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Assessing Demographic Changes and Income Inequalities: A Case Study of West Virginia

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Abstract: The study examines the trends in demographic changes and income inequalities in West Virginia from 1990 to 2000. The relationship between economic growth and income inequality is tested using a system of equations model and county level data. The empirical results indicate that except for 65 years and above age group, income inequality increased in all other age groups. The highest increase was in the age group under 25 years and those 35 to 44 years. Using 3-Stage-Least-Squares estimations, the endogenous dependent variable per capita income growth was positively related with population and employment growth, but it is significantly and negatively related with income inequality measured by county level Gini index. This indicates that higher income inequality is associated with slower economic growth in West Virginia.

Key Words: Income inequality, growth modeling, population change, per capita income.

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Introduction

Historically, changes in the structure of demographic characteristics of communities have attracted interest to understand the causes and implications of such demographic changes. These changes in demographic structure have serious economic implications at the local, regional, and national levels; consequently, greater attention has been placed in understanding population dynamics.

Previous studies indicate many countries experience substantial changes in their demographic age structure that is mainly due to declining death and birth rates. Recent research has been focused on the implication of this demographic change in terms of increasing proportion of old age and its implications, shrinking labor force resulting from declining birth rates, and in terms of distribution of income to demographic cohorts. The distribution of income among age cohorts and its degree of inequality has been particularly significant in guiding such public transfer programs as healthcare and social security supports as their sustainability depends on the income distribution and inequality in the labor force.

Increased attention has recently been focused on the relative economic well-being of older and younger generations (Gist and Wu, 1996; Quinn, 1987, Palmer, et al., 1988; Radner 1994). Other studies concluded that higher income inequality is observed in aged as compared to younger population cohorts (Radner, 1995; Hurd, 1990; Crystal and Shea, 1990). However, Rubin, et al. (2000) argued that based on their data analysis between 1967 and 1997, elderly households achieved greater equality in income distribution and converged with the distribution of non-elderly groups. Similarly, Radner (1995) argued that for the 1967 to 1992 period analysis, income inequality among the elderly declined while it rose in the non-elderly cohorts. Though there are contradictory conclusions in different studies, the implication is far more important to restructuring current transfer programs in response to current income distribution and inequality by different age cohorts.

The distribution of income in demographic groups and the extent of its inequality are determined by a vector of different socio-economic factors. Rubin, et al. (2000) argued that income distribution and inequality are in part explained by the functioning of market systems, government policies, household choices, economic opportunities, and labor market experiences. For demographic cohorts in the labor force, income inequalities are primarily wage driven (Burtless, 1990; Danzinger and Gottshalk, 1995; Levy and Murnane, 1992).

The traditional economic theories of "life cycle analysis" and "permanent-income hypothesis" are important theories that explain income and consumption patterns. However, they offer little help in explaining income inequalities. More recent theories focus on household economic behavior and decision making that influence household income and inequality. Gary Becker (1991) argued that human capital is the main determinant of adult income, which is significantly influenced by parental economic endowment and public expenditure on children. Hence, the income of parents is a determinant factor of later life income distribution and inequality. In contrast, Frank (1997) concluded that in addition to absolute incomes, relative household position in income distribution significantly affects household decision-making and inequality.

Based on social security projections in the US, the old age dependency ratio will double by the year 2075 (Senate Budget Committee 2001). This rising ratio may lead to societal pressures for later retirement, and consequently may impose an increase in resource costs on the population.

The economic implication of demographic change and income inequality is not limited to reduced labor force or increased resource costs of old age population. The limit of local and state budgetary incomes would mean that government spending programs have to be prioritized among competing social programs. A growing old age community would require more local spending on old age support in social security and healthcare while a shrinking labor force would mean that the fiscal base is shrinking and local incomes are unstable. In the long run, such demographic reality may lead to increased taxes to support public services or reduced public services are provided to other age groups. This change has a lingering effect on the delivery of government financed education, health care and children's services in the domain of local and state governments (McGuire, 1995).

Integrating migration in the overall analysis complicates the whole picture. Following Tieboutian thinking, tax differentials among local governments may provide households the incentive to migrate to high service, less tax cost locations. For communities that face aging population and shrinking labor force base, an increase in taxes to support local programs may result in out-migration that may seriously impact the provision of basic local services like education and health care. Migration is an important element in understanding demographic changes. While both birth and death rates change slowly and predictably in time, migration rates can change rapidly at the local and state level over a shorter time interval (Smith, 1986).

At the macro level, skewed income distribution among population cohorts has significant impact on regional development and poverty. Alesni and Rodrik (1994) analyzed the relationship between average growth rates and a measure of inequality and demonstrated that greater inequality in the distribution of income slows down economic growth. Similarly, Persson and Tabellini (1994) used time series data from 1830 to 1985 and concluded that more equality in the distribution of income accelerates growth. To provide some possible explanations for the above listed conclusions, Aghion, et al. (1999), who argue that inequality reduces investment opportunities, worsens borrowers' incentives, and creates macroeconomic volatility that impacts economic growth.

On the contrary, a regional study by Ngarambe et al. (1998) examined determinants of Southern US county level income growth and income inequality in the 1980s. The empirical result indicated a positive relationship between family income growth and income inequality in the 1980s. The study of Lozier (1993) on the relationship of income inequality and economic growth in West Virginia found no significant relationship between economic growth and household income inequality.

The main goal of this study is to assess the distribution and inequality of income among different population cohorts, and to evaluate the relationship between economic growth and income inequality in West Virginia. Specifically the objectives are: (1) to estimate and analyze changes in income inequality in population cohorts in West Virginia for the 1990-2000 period, (2) to develop a simultaneous system econometric model to empirically test the relationship between economic growth (growth in per capita income) and measured income inequality, and (3) to draw relevant conclusions that contribute to existing literature.

Theoretical Models

Gini Coefficient as a Measure of Income Inequality

There are a number of approaches to measure income inequality intertemporally across population cohorts. The Lorenz concentration curve is one such widely applied technique that has received acceptance in income inequality studies. The Lorenz curve measures the cumulative share of income as a function of cumulative population proportions. Gini coefficient is one measure in the family of inequality or dispersion measures that is widely used to measure income inequality in population cohorts based on the Lorenz curve. This study utilizes estimated Gini coefficients to measure income inequalities in population cohorts for their inter-temporal cross comparison.

Mathematically, the Lorenz curve can be estimated as follows. Let *P(x)* be defined as the population density function of a given income *x*. Then, the cumulative share of population for income less than or equal to *x* is given by:

$$P(x) = \int_0^x p(y)\,dy \cdot$$

The share of total income received by this population group can be estimated as:

$$\psi(x) = (1/\mu)\int_0^x y p(y)\,dy$$

where the mean $\mu = \int_0^\infty y p(y)\,dy$

The Lorenz curve function runs from 0 to 1. For perfect equality of distribution, the Lorenz curve becomes the diagonal horizontal line and the associated inequality measure becomes 0. To derive the Gini coefficient from the Lorenz curve, the following computation can be used:

$$G = 1 - 2\int_0^1 \psi(z)\,dz, \; where ... z = P(x)$$

To estimate this Gini coefficient, data on population share of each age group in the population and their associated income shares is collected. Data used for Gini Coefficient estimation includes US Population Census Data for household income and population in West Virginia.

Growth Equilibrium Model

Modeling the relationship between economic growth and income inequality requires the proper understanding of the factors that affect differences in regional economic growth. One proxy measure of economic growth that is used in this study is growth in per capita income. By definition, per capita income is mathematically related to changes in income and population, i.e., *PCI = GDP/POP* where *PCI* is per capita income, *GDP* is gross domestic product, and *POP* is population of the geographic area of interest. It can be argued that growth in income is highly correlated with growth in employment opportunity, hence employment growth can be used as a proxy for income growth. The relationship between economic growth and income inequality can thus be modeled as:

(1) $$PCI_i = f(POP, E, Gi, \Omega^{PCI})$$

where all the variables are as previously defined, E is employment density, G_i is measured Gini coefficient for county *i*, and Ω^{PCI} is the vector of all other variables that affect per capita income growth.

Estimation of equation (1) poses econometric problems of endogeneity and simultaneity as some of the explanatory variables are endogenous to the system. Not only do counties with higher population base affect the growth of per capita income through the provision of larger markets and agglomeration benefits to firms, but counties with higher per capita income affect migration patterns and influence demographic changes. This interdependence makes the two variables simultaneous in nature. Similarly, not only do counties with higher per capita income attract new businesses and employment opportunities, but counties with high employment opportunities also experience a growing per capita income. Furthermore, a number of studies posit a simultaneous relationship between population and employment in a region (Roback, 1982; Carlino and Mills, 1987; Duffy-Deno, 1998; Deller et al., 2001; Hailu and Rosenberger, 2004).

Growth equilibrium modeling enables simultaneous estimation of endogenous growth variables. In early applications, these models were used to resolve the debate over whether people follow jobs or jobs follow people (Carlino and Mills, 1987). Following the early work of Carlino and Mills (1987) and further developments by Deller et al. (2001) and Hailu and Rosenberger (2004), a simultaneous growth equilibrium model of income growth can be specified as:

(2) $PCI_i^* = f(POP^*, E^*, Gi \mid \Omega^{PCI})$

(3) $POP^* = f\,(E^*, PCI_i^* \mid \Omega^{POP})$

(4) $E^* = f\,(P^*, PCI_i^* \mid \Omega^{E})$

where POP^*, E^*, and PCI_i^* refer to equilibrium levels of population, employment, and per capita income respectively; Ω^{POP}, Ω^{E}, and Ω^{PCI} refer to a vectors of other exogenous variables having a direct or indirect relationship with population, employment and per capita income respectively.

Population and employment are likely to adjust to their equilibrium values with substantial lags (Mills and Price 1984). Similarly, per capita income also adjusts to its equilibrium value with lags. Therefore, distributed lag equations may be specified as:

(5) $$PCI_i^* = PCI_{t-1} + \lambda_{PCI} (PCI_i^* - PCI_{t-1})$$

(6) $$POP_t^* = POP_{t-1} + \lambda_{POP}(POP^* - POP_{t-1})$$

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

where $\lambda_{E,}$ λ_{POP} and λ_{PCI} are speed-of-adjustment coefficients with $0 \leq \lambda_{E,}$ $\lambda_{POP,}$ $\lambda_{AgL} \leq 1$, and t-1 is a one period lag. This indicates that current employment, population, and per capita income are dependent on their one period lagged level and on the change between equilibrium values and one lagged period values adjusted at speed-of-adjustment values of $\lambda_{E,}$ λ_P and λ_{AgL}.

Rearranging terms:

(8) $$\Delta PCI = A\ PCI_t - PCI_{t-1} = \lambda_{PCI} (PCI_i^* - PCI_{t-1})$$

(9) $$\Delta POP = POP_t - POP_{t-1} = \lambda_{POP}(POP^* - POP_{t-1})$$

(10) $$\Delta E = E_t - E_{t-1} = \lambda_E(E^* - E_{t-1})$$

where ΔPCI, $\Delta POP,$ and ΔE are changes in per capita income, population and employment respectively. With substitution and rearranging of terms, the linear equations of the model are specified as follows:

(11) $$\Delta PCI = \alpha_{0PCI} + \beta_{1PCI}PCI_{t-1} + \beta_{2PCI}\Delta POP + \beta_{3PCI}\Delta E + \beta_{4PCI}G_i + \sum\delta_{iPCI}\Omega_{AgL} + e_i$$

(12) $$\Delta POP = \alpha_{0POP} + \beta_{1POP}POP_{t-1} + \beta_{2POP}E_{t-1} + \beta_{3POP}\Delta E + \beta_{4POP}\Delta PCI + \sum\delta_{iPOP}\Omega^{POP} + e_i$$

(13) $$\Delta E = \alpha_{0E} + \beta_{1E}P_{t-1} + \beta_{2E}E_{t-1} + \beta_{3E}\Delta P + \beta_{3E}\Delta PCI + \sum\delta_{iE}\Omega^E + e_i$$

Equations (11), (12), and (13) indicate that per capita income, population and employment changes are dependent on their initial levels and changes of the other two endogenous variables, and vectors of other variables that affect the endogenous variables. The change in per capita income is affected by the initial levels of employment, population, and agricultural land density, changes of employment and population from one period to the other, and by a vector of other exogenous variables influencing agricultural land density changes. In such a system, the simultaneous interaction of per capita income, population, and employment can be identified.

The Gini measure method and the system-of-equations model are estimated using state and county level data for West Virginia. The endogenous variables in the model (ΔPCI, ΔPOP, *and* ΔE) are measured as per capita income directly given by census data, population density per square mile, and employment density per square mile from 1990 to 2000, respectively. Table 1 provides a definition and enumeration of variables used in the econometric model and compiles their statistical summary based on mean and standard deviation.

During the study period from 1990 to 2000, per capita income increased by 13 percent, population increased by 0.4 percent, and employment increase by 10 percent (1992-1997 REIS), though there is variation at the county level. The changes in Per capita income in West Virginia counties range from a maximum decline of $1,204 to a maximum gain of $5,137.00. The average change in per capita income for the period was an increase of $2,208.60. The changes in population density range from a maximum gain of 40 people per square mile to a maximum loss of 29 people per square mile. The average change in population density was 0.43 people per square mile. The change in employment density varied from a maximum gain of 33 jobs to a decline of 23 jobs per square mile. The mean change in employment density was 4.4 jobs per square mile.

Table 1. Definition and Descriptive Statistics of Variables, West Virginia (N=55).

Variable	Definition	Mean	Std Dev
Endogenous Variables			
ΔPCI	*Change in Per Capita Income ($PCI_{99} - PCI_{90}$)*	*2208.60*	*1270.84*
ΔPOP	*Change in population density ($DPOP_{99} - DPOP_{90}$)*	*0.426*	*9.724*
ΔE	*Change in employment density ($DEMP_{99} - DEMP_{90}$)*	*4.391*	*9.030*
Initial Conditions			
$DPOP_{90}$	*Population density in 1990*	*94.403*	*102.886*
$DEMP_{90}$	*Employment density in 1990*	*42.665*	*59.916*
PCI_{90}	*Per Capita Income in 1990*	*13073.51*	*2300.70*
Fiscal Factors			
$PCTAX_{90}$	*Per capita local taxes in 1990*	*315.109*	*126.389*
PROPTAX	*Property Tax in 1990*	*13892.96*	*18447.04*
GPERCAP	*Government direct expenditure per person*	*1800.49*	*606.13*
Local and Business Factors			
$HWYDEN_{99}$	*Interstate highway density in 1999*	*0.022*	*0.036*
$MEDHVA_{90}$	*Median housing value in 1990*	*44,614*	*10,725*
MEDINC90	*Median income in 1990*	*19557.47*	*3829.39*
$UNEMRT_{90}$	*Unemployment rate in 1990*	*11.11*	*3.98*
$POUTWORK_{90}$	*Proportion of employed residents working outside county of residence in 1990*	*0.33*	*0.15*
$PINMIGRT_{90}$	*Proportion of total jobs in a county held by people residing outside county in 1990*	*0.18*	*0.08*
CRIME10K	*Crimes reported per 10,000 people in 1990*	*1689.89*	*1035.57*
Other Exogenous Factors			
NUMESTAB	*Number of non-farm business establishments in 1990*	*684.07*	*878.37*
FAMBPOV	*Per cent of families below poverty line*	*17.68*	*6.37*
BACHDG	*Per cent of 25 years and older population with Bachelor's Degree +*	*10.05*	*4.09*
P65PLUSY	*Per cent of population with age 65 and above in 1990*	*15.10*	*2.07*
POVRT	*Rate of Poverty in 1990*	*21.55*	*6.84*
TGINI90	*Calculated Gini measure for 1990*	*0.16*	*0.034*

Specification of Variables

Change in Per Capita Income Equation (ΔPCI)

The change in per capita income is modeled as a function of the endogenous variables of change in population (ΔP) and employment density (ΔE), the initial condition of per capita income in 1990 (PCI_{90}), and a vector of exogenous variables.

The exogenous variable per capita government expenditure (*GPERCAP*) is included to capture the effect of public investment on per capita income growth. It is expected that the accumulation of social capital will accelerate growth in per capita income. For instance, previous studies indicate that investment in highways and transportation facilities increases local economic growth and productivity (Chandra and Thompson, 2000; Keeler and Ying, 1988; Garcia-Mila and McGuire, 1992). Per cent of families below poverty (*FAMBPOV*) is included to explain per capita income growth. Counties with higher proportion of families under poverty may experience slower income growth due to declining population and slow employment growth. The per cent of population above 65 years (*P65PLUSY*) is included to measure the effect of demographic characteristics on income growth. Counties with high proportions of population out of the labor force may experience slow income growth. Finally, Gini coefficient (*TGINI90*) as a measure of income inequality is included to test empirically the relationship between income growth and income inequality. There is divergent conclusion in the literature as to the direction of relationship between the variables. This study attempts to provide additional evidence on the nature of their relationship.

Change in Population Density Equation (ΔPOP)

Change in population density is a function of its initial value in 1990 ($DPOP_{90}$) and the endogenous variables of per capita income change (ΔPCI) and employment density change (ΔE) due to their simultaneity. A number of exogenous variables also explain temporal changes in population density.

The fiscal factors that affect population growth include per capita taxes ($PCTAX_{90}$), property taxes (*PROPTAX*), and government expenditure per capita (*GPERCAP*). Following

Tiebotian theory, higher property and per capita taxes may encourage out-migration to counties where these taxes may be lower, hence it affects population density changes across time. Higher government spending in terms of education, health services and other basic community services may affect the flow of population across space and time.

Local characteristics that may affect population density include the median housing value ($MEDHVA_{90}$), median income of community (*MEDINC90*), and crime rates (*CRIME10K*). Though it is difficult a priori to conclude on the relationship between housing value and population change, it may be argued that lower housing prices may encourage population growth (though higher population growth may increase the demand for housing and increase the price as well). Counties with high incomes may attract population growth through in-migration. Generally, counties with high crime rates are assumed to experience population declines as crime is a negative social externality. The per cent of families below poverty is also included to determine changes in population density. It is difficult to place expected relationship a priory. It could be argued that high poverty conditions discourage in-migration and population growth, however, population growth in rural communities at urban fringes with high unemployment and low economic opportunities may expand due to higher amenity endowments and consequent urban-to-rural migration.

Changes in Employment Density Equation (ΔE)

A change in employment density is estimated as a function of changes in per capita income (ΔPCI), population density (ΔPOP), and its initial population density ($DPOP_{90}$). In addition to the endogenous variables, a number of exogenous variables are also included to determine employment density changes. The fiscal factors may include per capita taxes (*PCTAX*$_{90}$), property taxes (*PROPTAX*), and government expenditure per capita (*GPERCAP*). An increase in per capita taxes may reduce effective demand and slow employment growth. Similarly, property taxes on businesses may have negative effects as they reduce business profits. The impact of government spending on business depends on how it is used in counties. Government spending on infrastructure and other social capital generally determines employment growth.

Access is an important factor in determining employment growth. Interstate highway density (*HWYDEN*$_{99}$) is used as a proxy for access. For instance, studies show that greater interstate highway investment is associated with higher levels of manufacturing and other sector employments (Carlino and Mills 1987). Other local characteristics variables include the commuting pattern of communities. The proportion of employed residents working outside county of residence (*POUTWORK*$_{90}$) and proportion of total jobs in a county held by people residing outside county (*PINMIGRT*$_{90}$) are introduced to measure employment growth based on commuting pattern. Crime rate (*CRIME10K*), number of business establishments (*NUMESTAB*), per cent of families below poverty (*FAMBPOV*), percent of 25 years and older county population with Bachelor's degree or higher (*BACHDG*) as a proxy for a measure of human capital formation are also included to determine employment density changes.

Empirical Results and Analysis

Gini Income Inequality Estimates

One common approach to measure income inequality is the estimation of Gini coefficients. Using county level data from the US Census of Population, the cumulative proportions of income shared by cumulative population groups is computed, and Gini coefficients are estimated for different age cohorts for the periods 1990 and 2000 as provided in Tables 2 and 3. The upper boundary of the highest income group is reported in open ended bracket of $100,000 or more for the 1990 Census period, and $200,000 or more for year 2000. To make similar reference in both time periods and to estimate Gini coefficients for grouped data with closed upper income brackets, creating and regrouping of income brackets is introduced. Following Rubin et al. (2000), an upper income boundary is defined for the top income group by introducing the upper limit as twice the upper limit of the next-to-last income group. This approach is demonstrated to closely approximate other approaches for grouped data.

The result in Table 2 indicates that for all age groups, except those 65 years and older, income inequality in West Virginia increased in 2000 compared to 1990. The highest increase in inequality is in the age groups under 25 years (an increase of 0.035) and 35 to 44 years (an increase of 0.026).

Table 2. Gini Estimates for Age Groups in WV for 1990 and 2000

Age Group	Gini Estimates 1990	Gini Estimates 2000	Net Inequality Change
Under 25 years:	0.416	0.451	0.035
25 to 34 years:	0.386	0.389	0.003
35 to 44 Years:	0.376	0.402	0.026
45 to 54 Years:	0.403	0.404	0.001
55 to 64 years:	0.441	0.445	0.004
65 to 74 years:	0.444	0.437	-0.007
75 years and over:	0.461	0.460	-0.001

While all other age groups experienced increased income inequality, particularly the retirement age group experienced improvement in income distribution. The increasing disparity in income distribution in age groups under 25 years and those between 35 to 44 years may be explained by differences in human capital accumulation and resulting disparities in labor market compensation. Increased government transfer programs to retired citizens may explain the decline in income distribution among older West Virginians.

Table 3 provides Gini coefficient estimates for a reclassified age group. The data on income distribution by age is classified among younger age groups with little labor market experience, early labor market experience and career development, pre-retirement years, and retirement age categories. In this classification, age groups under 25 years and those 25 to 44 years experienced increased income inequality by 0.035 and 0.014, respectively. Income for pre-retirement ages of 45 to 64 and post retirement years of 65 and older indicate a slight decline in income inequality.

Table 3. Gini Estimates for Regrouped Age Groups in WV for 1990 and 2000

Age Group	Gini Measure 1990	Gini Measure 2000	Net Change
Under 25 years:	0.416	0.451	0.035
25 to 44 years:	0.388	0.402	0.014
45 to 64 Years:	0.426	0.423	-0.003
65 years and over:	0.457	0.451	-0.006

Econometric Model Results

The estimated coefficients of the simultaneous equation system and the statistical properties are given in Table 4. To maximize the information gain and to simultaneously estimate all the endogenous variables in the equations system, a three-stage-least-square method is used. The model is corrected for heteroskedasticity using White's Heteroskedasticity Consistent Computation routine.

Based on adjusted R^2 statistics, the estimated model explains 52 percent, 66 percent, and 76 percent of the variations in Per capita income, change in population density, and change in employment density, respectively. First for the change in population density equation, the model result shows a number of significant relationships. The endogenous variables, change in per capita incomes (ΔPCI) and change in employment density (ΔE), are significantly and positively related to changes in population density (ΔPOP) at a 95 percent confidence level. A one percent increase in per capita income and employment density is expected to increase population density by 0.2 percent and 34.5 percent, respectively, *ceteris paribus*. Counties with high income growth and growing job opportunities are expected to experience population growth, one way being through in-migration.

The initial condition of population ($DPOP_{90}$) is negatively and significantly related to population growth. This finding supports previous finding of Deller et al. (2001) that areas with high population densities experience low growth, reinforcing the case for rural renaissance. The fiscal factors of per capita taxes ($PCTAX_{90}$) and property taxes (*PROPTAX*) are negatively related to population growth, however, both were not significant for our data set. Similarly, per capita government spending (*GPERCAP*) was not significant in determining population growth.

The local characteristics variables of median housing value ($MEDHVA_{90}$) and median income (*MEDINC90*) were both positively and significantly related to population growth. High median housing values were expected to be negatively associated with slow population growth due to high cost of housing. However, this may capture the reverse impact that communities with high property value may be those with high population density and high demand for housing property.

Table 4. Empirical Results for System of Equations Model, West Virginia (N=55)

Variable	**ΔP Equation**		**ΔE Equation**		**ΔPCI Equation**	
	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
Endogenous Variables						
ΔPCI	*0.002*	*0.025***	*0.002*	*0.002***	---	---
ΔP	---	---	*0.267*	*0.001****	*29.837*	*0.067**
ΔE	*0.345*	*0.002***	---	---	*66.826*	*0.002***
Initial Conditions						
PCI_{90}	---	---	---	---	*-0.367*	*0.000****
$DPOP_{90}$	*-0.059*	*0.000****	---	---	---	---
$DEMP_{90}$	---	---	*00002*	*0.514*	---	---
Fiscal Factors						
$PCTAX_{90}$	*-0.012*	*0.169*	*0.005*	*0.508*	---	---
PROPTAX	*-0.0001*	*0.447*	*-0.0003*	*0.056**	---	---
GPERCAP	*0.001*	*0.600*	*-0.001*	*0.594*	*0.016*	*0.936*
Business and Local Factors						
$HWYDEN_{99}$	---	---	*120.02*	*0.000****	---	---
$MEDHVA_{90}$	*0.0003*	*0.015***	---	---	---	---
MEDINC90	*0.002*	*0.001****	---	---	---	---
$POUTWORK_{90}$	---	---	*1.174*	*0.183*	---	---
$PINMIGRT_{90}$	---	---	*26.037*	*0.001****	---	---
Other Exogenous Factors						
NUMESTAB	---	---	*0.009*	*0.023***	---	---
FAMBPOV	*0.843*	*0.000****	---	---	*-62.331*	*0.139*
BACHDG	---	---	*0.866*	*0.001****	---	---
P65PLUSY	---	---	---	---	*6.305*	*0.919*
POVRT	---	---	*-0.965*	*0.073**	---	---
CGINI90	---	---	---	---	*-18490*	*0.055**
Constant	*-63.772*	*0.000****	*-17.511*	*0.001****	*15950*	*0.000****
$adjR^2$	*0.66*		*0.76*		*0.52*	

Note: An asterisk (*) denotes statistical significance at the 0.10 level, (**) at the 0.50 level, and (***) at the 0.01 level. Model is estimated using 3-stage-least-squares method and is corrected for heteroskedasticity using White's HCCM routine.

The positive relationship of population growth to median income is positive as expected; counties with high median incomes may attract population growth through regional migration adjustments. A one percent increase in median income is expected to result in a 0.002 percent density change in population percent, *ceteris paribus*.

The percent of families below poverty (*FAMBPOV*) is positively related to population growth. This finding indicates that in West Virginia, population growth is more concentrated in rural communities where unemployment rates and percent of families under poverty are high. This result reinforces the previous finding that counties with high initial population densities experienced a slow population growth indicating rural renaissance.

The employment density change equation is also explained by a number of endogenous and exogenous variables. The endogenous variables of per capita income and population density changes are significantly and positively related to employment growth as expected. A one percent increase in per capita income and population density is expected to result in a 0.002 percent and 0.267 percent increases in employment growth, respectively, *ceteris paribus*. Growing incomes and population densities may attract new investment to capture growing markets also support the economic base for new businesses to emerge.

The fiscal factors that may affect employment growth include per capita taxes ($PCTAX_{90}$), property taxes (*PROPTAX*), and government expenditure (*GPERCAP*). The signs of these variables are as expected, that high taxes are expected to discourage job creation, and government spending in social capital is expected to encourage employment growth. However, except for property taxes, the other two variables were not significant in the model in determining employment growth. A one percent increase in property taxes is expected to result in a job loss of 0.0003 percent, *ceteris paribus*.

Local factors that may affect employment growth include community commuting patterns and the extent of investment in access measured by interstate highway density. Development of interstate highway density ($HWYDEN_{99}$) is associated with a highly significant gain in employment growth, reaffirming similar conclusions in previous studies. Commuting characteristics are measured by the proportion of employed residents working outside of county of residence ($POUTWORK_{90}$) and the proportion of total jobs in a county held by people residing outside of county ($PINMIGRT_{90}$). Counties with high proportion of total jobs held by people residing outside county showed a significant and positive relationship to employment growth. The fact that these counties attract workers from neighboring counties with given commuting cost may indicate the relative distribution of employment opportunities across counties.

The number of business establishments (*NUMESTAB*) as a measure of threshold economic base, the percent of population above age 25 with a Bachelor's degree or higher (*BACHDG*) as a measure of human capital formation, and poverty rates (*POVRT*) as a measure of economic disparity, are also introduced to explain employment growth. The result matches prior expectations that a county with a large threshold business establishment significantly experiences better employment growth; counties with higher human capital accumulation significantly experience better job growth; and high economic disparity significantly discourages employment growth. A one percent increase in the number of county business establishments, in the percent of county population with a Bachelor's degree or higher, or in the poverty rate are expected to result in an increase of 0.009 percent, 0.86 percent, and a decline of 0.96 percent in employment growth, respectively, *ceteris paribus*.

The analysis of population and employment growth equations was made to develop a better understanding of the endogenous forces that affect the time path of economic growth. The per capita income growth equation is also modeled as a function of endogenous variables, initial conditions of endogenous variables, and exogenous variables that are hypothesized to interact with income growth. The endogenous variables, population (ΔPOP) and employment (ΔE) density growth are significantly and positively related to per capita income growth. This may indicate that counties with high employment opportunities experience income growth, and similarly counties with high population densities that support such employment growth may experience per capita income growth. The result indicates that a one percent increase in population and employment density is expected to have a 29.83 percent and 66.8 percent increase in change in per capita income, respectively. A growing employment opportunity may expand income opportunities, and an increase in population density may provide a market incentive for investment and a tax base for social investment. The initial per capita income condition (PCI_{90}) is negatively related to income growth, indicating a declining trend in per capita income growth.

The fiscal variable of per capita government spending is not significant in explaining income growth trends in West Virginia during the study period. The county demographic structure variable denoted by the percentage of county population with age 65 and above is not also significant in explaining income growth differences across counties. However, the percent of families below poverty line in a county is slightly significant in explaining per capita income changes. The result indicates that counties with high percentages of families below poverty line (*FAMBPOV*) may experience slow per capita income growth. A one percent increase in the percent of families below poverty line in counties is estimated to result a 62.33 percent decline in per capita income changes, *ceteris paribus*.

A similar measure of economic disparity generated to measure the relationship between income growth and income inequality is the Gini index. The variable is computed for counties to proxy income distribution disparities that enable to measure its relationship to income growth. The result indicates a highly significant negative relationship between income inequality and economic growth. It is expected from this result that counties with high income inequality may experience comparatively low growth in per capita income confirming similar findings in previous studies (Alesina and Rodrik, 1994, Persson and Tabellini, 1994, and Aghion, et al., 1999). These previous studies argued that inequality may negatively impact economic growth due to the facts that inequality reduces investment opportunities, worsens borrowers' incentives, and creates macroeconomic volatility that impact economic growth.

Conclusion

The study investigates trends in demographic changes and income inequalities in West Virginia for the study period from 1990 to 2000. The two main objectives are to investigate the demographic changes and income inequalities in West Virginia using computed Gini index measures to examine the relationship between income inequality and economic growth using simultaneous equation systems.

During the study period, West Virginia experienced changes in its demographic structure, per capita income growth, and income inequality. A Gini index income inequality measure is computed both at the state and county level to determine trends in income inequality in the state. The research findings indicate that for all age groups, except those 65 years and above, income inequality increased from 1990 to 2000. The highest increase was in the age group under 25 years and those 35 to 44 years group. The increase in income inequality in this age group may be due to differences in human capital accumulation and resulting labor market compensation disparities.

The endogenous variables of change in per capita income, population growth, and employment growth are estimated using simultaneous equation systems. The result of the 3-stage-least-squares model indicates that the endogenous dependent variable population growth is significantly and positively determined by employment and per capita income growth, but indicates a negative and insignificant relationship with per capita taxes and property taxes.

The empirical results indicate that the endogenous dependent variable of growth in employment density shows a positive and significant relationship with population and per capita income growth, highway density, number of business establishments, proportion of county population with Bachelor's degree or higher, but indicates a negative and significant relationship with county poverty rates and property taxes.

The endogenous dependent variable per capita income growth is also positively related with population and employment growth, but it is significantly and negatively related with income inequality measured by Gini index. This indicates that higher income inequality is associated with slower economic growth in West Virginia.

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