Analysis of Non-Farm Employment Growth in Alabama

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Research Article

ABSTRACT

Aims: The paper examines the economic linkages between rural farm and rural non-farm sectors in Alabama. Because growing land scarcity and land conversation pressure from urban development raises concerns about prospects for rural labor absorption, the paper highlights the impact of agricultural growth on rural nonfarm employment.
Study Design: Cross-section study.
Place and Duration of Study: Alabama counties, 2001 - 2007.
Methodology: The analysis employs cross-section county-level data to test the null hypothesis of no significant relationship between agricultural and non-agricultural employment growth in Alabama. The hypothesis is tested using instrumental variables approach.
Results: The key findings suggest that growth of the rural agricultural employment sector positively influences growth in the non-agricultural employment sector. The average multiplier was estimated at 1.10 percent, implying that one percent growth of the rural agricultural sector induces 1.10 percent growth of the non-agricultural sector in Alabama.
Conclusion: The results support the conclusion reached by previous studies that although agriculture continues to play a central role in rural development, the promotion of complementary engines of rural growth is of paramount importance.

Keywords: Rural-urban linkages; instrumental variables; employment; counties.

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1. INTRODUCTION

Traditionally, development policy and related research have adopted a simplified concept of rural and urban areas, with the word "rural" referring to more "remote farming areas" and "urban" to "crowded cities" (von Braun, 2007; Agarwal, 2007; Ravallion et al., 2007). To a large extent, this view has facilitated the isolated treatment of issues affecting each space, and until recently it has failed to acknowledge the important inter-linkages that exist between the two spaces and the many variants of the spaces (Douglass, 1998; von Braun, 2007; Seraje, 2007). There is mounting evidence, however, that rural households can and do participate in a wide range of non-agricultural activities, such as wage employment in commerce, manufacturing and services, alongside the traditional rural activities of farming and agricultural labor (Davis, 2009; Adams, 2003; Ellis, 1998; 2000; Adato et al., 2002). The recent increases in the scale of rural-urban linkages have been attributed to the decreasing incomes from farming, especially for small-scale producers who, because of lack of land or capital, are engaging in non-farm employment to supplement farm incomes (Tacoli, 2004; ADB, 2007; Satterthwaite, 2000).

Particularly, burgeoning trade and service sector activities have encouraged greater personal mobility and rural-urban linkages as heightened movement of economic actors bridge the physical distance between town and countryside (Bryceson and Mbara, 2003). Indeed, employment is one of the most noticeable ways that relative economic prosperity is shared across urban and rural areas (Holzer and Stoll, 2007). This paper examines the importance of rural-urban growth linkages in one of the most rural states in the United States—Alabama. Economic restructuring across the nation has affected Alabama in ways that are significantly different from the experiences of many other regions in the United States. Because agricultural productivity growth triggers the generation of non-market mediated linkages between the agricultural sector and the rest of the economy, the paper focuses on the impact of agricultural growth on rural non-farm employment.

The rest of the paper is organized as follows. First, a brief background of the study area is presented in Section 2, followed by a review of the literature, presenting an overview of the non-farm sector, to motivate the subsequent empirical analysis in Section 3. Section 4 discusses the theoretical model which underpins the analysis, followed by a discussion of the data and data sources in Section 5. The results and conclusions are presented in Sections 6 and 7.

1.1 Background on the Study Area

Along with much of rural America, rural Alabama faces serious questions concerning its prospects for economic performance in the future; and future economic opportunities in the state will partly be determined by current comparative advantage. Traditionally, the state's economy has been based on agriculture, but these industries have suffered declines in recent years due to international competition and declining demand. Fewer than 49,000 farms remain at present compared to 220,000 in 1950. In a 60-year period, Alabama's farm acreage dropped from 213 million to 9 million (USDA NASS, 2011; Sumners and Lee, 2005). Although agriculture continues to make a significant contribution to the state's economy, generating $5 billion a year and responsible for some 480,000 jobs, representing one-fifth of the work force (McMillan, 2011), the typical small farmer now derives a majority of his/her income off the farm. Even larger farms usually have at least one family member with a job "in town" to provide access to medical and other benefits (Sumners and Lee, 2005).

The state's economy continues to lag behind national averages on most economic measures. Estimates from 2009 show poverty rate of 21.0% in rural Alabama, compared with 16.2% in urban areas of the state. The average per-capita income for all Alabama residents in 2008 was $35,506 although rural per-capita income lagged at $29,036. Low rates of labor force participation and population loss are the general features of rural life (EPI, 2008; ACS, 2009, The State of working Alabama, 2009). The state has one of the highest unemployment rates in the country (10.9%), with many rural counties experiencing unemployment rates above 20%, without counting the underemployed and discouraged workers (ADIR, 2009). Data from 2000 finds that 30.7% of the rural population has not completed high school, while 22.2% of the urban population lacks a high school diploma (USDA ERS, 2010).

The continued departure of persons with high levels of human capital, that is, education, training and experience needed to fuel rural development efforts is one explanation of the persistent poverty (Watters, 2002). Similarly, the decline in the number of taxpayers has resulted in inadequate tax revenues (not to mention the ongoing economic turmoil) to maintain public services. While tax revenues are on the decline, the costs of running local governments have increased, forcing many localities to cut back on public services (Leachman et al., 2011); and these declines in local services have made rural Alabama less attractive for new businesses and industries. Some examples of counties that have been affected by the recent economic downturn include east central Alabama (Clay, Randolph, Coosa, Tallapoosa, Chambers and Macon counties); upper west central Alabama (Marion, Winston, Lamar, Fayette, Walker and Pickens counties); and south central Alabama (Butler and Covington counties) (Knox, 2010).

An important set of economic linkages between Alabama's urban core and its periphery is the non-farm employment shares, and these shares for 2007 are reported in Table 1. In rural settlements with population between 10,000 and 19,999, about 90 people per one thousand worked in non-farm occupation. In rural areas with population between 50,000 and 99,999, about 343 people per one thousand worked in non-farm occupation.

Table 1. Non-farm and farm employment density by size of settlement, 2007

Size of locality	Rural employment		Urban employment	
	Farm	Non-farm	Farm	Non-farm
10,000-19,999	7.775	90.311	---	---
20,000-49,999	14.451	289.864	1.458	48
50,000-99,999	13.049	343.44	2.439	208
100,000 and above	2.016	116.062	8.15	1471
Total	37.291	839.677	12.047	1727

Source: Computed by authors using data from the US Department of Labor (2009)

Another readily available indicator of the relative importance of the non-farm economy to economic growth in rural Alabama is the commuting into the core by workers who live in the periphery and the commuting by those living in the core to the periphery. The number of rural-to-urban commuters roughly tripled from 1982 to 2006 from about 16,000 to about 45,000 workers (USDA ERS, 2007). The number of urban-to-rural commuters also increased, though not nearly as quickly, from 8,500 to 18,500 over this period. The proportion of rural residents who work in urban areas increased from 2.7 percent in 1982 to 4.9 percent in 2006 (USDA ERS, 2007). This phenomenon of increased commuting is also

present in labor flows of urban residents to the rural areas for work. Between 1982 and 2006, the percentage of urban residents that worked in rural counties increased from 1.5 percent to 2.3 percent.

In light of these interdependencies, it is argued that strategic rural-urban alliances can strengthen both rural and urban economic development, and can help mediate competing interests, practices, and perceptions, particularly at the peri-urban interface (Dabson, 2007). In support of this view, different studies have investigated the determinants or factors that most influence the decision by rural residents to participate in non-farm activities, the choice of activities, and the extent of rural household participation (Dabson, 2007). Examples of these studies are summarized in the literature review section that follows.

2. LITERATURE REVIEW

Past studies on rural-urban linkages have highlighted that the nature of the linkages differs from one place to another and differs for different sectors in the same place (Kahn et al., 2001; Tacoli, 2004). For instance, Henry et al. (1997) found that urban growth tended to spread to the nearby rural and exurban areas, though they noted that there are differences depending on whether the urban-led growth originated in the core principal city or in the suburbs. Past studies also indicate that urban proximity benefits rural development through the provision of diverse employment opportunities, specialized services, social and cultural opportunities, end markets for rural production, and resources for public and private investment (Dabson, 2007; Partridge et al., 2007b). In turn, urban centers benefit from the rural provision of food, energy, stewardship, waste management, congestion relief, uniquely rural experiences, specialty agriculture, greater housing options, outsourcing of services, and alleviation of urban labor shortages. Partridge et al. (2007a) showed that U.S. rural employment growth is strongly affected by proximity to the nearest urban center, which is also the case when examining rural wages and housing values (Partridge et al., 2007b).

Bezabih et al. (2010) presented a good summary of recent studies examining the participation in off-farm employment by rural residents. Notable studies include Bezu et al. (2009) who looked at the activity choice in rural non-farm employment. They found education, gender, and land holding to be the most important determinants of activity choice. Hagos (2003) looked at the effect of program credit on participation in off-farm employment. He found that the effect of program credit was positive and statistically significant in the case of change in the level of income derived from self-employment, but that it had no significant effect in the case of wage employment. He also emphasized that this underscored the heavy impact of lack of access to capital on self-employment. This leads Bezabih et al. (2010) to conclude that, "involvement in rural non-farm activities, as a livelihood strategy among poor rural households, plays a vital role in promoting growth and welfare and offers a pathway out of poverty, if non-farm opportunities can be seized by the rural poor." They argue that, both "push and pull" factors appear to be involved in decisions by rural households to participate in rural non-farm activities. They argue for example, that some might be attracted by the incentives offered and labor availability (when households have more than enough laborers for their farm), whereas others might be pushed into the non-farm sector due to a lack of opportunities on the farm (for example, from drought or insufficient land holdings) (Bezabih et al., 2010).

Deichmann et al. (2008) presented empirical evidence on the relative importance of farm and urban linkages for rural non-farm employment. Their results suggest that people are more likely to be employed in well-paid wage employment and self-employment in the non-

farm sector if they are closer to urban centers. Those who are further away from such centers are even less likely to be in well-paying non-farm jobs if they are living in areas with greater agricultural potential. The empirical results highlight the need for improved connectivity of regions with higher agricultural potential to urban centers for non-farm development. Moellers et al. (2006) studied diversification decisions and rural incomes using data from a household survey. Their results confirm that non-farm employment and diversified income portfolios are outstanding features of rural households in Macedonia, where unfavorable economic conditions and insufficient farm incomes have driven farm households to open up income sources in the non-farm sector.

Mduma and Wobst (2005) also found that education level, availability of land, and access to economic centers and credit were the most important factors in determining the number of households that participated in a particular rural local labor market and the share of labor income in total cash income. Using data from 618 counties in the U.S. rural heartland, Miranowski et al. (2001) examined factors that explain growth in rural areas. The authors evaluated many of the growth hypotheses in the context of sectoral employment growth for counties in Iowa, Minnesota, Missouri, Kansas, Nebraska, South Dakota and North Dakota. Their results support the importance of human capital as a factor contributing to sectoral employment growth and show that increased concentration and specialization of employment within a county lead to slower growth in the rural heartland counties.

Whitener and Parker (2007) identified the changing nature of U.S. rural economic structures (including growth of non-farm employment and manufacturing) and suggested the need for new rural policies that are regional in scope. They argued that American rural policy has traditionally been commodity-based, but the new rural economy requires policy that can address a broader range of issues and offer innovative solutions to generate diverse employment and income opportunities, develop human capital, and expand critical infrastructure. More reviews on the importance of new policy perspectives for urban-rural partnerships can be found in Dabson (2007), Moseley (2002), Reimer (2005), and Caffyn and Dahlstrom (2005).

The general conclusion from literature is that the rural non-farm sector plays a critical role in promoting growth and welfare by slowing rural-urban migration, providing alternative employment for those left out of agriculture, and improving household security through diversification (Lanjouw and Lanjouw, 1999). This paper contributes to the body of knowledge by examining the determinants of non-farm employment in Alabama. The analysis utilizes a methodology adopted from Suryahadi et al. (2007) as described in the empirical analysis section that follows.

3. EMPIRICAL ANALYSIS

Suryahadi et al. (2007) define the economy as having three sectors: (i) rural farm sector, (ii) rural non-farm sector, and (iii) urban sector. In this case, total employment can be defined as the sum of employment of the three sectors:

$$e = e^{rf} + e^{rnf} + e^{u} \tag{1}$$

where (*e*) represents employment, the subscripts *r* and *u* refer to rural and urban areas, respectively, and the superscripts *f* and *nf* refer to farm and non-farm sectors, respectively.

Differentiating equation (1) and then dividing by *e* result in (Suryahadi et al., 2007):

$$\frac{\partial e}{e} = \frac{\partial e^{rf} + \partial e^{rnf} + \partial e^{u}}{e} \tag{2}$$

$$\tilde{e} = \frac{e^{rf}}{e}\frac{\partial e^{rf}}{e^{rf}} + \frac{e^{rnf}}{e}\frac{\partial e^{rnf}}{e^{rnf}} + \frac{e^{u}}{e}\frac{\partial e^{u}}{e} = h^{rf}\tilde{e}^{rf} + h^{rnf}\tilde{e}^{rnf} + h^{u}\tilde{e}^{u} \tag{3}$$

where $\tilde{e} = \dfrac{\partial e}{e}$ refers to real employment growth and *h* refers to each sector's share in total employment. Thus, equation (3) implies that total employment growth is the sum of its sectoral employment growth components, each weighted by the respective sector's share (*h*) in total employment. Then, assuming total economic growth is a function of a vector of exogenous variables X,

$$\tilde{e} = \tilde{e}(X) \tag{4}$$

Since total employment growth is a function of X, then implicitly all of its components are also a function of X:

$$\tilde{e}(X) = h^{rf}\tilde{e}^{rf}(X) + h^{rnf}\tilde{e}^{rnf}(X) + h^{u}\tilde{e}^{u}(X) \tag{5}$$

Rearranging equation (5):

$$h^{rnf}\tilde{e}^{rnf}(X) = \tilde{e}(X) - h^{rf}\tilde{e}^{rf}(X) - h^{u}\tilde{e}^{u}(X) \tag{6}$$

$$\tilde{e}^{rnf}(X) = \frac{1}{h^{rnf}}\tilde{e}(X) - \frac{h^{rf}}{h^{rnf}}\tilde{e}^{rf}(X) - \frac{h^{u}}{h^{rnf}}\tilde{e}^{u}(X) \tag{7}$$

Thus, equation (7) is an identity, defining the employment growth of rural non-farm sector. Behaviorally, it implies that the employment growth of rural non-farm sector can be defined as a function of the employment growth of the other two sectors in the economy, each weighted by the ratio of its employment share to the employment share of rural non-farm sector, conditional on X (Suryahadi et al., 2007):

$$\tilde{e}^{rnf} = f(\tilde{e}^{rf^{*}}, \tilde{e}^{u^{*}}; X) \tag{8}$$

where $\tilde{e}^{rf^{*}} = \dfrac{h^{rf}}{h^{rnf}}\tilde{e}^{rf}$ and $\tilde{e}^{u^{*}} = \dfrac{h^{u}}{h^{rnf}}\tilde{e}^{u}$ impose a linear functional form, enabling the estimable model of rural non-agricultural sector growth:

$$\tilde{e}^{rnf} = \alpha + \beta_{1}\tilde{e}^{rf^{*}} + \beta_{2}\tilde{e}^{u^{*}} + \beta X + \varepsilon \tag{9}$$

The coefficient of interest in equation (9) is β_1 , which shows the percent growth of rural non-farm sector due to one percent growth in rural farm sector times the inverse of the ratio of rural sector employment to rural non-farm sector employment shares. As Suryahadi et al. (2007) have noted, if the ratio of rural farm sector employment to rural non-farm sector employment share is 50 percent, and then β_1 is the percentage growth of rural non-farm sector due to a 2 percent growth in rural farm sector.

Equation (9) can be augmented to capture other variables, such as infrastructure, transportation, credit flow, population density and income that can influence employment growth multipliers. For instance, Infrastructure facilitates communication, while transport and credit flows should improve the responsiveness of the non-farm economy to demand increases from agriculture. Likewise, population density, especially in rural areas, may reduce the geographic catchment area necessary to achieve minimum efficient scales of production, reduce transport costs and thereby improve prospects for rural responses (Suryahadi et al., 2007). On the other hand, higher agricultural income should lead farm families to diversify their consumption into non-foods, thus increasing their incremental expenditure on non-foods. To take account of such influences on the growth linkages, the following extension of equation (9) is considered:

$$\tilde{e}^{rnf} = \beta_0 + \beta_1 \tilde{e}^{rf^*} + \beta_2 \tilde{e}^{u^*} + \beta_3 (Education) + \beta_4 (Govt\_Exp) + \beta_5 (Infrastructure)$$
$$+ \beta_6 (Incomeshare) + \beta_7 (Popn\_Density) + \beta_8 (IT\_Access) + \beta_9 (Tranportation)$$
$$+ \beta_{10} (Farm\_Concentration) + \beta_{11} Location + \varepsilon$$

(10)

3.1 Data Sources and Description

The analysis employs cross-section county-level data covering the period 2001 through 2007.The study area is defined according to the 2003 Rural-Urban Continuum codes, commonly known as the Beale codes (USDA ERS, 2003). The 2003 Urban Influence Codes divide the 3,141 counties in the United States into metropolitan and non-metropolitan designation, and further refine county types by their urban population and adjacency to metropolitan areas (USDA ERS, 2003). Based on the 2000 U.S. Census, 39 of the 67 Alabama counties were classified as non-metropolitan and the rest were metropolitan counties. The terms rural/urban and metropolitan/non-metropolitan counties are used interchangeably. Rural farm employment and non-farm employment data were obtained from the U.S. Bureau of Economic Analysis, Regional Economic Information System (U.S. BEA, 2010), while urban non-farm employment data were computed using information from the United States Department of Agriculture's Economic Research Services[1] (USDA ERS, 2009). Particularly, the three employment variables [rural farm employment (e^{rf}), rural non-

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[1]This database provides state factsheets that show the contribution of rural and urban areas to total non-farm employment for all states in the United States. The data for 2007 showed that rural areas represented 25 percent of the total non-farm employment in Alabama while urban areas represented 75 percent of the total non-farm employment. In 2001, rural areas represent 23 percent while urban areas represent 77 percent of the total non-farm employment. These percentages were used to disintegrate county-level total non-farm employment data into rural non-farm and urban non-farm employment.

farm employment (e^{rnf}), and urban employment (e^{u})] are measured by the number of jobs that are received from farm-related and non-farm-related activities.

To measure the linkages, the dependent variable, rural non-farm employment growth ($\tilde{e}^{rnf}$), is measured as the difference in non-farm employment between 2001 and 2007. Other independent variables including education, income and population density are drawn from the Alabama Data Center (ASDC, 2009), while access to information technology data are from the Bureau of Economic Analysis (U.S. BEA, 2009). The number of tracks per county, irrigated farmland per county and farm concentration data are drawn from the National Agricultural Statistics (USDA NASS, 2007) while government expenditures are from the Center for Economic and Business Research (2009) at the University of Alabama.

Table 2 presents the descriptive statistics and definitions of the variables. Particularly, access to urban markets is crucial to increasing incomes for rural and peri-urban farmers. Three aspects are crucial: physical infrastructure, including road networks and affordable transport; relations between producers, traders and consumers; and information on how markets operate, including price fluctuations and consumer preferences (Tacoli, 2004). This aspect is captured in this study using three variables: ITACCESS, TRUCKS and FCONCENT. First, ITACCESS measures the number of people in a county with access to the Internet, while TRUCKS measures availability of transportation for moving farm goods and services. FCONCENT represents farm concentration which is measured as the number of business operations that have relation with farm production at the county level. These three variables are hypothesized to have a positive effect on non-farm employment growth.

On the other hand, population growth and distribution patterns affect the availability of good agricultural land and can contribute to rural residents moving out of farming. With the expansion of urban centers, land use change from agricultural to residential and industrial, and in the peri-urban interface these processes go hand in hand with transformations in the livelihoods of different groups – with the poorest often losing out (Tacoli, 2004). The influence of this aspect on non-farm employment growth is examined using the variable PDENSITY which is measured by the number of people per square mile, and is hypothesized to have a positive effect.

Decreasing incomes from farming, especially for small-scale producers who, because of lack of land, water or capital, are unable to intensify production and switch to higher value crops, mean that growing numbers of rural residents engage in non-farm activities that are often located in urban centers (Tacoli, 2004). This aspect is captured using three interrelated variables (INCOMESHARE, EDUCATION and GOVEXP). Income is measured as the share of non-farm activities in total income while the number of people with at least a high school diploma and those with a college degree or higher are used to capture the human capital component, while government expenditure (GOVEXP) is measured by the amount of state and federal dollars spent in a county. These variables are hypothesized to have a positive effect on non-farm employment growth.

A number of studies (Mills and Hazarika, 2001; Mills, 2001; Porter et al., 2004) have also explored the impact of proximity to an urban region on the performance of rural regions. Mills (2001), for example, analyzes whether a rural community's adjacency to a metropolitan area has an effect on transition from unemployment to employment by rural workers. This aspect is examined in the current analysis using a dummy variable (LOCATION) to capture the

impact of adjacency to urban counties on the performance of rural counties. This variable is hypothesized to have a positive effect on non-farm employment growth.

Table 2. Descriptive statistics

Variable Name	Variable Description	Mean	Std. Dev.
$\tilde{e}^{\,rf*}$	Growth in rural farm employment is measured as the difference between farm employment in 2001 and 2007.	-79	68
$\tilde{e}^{\,rnf}$	Growth in rural non-farm employment is measured as the difference between rural non-farm employment in 2001 and 2007.	1693	2853
$\tilde{e}^{\,u*}$	Growth in urban employment is measured as the difference between urban employment in 2001 and 2007.	2315	4683
GOVEXP	Government expenditure is measured by the amount of state and federal dollars spent in 2007.	686,506	1,428,909
PDENSITY	Population density is measured by the number of people per square mile in 2007.	87.16	102
ITACCESS	Access to information technology is measured by the number of people with access to the Internet in 2007.	365	266
TRUCK	Truck is measured by the number of truck used to transport farm goods and services in 2007.	1,117	789
IRRIGATION	Irrigation is measured by the number of irrigated farmlands in 2007.	1,677	2,381
HIGHSCHOOL	High School is measured by the number of people with a high school diploma in 2007.	13,093	31,057
COLLEGE	College is measured by the number of people with a college degree or higher in 2007.	8,201	16,641
INCOMESHARE	Income share is measured by the share of non-agricultural income in total income in 2007.	70	108
FCONCENT	Farm concentration is measured by number of business operation in 2007 that have relation with farm production.	679	419
LOCATION	Location is a dummy variable coded 1 for rural counties that are adjacent to urban counties; and 0 otherwise.	0.46	---

3.1.1 Outliers and multicollinearity

Prior to estimating the model, the data were examined for outliers and multicollinearity. Outliers were defined as observations that appear to deviate markedly from other observations in the sample. Since identifying an observation as an outlier depends on the underlying distribution of the data, the normal distribution was hypothesized and tested using the skewness and kurtosis tests. Skewness describes asymmetry from the normal

distribution in a set of statistical data while kurtosis measure whether the data are peaked or flat relative to a normal distribution (Tabachnick and Fidell, 2000). The estimates suggested that all variables, with the exception of government expenditure and high school, have asymmetric distribution, as the skewness coefficients were different from zero. Conversely, the kurtoses of almost all variables were greater than zero, indicating the tails of their distribution to be closer to normal distribution.

Outliers were detected using the Gubbs' test (Barnett and Lewis, 1994):

$$Z = \frac{|\text{mean} - \text{value}|}{\text{Standard Deviation}}$$
(11)

According to the Gubbs' test, if Z is large, the value is far from the others. Since 5 percent of the values in a Gaussian population are more than 1.96 standard deviations from the mean, a value of Z greater than 1.96 was treated as outlier (Barnett and Lewis, 1984; Evans, 1999). Outlier identification and adjustments were performed only over the non-zero observations for each variable.

After adjusting the data for outliers, multicollinearity diagnosis was performed. Multicollinearity exists whenever two or more of the predictors in a regression model are moderately or highly correlated (Tabachnick and Fidell, 2000). A formal method of detecting multicollinearity is by means of *variance inflation factors* (VIFs). The variance inflation factors measure how much the variances of the estimated regression coefficients are inflated as compared to when the predictor variables are not linearly related. The variance inflation factor for the kth predictor is:

$$VIF_k = \frac{1}{1 - R_k^2}$$
(12)

where R^2_k is the R^2 value obtained by regressing the kth predictor on the remaining predictors (Tabachnick and Fidell, 2000). If the kth predictor is nearly a linear function of the other predictors, then R^2_k should be close to 1, and therefore VIF_k will be large. That is, the variance of the estimated regression coefficients will be inflated by a factor of VIF_k. On the other hand, if the kth predictor is not linearly related to the others, then R^2 should be close to 0, and therefore VIF_k will be close to 1. Variance inflation factors greater than 4 suggest that the multicollinearity should be investigated (Tabachnick and Fidell, 2000; O'Brien, 2007). The estimated VIFs revealed that several variables in equation (10), including college education, government expenditure, and population density, were highly correlated. To minimize the effect of multicolinearity, the variables were transformed by taking their product with the rural farm employment (e^{rf}) variable. Multicollinearity test was performed on the new set of variables and those that were still showing high correlations were removed from the model.

Following the corrections for outliers and multicollinearity, the final estimated model is of the form:

$$\tilde{e}^{rnf} = \beta_0 + \beta_1(\tilde{e}^{rf^*}) + \beta_2(\tilde{e}^{u^*}) + \beta_3(EDUCATION) + \beta_4(\text{PDENSITY}) + \beta_5(INCOMESHARE)$$
$$+ \beta_6(LOCATION) + \varepsilon$$

13)

Equation (13) can be estimated using Ordinary Least Squares (OLS) procedure if rural non-farm sector growth does not affect rural farm sector growth and urban sector growth. While this is likely to be true for the case of urban sector growth, it is more likely that this condition is not true for the case of rural farm sector growth (Suryahadi et al., 2007). In this case, the estimates obtained from OLS will be inconsistent. Thus, equation (13) was estimated using the Instrumental Variable (IV) procedure. In the IV estimation, farm concentration, proportion of irrigated farmland, IT access and number of trucks were used as instruments, while rural farm employment is treated as an endogenous variable. Suryahadi et al. (2007) have made sounding arguments for the use of these variables as instruments. They contend that, since the rural farm sector is known for its farm environment, it is reasonable to use farm concentration and proportion of irrigated farmland as instrumental variables. Meanwhile, the number of trucks is used as an instrument for rural farm sector growth because both agricultural inputs and outputs are bulky, so the number of trucks available in a county provides a good indication of the intensity of economic activities in the agricultural sector. Finally, access to information technology is important for marketing and purchasing farm inputs and outputs (Suryahadi et al., 2007).

4. ESTIMATED RESULTS

The results of the estimated IV model are reported in Table 4, but first, a review of the diagnosis tests for outliers and multicollinearity are presented. A close examination of the plot (normal Q-Q plot) of actual versus the fitted model (Figure 1) suggests that the model follows an approximately normal distribution with the regression line, implying that, the data show no signs of outliers. Similarly, the correlation matrix for the estimated model parameters (Table 3) are relatively low for most of the variables, suggesting that the degree to which multicollinearity is observed is not likely to have a major effect on the estimated results.

The goodness of fit parameter (R^2) obtained from estimating equation (13) using the IV approach (Table 4) is reasonably high (0.53), suggesting that, relatively 53 percent of the variations in rural non-farm employment can be explained by the independent variables included in the model. The estimated F-statistic is also significantly different from zero at the 1-percent level, verifying the significance of the independent variables as a whole.

The key parameter of interest is the estimated coefficient for the rural agricultural sector growth ($\tilde{e}^{rf*}$), which represents the agricultural sector growth multiplier in relation to non-agricultural sector growth. As reported in Table 4, the coefficient is positive and statistically significant at the one percent level, implying that, indeed the growth of the agricultural sector positively drives employment upward in the non-agricultural sector. When interpreting the magnitude of the coefficient, it is important to note that the variable was weighted by the ratio of the rural agricultural sector employment share to the rural non-agricultural sector employment share in total employment. Accordingly, the multiplier needed for interpreting the coefficient is obtained by multiplying the estimated coefficient by the ratio of rural agricultural sector employment share to rural non-agricultural sector employment share (Suryahadi et al., 2007). This ratio was estimated at 0.27 and 0.18 in 2001 and 2007, respectively, with an average of 0.20 over the entire period.
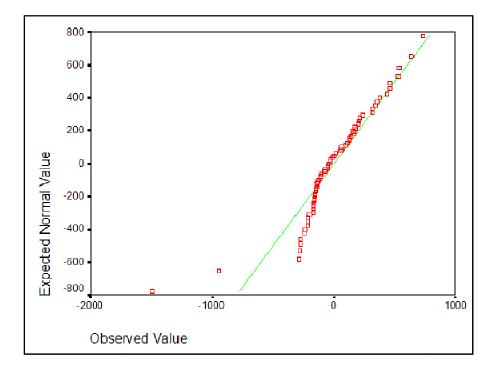
Fig. 1. Fitted model for rural non-farm employment (Q-Q plot)

Table 3. Correlation matrix of parameter estimates

Variable	$\widetilde{e}^{\,rf*}$	$\widetilde{e}^{\,u*}$	EDUC	PDENSITY	INCOME SHARE	LOCATION
$\widetilde{e}^{\,rf*}$	1.00					
$\widetilde{e}^{\,u*}$	-0.41	1.00				
EDUC	-0.18	0.79	1.00			
PDENSITY	0.23	0.63	-0.82	1.00		
INCOMESHARE	0.70	-0.57	0.59	0.75	1.00	
LOCATION	0.11	0.24	-0.32	-0.45	-0.55	1.00

Therefore, with the $\widetilde{e}^{\,rf*}$ coefficient estimated at 7.35 (Table 4) implies that in 2001, for instance, a one percent growth of the agricultural sector was able to induce 1.99 percent growth of the non-agricultural sector in rural areas. Similarly, a one percent growth of the agricultural sector in 2007 was able to induce 1.32 percent growth in the rural non-agricultural sector. Over the six-year period, the mean of the multiplier is estimated at 1.47 percent, which concurs with the conclusion reached by previous studies that the percent growth of rural non-agricultural sector is due to growth in the rural agricultural sector (Hazell and Rosegrant, 2000; Suryahadi et al., 2007). Similarly, the coefficient of the urban sector growth variable is positive and statistically significant at $p<0.01$. This indicates that urban development is directly complementary to the development of the non-agricultural sector in rural Alabama.

Table 4. Rural non-farm employment IV model results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	-570.77*	93.090	-6.131	0.000
$\tilde{e}^{rf*}$	7.349*	1.420	5.174	0.000
$\tilde{e}^{u*}$	0.375*	0.053	7.022	0.000
EDUCATION	-0.002	0.024	-0.068	0.946
PDENSITY	-0.216	0.271	-0.796	0.429
INCOMESHARE	0.204*	0.059	3.491	0.001
LOCATION	5.012	25.576	0.196	0.845
R-squared	0.53			
Adjusted R-squared	0.49			
S.E. of regression	2054.25			
F-statistic	497.384			
Prob (F-statistic)	0.000			

*Note: * denotes significance at the 0.01 level*

Furthermore, Carletto et al. (2007) have noted that the poverty and inequality implications of a growing rural non-agricultural sector are not straightforward. They depend on a number of factors, including the level of access of the poor to rural non-agricultural activities, the potential returns to rural non-agricultural activities and the share of rural non-agricultural activities in total income. In this paper, the level of access of the poor to rural non-agricultural activities is examined using a dummy variable LOCATION (adjacency to urban area = 1, non-adjacent = 0). The variable explores the influence of proximity to urban area on rural non-agricultural sector. The estimated coefficient has the hypothesized positive sign but is not statistically significant at the conventional levels. The positive sign affirms that households in counties that are adjacent to urban areas are more inclined to non-agricultural activities. This view is supported by past studies. For instance, Partridge et al. (2007a) showed that U.S. rural employment growth is strongly affected by proximity to the nearest urban center, which is also the case when examining rural wages and housing values (Partridge et al., 2007b).

On the other hand, the potential returns to rural non-agricultural activities are captured by the variable INCOMESHARE, which measures the share of rural non-agricultural activities in total income. High levels of income diversification are the norm among rural households. As Carletto et al. (2007) have noted, rural non-agricultural activities are often countercyclical with agriculture and, as such, may serve as a consumption smoothing or risk insurance mechanism, particularly when the returns to these activities are not highly correlated with agricultural returns, and may also absorb excess labor during agricultural off-peak periods. Further, given the small-scale, informal and home-based nature of some rural non-agricultural self-employment activities, they are often heralded as a promising strategic complement to agriculture for rural poverty alleviation (Carletto et al., 2007). The estimated coefficient for INCOMESHARE is positively related to rural non-agricultural sector growth and statistically significant at the one-percent level.

The human capital concept is examined here using the EDUCATION variable measured by the number of people with high school diploma. Particularly, education improves an individual's prospects for non-agricultural employment as well as increases his or her ability to allocate time to work efficiently among income-producing activities (Yang and An, 2002;

Mduma and Wobst, 2005). However, in early development phases many rural non-farm activities require only low levels of schooling. As Mecharla (2002) has noted, one would expect a positive relationship between modern non-farm occupations (like mechanical repairs of tractors, services, plywood factory) and level of education, but a negative relationship between level of education and traditional non-farm occupations (like toddy tapers, basket makers, barbers, clothes washing, tailors, mining workers, potters, and carpenters). The estimated coefficient for EDUCATION is negative and not statistically significant. This finding is not so surprising given that most non-agricultural employment opportunities in rural Alabama are the traditional non-farm occupations requiring relatively low-skill labor force and labor-intensive production methods. Similarly, the variable measuring population density is not statistically significant at the conventional levels.

5. CONCLUSION

This paper has employed cross-section data to test the null hypothesis that there is no statistically significant relationship between rural agricultural and rural non-agricultural employment growth in Alabama. The hypothesis was tested using the IV approach. The key finding suggests that growth of the rural agricultural sector in Alabama positively drives employment upward in the rural non-agricultural employment sector. Similarly, the positive and statistical significant coefficient for urban sector employment growth suggests that as employment in urban areas increase, rural non-agricultural employment will increase. The proportion of non-agricultural activities in total income (INCOMESHARE) was the only control variable found to significantly influence the growth in rural non-agricultural employment sector in Alabama.

As previous studies have observed, the challenge from a policy perspective is how to assure that the growth of the rural non-agricultural employment sector can best be harnessed to the advantage of poor rural households and how to identify the mechanisms to best exploit synergies across agricultural and non-agricultural sectors. As articulated by Carletto et al. (2007), it was only recently that the nearly exclusive emphasis on smallholder agriculture in rural development policy has come into question. The growing consensus is that although agriculture continues to play a central role in rural development, the promotion of complementary engines of rural growth is of paramount importance. Our results concur with previous conclusions (Haggblade et al., 2002; Carletto et al., 2007) that, in view of the importance and potential of the rural non-agricultural economy as part of a diversified income strategy alongside agricultural activities, the challenge for current and future rural development strategies in rural Alabama is thus to go beyond agriculture, so to identify the adequate elements of an integrated rural strategy that best complement the still pivotal role of a better-linked agricultural sector in Alabama.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

ACS. (2009). The 2008 American community survey poverty status, family income and food stamp data. Available at: http://www.census.gov/acs/www/.

ADB. (2003). Technical assistance for rural, urban, and subregional linkages in the Mekong region: A holistic approach to development and poverty reduction. Available at: http://www.adb.org/Documents/TARs/OTH/tar_oth_37156.pdf.

Adams, R.H. Jr., Page, J. (2003). International migration, remittances and poverty in developing countries. Policy Research Working Paper No. 3179, World Bank (Poverty Reduction Group), Washington, DC.

Adato, M., Meinzen-Dick, R.S. (2002). Assessing the impact of agricultural research on poverty using the sustainable livelihoods framework. EPTD discussion papers 89, International Food Policy Research Institute (IFPRI).

ADIR. (2009). Alabama Department of Industrial Relations. Available at: https://dir.alabama.gov/

Agarwal, P. (2007). Walter Christaller: Hierarchical Patterns of Urbanization. Available at: http://www.csiss.org/classics/content/67.

ASDC. (2009). Alabama State Data Center. Available at: http://asdc.cba.ua.edu/.

Barnett, V, Lewis, T. (1994). Outliers in statistical data, third ed. New York: Wiley.

Bezabih, M., Gebreegziabher, Z., GebreMedhin, L., Köhlin, G. (2010). Participation in Off-Farm Employment, Rainfall Patterns, and Rate of Time Preferences: The Case of Ethiopia. Environment for Development Discussion Paper Series, EfD DP 10-21. Available at: http://www.rff.org/rff/documents/EfD-DP-10-21.pdf

Bezu, S., Holden, S., Barrett, C.B. (2009). Activity choice in rural non-farm employment: survival versus accumulation strategy. Paper presented at the 8th Nordic Conference in Development Economics, Oscarsborg, Drobak, Norway, June 18–19, 2009.

Bryceson, D.F., Mbara, T. (2003). Petrol pumps and economic slumps: the reality of rural-urban linkages in Sub-Saharan Africa's globalization process. Tijdschrift voor Economische en Sociale Geografie, 94(3), 8, 335-39.

Caffyn, A., Dahlstrom, M. (2005). Urban-rural interdependencies: Joining up policy in practice. Regional Studies, 39(3), 283-296.

Carletto, G., Covarrubias, K., Davis, B., Krausova, M., Stamoulis, K., Winters, P., Zezza, A. (2007). Rural income generating activities in developing countries: re-assessing the evidence. Electronic Journal of Agricultural and Development Economics, 4(1), 146-193. http://www.fao.org/fileadmin/user_upload/riga/pdf/ai195e00.pdf.

Davis, J.R., Bezemer, D.J.J., Janowski, M., Wandschneider, T. (2009). The Rural Non-farm Economy and Poverty Alleviation in Armenia, Georgia and Romania: A Synthesis of Findings (April 2004). Available at SSRN: http://ssrn.com/abstract=695183.

Douglass, M. (1988). Regional network strategy for reciprocal rural-urban linkages. Third World Planning Review, 20(1), 1–34.

Dabson, B. (2007). Rural-urban interdependence: why metropolitan and rural America need each other. Available at: http://www.rupri.org/Forms/Dabson_Brookings.pdf.

Deichmann, U., Forhad, S., Renos, V. (2008). Spatial Specialization and Farm-Nonfarm Linkages (April 1, 2008). World Bank Policy Research Working Paper Series, Vol., pp. -, 2008. Available at SSRN: http://ssrn.com/abstract=1149114.

Ellis, F. (1998). Household strategies and rural livelihood diversification. Journal of Development Studies, 35(1), 1-38.

Ellis, F. (2000). Rural livelihoods and diversity in developing countries. Oxford: Oxford University Press. Francis, E. and J.

EPI. (2008). Center on budget and policy priorities and economic policy institute. Pulling apart: A state by state analysis of income trends. Available at: http://www.cbpp.org/4-9-08sfp.htm.

Evans, V.P. (1999). Strategies for detecting outliers in regression analysis: An introductory primer. In B. Thompson (Ed.), Advances in social science methodology, 5, 213-233. Stamford, CT.: JAI Press.

Haggblade, S., Hazell, P.B.R., Thomas, R. (2002). Strategies for stimulating poverty-alleviating growth in the rural nonfarm economy in developing countries: EPTD discussion papers 92, International Food Policy Research Institute (IFPRI).

Hagos, F. (2003). Poverty, institutions, peasant behavior, and conservation investments in northern Ethiopia. PhD diss., Department of Economics and Social Sciences, Agricultural University of Norway.

Hazell, P., Rosegrant, M. (2000). Transforming the Rural Asian Economy: The Unfinished Revolution. Study of Rural Asia: Volume 1. Available at: http://www.adb.org/Documents/Books/Rural_Asia/Unfinished_Revolution/

Henry, M.S., Barkley, D.L., Bao, S. (1997). The Hinterland's Stake in Metropolitan Area Growth. Journal of Regional Science, 37(3), 479-501.

Holzer, H.J., Stoll, M.A. (2007). Where Workers Go, Do Jobs Follow? Metropolitan Labor Markets in the U.S., 1990-2000. Brookings Institution, Metro Economy Series from the Metropolitan Policy Program at Brookings.

Kahn, R., Orazem, P.F., Otto, D.M. (2001). Deriving empirical definitions of spatial labor markets: the roles of competing versus complementary growth. Journal of Regional Science, 41(4), 735-56.

Knox, B. (2010). Alabama sees population decline in some rural areas. Available at: http://cw.ua.edu/2010/04/11/alabama-sees-population-decline-in-some-rural-areas/.

Lanjouw, P., Lanjouw, J.O. (1999). Rural Nonfarm Employment: A Survey. The World Bank, Policy Research Working Paper Series. W. Bank, World Bank.

Leachman, M., Williams, E., Johnson, N. (2011). Governors are proposing further deep cuts in services, likely harming their economies. Center on Budget and Policy Priorities. Available at http://www.cbpp.org/files/2-4-11sfp.pdf.

Mduma, J., Wobst, P. (2005). Determinants of rural labor market participation in Tanzania. African Studies Quarterly 8(2).http://www.africa.ufl.edu/asq/v8/v8i2a2.htm. Accessed on July 2010.

Mecharla, P.R. (2002). The determinants of rural non-farm employment in two villages of Andhra Pradesh (India). PRUS Working Paper No. 12. http://www.sussex.ac.uk/Units/PRU/wps/wp12.pdf.

McMillan, J. (2011). Op-Ed: Alabama's Economic Future Tied to Agriculture. State of Alabama, Press Release. Available at http://media.alabama.gov/pr/pr.aspx?id=4735.

Mills, B., Hazarika, G. (2001). The migration of young adults from non-metropolitan counties. American Journal of Agricultural Economics, 83(2), 329-340.

Mills, B. (2001). Unemployment duration in non-metropolitan labor markets. Growth and Change, 32, 174-192.

Miranowski, J.A., Monchuk, D., Wohlgemuth, D. (2001). Rural Growth In U.S. Heartland, 2001 Annual meeting, August 5-8, Chicago, IL 20655, American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association).

Moellers, J., Heidhues, F., Buchenrieder, G. (2006). Non-farm diversification decisions of rural households in Macedonia, 2006 Annual Meeting, August 12-18, 2006, Queensland, Australia 25402, International Association of Agricultural Economists.

Moseley, J.R. (2002). How Regions Change the Future of Rural Policy. Presented at the New Power of Regions: A Policy Focus for Rural America, May 9-10, Kansas City.

O'Brien, R.M. (2007). A Caution Regarding Rules of Thumb for Variance Inflation Factors. Quality and Quantity, 41(5), 673-690.

Partridge, M.D., Clark, J., Enver, A. (2007a). Growth and Change: Employment Growth, Future Prospects, and Change at the Ohio Rural-Urban Interface. The Exurban Change Project and Swank Program in Rural-Urban Policy Summary Report. Available at: http://www.aede.osu.edu/programs/Swank [April 23, 2008].

Partridge, M.D., Bollman, R., Olfert, M.R., Alasia, A. (2007b). Riding the Wave of Urban Growth in the Countryside: Spread, Backwash, or Stagnation. Land Economics, 83(2), 128-152.

Porter, M.E., Ketels, C.H.M., Miller, K., Bryden, R.T. (2004). Competitiveness in Rural U.S. Regions: Learning and Research Agenda. Accessed on June, 2010. Available at http://www.isc.hbs.edu/pdf/EDA_RuralReport_20040621.pdf.

Ravallion, M., Chen, S. Sangraula, P. (2007). The urbanization of global poverty. Background paper prepared for the World Bank's World development report, 2008. Washington, D.C.: World Bank.

Reimer, B. (2005). Rural and urban: differences and common ground, Chapter 4 in Hiller, Harry H. (ed.) Urban Canada: Sociological Perspectives, Don Mills: Oxford U. Press, pp.71-94.

Satterthwaite, D. (2000). Seeking an Understanding that Recognizes Rural-Urban Differences and Rural-Urban Linkages. IIED, London.

Seraje, M. (2007). Livelihood strategies and their implications for rural-urban linkages: The case of Wolenkomi town and the surrounding rural kebeles. Working papers on population and land use change in central Ethiopia, no. 10. Available at: http://www.svt.ntnu.no/geo/Doklager/Acta/serie_a_18_mohammed.pdf.

Sumners, J.A., Lee, L. (2005). Crossroads Connections: Strategies for Rural Alabama. http://www.auburn.edu/outreach/publications/cross_connections.pdf.

Suryahadi, A., Snryadarma, D., Sumarto, S., Molyneaux, J. (2007). Agricultural Demand Linkages and Growth Multipler in Rural Indonesia. Available at: http://www.eaber.org/intranet/documents/41/1640/SMERU_Suryahadi_2006_02.pdf.

Tabachnick, B.G., Fidell, L.S. (2000). Using multivariate statistics, 4th edition. Pearson Allyn and Bacon.

Tacoli, C. (2004). Rural-urban linkages and pro-poor agricultural growth: An Overview Agriculture and Pro-Poor Growth Task Team Helsinki Workshop, 17-18 June 2004. Available at: http://www.oecd.org/dataoecd/25/8/36562896.pdf.

The State of Working Alabama. 2009. Available at ARISE Citizen's Policy Project. Available at:
http://www.arisecitizens.org/index.php?option=com_docman&task=cat_view&gid=49&Itemid=44.

U.S. BEA. (2009). Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce. Available at: http://www.bea.gov/regional/reis/CA34fn.cfm.

U.S. BEA. (2010). Regional Data: County Personal Income and Employment. Available at: http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1.

U.S. Census Bureau. (2002). Census 2000 Urban and Rural Classification. Available at http://www.census.gov/geo/www/ua/ua_2k.html. Last accessed March 27, 2009.

USDA ERS. (2003). Urban Influence Codes. Available at: http://www.ers.usda.gov/Data/UrbanInfluenceCodes/.

USDA ERS. (2009). Alabama Fact Sheet/United States Department of Agriculture Economic Research Service. Available at: www.ers.usda.gov/statefacts/al.htm.

USDA ERS. (2010). USDA Economic Research Service: State Fact Sheets. Available at http://www.ers.usda.gov/StateFacts/.

USDA ERS. (2007). Rural-urban commuting area codes. Available at http://www.ers.usda.gov/briefing/Rurality/RuralUrbanCommutingAreas/.

USDA NASS. (2007). National Agricultural Statistics Service. 2007 Census Publication: Alabama Volume 1, Complete Report, All Tables. Available at: http://www.agcensus.usda.gov/Publications/2007/Full_Report/
Volume_1,Chapter_2_County_Level/Alabama/index.asp.

USDA NASS. (2011). Farms, land in farms, and livestock operations, 2010 Summary. http://usda.mannlib.cornell.edu/usda/current/FarmLandIn/FarmLandIn-02-11-2011_revision.txt.

Von Braun, J. (2007). Rural-urban linkages for growth, employment, and poverty reduction. Ethiopian Economic Association Fifth International Conference on the Ethiopian Economy June 7–9, 2007. Available at: http://www.ifpri.org/sites/default/files/publications/20070607jvbruralurban.pdf.

Watters, A.J. (2002). Rural Alabama. http://cber.cba.ua.edu/rbriefs/abwin02_rural.html.

Whitener, L.A. and T. Parker. (2007). Policy option for a changing rural America. Amber Waves, 3(2), 68-65.

Yang, D.T., An, M.Y. (2002). Human capital, entrepreneurship, and farm household earnings. Journal of Development Economics, 68(1), 65-88.