue that keeping resources in inefficient small farms reduced the overall productivity of the economy. This conclusion reaffirms the classic study of Heady and Sonka, who argue for a "macro" and "micro" perspective and reallocation of resources from less efficient to more efficient uses, but at the spatial cost of smaller farm numbers and lower aggregate income from farm production.

Gardner, however, argues that the focus of the debate should hinge on the economic well-being of the farm household and not necessarily the farm enterprise. Gardner suggests that "there is no identifiable connection between variables underpinning income from farming and the growth of farm-household income" (p. 1071). Rather he implies that to ensure a viable "family farm" in the sense of Ikerd, policy must be aimed at enhancing the

[1] Farm "sales" and farm "income" are commonly used interchangeably, particular in the popular press. In the discussion here, farm sales is the flow of money coming into the farm from the sale of commodities (e.g., crops and livestock). Income is the wages, salaries, and profits paid to farm workers and proprietors.

nonfarm economy to which farm workers have access.

A Theoretical Model of Economic Growth and Agriculture

One of the critiques of the preponderance of the literature addressing the widely held belief that the rural economy is dependent on a healthy farm economy is the lack of a rigorous theoretical framework in which to build the empirical analysis. Buttel questions much of this literature as being ad hoc in nature and lacking any rigorous theoretical foundation or empirical sophistication. In short, the majority of the empirical studies tend to be careless in design and implementation. Gardner argues that more rigorous examinations of the farming–rural economy linkage must be rooted in some theoretical construct of economic growth. For this analysis, a simple neoclassical model of regional growth is adapted from Barro and Sali-i-Martin and Mankiw, Romer, and Weil.

Conceptual Background

Beginning with Kuznets, a fundamental question in growth theory is the relationship between income inequality and economic growth. In brief, Kuznets argued that a simple agrarian economy should generally exhibit low income levels and little inequality across groups. Because of comparative advantages and economies of scale in production, firms (farms) will specialize, stimulating trade and increasing incomes. Demand for specialized production inputs will foster modest growth in manufacturing. Manufacturing, however, tends to be more productive per unit of labor than agriculture, which in turn introduces the notion of inequality in income.

According to Kuznets, economic growth involves, in part, a shift of persons and resources from agriculture in rural areas to higher paying manufacturing in newly developing urban areas. Persons who move experience a gain in income and change the economy's overall degree of inequality. The initial adapters to these changes benefit disproportionately, and initially there is a small group of relatively rich persons.

As more agricultural workers move into manufacturing, they benefit by gaining higher incomes. In addition, the demand for agricultural commodities increases as the economy grows. Given the increase in demand for agricultural workers, coupled with a diminishing supply of these workers, the income paid to agricultural workers should rise. These forces combined should lead to a reduction in overall income inequality.

Production agriculture plays a central role in the "convergence debate" begun by Kuznets. The "Kuznets story" relies on free market flows between industries (agriculture and manufacturing) and regions (rural and urban). But the logic of farm advocates like Gebremedhin, Christy, and Ikerd challenges the free flow of people and resources. In essence, the transition away from small-scale family farms hurts rural areas in the short run and thus should be avoided. In addition, advocates of small farms argue that through the consolidation of production agriculture, the owners of agricultural capital (i.e., land) exert monopoly powers in the agricultural labor markets. Also, there is a substitution of machinery for labor. Hence, the upward pressure on agricultural wages described in later stages of development does not occur.

This linkage to Kuznets provides a more rigorous foundation to the farm–rural economic linkage literature that Buttel argues is missing. In either view, the structure and size of agriculture should play a fundamental role in the convergence debate. If the advocates of agriculture, in particular small-scale family farms, are correct, rural areas that are characterized by larger farms should experience slower growth, and thus reflect a pattern of divergence.

Theoretical Framework

To examine the role of agriculture within the convergence debate, a stylized theory of growth is required. A traditional neoclassical model of regional economic growth as presented by Barro and Sala-i-Martin, Keely and

Quah, and Nijkamp and Poot is adapted here to test the central hypotheses discussed in the previous section. In neoclassical theory for closed economies developed by Ramsey, Solow, Cass, and Koopmans, growth rates in per capita income are inversely related to the initial levels of per capita income, or convergence should prevail. If economies are similar in terms of preferences and technology, poorer regions should grow faster than richer ones. In other words, there are natural economic forces that promote convergence.

Consider a closed economy with competitive markets exhibiting constant returns to scale with reproducible capital.[2] Further assume the production relationship follows a Cobb-Douglas technology, where output at time t (Y_t) is a function of capital (K_t), and technology-augmented labor (i.e., effective labor, A_tL_t),

$$(1) \qquad Y_t = K_t^{\alpha}(A_tL_t)^{1-\alpha} \Rightarrow y_t = k_t^{\alpha},$$

with α in (0, 1) and $y_t \equiv Y_t/A_tL_t$ and $k_t \equiv K_t/A_tL_t$. Assuming no labor–leisure trade-offs and full employment, population and labor are equivalent, and labor and technology grow at exogenous rates of n and g, respectively, or

$$(2) \qquad L_t = L_0e^{nt} \quad \text{and} \quad A_t = A_0e^{gt}.$$

Given the Cobb-Douglas specification, the production function has the normal curvature properties traditionally known as the Inada conditions. Economic growth in this stylized model reduces to growth in capital, which can be expressed as

$$(3) \qquad \Delta K_t = sY_t - \delta K_t \Rightarrow \Delta k_t = sy_t - \delta k_t,$$

where s and δ are savings and depreciation rates, respectively. Substituting the intensive form of Equation (1), given Equation (2), into Equation (3) yields

$$(4) \qquad \Delta k_t = sk_t^{\alpha} - (n + g + \delta)k_t.$$

The steady state is the level of k_t such that $\Delta k_t = 0$, or

$$(5) \qquad k_t^* = [s/(n + g + \delta)]^{1/(1-\alpha)}.$$

It has been widely shown that if the economy starts at, say $k_t^0 < k_t^*$, that k_t^0 will monotonically approach k_t^*. Conversely, if $k_t^0 > k_t^*$, k_t^0 will monotonically decrease; specifically, depreciation will outstrip new investments and technological gains and approach k_t^* from above. In other words, regardless of where an economy starts, it will move toward the steady state solution. The neoclassical model predicts convergence of economies to a common level, in which poorer economies grow more rapidly than richer economies.

This simple specification of the Solow model allows one to make empirical statements about the speed of adjustment to the steady state. Let y^* be the steady state level of income per effective worker as defined in Equation (1) and let y_t be the actual level at time t. The speed of convergence can be represented by the speed of adjustment coefficient, λ, where

$$(6) \qquad d\ln(y_t)/dt = \lambda[\ln(y^*) - \ln(y_t)]$$

$$(7) \qquad \lambda = (n + g + \delta)(1 - \alpha) \quad \text{in } (0, 1)$$
$$\qquad\qquad\quad + \quad + \quad + \quad +$$

The greater the value of λ, the more responsive the economy is to closing the gap between y^* and y_t.

The number of studies that have estimated some variation of Equation (6) is vast, and a review is beyond the scope of this article. The preponderance of these studies, most of which examine developed economies, have found strong evidence of convergence. It is important to note that the majority of these studies have found "conditional convergence"; that is, the empirical results depend on the specification of the empirical model that is estimated. From a theoretical perspective, convergence is conditional on the growth rates of labor and, in particular, technology, and this theory is supported in the empirical evidence. Studies find that levels of human capital, trade

[2] The presentation here closely follows Mankiw, Romer, and Weil.

policies, and a host of other factors can and do influence the convergence conclusion.

Empirical Framework

Theory suggests that the transition of agriculture to larger, more efficient, and hence profitable enterprises is consistent with the convergence hypothesis. The intent of this study is to examine the role of agriculture on convergence to test the broader popularist position that the movement away from smaller scale family farms to larger farms hurts the rural economy. If the theory is correct, the transition should benefit, not harm, rural communities.

For this study, we specify Equation (6) as

$$(8)\quad \ln(y_t/y_{t-1}) = \alpha_0 + \alpha_1 \ln(y_{t-1}) + \sum_{I=1,\ldots,m} \delta_I X_{it-1} + \varepsilon_t,$$

where y_t and y_{t-1} is per capita income for two distinct time periods, X is a vector of control variables or conditional convergence variables, and ε_t is an error term, where $\varepsilon_t \sim N(0, \sigma^2)$. Given this specification, the key relationship can be expressed as

$$(9)\quad \partial \ln(y_t/y_{t-1})/\partial_1 \ln(y_{t-1}) = \alpha_1,$$

where $\alpha_1 > 0$ implies divergence, or richer economies grow faster, and $\alpha_1 < 0$ implies convergence.[3]

We examine the role of agriculture with a variable parameter model specifically allowing the intercept term (α_0) and growth parameter (α_1) to be affected by measures of agricultural structure. Specifically,

$$(10)\quad \alpha_0 = \beta_0 + \beta_1 AG \quad \text{and} \quad \alpha_1 = \gamma_0 + \gamma_1 AG,$$

where AG is a measure of agriculture size and structure. Substituting Equation (10) into Equation (8) yields

$$(11)\quad \ln(y_t/y_{t-1}) = \beta_0 + \beta_1 AG + \gamma_0 \ln(y_{t-1}) + \gamma_1 AG \ln(y_{t-1}) + \sum_{I=1,\ldots,m} \delta_I X_{it-1} + \varepsilon_t.$$

Given the variable parameter specification, the convergence parameter becomes a function dependent on our measures of agricultural structure,

$$(12)\quad \partial \ln(y_t/y_{t-1})/\partial \ln(y_{t-1}) = \gamma_0 + \gamma_1 AG,$$

and the direct influence of agriculture becomes

$$(13)\quad \partial \ln(y_t/y_{t-1})/\partial AG = \beta_1 + \gamma_1 \ln(y_{t-1}).$$

If $\partial \ln(y_t/y_{t-1})/\partial AG > 0$, higher levels of the agricultural measure are associated with faster growth rates.

Data Used in Empirical Model

The data used in this study consists of county-level information for 2,249 nonmetropolitan U.S. counties, with control variables drawn from the 1990 Census and income growth data drawn from the Bureau of Economic Analysis' (BEA's) Regional Economic Information System (REIS). The dependent variable is the log of the ratio of per capita income observed in 1990 and 1995 as shown in Equation (8).[4] Specification of the right-hand side is similar to the approaches of Deller and Tsai, Deller et al., Duffy, and Wagner and Deller and focuses on measures of market supply and demand. These simple measures focus on capturing proxies for demand, such as income and population levels, and the ability of the local mar-

[3] It is important to note that the interpretation of the coefficient on initial income levels in the theoretical specification, λ in Equation (7), and the parameter on initial income in the empirical specification used in this study, α_1 in Equation (8), are exact opposites. This is because of the specific functional form used.

[4] On face value, a 5-year time period (1990–1995) might appear to be too short to truly capture any patterns in growth. Unfortunately, theory provides little guidance to the "appropriate" time frame and much of the empirical literature examines either annual growth patterns for a number of years or growth over 10 years, reflecting the availability of the 10-year census. We elected to limit this study to the 1990–1995 time period to avoid what is considered white noise at the local level from the unusual strength of macroeconomic growth and the influence of the strong stock market and its effect on perceived wealth and phenomena such as the dot-com craze of the late 1990s.

ket to supply, such as population density and the age profile of the local market.

For this analysis variables on the right-hand side include:[5]

- Log per capita Income 1990, $\ln(y_{t-1})$
- Population 1990
- Employment 1990
- Percentage of Population Young (under 18 years of age)
- Percentage of Population Old (over 65 years of age)
- Income Distribution (as represented by a calculated Gini coefficient)
- Percentage of Population with at Least a (4-year) College Degree
- Population Density
- Percentage of Population Nonwhite.

The measures of agricultural size and dependencies are designed to capture farm size and overall importance of farm production to the local economy. Clearly these measures are gross measures from readily available data and cannot capture the particulars of individual farm structure. We use two measures of agricultural size in relation to farm enterprise: Total Value Added per Farm and Total Sales per Farm. Although there are numerous measures of farm size and structure, these two measures are simple and direct. Stanton, Jinkins, Ahearn, and Hanson argue that total value added, as a complement to total sales, is a more appropriate economic measure to use when comparing farm size and structure. Value added emphasizes returns to farm households from the use of their land, labor, capital, and management in agricultural production. We also advance two simple measures of local economic dependency on farming: Percentage of County Population on Farms and Percentage of County Earnings from Farming. A total of four models are estimated: one model for each measure of agricultural structure/importance. Attempts to estimate one inclusive model were rejected because of multicollinearity among our four measures of agriculture.

Empirical Results

The results of the application of Equation (11) to our nonmetropolitan county data are shown in Table 1. Overall, the models appear to perform reasonably well, with equation F-statistics ranging from 87.93 to 146.16 and adjusted R^2s ranging from .298 to .415. Results of individual control variables accounting for local supply and demand characteristics tend to be stable across the four specifications of the model. In general, larger counties, as measured by population, seem to experience slightly slower growth rates, as shown by the negative parameter found on the 1990 population variable. Counties with larger employment bases tended to grow faster, as measured by growth rates in per capita income. This suggests that job growth drives income growth, as opposed to population growth, which is consistent with the literature (e.g., Deller et al.). In spite of this, counties with a higher population density seem to experience higher growth rates. This result is consistent with the notion of agglomeration economies.

A disproportionate age distribution, with either heavy dependency on younger or older populations, has a dampening effect on income growth. Education levels, at least higher education levels, have a mixed and somewhat weak influence on rural income growth rates. Likewise, income distribution as measured by the Gini coefficient seems to have mixed influences on income growth rates. Generally, higher levels of income inequality are associated with faster growth rates in per capita income. But this result is not stable across specifications of the model and should be discounted. Finally, a higher percentage of nonwhite population is associated with higher income growth rates. Counties with higher nonwhite populations tended to begin the pe-

[5] Clearly, our selection of right-hand side variables is limited given the vast range of potential variables, including but not limited to proximity to metropolitan areas, climate and natural amenity measures, and public land ownership, among others. It is not the intent of this study to examine all possible variables influencing rural economic growth; rather, its focus rather is to attempt to isolate the influence of broad measures of agricultural dependency and structure after controlling for key characteristics identified within the rural growth literature.

Table 1. County-Based Rural Economic Growth Model Results[a]

Variable	Model A	Model B	Model C	Model D
Intercept	2.0082	1.6603	1.0222	2.1696
	(13.82)[b]	(11.45)	(6.47)	(14.61)
Log per capita Income 1990	−.1892	−.1465	−.0710	−.2154
	(10.19)	(7.92)	(3.62)	(11.90)
Population 1990	−.0011	−.0010	−.0011	−.0021
	(3.27)	(2.86)	(3.46)	(6.29)
Employment 1990	.0030	.0027	.0019	.0042
	(4.43)	(3.96)	(2.97)	(6.41)
Percent of Population Young	−.0043	−.0040	−.0006	−.0021
	(6.83)	(6.64)	(0.94)	(3.52)
Percent of Population Old	−.0029	−.0032	−.0008	.0003
	(4.66)	(5.24)	(1.46)	(0.55)
Income Distribution (Gini)	.0826	.0469	−.0618	.0968
	(2.97)	(1.68)	(2.34)	(3.76)
Percentage of Population with at Least a College Degree	−.0007	−.0010	−.0003	−.0006
	(1.63)	(2.29)	(0.79)	(1.53)
Population Density	.2218	.2371	.1603	.2316
	(3.79)	(4.10)	(3.00)	(4.19)
Percentage of Population Nonwhite	.0010	.0010	.0007	.0003
	(8.18)	(8.76)	(6.10)	(2.48)
Total Sales per Farm	.5053	—	—	—
	(0.71)			
Total Value Added per Farm	—	6.2669	—	—
		(2.80)		
Percentage of County Earnings from Farming	—	—	.0122	—
			(3.02)	
Percentage of County Population on Farms	—	—	—	.0038
				(0.39)
Log per capita Income × Farm Measure	−.0649	−.7060	−.0016	−.0008
	(0.89)	(3.06)	(3.72)	(0.82)
F-statistic	87.93	94.18	146.16	120.77
Adjusted R^2	.2983	.3131	.4152	.3694

[a] Dependent variable is $\ln(y_t/y_{t-1})$, $t = 1990$, $t - 1 = 1990$. Sample includes 2,249 nonmetropolitan counties.
[b] Number in parentheses is the absolute value of the t-statistic.

riod with lower income levels. Some factor other than beginning income level is accounting for counties with large nonwhite populations to grow relatively rapidly, given that we have beginning income level as an exogenous explanatory variable.

The central results of interest to this analysis hinges on the influence of agriculture on rates of growth or convergence. Because of the variable parameter nature of the model, we need to evaluate the convergence results over a range of agricultural and income measures. First, we turn to the direct convergence question, or the behavior of Equation (12), in which we evaluate at the sample mean each of the four measures of farming activity. The results of these evaluations are presented in Table 2. In each case, the estimated convergence parameter is negative and statistically significant at the 95% level. For the two farm size measures, the results suggest that larger farms, as measured by sales and value added, tend to result in lower levels of growth. This seems to lend some credence to the argument that larger farms tend to make weaker contributions to the local economy. Yet, higher overall levels of dependency on farming, in terms of percentage of the population on farms and the

Table 2. Convergence Results over Ranges of Farm Activity

Farm Measure	Sample Mean	Marginal Effect	*t*-Statistic	95% Confidence Interval Upper Bound	95% Confidence Interval Lower Bound
$\partial \ln(y_t y_{t-1})/\partial \ln(y_{t-1})$[a]					
Sales per Farm	.0659	−.1984	−11.83	−.166	−.231
Value Added per Farm	.1772	−.2716	−7.32	−.199	−.344
Percentage of Population on Farms	8.14	−.2223	−15.27	−.194	−.251
Percentage of Earnings from Farms	14.72	−.0941	−8.02	−.062	−.126
$\partial \ln(y_t y_{t-1})/\partial$ lnA/b					
Sales per Farm	.0659	−.1138	−2.66	−.030	−.198
Value Added per Farm	.1772	−.4668	−5.92	−.312	−.621
Percentage of Population on Farms	8.14	−.0042	−15.90	−.004	−.005
Percentage of Earnings from Farms	14.72	−.0027	−13.99	−.002	−.003

[a] These results correspond to the marginal effects shown in Equation (12).
[b] These results correspond to the marginal effects represented by Equation (13).

share of total earnings derived from farming, also places downward pressure on growth in per capita income. These results taken in tandem suggest that counties that are characterized as dominated by agriculture, and in particular, larger scale agriculture, will experience slower growth rates in per capita income.

The second measure of interest is the relationship between agriculture and overall growth levels in Equation (13); the results of these evaluations are presented in Table 2. Again, the estimated partial is negative for each farm measure and statistically significant at or above the 95% confidence level. As agriculture expands in terms of individual farm size or overall share of the local economy, downward pressure is placed on regional growth rates, as shown by the negative marginal growth rates.

Conclusions

The primary objective of this study was to examine the role of production agriculture within the construct of a model of regional economic growth. Theory suggests that poorer regions should grow at faster rates than richer regions. The empirical results confirm this theoretical prediction for rural U.S. counties. More importantly, the empirical results also suggest that higher levels of dependency on production agriculture, either overall dependency or a larger portion of large farms, reduce growth rates and hinder the ability of the rural United States to grow at faster rates.

These results are based on an analysis of growth using observations on rural income between 1990 and 1995. The question remains as to how robust the results reported here are to other time periods. That is, in 1990, net farm income was $51.6 billion (1996 dollars). In 1995, this income had dropped to $37.7 billion, with one of the primary reasons being heavy flooding that occurred in major agricultural areas.[6] Thus, regardless of the relationship between agriculture-based explanatory variables and rural incomes, the years used in our analysis are inclined to generate the result that counties more dependent on agriculture would grow less over the study period than other rural counties because of the weather-induced decline in net farm income. An area of future research is to extend our model to alternative time periods to examine the robustness of our results concerning relative growth rates.

Building on an ad hoc literature relating farming to rural growth, a rigorous model of

[6] The authors are grateful to an anonymous reviewer who raised the question of the robustness of our results.

growth is presented and estimated. For U.S. rural counties, and given the 6-year period encompassed within this analysis, we find evidence that increased dependency on farming appears to retard rural economic growth. Should this result hold up for other time periods, it could indicate that policies aimed at preserving the family farm in the name of economic growth might be misplaced. If a goal of rural development policy is to maintain an element of the family farm as part of the American culture, policies might need to aimed at the promotion of alternative sources of income for farm families. Indeed, Vail hints at concerns about causation: Do strong rural communities allow for the survival of "weaker" smaller farms (e.g., sources of off-farm income)? Stronger farms might not provide the critical mass to support rural communities. Or as Gardner (p. 1072) stated in his Presidential Address to the American Agricultural Economics Association, ". . . raising rural living standards can hardly be accomplished in the absence of a growing nonfarm economy to which farm workers have access." Perhaps the best policy to ensure strong family farms is to ensure the availability of stable off-farm jobs.

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