How Do Location Decisions of Firms and Households Affect Economic Development in Rural America?

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Abstract

This paper examines the causes of spatial inequalities in economic development across rural America. A theoretical model is developed to analyze interactions between location decisions of firms and households as they are affected by natural endowments, accumulated human and physical capital, and economic geography. Based on the theoretical analysis, an empirical model is specified to quantify the effect of these factors on key indicators of economic development across counties in the United States. Preliminary results suggest that households are willing to trade better amenities for lower income, and firms take advantage of lower wage rates by locating in areas with better climate and more recreational opportunities. In equilibrium, counties with better climate and more creational opportunities have lower income and more employment opportunities. Accumulated human and physical capital also significantly affect economic development across counties in the United States. Counties with more accumulated human and physical capital have higher income, more employment opportunities, and high development density. Remoteness has a negative effect on every measure of economic development indicator. It reduces income, employment, housing prices and total developed areas. Implications of the results for policy development to promote economic prosperity in rural America are discussed.

Key words: Accumulated human and physical capital, amenities, economic development, economic geography, employment, housing price, land development, natural endowments, rural income.

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Development in Rural America?

For at least 30 years, dramatic social and economic changes have occurred in rural America. Shifting population, income losses, declining education and health services, and the weakening community structures have caused the quality of life to deteriorate in many rural communities. Increased global competition, changes in market structure, growing population, and increasing demands for recreational and environmental services from land and water resources have also changed the global environment within which the farm sector operates. These dramatic changes have created opportunities for some rural communities and raised new barriers for others.

Economic development is highly uneven between rural and urban communities as well as within rural areas. From 1969 to 2000, average earnings per job in the United States increased approximately 30 percent, while average earnings per job in rural America declined slightly. The unemployment and poverty rates were 10% and 28% higher, respectively, in rural America than in non-rural area in 2001 (Economic Research Service, 2004). These statistics have fueled the perceived rural-urban divide. In addition, there exists a large variance in economic development among rural communities. In some rural communities (e.g., rural Dakotas), dwindling rural economies have caused once-viable communities to become ghost towns. In others (e.g., rural California), urban development and suburbanization have encroached on rural communities.

What causes the rural-urban divide? Why do the spatial inequalities in economic development exist among rural communities? Why the spatial differences in land rents and wages not bid away by households and firms in search of high income and low production costs?

What policies are effective to stimulate economic growth in distressed rural communities? Understanding these issues is central for understanding many aspects of economic underdevelopment in rural communities and for developing effective policies to promote vitality and quality of life for rural Americans (Henderson et al., 2001).

Previous studies have identified three major factors as determining the spatial inequalities in economic development: a) natural endowments (e.g., water availability, land quality, environmental amenities); b) accumulated human and physical capital, and c) economic geography (see the literature review in the next section). These theories, however, have rarely been tested in the context of rural America, and little evidence exists as to what works in improving economic conditions in rural communities and how community actions and policy makers can strengthen the economic fabric in rural communities. Yet, understanding the relative contribution of these factors is central for understanding many aspects of economic development in rural communities, including the role of local and regional policies such as public infrastructure investments in shaping the pattern of economic activities in rural America.

The objective of this article is to evaluate the contributions of natural endowments, accumulated human and physical capital, and economic geography to the spatial inequalities in economic development in rural America. To this end, we first develop a theoretical model to analyze the interaction between location decisions of firms and households as they are affected by natural endowments, accumulated capital, and economic geography. We then conduct an empirical analysis to quantify the effect of natural endowments, accumulated capital, and economic geography on the spatial distribution of economic development activities across counties in the United States. Implications of the results for policy development to promote economic prosperity in rural America are discussed.

This paper develops a theoretical model to analyze the interactions between the location decisions of firms and households, which has rarely been analyzed in previous studies. It also fills a gap in the economic literature by evaluating the relative contributions of natural endowments, accumulated human and physical capital, and economic geography to the spatial variability in economic development across rural America. The results of this study should be of interest to a wide spectrum of individuals and groups. Empirical results regarding the relative contribution of natural endowment, accumulated capital, and economic geography to economic development should help rural counties as well as state and federal agencies develop more effective strategies for economic development in rural America. Data and methods used to model the interactions between firms and households and between private and public sectors should be of great interest to researchers working in the areas of rural development. The results of this analysis should also be of interest to conservationists and the public at-large who feel strongly about rural issues.

Relevant Literature

Much research has focused on location decisions of households and firms in urban and regional economics, but relatively few analyze the interaction between these locations. According to the classic theory, a household chooses the residential location that provides the best tradeoff between land costs and commuting costs. Wealthier households live in suburbs if and only if the income elasticity of demand for housing is larger than the income elasticity of commuting cost. Wheaton (1977) provides empirical evidence that questions the validity of this theory.

In searching for alternative explanations, many economists have turned to factors excluded from the simple monocentric model, such as availability of new suburban housing, the flight from central-city problems, transportation modes, and suburban zoning (e.g., LeRoy and

Sonstelie, 1983). Other economists suggest that cause and effect are simultaneous. Urban fiscal disparities and city decay are not only the causes of middle class flight, but the product as well (Bradford and Oates, 1974) The fragmented structure of local government and the presence of racial and social externalities are the primary forces that originally generated middle class flight (Tiebout, 1956). More recently, Brueckner et al. (1999) and Wu (2003) show that the location pattern of different income groups can be explained by the distribution of amenities over the landscape. These studies, however, do not consider the location decisions of firms and thus sources of household income.

In the public economics literature, several studies have focused on location decisions of households and the equilibrium structure of local jurisdictions (Epple and Romer 1991, Fernandez and Rogerson, 1996, Epple and Sieg, 1999). Although these studies provide strong predictions about community characteristics, they do not consider the location decisions of firms, nor the role of amenities and geography in the formation of municipal structure. More recently, Wu (2003) develops an equilibrium model to analyze the spatial pattern of land development and community characteristics. He shows that the spatial distribution of amenities and commuting costs are important factors determining the spatial patterns of land development and community characteristics (e.g., the level of public services and the ratio of low- to high-income households). This study, however, does not consider the interaction between the location decisions of firms and households.

Firm location decisions have also been at the center of economic research for many decades (Giannias and Liargovas 2002). According to Fujita et al. (1999), firms' location decisions are based both on input price considerations and on ease of access to markets. Firms want to locate close to input markets to save transportation costs. So a location with a lot of firms

will have a high demand for intermediate goods, making it an attractive location for intermediate producers. This in turn makes it an attractive location for firms that use intermediate goods. Thus, there is a positive feedback between location decisions of upstream and downstream firms in the chain of economic activity (Henderson et al., 2001). Firms also want to locate close to demand and population centers. As a disproportionate share of manufacturing is attracted to a location, either the wage rate is bid up or labor is attracted to the location, both of which will tend to increase this location's share of total expenditure still further. This "home market" or agglomeration effect has been explored in Krugman (1991).

Many studies also examine the impact of taxes on firm location decisions. These studies generally produce inconclusive and inconsistent results (see Rainey and McNamara (1999) for an review). Rainey and McNamara (1999) examine the impact of local tax differentials on the location of manufacturing firms and find that firms tend to avoid counties that have relatively high property tax rates. This suggests that tax relief incentives can be an important component of a county's industrial recruitment program.

Giannias and Liargovas (2002) view spatial variations in economic development as a result of firm and household location decisions. They develop an economic model to examine the behavior of households and firms and apply the model to 17 Arab countries. This study, however, does not examine the relative contribution of natural endowment and accumulated capital to economic development because regional differences are measured by a single index.

A number of theoretical studies have also analyzed spatial variations in economic development across regions/countries. Henderson, et al. (2001) review these studies and suggest that the spatial inequalities in economic development have to do partly with spatial variations in institutions and endowments, and partly also to do with the spatial relationship between

economic units. However, relatively few studies have examined the effect of these factors on

economic development empirically, particularly in the context of rural development.[1] Deller et

al. (2001) estimate a structure model of regional economic growth to determine the role of

amenity and quality of life attributes in regional economic growth. They find that there exist

predictable relationships between amenities, quality of life and local economic performance.

Other studies suggest that quality of life plays an increasingly important role in community

economic growth (e.g., Dissart and Deller, 2000; Halstead and Deller, 1997; Rudzitis, 1999;

Gottlieb, 1994).[2] In cross-country studies, Redding and Venables (2000) examine the

relationships between geographic characteristics, wage, and per capita income. Gallup and Sachs

(1999) regress national per capita income on four variables (a measure of hydro-carbons per

capita, a dummy variable for incidence of malaria, the proportion of population who live within

100 km of the coast, international transportation costs) and find that these four variables alone

account for an astonishing 69% of the per capita income variations across their sample of 83

countries. Rappaport and Sachs (2002) analyze the effect of coastal proximity on the

concentration of economic activity in the U.S. using regression and find that the costal

concentration derives primarily from a productivity effect but also, increasingly, from a quality-

of-life effect. To our knowledge, no study has evaluated the relative contribution of natural

endowments, accumulated capital, and economic geography to spatial variations in economic

activity across counties in the United States.

Theoretical Model

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[1] A few studies have examined the impact of geography on land development patterns. See, e.g., Irwin and Bockstael (2002) and Wu (2001).
[2] See Castle (1995) for a review and analysis of changing American countryside.

This section present a model to analyze the interactions between location decisions of firms and households as they are affected by natural endowments, accumulated human and physical capital, and economic geography. To be consistent with the empirical analysis, the model selects county as the basic unit of analysis. County is the smallest geographic unit at which most economic data are reported at the national level. County is also the basic political unit (jurisdiction) in which many local regulations and policies are developed. Counties differ by natural endowments, accumulated human and physical capital, and economic geography. Some of these natural, institutional and geographical factors directly affect households' utility, others directly affect firms' output and/or production costs. Those directly affecting households' utility and residential location decisions are referred to as amenities and are indexed by ε, and those directly affecting firms' location decisions are referred to as capital and are indexed by κ. Thus, counties are differentiated by (ε, κ), and rural counties generally have higher ε / κ ratios than urban counties.

Households are assumed to have preferences defined over residential space (h), a numeraire non-housing good (z), and the level of amenities in the county (ε). Each household supplies one unit of labor and receives income (y) in return. Households choose residential locations that provide the best tradeoffs among income, amenities, and housing price (p). At any location, they solve the following utility maximization problem:

(1)
$$\max_{h,z} u(h, z, \varepsilon)$$

$$\text{subject to} \quad ph + z = y.$$

Solving the maximization problem gives the household's demand function for housing and the non-housing good: $h^* = h(p, y, \varepsilon)$ and $z^* = z(p, y, \varepsilon)$. Substituting these demand functions into the utility function gives the household's indirect utility function:

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$$(2) \quad\quad\quad v(\varepsilon, y, p) \equiv u(h^*, z^*, \varepsilon)$$

Equation (2) implies that when choosing residential locations, households consider the tradeoffs between income, amenities and housing prices. Thus, both the total supply of the labor (L^s) and the total demand for residential development (H^d) in a county are functions of income (*y*), amenities (ε), and housing prices (*p*):

$$(3) \quad\quad\quad L^s = L^s(y, p, \varepsilon)$$

$$(4) \quad\quad\quad H^d = H^d(y, p, \varepsilon)$$

If households are assumed to be completely mobile, and migration is costless. Equilibrium for households requires that utility is the same in all counties, that is, $v(\varepsilon, y, p) = \bar{v}$, where $\bar{v}$ is the national utility level. Fig. 1 illustrates the tradeoffs between income and amenities for households. Along each iso-utility curve, the housing price are fixed. Households living in areas with lower levels of amenities must be compensated with higher levels of income to maintain the same utility. The iso-utility curves are higher for areas with higher housing prices because given the level of income households living in areas with higher housing prices must be compensated with higher levels of amenities to maintain the same level of utility. As shown in Fig. 1, the housing price in county 2 is higher than the housing price in county 1.

Firms' location decisions are analyzed by extending the model by Giannias and Liargovas (2002). Specifically, capital is assumed to be completely mobile, production technologies are the same for all firms in the same industry. A firm chooses locations to minimize its total production and transportation cost by considering the tradeoff between input prices, local infrastructure, and transportation costs. At any given location, it chooses the best combination of labor, capital and factory space to minimize the total production cost:

$$c^p(\kappa, y, p) \equiv \min_{L, K, H} \ yl + rk + ps$$

(5)

$$\text{subject to } f(l, k, s, \kappa) = z,$$

where *l, k,* and *s* are labor, capital, and factory space, respectively, $f(.)$ is the production

function, Z is the total output. The firm's transportation cost, c^t, is a function of its location

characteristics $\rho: c^t = c^t(\rho)$.

When choosing locations, a firm may face a tradeoff between production costs and

transportation costs. Counties with cheaper labor and factory space may be located in remote

areas that are farther away from output markets and thus will have a high transportation cost.

Given that firms choose locations to minimize the total costs $c(y, p, \kappa, \rho) \equiv c^p(\kappa, y, p) + c^t(\rho)$,

counties with low income, low housing prices, low transportation costs, and a high level of

accumulated capital will attract more firms. Thus, both the total demand for the labor (L^d) and

the total demand for industry development (S^d) in a county are functions of income (*y*), housing

prices (*p*), accumulated capital (κ), and the location characteristics of the county (ρ):

(6) $$L^d = L^d(y, p, \kappa, \rho)$$

(7) $$S^d = S^d(y, p, \kappa, \rho)$$

Equilibrium for firms requires that the total cost is the same in all counties:

$c(y, p, \kappa, \rho) = \overline{c}$, where $\overline{c}$ is a constant. This implies that firms located in counties with more

accumulated capital or lower transportation costs will have to pay higher wages and/or higher

rents. Fig. 2 shows the iso-cost curves for firms. The rental rate of factory space is fixed along

each iso-cost curve, and the curves shift up as rental rates increase. The iso-cost curves are

higher for higher rental rates because given the wage rates firms located in areas with higher

rental rates must be compensated with higher levels of accumulated capital. As shown in Fig. 4,

the rental rate in county 2 is higher than the one in county 1.

Total demand for land development include both demand for housing and non-housing industrial and commercial development. From equations (4) and (7), the total demand for land development equals

(8) $$A^d \equiv H^d(y, p, \varepsilon) + S^d(y, p, \kappa, \rho).$$

The total supply of developed land, A^s, is a function of housing price (p) and development costs, which depend on local construction wage rates (w), agricultural land prices (r), and accumulated capital (κ):

(9) $$A^s \equiv A^s(p, w, r, \kappa).$$

Interdependencies between firms and households shape labor and housing markets and determine the pattern of income inequalities across counties. Equilibrium in the economy is defined as follows: 1) no household can increase its utility by moving to another location or community; 2) no household can increase its utility by changing its consumption bundle; 3) no firm can reduce its total cost by moving to another county, 4) within each county the housing and labor markets clear. With the basic set up, we examine the interactions between the location decisions of firms and households as affected by natural endowments, accumulated human and physical capital, and remoteness below.

Natural Endowments and Economic Development

To examine the effect of natural endowments and environmental amenities on economic development, consider two counties that have the same level of accumulated capital and transportation costs, but county 1 has a lower level of amenities. Fig. 3 illustrates the equilibrium levels of income and housing prices in the two counties. In Fig. 3, the relevant iso-

utility curve for households in county 1 is $V(\varepsilon, y, p_1) = \bar{V}$, and the relevant iso-cost curve for firms in county 1 is $C(y, p_1, \kappa, \rho) = \bar{C}$. The iso-cost curves for firms are vertical in the (ε, y)-plane because the firm's production cost is affected by y but not by ε. Given the level of amenities in county 1, ε_1, the equilibrium income and housing price in county 1 will be y_1 and p_1, respectively. Using county 1 as a reference point, consider the equilibrium level of housing price and income in county 2. Because the level of amenities in county 2 is higher, the housing price in county 2 must be higher. Otherwise, county 2 would have a lower housing price and a higher level of amenities. This would imply that county 2 must have lower income in equilibrium to ensure same utility for households living in the two counties. However, this could not be an equilibrium for the firms because county 2 has both lower wage rates and lower rental costs. Thus, in equilibrium, the housing price in county 2 must be higher than in county 1, which implies that the iso-utility curve for county 2 is located above the iso-utility curve for county 1, and the iso-cost curve for county 2 is located to the left of the iso-cost curve for county 1. In equilibrium, county 2 (with a higher level of amenities) has lower income and higher housing prices than county 1. In county 2, households trade lower income for higher amenities, and firms trade a higher rental cost for lower wage rates.

Accumulated Capital and Economic Development

To analyze the effect of accumulated capital on the equilibrium level of income and housing price, consider two counties that have the same level of natural endowments and transportation costs, but county 1 has a higher level of accumulated human or physical capital. Fig. 4 illustrates the equilibrium levels of income and housing prices in the two counties. In this case, the iso-utility curves are vertical in the (κ, y) plane, but the iso-cost curves are upward sloping. In

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equilibrium, housing prices in county 2 are lower than housing prices in county 1. The iso-cost curve for county 1 is above the iso-cost curve for county 2. The iso-utility curve for county 1 is located to the right of the iso-utility curve for county 2. The county with higher level of accumulated capital will have higher income and housing prices than the county with lower level of accumulated capital.

Remoteness and Economic Development

The effect of economic geography on economic development can be similarly analyzed as the effect of accumulated capital. Consider two counties that have the same level of natural endowments and accumulated capital, but county 2 is located in a more remote area than county 1. The relative levels of income and housing prices in the two counties can be illustrated using figure 4 if we assume that a higher level of κ represents less remoteness (i.e., lower ρ). As shown by the figure, county 2 (i.e., the county located in the remote area) will have lower income and lower housing prices than county 1. This result supports the argument that communities locating in a remote area have a disadvantage for economic development.

In sum, variations in income and housing prices across counties can be explained by the spatial variation in natural endowments, accumulated human and physical capital, and economic geography. Counties with more accumulated human or physical capital and a low level of environmental amenities and transportation costs (i.e., some metro counties) will have a high level of income in equilibrium, while counties with a low level of accumulated human or physical capital and a high level of environmental amenities and transportation costs (i.e., some rural counties) will have a low level of income. Housing prices in those two types of counties depend on the relative magnitude of the amenity, capital, and location effects. In contrast, counties with a high level of capital and amenities and low transportation costs (e.g., some

suburban counties) will have higher housing prices, while counties with a low level of capital

and amenities and high transportation costs (rural counties) will have lower housing prices.

Income in those types of counties will depend on the relative magnitude of the amenity, capital,

and location effects. These results are illustrated in Fig. 5.

Although the stylized model outlined above omits any direct representation of public

policies, it has some important implications on certain exogenously imposed rural development

policies. For example, our results suggest that public investments in rural infrastructure or

training of rural labor force can be an effective policy for promoting rural development. With

improvements in rural infrastructure, firms are more likely to be located in rural areas, which

may lead to higher income and higher housing prices in rural communities. Our results also

suggest that conservation to increase amenities in central city communities may not be an

effective policy to reduce poverty in inner city communities. Improving amenities in inner city

communities may attract some higher income households to those communities, but does not

create incentive for firms to provide jobs in those communities. Firms are willing to locate in

those communities only when households are willing to accept lower wages in exchange for the

improved amenities.

Empirical Model

Equations (3), (6), (8) and (9) describe the demand and supply sides of labor and land markets as

affected by natural endowments, accumulated human and physical capital, and economic

geography. These equations provide the theoretical basis for our empirical analysis of the effect

of natural endowments, accumulated human and physical capital, and economic geography on

economic development across counties in the U.S. Assuming the double-log functional form, the

demand and supply functions of labor and land development are empirically specified as follows:

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$$(10) \qquad \ln\left(\frac{L_i^s}{TA_i}\right) = \alpha_1 + \alpha_2 \ln y_i + \alpha_3 \ln p_i + \sum_k \alpha_{4k} \ln \varepsilon_{ki} + \alpha_5 \ln \tau_i + \upsilon_i^s,$$

$$(11) \qquad \ln\left(\frac{L_i^d}{TA_i}\right) = \beta_1 + \beta_2 \ln y_i + \beta_3 \ln p_i + \sum_j \beta_{4j} \ln \kappa_{ji} + \beta_5 \ln \tau_i + \beta_6 \ln \rho_i + \upsilon_i^d,$$

$$(12) \qquad \ln\left(\frac{A_i^s}{TA_i}\right) = \gamma_1 + \gamma_2 \ln p_i + \sum_j \gamma_{3j} \ln \kappa_{ji} + \gamma_4 \ln w_i + \gamma_5 \ln p_i^{ag} + v_i^s,$$

$$(13) \qquad \ln\left(\frac{A_i^d}{TA_i}\right) = \delta_1 + \delta_2 \ln y_i + \delta_3 \ln p_i + \sum_k \delta_{4k} \ln \varepsilon_{ki} + \sum_j \delta_{5j} \ln \kappa_{ji}$$

$$\qquad\qquad + \sum_{k,j} \delta_{6kj}(\ln \varepsilon_{ki} \ln \kappa_{ji}) + \delta_7 \ln \tau_i + v_i^d$$

$$(14) \qquad L_i^s = L_i^d, A_i^s = A_i^d$$

where i is an index of county, TA_i is the total land area in county i, and $(\upsilon_i^s, \upsilon_i^d, v_i^s, v_i^d)$ are random disturbances. The simultaneous equation system is estimated using three-stage least squares.

Data

The county-level data required for the estimation of the equation system come from a variety of sources. Beginning with the labor market, the total employment data (L) are taken from the *County Business Patterns* (CBP), a publication of the Census Bureau, U.S. Department of Commerce. The county-level median household income (y) and the median price of vacant housing units for sale (p) are obtained from the *Census Summary File 3* (SF3). Both the total land area and the total developed land area are estimated using the 1997 *National Resources Inventory* conducted by the Natural Resources Conservation Service, U.S. Department of Agriculture.

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The exogenous variables are broadly grouped into three categories: amenities (ε), physical and human capital/infrastructure (κ), and locational characteristics (ρ). The amenity variables used in this study are generated using data from National Outdoor Recreation Supply Information System (NORSIS), USDA Forest Service's Wilderness Assessment Unit, Southern Research Station, Athens, Georgia. The NORSIS is a comprehensive county level data set with more than 250 amenity variables. We compiled the amenity variables into three indexes: climate (ε_1), recreation (ε_2), and water (ε_3) resources. To obtain these indexes, we use principal component analysis to compress higher dimension variables in each category into a single scalar. The single scalar is called a score, which is a the linear combination of the original variables, where the linear weights are the eigenvectors of the correlation matrix between the set of factor variables. Since the principal component is very sensitive to scale, all variables used in the principal component analysis are standardized to zero mean and unit variance. The final score or index equals $\sum_{m=1}^{M} \lambda_m \tilde{x}_m$, where λ_m is the eigenvector computed from the variance-covariance matrix of the original data, $\tilde{x}_m$ is the standardized amenity variables and M is the number of variables in a category.

For κ, physical capital data include road and lane miles, and the number of firms. Data on road and lane miles (κ_1) are from the Bureau of Transportation Statistics, U.S. Department of Commerce. Data on firms by employment size are from CBP, which are used to construct a weighted average of the number of firms (κ_2). Human capital (κ_3) is the share of bachelor-degree holders in the labor force, which is obtained from SF3.

The location characteristics (ρ) are represented by a set of county-level urban influence categories developed by the Economic Research Service, U.S. Department of Agriculture. The

urban influence codes divide the counties in the United States into 12 groups. Metro counties are divided into two groups by the size of the metro area—those in large areas with at least 1 million residents and those in areas with fewer than 1 million residents. Nonmetro, micropolitan counties are divided into three groups by their adjacency to metro areas—adjacent to a large metro area, adjacent to a small metro area, and not adjacent to a metro area. Nonmetro, noncore counties are divided into seven groups by their adjacency to metro or micro areas and whether or not they have their own town of at least 2,500 residents. Hence, the urban influence code takes on values 1 through 12 with higher values indicating remoteness.

Data related to county governments, which serve as controls in our model are obtained from the *Census of Governments* complied by the U.S. Census Bureau. For instance, public education, health and safety expenditures are available to compute their shares in total public expenditures by county. Moreover, the ratio of median real estate taxes and median housing value, both from SF3, are used to represent the median property tax rate (τ) of a county. To reflect variations in costs of land development, wage rates in the construction sector (w), and farmland prices (p^{ag}) are included in the supply equation of land development. The wage rates in the construction sector (w) are obtained from CBP, and the farmland prices are obtained from Lobowski, Plantinga, and Stavings (2003). Table 1 presents the summary statistics of all variables used in the empirical analysis.

Results

The equation system (10)-(14) is estimated using the data described in the last section. The estimated coefficients are reported in table 2. Overall, the models fit the data well, with a system-weighted R-square 0.75. Almost all coefficients are statistically significant at the 5% level. Because the double-log functional form is used, the coefficients directly measure the

elesticities of demand and supply with respect to the corresponding variables.

The upper part of table 2 reports the labor supply and demand equations. As expected, income is highly significant in both the demand and supply equations of labor. An increase in income will increase the supply of labor, but reduce the demand for labor. Climate and recreational opportunities are two measures of amenities and natural endowments. Consistent with the theory, both are positive and statistically significant in the labor supply equation. This implies that counties with mild climate and more recreational opportunities will attract more labor. Likewise, accumulated physical and human capital, as measured by road density and the percent of population with college education, are positive and highly significant in the labor demand equation. This implies that counties with more accumulated human and physical capital will attract more firms and thus have a high demand for labor. Remoteness, as measured by urban influence code, is also statistically significant in the labor demand equation. Counties located in remote areas are less attractive for firms and thus have lower demand for labor.

Housing prices and property taxes also affect labor demand and supply. As expected, higher housing prices and higher property taxes reduce the supply of labor. However, the positive effect of housing prices and property taxes on labor demand is less intuitive. Housing prices and property taxes are included in the labor demand function to measure the cost of factory space. An increase in the cost of factory space in a county may have two effects. First, it may reduce the total number of firms located in the county because of higher production costs. Second, it may cause both input substitutions within a firm and exit/entry of firms to the county. As the cost of factory space increases, space-intensive firms may move out of the county, while some labor-intensive firms may move into the county. Firms that stay in the county may substitute some labor for factory space. The net effect of increasing housing prices on labor

demand will depend on the relative magnitude of the intensive and extensive marginal effects. The positive signs on the housing price and property tax rate in the labor demand equation imply that the intensive marginal effect dominates.

Table 2 also reports the estimated coefficients of the demand and supply equations of land development. As expected, an increase in housing price increases the supply of developed area, while an increase in the production costs as measured by farmland prices and construction wage rates reduces the supply of developed area. The demand for developed land is significantly affected by housing price, income, amenities, and accumulated human capital. A 1% increase in housing price reduces total demand for developed areas by 0.39%. The demand for developed land is much more responsive to income and accumulated human capital than to housing prices. A 1% increase in income and the percent of population with college education will increase the demand for housing by 2.8% and 1.2%, respectively.

Amenities, Capital, Geography, and Spatial Variations in Economic Development

The interactions between the location decisions of firms and households shape the labor and land markets and determine economic development across the counties. Because in most cases, natural endowment, accumulated human and physical capital, and remoteness affect both the firm and household decisions, either directly or indirectly, the final effect of these factors on communities depends on the relative magnitudes of their effects on the demand and supply of labor and land development. To evaluate the final effects, we derive the reduced-form equations of income, employment, housing prices, and total developed area as functions of these factors from the structural equations. The results are reported in table 3. Because the double-log functional form is used, the coefficients measure the elasticities of income, employment, housing price, and total developed area with respect to these exogenous variables in equilibrium.

Results suggest that counties with better climate and more creational opportunities have lower income and more employment opportunities in equilibrium. This implies that households are willing to trade better amenities for lower wages. Firms take advantage of households' willingness to accept lower wages by locating in those counties with better climate and more recreational opportunities. Because of lower income, counties with better amenities have lower housing prices and less developed area in equilibrium. Counties with more accumulated human and physical capital, as measured by road density and percent of population with college education, have higher income, more employment opportunities, and high development density. However, high road density reduces housing prices, although more accumulated human capital raises housing prices. Remoteness, as measured by urban influence code, has a negative effect on every measure of economic development indicator. It reduces income, employment, housing prices and total developed areas.

Conclusions

This article evaluates the contributions of natural endowments, accumulated human and physical capital, and economic geography to the spatial inequalities of economic development in rural America. A theoretical model is developed to analyze the interrelationship between location decisions of firms and households as they are affected by natural endowments, accumulated capital, and economic geography. Based on the theoretical analysis, an empirical model is specified and estimated to quantify the effect of natural endowments, accumulated capital, and economic geography on the spatial distribution of economic activities across counties in the United States. Preliminary results suggest that households are willing to trade better amenities for lower income, and firms take advantage of this by locating in areas with better climate and more recreational opportunities. In equilibrium, counties with better climate and more creational

opportunities have lower income and more employment opportunities. Because of lower income in those counties, counties with better amenities have lower housing prices and less developed area in equilibrium. Likewise, accumulated human and physical capital also significantly affect economic development across counties in the United States. Counties with more accumulated human and physical capital have higher income, more employment opportunities, and high development density. However, high road density reduces housing prices. Remoteness, as measured by urban influence code, has a negative effect on every measure of economic development indicator. It reduces income, employment, housing prices and total developed areas. The results increase our understanding of causes of spatial inequalities in economic development and provide information for policy development to promote community vitality and economic prosperity in rural America.

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Table 1: Descriptive Statistics of County Data (2677 Counties)

Name of Variable	Unit	Mean	Standard Deviation	Minimum	Maximum
Employment	Number	44677	145939	434	4421930
Income	$	36576	8759	17062	91210
Developed area	1000 acres	32.7364	46.3656	1.5000	945.8000
Housing price	$	68278	57610	9999	1000001
Climate	Index	0.5640	0.2187	0.0000	1.0000
Recreation	Index	0.0498	0.0364	0.0000	1.0000
Road density	Miles/acre	2.9738	2.0619	0.1282	26.4234
College education	% population	0.1097	0.0488	0.0247	0.4001
Median property tax rate	%	1.0475	0.4945	0.2163	3.1566
Farmland price	$/acre	1772	5368	87	242143
Construction wages	$/year	5714	1808	500	34950
Urban influence code	Index	5.3403	3.3877	1.0000	12.0000

Table 2: Parameter Estimates for the Demand and Supply Equations of Labor and Developed Area

	Parameter	t ratio		Parameter	t ratio
Labor Supply			*Labor Demand*		
Intercept	-42.345*	-19.91	Intercept	28.541*	7.70
Income	5.039*	17.70	Income	-4.344*	-9.85
Housing price	-0.216*	-2.21	Housing price	1.648*	18.49
Climate	0.619*	21.87	Road density	2.016*	68.12
Recreation	1.378*	21.65	College education	0.545*	5.58
Property tax rate	-0.402*	-6.51	Urban Influence code	-0.112*	-18.48
			Median prop tax rate	0.306*	5.34
Supply of Developed Area			*Demand for Developed Area*		
Intercept	-11.678*	-56.15	Intercept	-28.619*	-8.76
Housing price	0.871*	32.28	Housing price	-0.388*	-3.20
Road density	1.279*	62.83	Income	2.816*	6.61
Farm land price	-0.266*	-12.71	Recreation	0.188	0.90
Construction wages	-0.087*	-3.42	College education	1.166*	4.73
			Property tax rate	-0.345*	-4.54
			Recreation*Education	0.263	3.62

*Significant at the 5% level.

Table 3: Reduced-form Equations of Income, Employment, Housing Price, and Total Development Area

Independent Variable	Income	Employment	Housing Price	Developed Area
Intercept	8.786	6.704	6.196	-6.282
Climate	-0.119	0.078	-0.266	-0.231
Recreation	-0.211	0.385	-0.322	-0.281
Road	0.023	0.326	-0.963	0.440
Education	0.436	1.785	1.901	1.655
Urban influence code	-0.021	-0.098	-0.048	-0.042
Farmland price	0.076	0.298	0.380	0.065
Construction wages	0.003	0.000	0.076	-0.021
Property tax rate	0.038	-0.169	-0.188	-0.164
Recreation*Education	0.075	0.140	1.093	0.952

$$V(\varepsilon, y, p_2) = \bar{V}$$
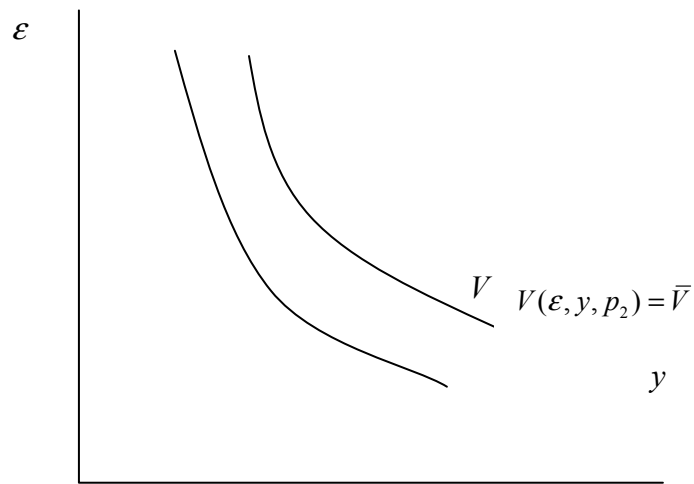
Fig. 1. Tradeoffs between income and amenities for households

$$C(y, p_2, \kappa, \rho) = \bar{C}$$

$$C(y, p_1, \kappa, \rho) = \bar{C}$$
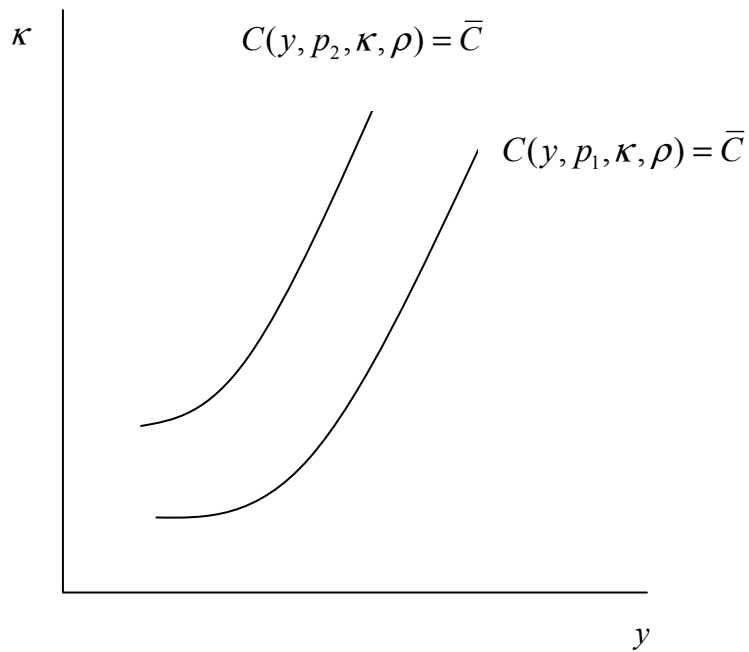
Fig. 2. Tradeoffs between wage rates and accumulated capital for firms

$$\varepsilon$$

$$C(\kappa, y, p_2, \rho) = \bar{C}$$

$$C(\kappa, y, p_1, \rho) = \bar{C}$$

$$\boxed{p_2 > p_1}$$

$$\varepsilon_2$$

$$V(\varepsilon, y, p_2) = \bar{V}$$

$$\varepsilon_1$$

$$V(\varepsilon, y, p_1) = V$$

$$y_2 \quad y_1 \qquad\qquad y$$

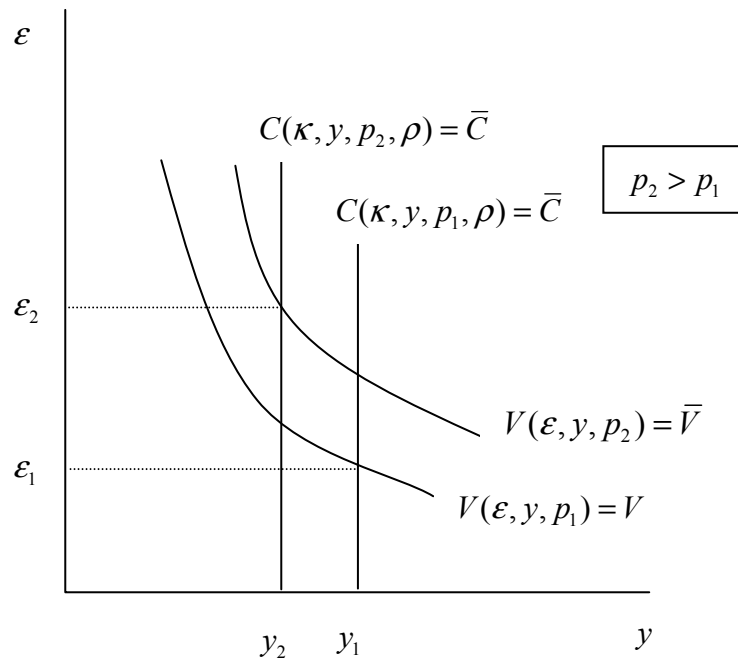**Fig. 3. The equilibrium levels of income in two counties with the same accumulated capital but different levels of amenities**

$$\kappa$$

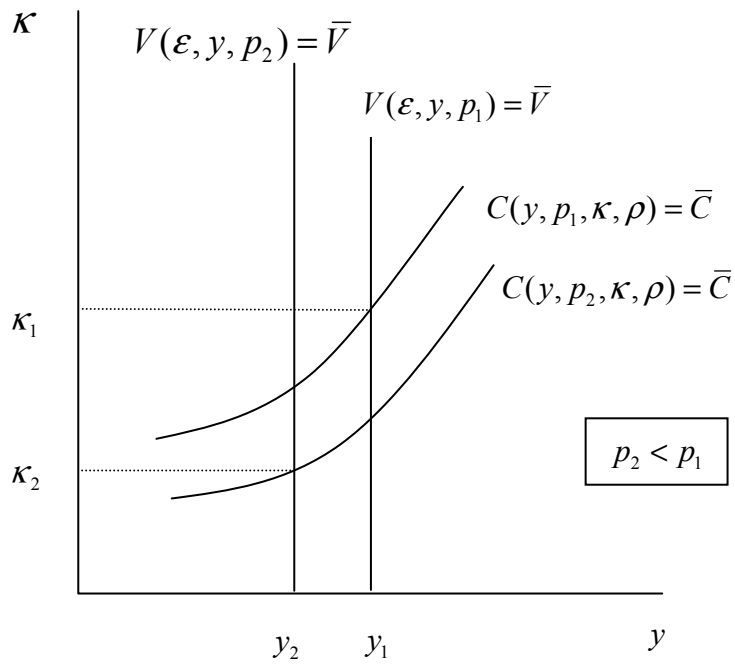$$V(\varepsilon, y, p_2) = \bar{V}$$

$$V(\varepsilon, y, p_1) = \bar{V}$$

$$C(y, p_1, \kappa, \rho) = \bar{C}$$

$$C(y, p_2, \kappa, \rho) = \bar{C}$$

$$\kappa_1$$

$$\boxed{p_2 < p_1}$$

$$\kappa_2$$

$$y_2 \quad y_1 \qquad\qquad y$$

Fig. 4. The equilibrium levels of income in two counties with the same amenities but different levels of accumulated capital

κ or ρ

Income: High *Housing price:* • High if the capital effect dominates • Low if the amenity effect dominate	*Income:* • High if the capital effect dominates • Low if the amenity effect dominate *Housing price:* High
Income: • High if the amenity effect dominates • Low if the capital effect dominate *Housing price:* Low	*Income:* Low *Housing price:* • High if the amenity effect dominates • Low if the capital effect dominate

ε

Fig. 5. Amenities, accumulated capital, and the spatial variation in income and housing prices