An Empirical Analysis of Employment, Migration, Local Public Services and Regional Income Growth in Appalachia

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Abstract: This study develops a five-equation simultaneous system in a partial lag-adjustment growth-equilibrium framework. It improved previous models in the growth-equilibrium tradition by explicitly modeling local government and regional income in the growth process. It also explicitly modeled gross in-migration and gross out-migration separately in order to spell out the differential effects. The results show the existence of feedback simultaneities among the endogenous variables of the model. This finding is important from economic policy perspective because it indicates that sector specific policies should be integrated and harmonized in order to achieve the desirable outcome. Under this circumstance, looking at the direct plus indirect impacts of a change in a given policy is important.

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1. INTRODUCTION

Differential rate of economic growth has become a process that characterized the US economy. Thus, despite decades of unprecedented expansion of the economy of the United States, many regions in Appalachia are still suffering from high unemployment, shrinking economic base, deeply rooted poverty, low human capital formation, and out migration (Rupasingha and Goetz, 2003). This characterization of Appalachia has become a basis for regional development policy that aims at revitalizing the local economy. However, understanding the determinants of regional growth variation is important from a local economic development policy perspective. In recognition of this perspective, this study examines the determinants of growth in Appalachia during the 1990s.

The relationship between economic growth and its determinants has been studied extensively in the economic literature. The issue whether regional development can be associated with population driving employment changes or employment driving population changes (do ‘jobs follow people’ or ‘people follow jobs’?) has, for example, recently attracted considerable interest among researchers and policy makers. Empirical works on identification of the direction of causality in this ‘jobs follow people’ or ‘people follow jobs’ literature (Steinnes and Fischer, 1974) have resulted in the view that empirical models of regional development often reflect the interdependence between household residential choices and firm location choices. To account for this causation and interdependency, Carlino and Mills (1987) suggested and constructed a two-equation simultaneous system with the two partial location equations as its components. This model has subsequently been used by a number of regional science researchers in order to examine regional economic growth (see Boarnet, 1994; Duffy, 1994; Henry, Barkley, and Bao, 1997; Duffy-Dino, 1998; Barkley, Henry and Bao 1998, Henry, Schmitt, Kritstesen, Barkley, and Bao, 1999; Edmiston, 2004). More recently, Deller, Tsai, Marcouiller, and English (2001) have expanded upon the original Carlino-Mills model to capture explicitly the role of income. According to the proposition of utility maximization in the traditional migration literature, households migrate to capture higher wages or income. The model expanded by Deller et al, (2001) is three-dimensional (jobs-people-income) and explicitly traces the role of income in regional growth process. It also explicitly captures the increasing concerns about job quality as measured by income levels those jobs can support. There have also been efforts to model the interactions between employment growth and human migration (MacDonald, 1992; Clark and Murphy, 1996), per capita personal income and public expenditures (Duffy-Deno and Eberts, 1991), net migration, employment growth, and average income (earnings) (Greenwood and Hunt 1984; Greenwood et al., 1986; and Lewis, Hunt and Plantigna, 2002) in simultaneous-equations methods.

A shortcoming of the Carlino-Mills type models is their assumptions about in-migrants and out-migrants. The endogenous variable “population change” includes both (1) natural population increase and (2) the difference between in-migration and out-migration. Unless the characteristics of in-migrants and out-migrants are assumed to be the same (with respect to their effects to regional economy), taking “population change” as a net figure will gloss over the differential effects of in-migrants and out-migrants.

This is even certain for Appalachia where in-migrants and out-migrants are markedly different. Another shortcoming of these models is, although local governments, through their taxation and spending actions, affect the economy and are being affected by it, the role of government is not explicitly captured by these models. The government sector is generally considered exogenous to the system. Besides, the level of per capita regional income is also treated as exogenously determined.

The methodology followed in this study is an extension of the "jobs follow people, or people follow jobs" literature. A simultaneous-equation system that expresses the interdependences among small business growth, migration behavior, local public services and median household income is developed in a partial lag-adjustment growth-equilibrium framework. This model improves previous models in the growth-equilibrium tradition by explicitly modeling the role of local government and regional income in the growth process. It is obvious that local governments through their spending and taxation actions affect and being affected by the local economy. Regional income is not also something that is exogenously determined. It also affects and being affected by the other regional factors. The model developed in this study is thus more realistic compared to previous models.

The model in this study also explicitly modeled in-migration and out-migration separately in order to spell out their differential effects, which used to be glossed-over under net population change in previous models. This is significantly important because migration is treated as population equilibrating process in the growth-equilibrium models. Taking net population change as a variable of interest has a potential effect of hiding any differential effect between in-migration and out-migration on the local economy, unless in-migrants and out-migrants are characteristically similar. In-migrants and out-migrants in Appalachian counties, however, are characteristically different. Appalachia tends to be the destination for low-income people with little education, and low-occupational status. During the second half of the 1990s, for example, more people in poverty moved into Appalachia, while those with higher incomes, more education and higher job status moved out (Obermiller and Howe, 2004).

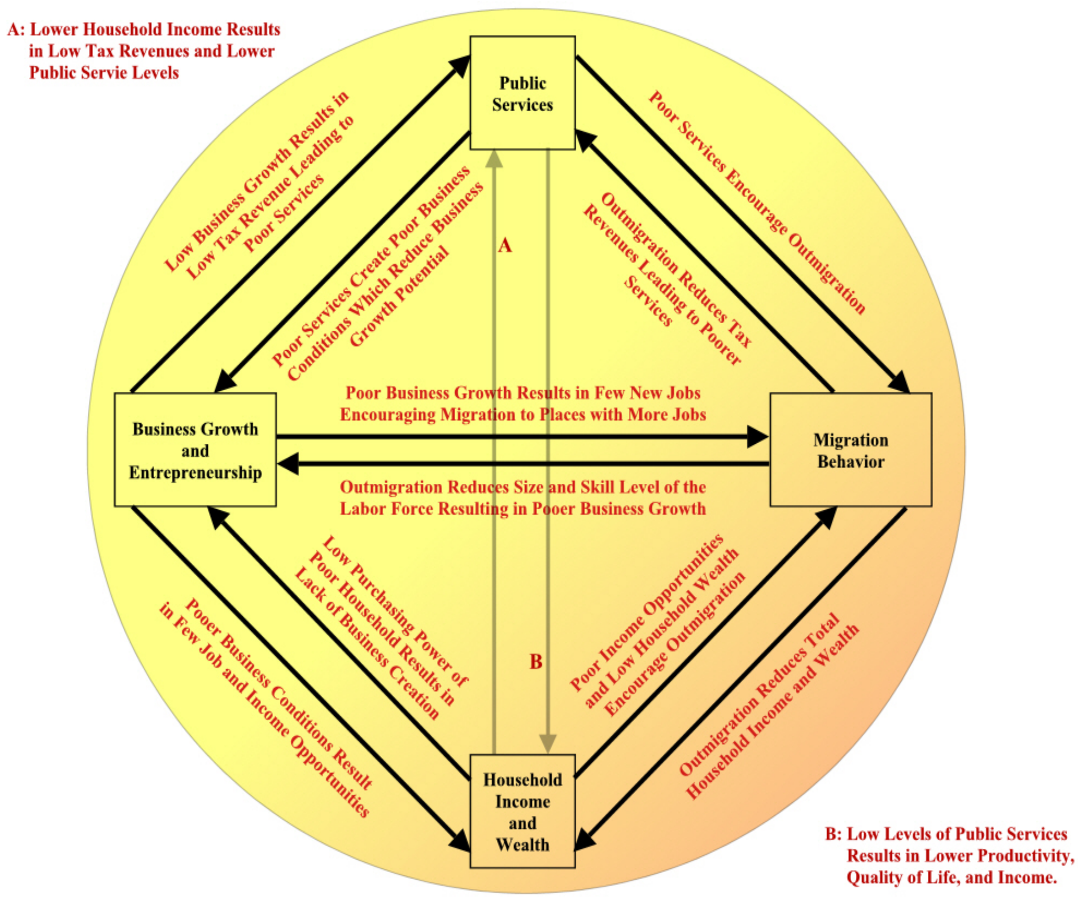
Hence, a five-equation standard simultaneous equation model that explains the interdependences among small business growth, migration behavior, household income, local public services at the county-level is developed in a growth equilibrium framework. The model spells out the ‘feed-back simultaneities among these five endogenous variables conditional on a set of regional socio-economic variables. The rationale for this type of modeling is based on the fact that estimating the coefficients of each equation of the model without considering the feed-backs would lead to biased, inconsistent and inefficient estimates. Consequently, this leads to wrong inferences and policy recommendations. The empirical implementation of this model uses data on 418 Appalachian counties. Although Appalachia is far from being homogenous, the region remains a distinct part of America. Appalachia lags the rest of the nation in every measure of socio-economic indicator. Thus, Appalachia defines a good study area to test the hypotheses set in this study.

2. MODEL DEVELOPMENT

The theoretical base for the interdependencies between population (migration behavior), employment and income is the idea that households and firms are both mobile and that household location decisions maximize utility while firm location decisions maximize profits. That is, households migrate to capture higher wages or income and firms migrate to be near growing consumer markets. These actions in turn generate income to the regional (local) economy. However, according to the principle of utility maximization, household location decisions are expected to be influenced not only by the location of job opportunities and income but also by other factors such as the provision of local public goods and services, social and natural amenities (and disamenities), demographic factors, and regional location. Similarly, the location decisions of firms are expected to be influenced not only by population and income (i.e., growing consumer markets) but also by other factors such as local business climate, wage rates, tax rates, local public services, and regional location. Firm location decisions are also influenced by the substantial financial incentive that local governments offer in an effort to create jobs, spur income growth, and enhance the economic opportunities of the local population. According to the median-voter models of local fiscal behavior, local public expenditures, however, approximate the choices of the utility-maximizing median voter and so depend on income and other revenue sources such as property taxes, income taxes, and factors that determine consumer preferences. In this study, the 'jobs versus people versus income' debate is expanded from three-dimensional into four-dimensional: 'jobs versus people (migration behavior) versus income (poverty) versus local public services'. By expanding the growth partial equilibrium model into four dimensions to explicitly trace the role of local public services in regional growth, the model in this fully captures the growth process. The complex causations and interdependencies between business growth and entrepreneurship, migration behavior, household income and wealth and local public services are given in Figure 1 as shown below.

In general, it is assumed that both households and business firms are free to migrate. Utility-maximizing households migrate in search of utility derived the consumption of market goods, amenities (both social and natural) and local public services. Profit-maximizing business firms migrate in search of lower production costs and higher consumer market demands. The determinants of the demand for local public services are based upon the principles of the median-voter models that assume that local governments use property and income taxes to collect revenues. Local fiscal behavior is influenced by the need for local governments to actively pursue policies that encourage newly locating and expanding business firms in order to create jobs, spur income growth and enhance economic opportunities to the public, provide efficient and quality public services, and balancing their budgets. Based upon these assumptions, the following central hypotheses are formulated in this research:

Figure 1: Cycle of Poverty



1. Employment growth, migration behavior (in-migration and out-migration), household median income and local public services are interdependent and are jointly determined by regional covariates
2. Growth is conditional upon initial conditions.

These hypotheses form the core research agenda for this study. Specifically, emphasis is put not only on examining the linkages among employment growth, migration behavior, household median income and local public services, but also on investigating the elasticity of these variables with respect to each of the regional covariates. The elasticity analyses help to draw some policy recommendations for regional and rural development.

To test these hypotheses, a spatial simultaneous equations model of employment growth, migration behavior, household median income, and local public services is used. Following the Carlino and Mills tradition and building upon Deller et al. (2001) and Lewis et al. (2002), the basic model is specified as:

$$\left\{\begin{array}{l} INM_{it}^{*} = f_1(OTM_{it}^{*}, EMP_{it}^{*}, GEX_{it}^{*}{}_{it}, MHY_{it}^{*} \mid \mathbf{X}_{it}^{in}) \\ OTM_{it}^{*} = f_2(INM_{it}^{*}, EMP_{it}^{*}, GEX_{it}^{*}{}_{it}, MHY_{it}^{*} \mid \mathbf{X}_{it}^{ot}) \\ EMP_{it}^{*} = f_3(INM_{it}^{*}, OTM_{it}^{*}, GEX_{it}^{*}{}_{it}, MHY_{it}^{*} \mid \mathbf{X}_{it}^{em}) \\ GEX_{it}^{*} = f_4(INM_{it}^{*}, OTM_{it}^{*}, EMP_{it}^{*}, MHY_{it}^{*} \mid \mathbf{X}_{it}^{ge}) \\ MHY_{it}^{*} = f_5(INM_{it}^{*}, OTM_{it}^{*}, EMP_{it}^{*}, GEX_{it}^{*} \mid \mathbf{X}_{it}^{mh}) \end{array}\right\} \ldots\ldots\ldots(4.1)$$

where INM_{it}^{*}, $OTM_{it}^{*}, EMP_{it}^{*}$, GEX_{it}^{*}, and MHY_{it}^{*} are equilibrium levels of gross in-migration, gross out-migration, private business employment, median household income and local public expenditures respectively, and i and t index county and time, respectively. The vectors of additional exogenous variables that are included in the respective equations of the system of simultaneous equations are given by $\mathbf{X}_{it}^{in}$, $\mathbf{X}_{it}^{ot}$, $\mathbf{X}_{it}^{em}$, $\mathbf{X}_{it}^{ge}$, and $\mathbf{X}_{it}^{mh}$, respectively.

In order to reduce the effects of the large diversity found in the data used in empirical analysis, a multiplicative (log-linear) form of the model is used. Such specification also implies a constant-elasticity form for the equilibrium conditions given in (4.1). A log-linear (i.e., log-log) representation of these equilibrium conditions can thus be expressed as:

$$INM_{it}^{*} = \left(OTM_{it}^{*}\right)^{a_1} \times \left(EMP_{it}^{*}\right)^{b_1} \times \left(GEX_{it}^{*}{}_{it}\right)^{c_1} \times \left(MHY_{it}^{*}\right)^{d_1} \times \prod_{k_1=6}^{K_1} \left(\mathrm{X}_{k_1 it}^{in}\right)^{x_{1k_1}}$$

$$\rightarrow \ln\left(INM_{it}^{*}\right) = a_1 \ln\left(OTM_{it}^{*}\right) + b_1 \ln\left(EMP_{it}^{*}\right) + c_1 \ln\left(GEX_{it}^{*}{}_{it}\right) + d_1 \ln\left(MHY_{it}^{*}\right) + \sum_{k_1=6}^{K_1} x_{1k_1} \ln\left(\mathrm{X}_{k_1 it}^{in}\right) \tag{4.2a}$$

$$OTM_{it}^{*} = \left(INM_{it}^{*}\right)^{a_2} \times \left(EMP_{it}^{*}\right)^{b_2} \times \left(GEX_{it}^{*}{}_{it}\right)^{c_2} \times \left(MHY_{it}^{*}\right)^{d_2} \times \prod_{k_2=6}^{K_2} \left(\mathrm{X}_{k_2 it}^{ot}\right)^{x_{2k_2}}$$

$$\rightarrow \ln\left(OTM_{it}^{*}\right) = a_2 \ln\left(INM_{it}^{*}\right) + b_2 \ln\left(EMP_{it}^{*}\right) + c_2 \ln\left(GEX_{it}^{*}{}_{it}\right) + d_2 \ln\left(MHY_{it}^{*}\right) + \sum_{k_2=6}^{K_2} x_{2k_2} \ln\left(\mathrm{X}_{k_2 it}^{in}\right) \tag{4.2b}$$

$$EMP_{it}^{*} = \left(INM_{it}^{*}\right)^{a_3} \times \left(OTM_{it}^{*}\right)^{b_3} \times \left(GEX_{it}^{*}{}_{it}\right)^{c_3} \times \left(MHY_{it}^{*}\right)^{d_3} \times \prod_{k_3=6}^{K_3} \left(\mathbf{X}_{k_3 it}^{em}\right)^{x_{3k_3}}$$

$$\rightarrow \ln\left(EMP_{it}^{*}\right) = a_3 \ln\left(INM_{it}^{*}\right) + b_3 \ln\left(OTM_{it}^{*}\right) + c_3 \ln\left(GEX_{it}^{*}{}_{it}\right) + d_3 \ln\left(MHY_{it}^{*}\right) + \sum_{k_3=6}^{K_3} x_{3k_3} \ln\left(\mathrm{X}_{k_3 it}^{in}\right) \tag{4.2c}$$

$$GEX_{it}^{*} = \left(INM_{it}^{*}\right)^{a_4} \times \left(OTM_{it}^{*}\right)^{b_4} \times \left(EMP_{it}^{*}\right)^{c_4} \times \left(MHY_{it}^{*}\right)^{d_4} \times \prod_{k_4=6}^{K_4} \left(\mathrm{X}_{k_4 it}^{em}\right)^{x_{4k_4}}$$

$$\rightarrow \ln\left(GEX_{it}^{*}\right) = a_4 \ln\left(INM_{it}^{*}\right) + b_4 \ln\left(OTM_{it}^{*}\right) + c_4 \ln\left(EMP_{it}^{*}{}_{it}\right) + d_4 \ln\left(MHY_{it}^{*}\right) + \sum_{k_4=1}^{K_4} x_{4k_4} \ln\left(\mathrm{X}_{k_4 it}^{in}\right) \tag{4.2d}$$

$$MHY_{it}^{*} = \left(INM_{it}^{*}\right)^{a_5} \times \left(OTM_{it}^{*}\right)^{b_5} \times \left(EMP_{it}^{*}\right)^{c_5} \times \left(GEX_{it}^{*}\right)^{d_5} \times \prod_{k_4=1}^{K_5} \left(\mathrm{X}_{k_4 it}^{em}\right)^{x_{5k_4}}$$

$$\rightarrow \ln\left(MHY_{it}^{*}\right) = a_5 \ln\left(INM_{it}^{*}\right) + b_5 \ln\left(OTM_{it}^{*}\right) + c_5 \ln\left(EMP_{it}^{*}{}_{it}\right) + d_5 \ln\left(MHY_{it}^{*}\right) + \sum_{k_4=1}^{K_5} x_{5k_4} \ln\left(\mathrm{X}_{k_4 it}^{in}\right) \tag{4.2e}$$

where a_i, b_i, c_i, d_i for $i = 1, 2, 3, 4$ are the exponents on the endogenous variables, x_{ik_j} for $i, j = 1, ..., 5$ are vectors of exponents on the exogenous variables, $\prod$ is the product operator, and K_i for $i = 1, .., 5$ are the number of exogenous variables in the in-migration, out-migration, employment growth, local public expenditure, and median household income equations respectively. The log-linear specification has an advantage of yielding a log-linear reduced form for estimation, where the estimated coefficients represent elasticities. Duffy-Deno (1998) and MacKinnon, White, and Davidson, 1983) also showed that, compared to a linear specification, a log-linear specification is more appropriate for models involving population and employment densities.

The various literatures (Edmiston, 2004; Hamalainen and Bockerman, 2004; Aronsson, Lundberg, and Wikstrom, 2001; Deller et al., 2001; Henry et al., 1999; Duffy-Deno, 1998; Barkley et al., 1998; Henry et al., 1997; Boarnet, 1994; Duffy, 1994, Carlino and Mills, 1987; Mills and Price, 1984) suggest that in-migration, out-migration, employment, local public expenditure and median household income likely adjust to their equilibrium levels with a substantial lags (i.e., initial conditions). Following the previous literature a distributed lag adjustment is introduced and the corresponding partial-adjustment process for each of the equations given in (4.1) is of the form:

$$\frac{INM_{it}}{INM_{it-1}} = \left(\frac{INM_{it}^{*}}{INM_{it-1}}\right)^{\eta_{in}}$$

$$\rightarrow \ln\left(INM_{it}\right) - \ln\left(INM_{it-1}\right) = \eta_{in}\ln\left(INM_{it}^{*}\right) - \eta_{in}\ln\left(INM_{it-1}\right) \tag{4.3a}$$

$$\frac{OTM_{it}}{OTM_{it-1}} = \left(\frac{OTM_{it}^{*}}{OTM_{it-1}}\right)^{\eta_{ot}}$$

$$\rightarrow \ln\left(OTM_{it}\right) - \ln\left(OTM_{it-1}\right) = \eta_{ot}\ln\left(OTM_{it}^{*}\right) - \eta_{ot}\left(OTM_{it-1}\right) \tag{4.3b}$$

$$\frac{EMP_{it}}{EMP_{it-1}} = \left(\frac{EMP_{it}^{*}}{EMP_{it-1}}\right)^{\eta_{em}}$$

$$\rightarrow \ln\left(EMP_{it}\right) - \ln\left(EMP_{it-1}\right) = \eta_{em}\ln\left(EMP_{it}^{*}\right) - \eta_{em}\left(EMP_{it-1}\right) \tag{4.3c}$$

$$\frac{GEX_{it}}{GEX_{it-1}} = \left(\frac{GEX_{it}^{*}}{GEX_{it-1}}\right)^{\eta_{ge}}$$

$$\rightarrow \ln\left(GEX_{it}\right)-\ln\left(GEX_{it-1}\right)=\eta_{ge}\ln\left(GEX_{it}^{*}\right)-\eta_{ge}\left(GEX_{it-1}\right) \tag{4.3d}$$

$$\frac{MHY_{it}}{MHY_{it-1}}=\left(\frac{MHY_{it}^{*}}{MHY_{it-1}}\right)^{\eta_{mh}}$$

$$\rightarrow \ln\left(MHY_{it}\right)-\ln\left(MHY_{it-1}\right)=\eta_{mh}\ln\left(MHY_{it}^{*}\right)-\eta_{mh}\ln\left(MHY_{it-1}\right) \tag{4.3e}$$

where the subscript t-1 refers to the indicated variable lagged one period, one decade in this study, and $\eta_{in},\eta_{ot},\eta_{em},\eta_{ge}$, and η_{mh} are the speed of adjustment parameters that represent, respectively, the rate at which in-migration, out-migration, employment, local public expenditure and median household income adjust to their respective desired equilibrium levels. They are interpreted as the shares or proportions of the respective equilibrium rate of growth that were realized each period

Solving equations (4.3a)-(4.3e) for the equilibrium values gives:

$$\begin{aligned}\ln\left(INM_{it}^{*}\right)&=\frac{1}{\eta_{in}}\left(\ln\left(INM_{it}\right)-\ln\left(INM_{it-1}\right)+\eta_{in}\ln\left(INM_{it-1}\right)\right)\\&=\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\end{aligned} \tag{4.4a}$$

$$\begin{aligned}\ln\left(OTM_{it}^{*}\right)&=\frac{1}{\eta_{ot}}\left(\ln\left(OTM_{it}\right)-\ln\left(OTM_{it-1}\right)+\eta_{ot}\ln\left(OTM_{it-1}\right)\right)\\&=\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\end{aligned} \tag{4.4b}$$

$$\begin{aligned}\ln\left(EMP_{it}^{*}\right)&=\frac{1}{\eta_{em}}\left(\ln\left(EMP_{it}\right)-\ln\left(EMP_{it-1}\right)+\eta_{em}\ln\left(EMP_{it-1}\right)\right)\\&=\frac{1}{\eta_{em}}EMPR_{it}+\ln\left(EMP_{it-1}\right)\end{aligned} \tag{4.4c}$$

$$\ln\left(GEX_{it}^{*}\right) = \frac{1}{\eta_{ge}}\left(\ln\left(GEX_{it}\right) - \ln\left(GEX_{it-1}\right) + \eta_{ge}\ln\left(GEX_{it-1}\right)\right)$$
$$= \frac{1}{\eta_{ge}} GEXR_{it} + \ln\left(GEX_{it-1}\right) \tag{4.4d}$$

$$\ln\left(MHY_{it}^{*}\right) = \frac{1}{\eta_{mh}}\left(\ln\left(MHY_{it}\right) - \ln\left(MHY_{it-1}\right) + \eta_{mh}\ln\left(MHY_{it-1}\right)\right)$$
$$= \frac{1}{\eta_{mh}} MHYR_{it} + \ln\left(MHY_{it-1}\right) \tag{4.4e}$$

where INMR, OTMR, EMPR, GEXR, and MHYR denote the gross in-migration growth rate, gross out-migration growth rate, employment growth rate, local public expenditure growth rate and median household income growth rate, respectively.[1]

Substituting from equations (4.4a)-(4.4e) into equations (4.2a)-(4.2e) gives:

[1] The growth rate from period t-1 to period t in a time series observation, say, y_t can be denoted by g_t, where

$$g_t = \frac{y_t}{y_{t-1}} - 1$$

Now, if x is a small number, then $\ln(1+x) \approx x$. Therefore, if g_t is small, $\ln(1+g_t) \approx g_t$ or $\ln\left(\frac{y_t}{y_{t-1}}\right) \approx g_t$ or $\ln(y_t) - \ln(y_{t-1})$.

Gross In-migration Growth Rate Equation:

$$\frac{1}{\eta_{in}} INMR_{it} + \ln\left(INM_{it-1}\right) = a_1\left(\frac{1}{\eta_{ot}} OTMR_{it} + \ln\left(OTM_{it-1}\right)\right) + b_1\left(\frac{1}{\eta_{em}} EMPR_{it} + \ln\left(EMP_{it-1}\right)\right)$$
$$+ c_1\left(\frac{1}{\eta_{ge}} GEXR_{it} + \ln\left(GEX_{it-1}\right)\right) + d_1\left(\frac{1}{\eta_{mh}} MHYR_{it} + \ln\left(MHY_{it-1}\right)\right) + \sum_{k_1=6}^{K_1} x_{1k_1} \ln\left(\mathrm{X}_{k_1 it}^{in}\right)$$
$$\rightarrow INMR_{it} = \eta_{in}\left\{a_1\left(\frac{1}{\eta_{ot}} OTMR_{it} + \ln\left(OTM_{it-1}\right)\right) + b_1\left(\frac{1}{\eta_{em}} EMPR_{it} + \ln\left(EMP_{it-1}\right)\right)\right.$$
$$\left. + c_1\left(\frac{1}{\eta_{ge}} GEXR_{it} + \ln\left(GEX_{it-1}\right)\right) + d_1\left(\frac{1}{\eta_{mh}} MHYR_{it} + \ln\left(MHY_{it-1}\right)\right) + \sum_{k_1=6}^{K_1} x_{1k_1} \ln\left(\mathrm{X}_{k_1 it}^{in}\right) - \ln\left(INM_{it-1}\right)\right\}$$

$$\rightarrow INMR_{it} = \beta_{11} OTMR_{it} + \beta_{12} EMPR_{it} + \beta_{13} GEXR_{it} + \beta_{14} MHYR_{it} + \gamma_{11} \ln\left(INM_{it-1}\right) + \gamma_{12} \ln\left(OTM_{it-1}\right)$$
$$+ \gamma_{13} \ln\left(EMP_{it-1}\right) + \gamma_{14} \ln\left(GEX_{it-1}\right) + \gamma_{15} \ln\left(MHY_{it-1}\right) + \sum_{k_1=6}^{K_1} \gamma_{1k_1} \ln\left(\mathrm{X}_{k_1 it}^{in}\right) \qquad (4.5a)$$

Gross Out-Migration Growth Rate Equation:

$$\frac{1}{\eta_{ot}} OTMR_{it} + \ln\left(OTM_{it-1}\right) = a_2\left(\frac{1}{\eta_{in}} INMR_{it} + \ln\left(INM_{it-1}\right)\right) + b_2\left(\frac{1}{\eta_{em}} EMPR_{it} + \ln\left(EMP_{it-1}\right)\right)$$
$$+ c_2\left(\frac{1}{\eta_{ge}} GEXR_{it} + \ln\left(GEX_{it-1}\right)\right) + d_2\left(\frac{1}{\eta_{mh}} MHYR_{it} + \ln\left(MHY_{it-1}\right)\right) + \sum_{k_2=6}^{K_2} x_{2k_2} \ln\left(\mathrm{X}_{k_2 it}^{in}\right)$$
$$\rightarrow OTMR_{it} = \eta_{ot}\left\{a_2\left(\frac{1}{\eta_{in}} INMR_{it} + \ln\left(INM_{it-1}\right)\right) + b_2\left(\frac{1}{\eta_{em}} EMPR_{it} + \ln\left(EMP_{it-1}\right)\right)\right.$$
$$\left. + c_2\left(\frac{1}{\eta_{ge}} GEXR_{it} + \ln\left(GEX_{it-1}\right)\right) + d_2\left(\frac{1}{\eta_{mh}} MHYR_{it} + \ln\left(MHY_{it-1}\right)\right) + \sum_{k_2=6}^{K_2} x_{2k_2} \ln\left(\mathrm{X}_{k_2 it}^{in}\right) - \ln\left(OTM_{it-1}\right)\right\}$$

$$\rightarrow OTMR_{it} = \beta_{21} INMR_{it} + \beta_{22} EMPR_{it} + \beta_{23} GEXR_{it} + \beta_{24} MHYR_{it} + \gamma_{21} \ln\left(INM_{it-1}\right) + \gamma_{22} \ln\left(OTM_{it-1}\right)$$
$$+ \gamma_{23} \ln\left(EMP_{it-1}\right) + \gamma_{24} \ln\left(GEX_{it-1}\right) + \gamma_{25} \ln\left(MHY_{it-1}\right) + \sum_{k_2=6}^{K_2} \gamma_{2k_2} \ln\left(\mathrm{X}_{k_2 it}^{in}\right) \qquad (4.5b)$$

Business (Employment) Growth Rate Equation

$$\frac{1}{\eta_{em}}EMPR_{it}+\ln\left(EMP_{it-1}\right)=a_3\left(\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\right)+b_3\left(\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\right)$$
$$+c_3\left(\frac{1}{\eta_{ge}}GEXR_{it}+\ln\left(GEX_{it-1}\right)\right)+d_3\left(\frac{1}{\eta_{mh}}MHYR_{it}+\ln\left(MHY_{it-1}\right)\right)+\sum_{k_3=6}^{K_3}x_{3k_3}\ln\left(X_{k_3it}^{in}\right)$$
$$\rightarrow EMPR_{it}=\eta_{em}\left\{a_3\left(\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\right)+b_3\left(\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\right)\right.$$
$$\left.+c_3\left(\frac{1}{\eta_{ge}}GEXR_{it}+\ln\left(GEX_{it-1}\right)\right)+d_3\left(\frac{1}{\eta_{mh}}MHYR_{it}+\ln\left(MHY_{it-1}\right)\right)+\sum_{k_3=6}^{K_3}x_{3k_3}\ln\left(X_{k_3it}^{in}\right)-\ln\left(EMP_{it-1}\right)\right\}$$

$$\rightarrow EMPR_{it}=\beta_{31}INMR_{it}+\beta_{32}OTMR_{it}+\beta_{33}GEXR_{it}+\beta_{34}MHYR_{it}+\gamma_{31}\ln\left(INM_{it-1}\right)+\gamma_{32}\ln\left(OTM_{it-1}\right)$$
$$+\gamma_{23}\ln\left(EMP_{it-1}\right)+\gamma_{34}\ln\left(GEX_{it-1}\right)+\gamma_{35}\ln\left(MHY_{it-1}\right)+\sum_{k_3=6}^{K_3}\gamma_{3k_3}\ln\left(X_{k_3it}^{in}\right) \qquad (4.5c)$$

Local Government Expenditure Growth Rate Equation:

$$\frac{1}{\eta_{ge}}GEXR_{it}+\ln\left(GEX_{it-1}\right)=a_4\left(\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\right)+b_4\left(\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\right)$$
$$+c_4\left(\frac{1}{\eta_{em}}EMPR_{it}+\ln\left(EMP_{it-1}\right)\right)+d_4\left(\frac{1}{\eta_{mh}}MHYR_{it}+\ln\left(MHY_{it-1}\right)\right)+\sum_{k=1}^{K_4}x_{4k}\ln\left(X_{kit}^{in}\right)$$
$$\rightarrow GEXR_{it}=\eta_{ge}\left\{a_4\left(\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\right)+b_4\left(\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\right)\right.$$
$$\left.+c_4\left(\frac{1}{\eta_{em}}EMPR_{it}+\ln\left(EMP_{it-1}\right)\right)+d_4\left(\frac{1}{\eta_{mh}}MHYR_{it}+\ln\left(MHY_{it-1}\right)\right)+\sum_{k_4=6}^{K_4}x_{4k_4}\ln\left(X_{k_4it}^{in}\right)-\ln\left(GEX_{it-1}\right)\right\}$$

$$\rightarrow GEXR_{it}=\beta_{41}INMR_{it}+\beta_{42}OTMR_{it}+\beta_{43}EMPR_{itit}+\beta_{44}MHYR_{it}+\gamma_{41}\ln\left(INM_{it-1}\right)+\gamma_{42}\ln\left(OTM_{it-1}\right)$$
$$+\gamma_{43}\ln\left(EMP_{it-1}\right)+\gamma_{44}\ln\left(GEX_{it-1}\right)+\gamma_{45}\ln\left(MHY_{it-1}\right)+\sum_{k_4=6}^{K_4}\gamma_{4k_4}\ln\left(X_{k_4it}^{in}\right) \qquad (4.5d)$$

Median Household Income Growth Rate Equation:

$$\frac{1}{\eta_{mh}}MHYR_{it}+\ln\left(MHY_{it-1}\right)=a_5\left(\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\right)+b_5\left(\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\right)$$
$$+c_5\left(\frac{1}{\eta_{em}}EMPR_{it}+\ln\left(EMP_{it-1}\right)\right)+d_5\left(\frac{1}{\eta_{ge}}GEXR_{it}+\ln\left(GEX_{it-1}\right)\right)+\sum_{k_5=1}^{K_5}x_{5k_5}\ln\left(\mathrm{X}_{k_5it}^{in}\right)$$
$$\rightarrow MHYR_{it}=\eta_{mh}\left\{a_5\left(\frac{1}{\eta_{in}}INMR_{it}+\ln\left(INM_{it-1}\right)\right)+b_5\left(\frac{1}{\eta_{ot}}OTMR_{it}+\ln\left(OTM_{it-1}\right)\right)\right.$$
$$\left.+c_5\left(\frac{1}{\eta_{em}}EMPR_{it}+\ln\left(EMP_{it-1}\right)\right)+d_5\left(\frac{1}{\eta_{ge}}GEXR_{it}+\ln\left(GEX_{it-1}\right)\right)+\sum_{k_5=6}^{K_5}x_{5k_5}\ln\left(\mathrm{X}_{k_5it}^{in}\right)-\ln\left(MHY_{it-1}\right)\right\}$$

$$\rightarrow MHYR_{it}=\beta_{51}INMR_{it}+\beta_{52}OTMR_{it}+\beta_{53}EMPR_{it}+\beta_{54}GEXR_{it}+\gamma_{51}\ln\left(INM_{it-1}\right)+\gamma_{52}\ln\left(OTM_{it-1}\right)$$
$$+\gamma_{53}\ln\left(EMP_{it-1}\right)+\gamma_{54}\ln\left(GEX_{it-1}\right)+\gamma_{55}\ln\left(MHY_{it-1}\right)+\sum_{k_5=6}^{K_5}\gamma_{5k_5}\ln\left(\mathrm{X}_{k_5it}^{in}\right) \qquad (4.5e)$$

Equations (4.5a)-(4.5e) are the structural equations of the basic simultaneous-equations model which constitute the basis for the empirical work reported in this study.

3. DATA TYPE AND SOURCES

The data for the empirical analysis is for all 418 Appalachian counties, which have been collected and compiled from County Business Patterns, Bureau of Economic Analysis, Bureau of Labor Statistics, Current Population Survey Reports, County and City Data Book, U.S. Census of Population and Housing, U.S. Small Business Administration, and Department of Employment Security. County-level data for employment, gross in-migration, gross out-migration, local government expenditures and median household income have been collected for 1990 and 2000. In addition, data for a number of control variables have been collected for 1990 from the different sources (see table 1 for the data description).

Dependent Variables

The dependent variables used in the empirical analysis include growth rate of employment, growth rate of gross in-and out-migration, growth rate of median household income and growth rate of per capita direct local government expenditures.

Growth Rate of Employment (EMPR): The growth rate of employment is measured by the log-difference between the 2000 and the 1990 levels of private non-farm employment. It is used as a proxy for the growth rate of small business. The justification for this measure is based on the results from empirical studies that indicate that newly created jobs are generated by new businesses that start small (Acs and Audretsch, 2001; Audretsch *et al*., 2000; Carree and Thurik, 1998, 1999; Wennekers and Thurik, 1999; Fritsch and Falck, 2003). Research by the U.S. Small Business Administration also shows that job creation capacity in the U.S. is inversely related to the size of the business. Between 1991 and 1995, for example, the net jobs created in enterprises employing fewer than 500 people was 3.843 million (1-4), 3.446 million (5-19), 2.546 million (20-99), and 1.011 million (100-499), respectively; whereas enterprises employing 500 or more people lost 3.182 million net jobs (U.S. Small Business Administration, 1999).

Growth Rate of Gross In-Migration (INMR): The growth rate of gross in-migration is measured by the log-difference between the levels of gross in-migration into a given county in 2000 and in 1990.

Growth Rate of Gross Out-Migration (OTMR): The growth rate of gross out-migration is measured by the log-difference between the levels of gross out-migration away from a given county in 2000 and in 1990. The gross in- and gross out-migration variables are used as measures of migration behavior in contrast to the use of net-migration. The use of both gross in-migration and gross out-migration variables is preferable to the use of variable relating to net-migration (see Bowman and Myers (1967) and Sjaastad (1962) for details on this issue). Greenwood (1975) also argued that the use of net-migration concept would involve a substantial loss of information and posses no apparent advantages that cannot also be achieved by regarding the effects of net migration as the sum of the effects of gross in- and gross out-migration. Note that the effects of migration on the sending and on the receiving counties depend critically on the characteristics of the migrants themselves and for any county in-migrants and out-migrants are not likely to have identical characteristics. Moreover, certain variables that are relevant to explaining gross in-migration are not relevant to explaining gross out-migration and the magnitudes of the influence of certain variables on gross in-migration is likely to be different from the magnitudes of these variables on gross out-migration. The models employed in this study attempt to explain the determinants and consequences of gross in- and gross out-migration without the explicit introduction of an individual decision functions. Rather, gross in- and gross out-migration are related to a number of aggregate variables.

Growth Rate of Median Household Income (MHYR): The log-difference between the 1999 and the 1989 levels of median household income in a given county are used to measure the growth rate of median household income. Median household income is used as an average overall measure of county-level income. Median household income is preferable to using the mean or average household income figure, because unlike the mean the median is not influenced by the presence of few extreme values.

Growth Rate of Direct Local Government Expenditures (GEXR): . Local governments spend money on local public services such as education, recreation, police, infrastructure, and others. The total local government expenditures at county-level on local public services divided by the total county population is used as a measure of local public services. The growth rate of direct local government expenditures per capita is measured by the log-difference between the 2002 and the 1992 levels of per capita local government expenditures.

Independent Variables

A number of independent variables are used in the empirical analysis. These variables include demographic, human capital, labor market, housing, industry structure, and amenity and policy variables. In line with the literature, unless otherwise indicated, the initial values of the independent variable are used in the analysis. This type of formulation also reduces the problem of endogeneity. All the independent variables are in log form except those that can take negative or zero values. The descriptions of each of the independent variables of the models are given below.

Equations (1.4a) and (1.4b) contain vectors $\mathbf{X}^{in}_{k_1 t-1}$ and $\mathbf{X}^{ot}_{k_2 t-1}$, for $k_1 = 1,...,K_1$, and , $k_2 = 1,...,K_2$ that include exogenous variables, which are believed to affect gross in-migration into and gross out-migration from a county, respectively. These include: county unemployment rate (UNEMP), county area (AREA), county initial population size (POPs), percentage of owner occupied dwelling (OWHU), median contract rent of housing cost (MCRH), Natural Amenity Index (NAIX)[2], and local public expenditures per capita per unit of personal income tax per capita (EXTAX).

[2] I use the Natural Amenity Index from http://www.ers.usda.gov/Data/NaturalAmenities/natamenf.xls created by David A. McGranahan (1999) from standardized mean values of climate measures (January temperature, January days of sun, July temperature, and July humidity), topographic variation and water area as proportion of county area.

The county unemployment rate (UNEMP) indicates the extent of economic distress in the county and it is expected to exert a negative influence on net migration. POPs is included to account for the positive impacts of the potential spillover effects and good economic opportunities that are associated with larger population areas on migration. OWHU is included to measure community stability and neighborhood quality which are potential attractions to migrants. MCRH is included to account for the potential impacts the cost of renter occupied housing on in-migration. To account for the differential impact of the quality of places on migration behavior, NAIX is included in both equations. How much of the tax paid is put back in the form of local public service may be more important in influencing migration behavior than the absolute amount of tax paid. EXTAX is included in both equations to account for this type of differential effects on migration behavior.

Equation (1.4c) includes a vector of control variables ($\mathbf{X}_{k_3 t-1}^{em}$) for $k_3 = 1,...,K_3$, which consists of, among others, human capital, agglomeration effects, unemployment, and other regional socio-economic variables that are assumed to influence county employment growth (business growth) rate. Human capital is measured as the percentage of adults (over 25 years old) with college degrees and above (POPCD), and the percentage of adults (over 25 years old) with high school diploma (POPHD) and it is expected that educational attainment is positively associated with employment growth (business growth). To control for agglomeration effects from both the supply and demand sides, the percentage of the population between 25 and 44 of age (POP25-44) is included and it is expected that agglomeration effects to have a positive impact on employment growth (business growth). The proportion of female household header families (FHHF) is included to control for the effect of local labor market characteristics on employment. The county unemployment rate (UNEMP) is also included as a measure of local economic distress. Although a high county unemployment rate is normally associated with a poor economic environment, it may provide an incentive for individuals to form new businesses that can employ not only the owners, but also others. Thus, we don know a priori whether the impact of UNEMP on employment growth is positive or negative. Establishment density (ESBd), which is the total number of private sector establishments in the county divided by the total county's population, is included to capture the degree of competition among firms and crowding of businesses relative to the population. The coefficient on ESBd is expected to be negative. Vector $\mathbf{X}_{k_3t-1}^{em}$ also includes OWHU to capture the effects of the availability of resources to finance businesses and create jobs on employment growth in the county. The percentage of owner-occupied dwellings is expected to be positively associated with employment growth in the county. Also included in $\mathrm{X}_{k_3it-1}^{em}$ are property tax per capita (PCPTAX), percentage of private employment in manufacturing (MANU), percentage of private employment in whole sale and retail trade (WHRT), Social Capital Index (SCIX)[3] , NAIX, and highway density (HWD).

The vector of exogenous variables ($\mathbf{X}_{k_4t-1}^{ge}$), $k_4 = 1,...,K_4$ in equation (1.4d) contains POPs, percentage of school age population (POP5-17), Serious Crime per

[3] I thank Anil Rupasingha, Stephan J. Goetz and David Freshwater (2006) for allowing me to use their data set on Social Capital Index for U. S. counties. They created a social capital index at the county-level by extracting principal components from associational density (associations such as civic groups, religious organizations, sport clubs, labor unions, political and business organizations), percentage of voters who vote for presidential elections, county-level response rate to the Census Bureau's decennial census, and the number of tax-exempt non-profit organizations

100,000 population (SCRM), Direct Federal Expenditure and Grants Per Capita (DFEG), Per Capita Personal Income Tax (PCTAX), Per Capita Long-Term Outstanding Debt (PCLD), and Per Capita Long-Term Debt (LTD).

Equation (1.4e) also contains a vector of exogenous variables ($\mathbf{X}_{k_5 t-1}^{mh}, k_5 = 1,...,K_5$), which includes, among others, POPs, POPs^2, FHHF, POPHD, UNEMP, MANU, WHRT, and SCIX.

The initial levels of employment (EMPt-1), gross in-migration (INMt-1), gross out-migration (OTMt-1), median household income (MHYt-1) and direct local government expenditures per capita (GEXt-1) are also included in the respective equations of (1.4a)-(1.4e). These variables are treated as predetermined variables because their values are given at the beginning of each period and hence are not affected by the endogenous variables. Table 1 provides the full list of the endogenous, the spatial lag and control variables, their descriptions and the sources of the data.

4. RESULTS AND ANALYSES

Generalized Method of Moments is the most efficient among the Full-Information method of estimating system of equations. It is robust estimator, in the sense that, unlike maximum likelihood estimation, it does not require information on the exact distribution of the disturbances. In the cross-section setting, White’s heteroskedasticity consistent covariance matrix is used as weighting matrix in estimating the coefficients of the model. The GMM estimates of (4.8a) for the 1990-2000 Appalachian data sets are given Table 3.

Employment (Business) Growth Rate

The growth rate in private employment (EMPR), which is the proxy for the rate of growth in small business, is regressed on the endogenous variables of the model and on a set of county-level conditioning variables related to labor market characteristics, industry structure, such as the proportion, demographic variables, policy variables, amenity and accessibility index variables, as well as the initial employment condition.

The results indicate some level of positive *feedback simultaneities* between EMPR and the endogenous variables. Particularly, the rate of growth in employment is positively and significantly affected by the rate of growth in median household income (MHYR) at the county-level during the study period. This is consistent with economic theory and empirical findings in the literature (Armington and Acs, 2002). Increases in median household income tend to increase regional wealth and consumer demands for goods and services increases as wealth increases. The growth of the market demand in turn encourages the formation small businesses. Increases in median household income could also lead to capital formation in the form of household savings that finance new firm formation.

The formation and expansion of businesses creates employment opportunity and income for the new and the expanding entrepreneurs. These increases in labor and entrepreneurial incomes, in turn, feed *back* into the MHYR equation and further leads to an increase in median household income. This is shown by the positive and highly significant coefficient estimate on the EMPR in the MHYR equation.

To control for agglomeration effects, the model includes measure of population statistics such as the percentage of population between 25 and 44 years old (POP25_44).

The results show that POP25_44 has positive and significant effects on EMPR. This result is consistent with the literature (Acs and Armington, 2004a) which indicates that a growing population increases the demand for consumer goods and services, as well as the pool of potential entrepreneurs which encourage business formation. This result is important from a policy perspective because it indicates that counties with high population concentration are benefiting from the resulting agglomerative and spillover effects that lead to localization of economic activities, in line with Krugman's (1991a, 1991b) argument on regional spillover effects. Consistent with the theoretical expectations, the results also show initial human capital endowment as measured by the percentage of adults (over 25 years old) with college degree (POPCD) is positive and statistically significant at one percent level. Highly educated people in most case have more access to research and development facilities, and perhaps a good insight to the business world and thus a clear idea about the present and the future needs of the market. As Christensen (2000) contends, entrepreneurs with good education are also more likely to know how to transform innovative ideas into marketable products. Thus, people with more educational attainment tend to establish businesses, and to be more successful when they do, more often than those with less educational attainments. This result is also consistent with Acs and Armington's (2004b) findings which indicates that the agglomerative effects that contribute to new firm formation could come from the supply factors related to the quality of local labor market and business climate. More educated people would mean more human capital embodied in their general and specific skills, for implementing new ideas for creating and growing new businesses. One possible implication of these findings is that regions or counties with different levels of human capital endowment and different propensities of locally available knowledge to spill over and stimulate new firm formation tend to have different rates of new firm formation, survival and growth. The percent of female householder families (FHHF) is another conditioning demographic variable included in the model. Female householder families tend to have low labor participation rate. Although insignificant, our results show that FHHF has negative impact on EMPR, consistent with theoretical expectations and empirical findings. FHHF affects both the supply-side (as source of labor input) and the demand-side (as source of demand for consumer goods) of the market.

The coefficient on the variable representing the percentage of home owned by their occupants (OWHU) is positive, although insignificant. This result indicates that high home ownership is positively associated with business formation in Appalachia. This is consistent with theoretical expectation that high home ownership is an indication that there is a capacity to finance new business by potential entrepreneurs, either by using the house as collateral for loan or as indication of availability of personal financial resources to start new businesses.

The percentage of people employed in manufacturing (MANU) and the percentage of people employed in wholesale and retail trade (WHRT) are included in the EMPR equation to control for the influence of sectoral concentration of employment on the overall employment of business growth rate. The coefficient on MANU is negative and statistically significant at ten percent level, indicating an inverse relationship between growths in over all employment or business expansion and manufacturing employment. This is not unrealistic finding when we consider the fact that manufacturing has been declining in relative terms during the 1990’s as a result of industrial restructuring. The coefficient on WHRT, on the other hand, is positive and significant at the one percent level, indicating the positive role played by the service sector in expanding employment and business in Appalachia during the study period. This is not also unrealistic because the 1980's industrial restructuring has led to a shift from manufacturing into services, encouraging service sector employment growth.

The coefficient on the per capita property income tax (PCPTAX) is negative and significant at almost the 5 percent level. Note that property tax has both direct cost and input mix effects which have opposing effects on employment and business expansion. Property tax could be levied on land or on capital or on both. The direct cost effect on location decision is negative. Once location is determined, the input mix effect could, however, be in the opposite direction. An increase in property tax in capital could push existing firms towards land and labor-intensive industries, expanding employment opportunities. Similarly, an increase in property tax on land could push existing firms towards capital and labor-intensive industries, again, expanding employment opportunities. Thus, in *a priori*, the impact of property tax on business growth and employment is at best ambiguous. The negative coefficient in this study is an indication that the negative direct cost effect dominates the input mix effect, indicating per capita property income taxes have been associated with low business formation and employment growth rate in Appalachia during the study period.

The coefficient on the natural amenity index (NAIX) is positive, but statistically insignificant. This result is consistent with McGranahan (1999) who found weaker overall association between natural amenities and employment change. High-way density (HWD) is included in the EMPR equation to measure the influence of accessibility to business and employment growth. The positive and statistically significant coefficient on HWD shows a positive association between the concentration of roads and employment growth. This result suggests that Appalachian counties with higher road densities show increases in the growths of employment, compared to counties with low road densities, during the study period. This finding is consistent with both theory and empirical findings (see Carlino and Mills, 1987).

Establishment density (ESBd), which is the total number of private sector establishments in the county divided by the total county's population, is included in our model to capture the degree of competition among firms and crowding of businesses relative to the population. The coefficient on ESBd is negative and significant indicating that Appalachia region has reached the threshold where competition among firms for consumer demands crowds businesses. According to the results, high ESBd is associated with low growth in employment (business growth), indicating that firms tend not to locate near each other possibly due to high competition for local demand.

Finally, the elasticity of EMPR with respect to the initial employment level (EMPt-1) is negative and statistically significant indicating convergence in the sense that counties with initial low level of employment at the beginning of the period (1980) tend to show higher rate of growth of business than counties with high initial level of employment conditional on the other explanatory variables in the model. This result supports prior results of rural renaissance in the literature (Deller *et al.*, 2001; Lundberg, 2003).

Gross In-Migration Growth Rate

The results from the INMGR equation also indicate that the growth rate of gross in-migration into a county is strongly dependent on the growth rates of employment, median household income and direct local government expenditures. These interdependences are explained by the highly statistically significant coefficients on the endogenous variables of the model. The coefficient on the EMPR in the INMGR equation, for example, is positive and significant at the one percent level. The coefficient on INMR in the EMPR equation is also positive, although not significant. These indicate that counties with high levels of in-migration are favorable for small business growth and the growth in small business further encourages in-migration into the counties. But note that the attractive effect of business growth (employment) is more than the effect of gross in-migration on employment as indicated by the level of the coefficients on the respective variables. This result is consistent with the Todaro-thesis of rural-urban migration. A single job opening encourages more than one migrant. The results also support previous findings from the human- capital-based migration researches where migration is viewed as an investment and that real income and the probability of employment as important determinants of interregional migration (Greenwood and Hunt, 1989; Lundberg, 2003). Although one would expect in-migrants and out-migrants to have different characteristics which might lead to have a situation in which counties with high/low gross in-migration growth rates are also counties with high/low gross out-migration growth rates, the results in Table 3 do not establish that relationship. The *feedback simultaneity* between gross out-migration and gross in-migration is not statistically significant.

The existence of strong interdependence between gross in-migration rate and median household income growth rate is reflected by the statistically significant coefficients on the variables in the respective equations. Gross in-migration growth rate in a given county is positively and significantly affected by the growth rate of median household income in that county. This result is consistent with theoretical expectations in that growing income counties can support large market demand for business expansion that can encourage in-migrants who look for the newly crated jobs. Besides, growing income counties can support a lager tax bases that enable local governments to raise enough finance to provide quality public services. These taxes could capitalize into local amenities that attract new residents. The result also supports previous empirical findings by Greenwood (1975, 1976), and Lundberg (2003) who analyzed the relationship between interregional migration and the growth of median income.

Consistent with theoretical expectations, the results in Table 3 also indicate a strong negative interdependence between gross in-migration growth rate (INMGR) and the growth rate in local public expenditures (DGEXR). The coefficient on DGEXR in the INMGR equation is negative and statistically significant at the 5 percent level. This result supports previous migration researches in both the Tiebout (1956) and non-Tiebout tradition Local government expenditures that are financed through higher taxes, particularly property taxes, tend to deter in-migration and encourage out-migration. The property taxes have their deterrent effects on in-migration through changes in employment as discussed above. Previous studies by Mead (1982) and Schachter and Athaus (1989) have also generated similar results. The implications of this finding is that many poorer communities in Appalachian region which are forced to levy higher taxes to finance local public services at a certain level would not be able to attract people and even loose people. As the counties/communities continue to lose people, the per capita tax price of local public service for the remaining population increases which further leads to deterioration in the respective communities.

The population size (POPs) at the initial period has a positive and strong effect on in-migration into a given county. The positive and statistically significant coefficient on POPs is an indication that people migrate to areas (counties) with high concentration of population. Note also that the coefficient on POPs in the out-migration equation is positive and statistically significant at one per cent level, indicating that counties with high population concentration encourage out-migration and vice versa. These two results suggest that Appalachian counties with higher initial population sizes were both destinations and sources of migrants during the study period. This situation is possible because out-migrants and in-migrants could be people with different labor market characteristics.

County unemployment rate (UNEMP) is included in the vector of exogenous variables as a measure of local economic distress. The results suggest that high unemployment rate in a given county is associated with low gross in-migration growth rate in that county. This result is consistent with the theoretical expectations and empirical results in the migration literature. Economic theory postulates that job seekers are expected to move from high –unemployment regions where they cannot find a job to low-unemployment regions where the prospects of finding employment are more favorable. Research results from a number of studies have also supported this proposition

(Carlino and Mills, 1987; Gabriel et al., 1995; Hunt, 1993; Herzog, Schlottman and Boehm, 1993; Hamalainen and Bockerman, 2004).

The coefficient on the MCRH (Median Contract Rent of Specified Renter-Occupier) is positive and statistically significant at the one percent level. This is not consistent with the theoretical expectations. One would normally expect that an increase in the cost of rental housing would discourage in-migration by increasing the cost of migration. But it is important to look at MCRH as representing both the availability as well as the cost of rental housing. The expectation that increases in the cost of rental housing to discourage in-migration is based on the assumption that enough rental housing is available in all potential in-migration regions. The availability and the cost (affordability) of rental housing have opposing effects on in-migration. The result in this study suggests that the positive effect of availability dominates the negative effect of rental cost. This observation gives support to the results in Hamalainen and Bockerman, (2004) that suggested a lack of rental housing in potential in-migration regions deter out-migration from high unemployment regions.

The coefficient on the natural amenity index (NAIX) failed to be significant and showed unexpected sign. This result might suggest that Appalachia was not a destination for amenity-based migration. The coefficient on EXTAX is statistically significant showed unexpected sign. The EXTAX variable is derived by dividing the per capita local government expenditures by the per capita income taxes. Normally, one would expect high local expenditures on public services to encourage in-migration. But this out come is sensitive to the nature of government spending. High per capita spending in education, health and crime prevention induces in-migration. One possible explanation of the unexpected sign could, thus, be that although overall EXTAX could be high, per capita spending on those public services which induce in-migration might actually be low.

Finally, the coefficient on INMGt-1 is negative and statistically significant indicating convergence in the sense that counties with initial low level of in-migration at the beginning of the period (1990) tend to show higher rate of growth of INMG than counties with high initial gross in-migration conditional on the other explanatory variables in the model.

Gross Out-Migration Growth Rate

The results from the out-migration equation also show similar trends. The *feed-back simultaneities*, however, are not strong. Only EMPR shows statistically significant effect on OTMGR. The coefficients on INMGR and DGEX are negative but statistically insignificant. The coefficient on MHYR is positive but also insignificant.

Similar to the case of in-migration growth rate equation, the coefficients on initial population size (POPs) and county area (AREA) are positive and statistically significant at one percent level. This result indicates that counties with high initial population sizes have experienced high growth in out-migration rate.

The impact of home ownership on out-migration is negative and significant which is consistent with the theoretical expectations. Normally, one would expect that owing a house to decrease the propensity to migrate due to the transaction cost and liquidity of real estate in location of economic distress. Investing in own housing may also reflect a decision to stay in the area of current residence for long. The estimated results also show a positive and statistically significant (at the one per cent level) coefficient on OWHU.

This result indicates that home ownership is negatively associated with out-migration in Appalachia during the study period.

The coefficient on UNEMP shows an unanticipated sign and yet statistically significant at the one percent level. Normally, one would expect that people to move away from high-unemployment counties to low-unemployment counties. The result in Table 3, however, suggests that the growth rate of out-migration (OTMGR) in a given county is negatively associated with the initial level of unemployment in that county. One possible explanation of this observation, similar to what Lansing and Mueller (1967) have argued, is that unemployment tends to be highest in the least mobile groups in the labor force. It should also be noted that prospective unemployment rather than the level of unemployment rate is the major determinant of migration. Besides, the lack of rental housing in the potential in-migration counties/regions could deter out-migration from the high-unemployment counties/regions.

Similar to the case in the INMGR equation, the coefficient on the NAIX neither is statically significant nor has the expected sign. Normally, one would expect NAIX to have negative influences on OTMGR. But, it is important to note that migrations are usually motivated by the altered demand for amenities that are sight-specific. In this respect, amenity data at the county level is highly aggregated and may not reflect the true interdependence between OTMGR and NAIX.

The results in Table 3 also show that an increase in EXTAX discourages out-migration from a given county. This is indicated by the significant negative coefficient on the EXTAX variable. This result suggests that the more local government puts tax money back to society in the form of local public services, the more people want to stay in that jurisdiction. This has significant implications from a policy perspective because, it not only encourages people to stay but it can also encourage people to come and stay which in turn help check a declining population. Otherwise, a declining population not only increases the cost of providing local public services but also constrains the expansion and growth of small business by limiting the supply of labor and the demand for small business products. Low quality and quantity of public services also reduces the earning capacity of residents and discourages small business growth and employment. The ultimate result is the perpetuation of poverty and underdevelopment Appalachia.

Finally, the results presented in Table 3 indicate the existence of significant conditional convergence in the out-migration growth rate equation. This is indicated by the negative and statistically significant coefficient on the lagged dependent variable for out-migration (OTMGt-1). Conditioned upon the other exogenous variables that are included in the OTMGR equation, counties with low initial level of out-migration showed higher growths in out-migration growth rates compared to counties with higher initial levels of out-migration.

Median Household Income Growth Rate

Similar to the results in the other equations, the estimates from the MHYR equation show the existence of significant *feedback simultaneity*. Two of the endogenous variables have statistically significant effect on the growth rate median household income (MHYR). The contemporaneous effect with respect to the rate of growth in employment (EMPR) on median household income, for example, is positive and statistically significant at the one percent level. This result indicates that high growth rate in median household income is positively associated with high growth rate of employment which is consistent with the expectations of economic theory. The contemporaneous effect with respect to the growth rate of in-migration (INMGR) on the growth rate of median household income was negative and statistically significant at the one percent level. This result indicates that the growth rate of median household income in a given county is negatively associated with the growth rate of in-migration to that county. This, in turn, suggests that the average incomes of the in-migrants were lower than that of the median incomes of the non-movers. The contemporaneous effect with respect to the growth rate of out-migration (OTMGR) on the growth rate of median household income is positive, but statistically insignificant. Although the impact would be insignificant, this result suggests that median household income decreases with out-migration. This, in turn, would mean that the average income of the out-migrants was lower than that of the median income of the non-movers. These two results, thus, suggests, compared to the non-movers, the movers were poor. Based on these results, it is, therefore, possible for one to claim that the population movements in Appalachia during the study period were, on average, for economic reasons.

Turning to the conditioning variable in the MHYR equation, the results indicates that the rate of growth in median household income is negatively and significantly affected by the percentage of families with female family householder (FHHF), the unemployment rate (UNEMP), and the social capital index (SCIX). POPs is also negatively associated with MHYR, but insignificantly. Due to the beneficial effects of agglomeration economies of firm location, one would normally tend to expect that POPs to have positive effect on median household income. A growing population captures the extent to which counties are relatively attractive to migrants and a growing population increases the demand for consumer services which in turn leads to growth in business and employments, which are themselves sources of income to the county. The coefficient on the index of social capital (SCIX) is negative and significant indicating that counties with high level of social capital decrease the well-being of their communities. This result is not consistent with the expectation of economic theory. But remember that social capital index is a composite of many factors of which ethnic homogeneity, income inequality, community attachment and homeownership are the major components. These elements are more experienced in rural and small Appalachian communities where median household income is traditionally very low, compared to metropolitan communities. The negative association of social capital index and the rate of growth of median household income could be the refection of this fact in Appalachia. The negative effect of the FHHF on MHYR, however, is consistent with theoretical expectations. Although the proportion of female family householder per se is not what is important, research results show that poverty increases with an increase in the proportion of female headed householder in a community. Female headed households tend to have low human capital, low labor participation rate and hence lower income earning capacities. The negative relationship between the rate of growth in median household income and FHHF is, therefore, a reflection of this fundamental economic fact in Appalachia.

As expected, the coefficient on the variable that measures the proportion of the population 25 years and above with high school or above diploma (POPHD) is positive and statistically significant at the one percent level. Human capital theory postulates that entrepreneurship is related to educational attainment and work experience. People with more educational attainments tend establish businesses and also have more probability of getting and securing higher paying jobs than those with low educational background. Although industrial restructuring in the 1980's has led to a shift from manufacturing to service based industries, the process has been low in Appalachia and manufacturing remained as a major source of income compared to service industries. The positive and statistically highly significant coefficient on MANU supports this assertion. Note, however, that this does not mean that manufacturing remained as a major employer during that period. Actually, as explained above, the declining trend in manufacturing employment is supported by the results of this study.

Finally, the negative and statistically significant coefficient on MHYt-1 is an indication that there was conditional convergence with respect to the rate of growth in median household income in Appalachia during the study period. This means that counties with low initial median household income grew faster than counties with higher initial median household income.

Direct Government Expenditures Growth Rate

The growth rate of direct local government expenditures per capita (DGEXR) is regressed on the endogenous variables of the model and on a set of county-level conditioning variables related to demographic and policy environments, as well as on the initial condition of direct local government expenditures.

Similar to the results in the other equations, the estimates from the DGEXR equation show the existence of significant feed-back simultaneity. Three of the endogenous variables have statistically significant effect on the growth rate of direct local government expenditures per capita. The contemporaneous effect with respect to the rate of growth in out-migration (OTMGR) on direct local government expenditures per capita, for example, is positive and statistically significant at the one percent level. This result indicates that high growth rate in direct local government expenditures per capita is positively associated with high growth rate of out-migration which is consistent with expectations of economic theory. Migration has important impacts on the demand of locally provided public goods and services as well as on the revenue that support the provision of these public goods and services by changing the size and the density of population of a region or a county. Out-migration reduces the possibility of gaining economies of scale in the provision of public services. Excessive out-migration creates excess capacity and very high costs of maintaining overstock of public infrastructure, such as schools, police facilities, fire protection, etc., in the area of origin. The contemporaneous effect with respect to the growth rate of in-migration (INMGR) on the growth rate of direct local government expenditures per capita is negative and statistically significant at the ten percent level. This result indicates that the growth rate of direct local government expenditures per capita in a given county is negatively associated with the growth rate of in-migration to that county. One possible explanation for this observation is that in-migration may lead to increase in population and its density in the receiving region that enable local government to realize the advantages of economies of scale in the provision of public services. In that case, although total local government expenditures may increase, per capita could still decline if the advantages of economies of scale are realized. The contemporaneous effect with respect to the growth rate of employment (EMPR) on the growth rate of direct local government expenditures per capita is also negative as expected, but statistically insignificant. The coefficient on MHYR is negative and statistically significant at the ten percent level. This result is not consistent with the theoretical expectations. Increases in per capita income provide local governments with more tax revenues that support the provision of more public goods and services, which in turn lead to higher local public expenditures. The result does not give support to empirical findings in Painter and Bae (2001) that indicate a positive and significant impact of increases in per capita income on government expenditures.

As expected, the coefficient on POPs is negative, but not very significant. Economic theory postulates that the size of population plays important roles in per capita spending on non-rival goods such as transportation and communication as well as merit goods and other economic services. Although statistically speaking its impact could be not very strong, negative coefficient on POPs, thus, indicates the advantages of economies of scale in the provision of local public services in Appalachia during the study period. This result also supports empirical findings in Falch and Rastto (1997), Fay (2000), and Hashimati (2001) which show that population has negative coefficient.

The proportion of school age population denoted by POP5-17 is included in the model to control for the differential impact of population age structure on local government expenditures. As expected, the coefficient on POP5-17 is positive, although insignificant. Increases in the proportion of school age population create pressure for increase in local spending on education.

As expected, the coefficients on SCRM (serious crime per 100,000 population), and PCTAX (per capita income tax) are all positive and statistically significant at the 1, and 10 percent levels, respectively. These results indicate that (1) increases in SCRM leads to increases in local government expenditures in the form of police and crime prevention and protection expenses; and (2) since PCTAX is one of the components of local government the revenue, increases in PCTAX would provided local government with more money to spend on local public services. The coefficient on PCTD (total debt outstanding per capita) is negative and statistically significant at the one percent level. This result is consistent with theoretical expectations in that the amount of total debt outstanding accumulated constrain local governments their capacity to further borrow apart from their obligation to pay their debts now. The effect would be to decreases in local public expenditures. One of the components of local government revue is grants-in-aid from higher governments. To control for the impacts of this component, DFEG (direct federal expenditures and grants) is included in the model. Contrary to the theoretical expectations, the coefficient on DFEG is negative, although very insignificant. To control for the impacts of the ability of local government to borrow from external sources in order to finance the provision of local public services, LTD (Long-Term Debt per capita) is also included in the model. The coefficient on LTD is negative which is not consistent with theoretical expectations.

Finally, the negative and statistically significant coefficient on GEXt-1 is an indication that there was conditional convergence with respect to the rate of growth in direct local government expenditures in Appalachia during the study period. This means that counties with low initial direct local government expenditures had higher growth in direct local government expenditures than counties with higher initial direct local government expenditures.

5. CONCLUSIONS

Generally, the results from these model estimations are consistent with the theoretical expectations and empirical findings in the equilibrium growth literature and provide support to the basic hypotheses of this study. First, the estimates show the existence of some *feedback simultaneities* among the endogenous variables of the model. Second, the results also show the existence of conditional convergence with respect to the respective endogenous variable of each equation of the models. This is indicated by the negative and statistically highly significant coefficients on the lagged dependent variables of the models. This implied that the rates of growth of employment, gross in-migration, gross out-migration, median household income and direct local government expenditures were higher in counties that had low initial levels of employment, gross in-migration, gross out-migration, median household income and direct local government expenditures, respectively compared to counties with high initial levels of the same. The ten-year period speeds of adjustments are comparable to those in the literature and they range from 7.05 percent in the EMPR equation to 52.76 percent in the INMR equation.

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Table 1: Variable Description and Data Sources

Variable Code	Variable Description	Source
Endogenous Variables		
EMPR	Growth Rate of Employment, 1990-2000	Computed
INMR	Growth Rate of Gross In-Migration, 1990-2000	Computed
OTMR	Growth Rate of Gross Out-Migration, 1990-2000	Computed
MHYR	Growth Rate of Median Household Income, 1989-1999	Computed
GEXR	Growth Rate of Local Public Expenditures Per Capita, 1992-2002	Computed
Initial Condition Variables		
EMPt-1	Employment, 1990	County & City Data Book
INMt-1	In-migration, 1990	Internal Revenue Service
OTMt-1	Out-migration , 1990	Internal Revenue Service
MHYt-1	Median Household Income, 1989	Bureau of Economic Analysis
GEXt-1	Local Public Expenditures per Capita, 1992	U.S. Bureau of the Census
Regional and Policy Variables		
AREA	Land Area in square miles 1990	U.S. Bureau of the Census
POPs	Population ,1990	U.S. Bureau of the Census
POP2	Population-square,1990	U.S. Bureau of the Census
POP5-17	Percent of population between 5 -17 years , 1990	U.S. Bureau of the Census
POP25-44	Percent of population between 25 -44 years old , 1990	U.S. Bureau of the Census
FHHF	Percent of Female Householder, Family Householder, 1990	County & City Data Book
SCRM	Serious crime per 100,000 population, 1990	County & City Data Book
POPHD	Persons 25 years and over, % high school, 1990	County & City Data Book
POPCD	Persons 25 years and over, % bachelor's degree or above, 1990	County & City Data Book
OWHU	Owner-Occupied Housing Unit in percent, 1990	U.S. Bureau of the Census
MCRH	Median Contract Rent of Specified Renter-Occupied , 1990	U.S. Bureau of the Census
UNEMP	Unemployment Rate , 1990	Bureau of Labor Statistics
MANU	Percent employed in manufacturing , 1990	County & City Data Book
WHRT	Percent employed in wholesale and retail trade , 1990	County & City Data Book
DFEG	Direct Federal Expenditures and Grants per Capita,, 1992	County & City Data Book
PCTAX	Per Capital Local Tax , 1992	County & City Data Book
PCPTAX	Property Tax per Capita , 1992	County & City Data Book
PCTD	Total Debt Outstanding per capita , 1992	County & City Data Book
LTD	Long-Term Debt, Utility , 1992	County & City Data Book
SCIX	Social Capital Index , 1997	Rupasingha *et al*, 2006
NAIX	Natural Amenities Index 1980, 1990	USDA
HWD	Highway Density , 1990	US Highway Authority
ESBd	Establishment Density , 1990	County Business Pattern
EXPTAX	Personal Income Tax/Local General Expenditure, 1990	Computed

Table 2: Descriptive Statistics for Appalachia Counties, 1990-2000.

Variable	Description	Mean	Std Dev	Minimum	Maximum
EMPR	Growth Rate of Employment, 1990-2000	0.17672	0.24499	-0.69448	1.7868
INMR	Growth Rate of Gross In-Migration, 1990-2000	0.096241	0.24922	-0.92655	1.08588
OTMR	Growth Rate of Gross Out-Migration, 1990-2000	0.096679	0.22048	-1.09537	0.99832
MHYR	Growth Rate of Median Household Income, 1989-1999	0.47743	0.30826	-0.49426	1.39569
GEXR	Growth Rate of Local Public Expenditures Per Capita, 1992-2002	0.61617	0.44636	-0.54832	4.95896
AREA	Land Area in square miles ,1990	6.00903	0.74824	1.09861	7.27656
POPs	Population ,1990	10.29714	0.94766	7.87664	14.10553
POP2	Population-squared,1990	106.9271	19.95609	62.04143	198.9659
POP5-17	Percent of population between 5 -17 years ,1990	2.92443	0.12003	2.17475	3.22287
POP25-44	Percent of population between 25 -44 years old,1990	3.37993	0.077483	2.78501	3.74479
FHHF	Percent of Female Householder, Family Householder,1990	2.32185	0.20314	1.81143	3.18787
SCRM	Serious crime per 100,000 population ,1990	2284.809	1561.256	0	8487
POPHD	Persons 25 years and over, % high school,1990	4.10041	0.1706	3.56953	4.4682
POPCD	Persons 25 years and over, % bachelor's degree or above,1990	2.26938	0.40654	1.30833	3.7305
OWHU	Owner-Occupied Housing Unit in percent,1990	4.32524	0.076094	3.86703	4.47278
MCRH	Median Contract Rent of Specified Renter-Occupied ,1990	5.64139	0.20586	4.94164	6.35784
UNEMP	Unemployment Rate ,1990	2.15356	0.34816	1.22378	3.24649
MANU	Percent employed in manufacturing ,1990	26.24019	11.29556	2.2	53.6
WHRT	Percent employed in wholesale and retail Trade,1990	18.82775	3.53195	8.7	27.7
DFEG	Direct Federal Expenditures and Grants per Capita,1992	7.98688	0.3758	6.98286	10.1766
PCTAX	Per Capital Local Tax ,1992	5.91452	0.52985	4.50736	7.42253
PCPTAX	Property Tax per Capita ,1992	5.5236	0.61602	3.91202	7.36265
PCTD	Total Debt Outstanding per Capita ,1992	1180.022	2271.215	0	30332
LTD	Long-Term Debt, Utility ,1992	11728.35	71189.12	0	1368142
SCIX	Social Capital Index ,1990	-0.59298	0.95959	-2.5266	5.64457
NAIX	Natural Amenities Index ,1990	0.14333	1.15867	-3.72	3.55
HWD	Highway Density ,1990	0.69039	0.40412	-0.33914	2.63189
ESBs	Establishment Density ,1990	2.92833	0.3351	1.87398	4.09316
EXPTAX	Personal Income Tax/Local General Expenditure,1990	0.8429	0.51449	-0.98373	2.60823
EMPt-1	Employment,1990	8.82649	1.25425	5.42054	13.38131
INMt-1	Gross In-Migration,1990	7.08755	1.00192	4.54329	10.51994
OTMt-1	Gross Out-Migration,1990	7.03768	0.97551	4.49981	10.54952
MHYt-1	Median Household Income,1989	9.9439	0.2261	9.05894	10.68093
GEXt-1	Local Public Expenditures per Capita,1992	7.22576	0.27948	6.49224	8.10832

***Note**: All variables except SCRM, PCTD, LTD, SCIX and NAIX are in log form*

Table 3: GMM Estimation Results for Appalachian counties, 1990-2000

	EMPR Equation		**INMR Equation**		**OTMR Equation**		**MHYR Equation**		**GEXR Equation**	
VARIABLE	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
CONSTANT	-1.73219	-2.055814	-2.602709	-7.22641	0.66199	1.04846	2.518298	5.689111	2.933612	8.157871
EMPR			0.265548	3.480849	0.323431	5.257001	0.28171	13.29835	-0.029734	-0.45945
INMR	0.028631	1.24838			-0.02686	-1.2574	-0.063624	-5.380822	-0.043234	-1.87872
OTMR	0.098457	1.638707	0.041147	0.585952			0.006405	0.286269	0.174625	3.493331
MHYR	1.250831	7.939504	0.727382	3.810203	0.069065	0.471385			-0.215391	-1.75737
GEXR	0.022519	0.268154	-0.229958	-2.37357	-0.02902	-0.36146	-0.02397	-0.747794		
AREA			0.032563	1.769543	0.079316	4.797523				
POPs			0.496597	11.6411	0.308621	8.379891	-0.004277	-0.068481	-0.020427	-1.60074
POPd							0.00116	0.395829		
POP5_17									0.097096	1.218408
POP25_44	0.393721	3.107833								
FHHF	-0.027567	-0.550342					-0.055612	-2.364159		
POPHD							0.208222	8.621999		
POPCD	0.090716	2.427921								
OWHU	0.119479	0.759398			-0.35236	-2.86549				
MCRH			0.26988	4.5475						
UNEMP			-0.203022	-4.31667	-0.23367	-6.27791	-0.107239	-8.486429		
MANU	-0.002129	-1.738737					0.003817	11.66419		
WHRT	0.017512	4.860183					-5.53E-06	-0.003692		
SCRM									5.18E-05	4.254326
DFEG									-0.004878	-0.29012
PCTAX									0.037333	1.955211
PCPTAX	-0.030163	-2.443016								
PCTD									-1.90E-05	-2.48047
LTD									-1.73E-07	-0.30219
SCIX							-0.027566	-5.567816		
NAIX	-0.030163	-2.443016	-0.000652	-0.0684	0.00467	0.699106				
HWD	0.082095	3.671592								
ESBd	-0.058833	-1.964396								
EXTAX			-0.08167	-2.73952	-0.04296	-2.23125				
EMPt-1	-0.070469	-4.728455								
INMGt-1			-0.52764	-12.0241						
OTMGt-1					-0.34317	-10.0581				

MHYt-1							-0.290136	-8.371574		
DGEXt-1									-0.379066	-8.87604
ADJ.R^2	0.2829		0.5928		0.6144		0.4227		0.1154	
N	418		418		418		418		418	
Eta (η)	0.0705		0.5276		0.3432		0.2901		0.3791	
Half-Life	97.87		13.08		15.57		23.78		18.20	
PE Test	log		log		log		log		log	

Note: *A coefficient is considered as statistically significant at 10 percent, 5 percent and 1 percent levels ,if* $1.65 \leq |\text{t-stat.}| \leq 1.98$, $1.98 < |\text{t-stat.}| \leq 2.58$, and $|\text{t-stat.}| > 2.58$, *respectively.*