An Empirical Analysis of Agriculture in Economic Growth of North Carolina

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Abstract

Agriculture is an important sector in economic growth of North Carolina that contributes 19 percent of the state's income and employs over 20 percent of the work force. Of the total population, 30 percent are living in rural North Carolina where income earnings, education level, and employment opportunities are low while poverty and unemployment rates are considerably high. Of 100 counties 85 are rural and agriculture is one of the significant employment sectors. The objective of this study is to examine the potential use of agricultural sector in the economic growth of North Carolina. County level data gathered from U.S. Bureau of Labor Statistics, USDA, and U.S. Census Bureau for the period of 2000 to 2010 are used for the study. A system of simultaneous equations is used for analysis. The results summarize that increasing income increases agricultural activities and vise versa. Thus, counties with high income levels are more capable of improving agriculture and counties with high gains through agriculture are more competent of improving income levels. Results highlight the importance of secured satisfactory level of income through agriculture to enhance economic growth.

Key Words: Agriculture, Simultaneous Analysis, North Carolina

Introduction

Agriculture plays a significant role in rural economies of the United States. It creates job opportunities, supports rural development, and secures food production (Rosenberger et al., 2002; Rephann, 2008). The farm sector consists of small and large farms. The small family farms, which have the annual sales less than $250,000, reported 88 percent of total US farm number in 2007 (U.S. Department of Agriculture, 2011_b). The profit margins of small farms are less than the large farms but play a key role in rural economic growth (Hoppe and Banker, 2010). The large farms resulted 12 percent of total U.S. farms in 2007 and contributed to 84 percent of the total value of U.S. production (Hoppe and Banker, 2010).

Investment in agriculture is important for economic growth. Lack of investment in rural communities, is a main reason for the chronic poverty in rural areas (Duncan, 2005). Agricultural growth benefits the urban poor by reducing food prices (Byerlee, 2000). Sometimes, urbanization and its associated policies may decrease agricultural and other rural lands hindering agricultural production and environmental qualities (Rosenberger et al., 2002). Comprehensive policy interventions could help maintain agricultural benefits parallel to urbanization. For instance, agritourism could be enhanced with urbanization to generate more revenue for rural agricultue (Phillips et al., 2011). Agritourism entrepreneurs with business plans receive about twice as much income as to those with no business plans for their enterprises (Phillips et al., 2011).

Enhancing efficiency of existing agricultural productivity, agricultural research, education, extension, and technologies are important for rural economic development (van der Ploeg, 2000). Increasing the value of the product generated by agricultural enterprise by constructing new linkages with markets, strengthen rural agricultural economy (Banks and Marsden, 2000). Community supported agricultural farms (CSA), direct marketing, agritourism, and roadside marketing are potential niche markets for rural economic development (Phillips et al. 2009). Agritourism brings significant revenues to the rural farmers in California and Colorado (Rilla et al. 2011; Phillips et al. 2011). Agricultural institutes, education and training opportunities, and developed ways of keeping in touch with labor markets are essential for sustainable agricultural development (Bawden, 1996).

2. Background of the Study Area

North Carolina had 52,400 farms in 2009 and an average size of a farm was 163 acres (USDA, 2011_a). A total of 8,474,671 (2007) acres of North Carolina's land is in farms. North Carolina's agricultural industry, including food, fiber and forestry, contributes over $74 billion annually to the state's economy. It accounts for 19 percent of the state's income and employs over 20 percent of the work force. North Carolina produces tobacco, soybeans, corn, cotton, sweet potatoes, wheat, peanuts, blueberries, potatoes, tomatoes, cucumbers, and a wide variety of other crops (USDA-ERS, 2011_b). Broilers, hogs and pigs, turkeys, and cattle and calves are the main animals raised in farms. Of the total population, 30 percent are living in rural North Carolina (USDA-ERS, 2011_b). Nearly 68.5 percent of the state's population is White, 21.5 percent is Black, and 8.4 percent is Hispanic/Latino origin (U.S. Census and Bureau, 2010). The average per-capita income was $34,879, in 2009, but rural per-capita income lagged at $30,707. Rural North Carolina indicates a high poverty rate and in 2010, rural poverty rate was 20.3 percent, compared to 16.2 percent in urban areas. Poor education levels are reported mainly from rural North Carolina; about 21 percent of the rural population has not completed high school, compared to 14.5 percent for urban populations (ACS, 2010). The unemployment rate is 11.8 percent in rural areas while it is 10.0 percent in urban areas (USDA-ERS, 2011_a).

The main objective of this study is to examine the potential use of the agricultural sector in economic growth of North Carolina, using county level data for the period of 2000 to 2010.

The paper is organized into five sections. Section 2 provides background information of North Carolina. Section 3 covers methodology. Section 4 describes empirical results and analysis. Section 5 presents conclusions and policy implications.

3. Methods and Data

The analytical method is derived based on the non-spatial simultaneous approach of Carlino and Mills (1987); later modified by Deller et al. (2001). A system of simultaneous equations is used with the dependent variables of agricultural employment growth, income growth, and population growth in North Carolina. A system of equations estimates all the identified structural equations together as a set. Thus, it accounts for interactions among the interdependent variables which give comprehensive estimations. The most important advantage of this method is to have a small asymptotic variance. Simultaneity helps in overcoming

inconsistency and bias, and leads to efficient estimation. Three-stage least squares (3SLS) estimation was followed for the analysis.

For empirical analysis, county level data were used for all the dependent variables of income growth, agricultural employment growth, population growth and for the other independent variables of social factors (SF), behavioral factors (BF) and environmental factors (EF). The variables Income*, Agricultural Employment*, and Population* represent the equilibrium levels of income, agricultural employment, and population. Ω^I, Ω^E, and Ω^P are a set of variables describing initial conditions that measure social factors (SF), environmental factors (EF,) and behavioral factors (BF) that are linked to employment growth. Thus, the general form of the three equations model is:

(1) Income* = f (Employment*, Population*, Ω^I)

(2) Employment* = g (Income*, Population*, Ω^E)

(3) Population* = h (Income*, Employment*, Ω^P)

From the equilibrium framework of the model, a simple liner relationship among the variables can be presented as (where I is income, E is employment, and P is population):

(4) $I^* = \alpha_{oI} + \beta_{1I}E^* + \beta_{2I}P^* + \sum\delta_I\Omega^I$

(5) $E^* = \alpha_{oE} + \beta_{1E}I^* + \beta_{2E}P^* + \sum\delta_E\Omega^E$

(6) $P^* = \alpha_{oP} + \beta_{1P}I^* + \beta_{2P}E^* + \sum\delta_P\Omega^P$

where α values indicate the intercepts of each equation, β values indicate coefficient estimations of each interdependent variable and δ values indicate the coefficients of the set of variables that describe initial conditions.

Moreover, income, agricultural employment, and population likely adjust to their equilibrium levels with substantial lags (i.e., initial conditions). Thus, partial adjustment equations to the equilibrium levels are as:

(7) $I_t = I_{t-1} + \phi_I(I^* - I_{t-1})$

(8) $E_t = E_{t-1} + \phi_E(E^* - E_{t-1})$

(9) $P_t = P_{t-1} + \phi_P(P^* - P_{t-1})$

The current, income, agricultural employment, and population levels at time t are functions of their initial conditions and the changes between the equilibrium values and initial conditions and their respective speed of adjustment values, where I_{t-1}, E_{t-1}, and P_{t-1} are initial conditions of income, employment, and population; ϕ_I, ϕ_E, and ϕ_P are the speed of adjustment coefficients related to the desired utility maximization level of income, agricultural employment, and population, respectively. Substituting equations 7 through 9 into equations 4 through 6, and rearranging the model can be expressed as:

(10) $\Delta I = \alpha_{oI} + \beta_{1I}I_{t-1} + \beta_{2I}E_{t-1} + \beta_{3I}P_{t-1} + r_{1I}\Delta E + r_{2I}\Delta P + \sum\delta_I\Omega^I$

(11) $\Delta E = \alpha_{oE} + \beta_{1E}I_{t-1} + \beta_{2E}E_{t-1} + \beta_{3E}P_{t-1} + r_{1E}\Delta I + r_{2E}\Delta P + \sum\delta_E\Omega^E$

(12) $\Delta P = \alpha_{oP} + \beta_{1P}I_{t-1} + \beta_{2P}E_{t-1} + \beta_{3P}P_{t-1} + r_{1I}\Delta I + r_{2I}\Delta E + \sum\delta_P\Omega^P$

where ΔI, ΔE, and ΔP are the changes in income, agricultural employment, and population, respectively. The speed of adjustment coefficients become embedded in the linear estimated parameters α, β, r and δ. The model captures structural relationships while simultaneously isolating the influence of employment on income. Equations 10-12 estimate short-term adjustments of income, agricultural employment, and population (ΔI, ΔE, and ΔP) to their long-term equilibriums (I^*, E^*, and P^*).

Data Sources

County-level data of all 100 counties of North Carolina are used for analysis. Data for population, household income, agricultural employment, and other variables are collected from the Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, U. S. Department of Agriculture, and County and City Data Books (C&CDB) for the period of 2000 to 2010. The statistical package of STATA is used for the estimation.

Definitions of all endogenous and exogenous variables used in the analysis are presented in Table 1 with mean, minimum, and maximum values. As seen in Table 1 percentage of population has increased by 5 percent from 2000 to 2010. Average annual household income has increased nearly by 5 percent while percentage of agricultural employed decreased by 6 percent.

Table 1: Definition for county level variables

Variable	Definition	Mean	Mix	Max
ΔPOP	Percentage of population change	5.10	-2.1	21.1
ΔINC	Percentage of income change	4.82	-2.7	13.5
ΔEMP	Percentage of agricultural employment change	-6.14	-26.0	0
POP2010	Population in 2010	95,355	4,407	919,628
INC2010	Median household income in 2010	39,750	27,421	63,770
EMP2010	Agricultural employment in 2010 (farming, agriculture, fishing, forest and hunting)	731	0	2,526
POP2000	Population in 2000	80,493	4,149	695,454
INC2000	Median household income in 2000	35,493	25,864	58,099
EMP2000	Agricultural employment in 2001 (farming, agriculture, fishing, forest and hunting)	838	0	2,858
CRME2000	Crime rate 2000	909	0	7,675
PNFE2000	Private nonfarm establishments in 2000	2,038	79	24,245
OEMP2001	Employment other than farm employment 2001	47,926	1,322	615,752
EDUC2000	Percentage of population 25 years or more with college degree	17	8	51
PWHE2000	Percentage of white population 2000	75.22	35	98.5
FARM2007	Average Farm Numbers 2007	529	7	1501

4. Empirical Results and Analysis

The empirical results for the system of simultaneous equations are shown in Table 2. The first column of the table shows the exogenous variables used in each equation. Columns 2 and 3 indicate results for the population change (ΔPOP) equation while columns 4 and 5 present results for income change (ΔINC). Results for the agricultural employment change (ΔEMP) equation are shown in columns 6 and 7.

According to the empirical results for population change (ΔPOP) in columns 2 and 3, income change (ΔINC) is significantly and positively related with population. A 1 percent increase in income change (ΔINC) increases population change (ΔPOP) by 1.4 percent. This may be due to people migrating from other regions of the United States or from foreign countries. According to Economic Index of 2011 (NCDC, 2011), the major reason of population increase is migration. Results show that population change (ΔPOP) and agricultural employment change (ΔEMP) are significantly and positively related. A one percent change (decrease) in agricultural employment (ΔEMP) increases population change by 1.8 percent. This may be due to different reasons. One could be suburban sprawl which reduces direct agricultural employments and

increases population growth. The result is supported by the findings of Hartgen (2003). Income level in the initial year (INC2000) shows a positive and significant relationship with population growth, but impact is low. Number of farms (NFARM2007) has positively affected on increasing population at county level. This could be associated with more labor requirement for agricultural activities.

Results for income change (ΔINC) are in columns 4 and 5. The significant and positive relationship between income change (ΔINC) and population change (ΔPOP) indicates that a 1 percent increase in population increases income by 0.63 percent. This is due to more employment created with more population. Importantly, agricultural employment growth, increases income growth in North Carolina. When agricultural employment change (ΔEMP) decreases by 1 percent income change (ΔINC) or the income growth decreases by 1.9 percent. This implies a higher potential of income earnings through agricultural activities. This could be due to many reasons. According to USDA (2011_b), many of the small farmers earn more money through off-farm activities other than the direct farming activities (USDA, 2011_b). Results further show that the counties with high number of farms (NFARM2007) reduce income growth. This may be associated with poor performance of agricultural farms in generating income compared to the other income earning sectors.

The results for the agricultural employment change in columns 6 and 7 (ΔEMP) indicate that 1 percent increase in population growth decreases agricultural employment change (ΔEMP) by 0.43 percent. This may be associated with urban and suburban sprawl that may limit farming, agriculture, forest, and fishing and hunting. The income change indicates a negative relationship with agricultural employment change. When income change (ΔINC) increases by 1 percent, employment change in agricultural sector (ΔEMP) decreases by 1.1 percent. This means increasing household income increases agricultural activities. This could be associated with high potential of bearing risk linked to agriculture with adequate alternative income sources. Results show that the counties reported high numbers of agricultural employments (EMP2000) are positively related with employment growth, but impact is minimal. The counties reported high number of farms (FARM2007) decreases the employment change; i.e. decreases the rate of decreasing agricultural employments. This may be due to more employment opportunities with more farms availability.

Table 2: The Results of Empirical Model

Variable	**ΔPOP**		**ΔINC**		**ΔEMP**	
	Coef.	P>|Z|	Coef.	P>|Z|	Coef.	P>|Z|
ΔPOP			0.638477 ***	0.00	0.435976 ***	0.00
ΔINC	1.242018 ***	0.00			-1.095716 ***	0.00
ΔEMP	2.109527***	0.00	-1.936952 ***	0.00		
POP2000	1.83e-08	0.93	-0.000001	0.14	-0.000001	0.61
INC2000	0.000008*	0.07	-0.000002**	0.03		
EMP2000	-0.000022	0.25	0.000017	0.31	0.000019*	0.09
FARM2007	0.000061*	0.08	-0.000048*	0.10	-0.000056***	0.00
CRME2000	0.000002	0.85	-0.000003	0.82	-0.000003	0.73
EDUC2000			-0.000203	0.36		
PWHE2000					-0.000133	0.15
PNFE2000					-0.000001	0.78
OEMP2001	0.000001	0.51				

No. Obs =100; R^2 value: ΔPOP = 0.38; ΔINC = 0.28; ΔEMP = 0.76
Chi^2 value: ΔPOP =158.74; ΔINC = 151.89; ΔEMP = 385.76
***, **, * *are significant at 1%, 5% and 10% respectively*

5. Conclusions and Policy Implications

The main objective of this study was to examine the potential use of agriculture in economic growth of North Carolina. The results summarize that increasing income increases agricultural activities and vise versa. Thus, counties with high income levels are more capable of improving agricultural employments and counties with high gains through agriculture are more competent of improving income levels. Overall, this implies the importance of secured satisfactory level of income through agriculture. This can be achieved in many ways. One way of doing this would be improved agricultural channels of production, processing, transporting, labeling, and marketing that retain more revenue within farm families. Identifying niche markets like agro-tourism, organic farming, farmers' market, and improving information technology would be another way. Thus, identifying such policy options and a clear understanding of the prevailing challenges, and policy decisions taken together with farmers would help in meeting economic growth.

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