Natural Amenities, Income Mix, and Endogenous Community Characteristics

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Introduction

Substantial income variation is present across communities in the United States. Some communities are inhabited largely by high-income households, others by those largely in poverty. For example, over 50% of households in Douglas County in Colorado had incomes above $75,000 in 2000, while more than 50% of households in Buffalo County, South Dakota were in poverty (Census Bureau 2000). On the other hand, there exists significant variation in public services across communities. Take public education as an example. Public education spending per capita is as high as $6,539 in Lake County in Colorado, but only $39 in Platte County in Suffolk City in Virginia, much lower than the national average $1,128. Then, the question is what causes variations in income and public services across communities, and do these two variations affect each other? To answer the above questions adequately, we need to understand how households with various incomes make location decisions.

The primary objective of this study is to investigate how households distribute themselves across communities, and more generally how community characteristics serve to attract alternative income groups, and how these alternative income groups in turn have impacts on community characteristics, especially public services. The answers to these questions are important because income distribution directly affects a community's economic base and vitality, and because understanding the attraction of community characteristics to alternative income groups is critical to local policy maker.

A number of studies have examined households' location decisions. In the public finance literature, Tiebout sorting has been traditionally the theoretical foundation of community

selection. The argument, first proposed by Tiebout(1956), is that households sort themselves across local jurisdiction according to their public good preferences. Wealthier households value public services more than do poor households and hence more likely reside in communities with better public services. Tiebout framework has been the basis for numerious economic and political science articles (Rhode and Strumpf 2003). These studies, for example, include Epple, Filimon and Romer (1984), Epple and Romer (1991), Fernandez and Rogerson (1997), and Wooders (1999), among others. Some recent examples include Nechyba (1999;2000), who study education spending; Perroni and Scharf (2001), who analyze generic local public goods.

Several other theories have been advanced to explain why rich households make different location decision than poor households. For instance, Schmidheiny (2002;2006) proposes that a progressivity of a local income tax as a new theoretical explanation for income segregation of the population; and Ross and Yinger (1999) in their literature survey suggest that property tax explains the income sorting.

In the urban economic literature, the classic monocentric-city model, developed by Alonso-Mills-Muth, assumes that the income elasticity of housing demand is greater than the income elasticity of commuting cost, and thus, wealthier households tend to live in suburbs. However, the validity of the assumption is called into question by empirical evidence from Wheaton (1977).

The other important factor affecting location decision by income group is the heterogeneity of amenities across jurisdictions. Brueckner et al. (1999) suggest that even if the income elasticity of housing demand is identical to the income elasticity of commuting cost, income segregation is likely to occur if amenities are spatially heterogeneous across communities. Brueckner et al. use this amenity-based theory of residential location decisions to explain why

high-income households in the urban United States tend to live in suburbs, but in the city center in Paris. Wu and Cho (2002) study the income distribution and suggest that the ignorance of amenities would result in a biased estimate of preference parameters. Wu (2006) develops a theoretical model to analyze the residential location decisions and community's characteristics and finds that socioeconomic characteristics of communities are heavily influenced by their environmental characteristics.

Compared to the rich literature on income segregation theories, there are much fewer empirical studies on income segregation. In the limited empirical works, metropolitan areas are frequently the study areas. Friedman (1981), Nechyba and Strauss (1998) study the location choice of households in San Francisco area and suburbs of Philadelphia, respectively, and find that public expenditures are an important locational factor. Epple and Sieg (1999a), and Epple, et al. (2001) empirically model community choice as the result of sorting on public goods provision and housing prices in 92 communities in the Boston areas. Feld and Kirchgässner (2001) find that income tax rate has a negative impact on the share of rich households in Swiss cantons and main cities. They use instrumental variables of lagged observations to solve the generic endogeneity of income tax rate, but this treatment may be insufficient to eliminate the endogeneity problem (2006). Schmidheiny (2006) also study Switzerland and reaches the same results by assuming constant public goods across communities and controlling other segregation factors such as social interaction and distance from the central business district.

Our study makes several contributions to literature. First, different from previous studies which typically treat provisions of public goods as given, our study endogenizes provisions of public services which are determined by the location pattern of different income groups (Epple and Romer 1991;Epple and Sieg 1999a). Second, we explicitly take into account environmental

amenities which have been ignored in most previous studies, except Feld and Kirchgässner (2001), who use the ranks of three criteria 'silence', 'landscape' and 'beauty of the locality' of the survey of Swiss recruits to approximate the amenity level in the canton.

The Model

Assume there are three income groups, with $i = h, m, l$ denoting high-, median, and low-income groups, respectively. Given certain community characteristics Z_j in community j, households derive their utility, U_i, from public services (g_j), and environmental amenities (a_j) and consumptions of private goods. Public services such as public education represent the social amenities, and are determined endogenously by income mix in community j. Environmental amenities are exogenously provided by geographic feature and vary across communities, but are homogenous within each community. This assumption indicates households living in a community share the same environmental amenities, but households in different communities enjoy different amenities. The utility function for income group i in community j is

$$(1) \quad U_{ij} = U[g_j, a_j, Z_j, y_i - C_i(g_j)]$$

where $y_i - C_i(g_j)$ is the available budget for consumptions of private goods, with y_i denoting household income, $C_i(g_j)$ the amount of tax that a household in income group i has to pay to finance the local public services, and $C_i'(g_j) \geq 0$. Thus, income group i's desired public services level g_j^* is

$$(2) \quad g_{ij}^* = argmax U[g_j, a_j, Z_j, y_i - C_i(g_j)], \quad i = l, m, h.$$

As in previous models of local jurisdiction (Epple and Romer 1991;Epple and Sieg 1999a), the public services level in a community is determined by majority vote of its residents. For example,

if lower income household group is the dominant resident group, then by majority rule the level of public services preferred by low-income group is the level of the public service in that community. We define the level of public services decided by the majority rule in a community as g_{Mj}^{*}. Households' indirect utility can be expressed as

(3) $$V_{ij}^{*} = U_{ij}[g_{Mj}^{*}, a_j; Z_j, y_i - C_i(g_{mj}^{*})]$$

Given the exogenous income y_i, household would reside in the community j if V_{ij}^{*} obtained in the community j is greater than the indirect utility obtained from any other communities. Because the household's indirect utility is unobservable, V_{ij}^{*} can be considered as a random variable as follows

(4) $$V_{ij}^{*} = \beta X + \varepsilon_{ij}$$

where β is the parameter, X is a vector including the level of public services, natural amenities, and other exogenous community characteristics Z_j in demography (DEMO), economics(ECON), geography (GEO), and politics (POL), and ε_{ij} is a random error term. If the random error term is assumed to follow Weibull distribution, then the probability that the income group i live in the community j is given by Multinomial logit model (Maddala 1983)

(5) $$P_{ij} = \frac{\exp(\beta_i ' X_j)}{\sum_i \exp(\beta_i ' X_j)}, \quad i = l, m, h$$

Because individual household data are not available, we use county level aggregate data, the share of alternative income groups ($\overline{P_{ij}}$), to approximate the p_{ij}. Normalization of each share by the share of median income group ($\beta_m = 0$) yields

(6) $$\overline{p_{ij}} = \frac{\exp(\beta_i X_j)}{1 + \sum_{i=l,h} \exp(\beta_i X_j)},$$

and the share of the reference group is

(7) $$\overline{p_{mj}} = \frac{1}{1 + \sum_{i=l,h} exp(\beta_i X)}$$

The multinomial logit model has been widely used in farmer's land allocation decisions (Wu and Segerson 1995), the choice of irrigation technology and alternative crop management practices (Caswell and Zilberman 1985;Wu and Babcock 1998).

Marginal effects of changes of explanatory variables on the share of alternative income group in a community are nonlinear combinations of the explanatory variables and can be written as (Greene)

(8) $$ME = \frac{\partial \overline{p_{ij}}}{\partial x_k} = (\hat{\beta}_{ik} - \sum_{i=l,h} \overline{\hat{p}}_i \hat{\beta}_{ik}) \overline{\hat{p}}_{ij}$$

where x_k is a specific community characteristic k, $\hat{\beta}_{ik}$ is the estimated coefficient of x_k ($\hat{\beta}_{ik}$ =0 when $i = m$), and $\overline{\hat{p}}_i$ is the estimated share of households in income group i $(i = l, h)$. The sign and magnitude of this marginal effect have no direct relationship with any specific coefficient.

Empirically, the following logarithmic transformations are used to estimate $\hat{\beta}_i s$

(9) $$\log \frac{\overline{p_{lj}}}{\overline{p_{mj}}} = \beta_l X_j + \varepsilon_{lj},$$

(10) $$\log \frac{\overline{p_{hj}}}{\overline{p_{mj}}} = \beta_h X_j + \varepsilon_{hj}$$

The vector of community characteristics, X_j, is exogenous, except the community pubic service, g_{Mj}^*, which is endogenously defined by equation (2). We assume that g_{mj}^* takes linear functional form as follows

(11) $$g_{Mj}^* = \gamma W_j + \varepsilon_{Mj},$$

where W_j includes not only environmental amenity, variables in Z_j (DEMO, ECON, GEO, and POL), but also local property tax, and shares of low- and high- income group in community j. Local property tax is included because local public services in U.S. are mainly funded by local property tax revenues. One objective of this study is to examine the effect of income mix on the provision of public goods, thus, shares of alternative income group are included in equation (11).[1] Equation(9), (10), and (11) form the simultaneous equation system of our empirical study.

The equation system is estimated using the county level data. County is the smallest geographic unit that most economic data are available, and also county is the basic political unit that local government fulfills its administrative duty such as providing local public service. Since county-level data are cross-sectional and a random shock in a county may affect neighboring counties as well, potential spatial autocorrelation exists. Not correcting spatial dependence can result in misspecifiation, which further leads to biased and inconsistent OLS estimate (Anselin 1988;Anselin 1988). Given this, the system is estimated using generalized spatial three-stage least square estimator (GS3SLS) developed by Kalijian and Prucha (2004). At first step, two-stage least square estimator is used to estimate equation (9), (10), and (11). At the second step, Moran's I test is used to test if spatial autocorrelation exists for each equation using residuals from the first step. If spatial autocorrelation is identified, then spatial autocorrelation parameter ρ is estimated using equation (7) in Kelejan and Prucha (1999). We

[1] To avoid perfect colinearity, only shares of low- and high- income group are included.

assume in this study the spatial dependence operates through the error term ε and follow the structure $\varepsilon = \rho\varpi\varepsilon + \mu,$[2] where ϖ is the spatial weight matrix created based on the geographic adjacency rule,[3] and μ has a $N(0, \sigma^2 I_n)$ distribution. Using the estimated $\hat{\rho}$, $(I - \hat{\rho}\varpi)^{-1}$ is used to adjust the original data to correct the spatial autocorrelation. Finally, after correcting the endogeneity and spatial autocorrelation, at the third step, Lagrange Multiplier statistic (λ_{LM}) is used to test whether cross-equation correlation exists or not (Greene 2003).[4] If cross-equation correlation is identified, then seemingly unrelated estimator (SUR) is applied to correct the contemporaneous correlation.

Data and Variable Description

The objective of this study is to investigate the interaction between community characteristics and income segregation. Data on community characteristics and income segregation are required to conduct our empirical study, which covers 2992 counties in lower 48 states. Our data come from a range of sources including Census of Bureau (2000), Economic Research Service (ERS), Census of Government (1997), Natural Resource Inventory (NRI 1997) and USA Today. Table 1 lists variable descriptions and statistics.

Dependent Variables

[2] The other type of spatial dependence is called spatial lagged dependence, which is operated through the lagged term of dependent variables.

[3] Two criteria are usually used to create spatial weight. One is contiguity-based spatial weight and the other is distance-based spatial weight. The contiguity-based spatial weight usually uses two criteria: rook contiguity, which uses common boundaries to define neighbors, and the queen contiguity which uses common points (boundaries and vertices) in the definition. Distance-based spatial weight defines the neighbors according to the specified distance, or the specified k-nearest neighbors. The spatial weight matrix can be created in a variety of softwares such as Arcview 3.2, ArcGIS 9.0, SpaceStat, and Geoda.

[4] LM statistic has a limiting chi-squared distribution with M(M-1)/2 degree of freedom, where M is the number of equations in the simultaneous system. For details about the Lagrange Multiplier statistic, please check page 350 in Green (5th edition, 2003).

As mentioned above, households are grouped into three categories: low-, median-, and high income groups. Income distribution data are from Census Bureau 2000 Summary File 3 (SF3), which represents measurements of variables in 1999. The summary file provides a rich set of information on population and housing at the county level. Particularly, SF 3 reports the number of households in the 16 income categories.

Low income household is defined according to the poverty definition set by the Census Bureau. Households are low income households (or under poverty) if their family pre-tax money income in a given year is below the poverty threshold for their family size and age composition. The 1999 average poverty threshold for a family of four persons was $17,092. Poverty thresholds were applied on a national basis and were not adjusted for regional, state or local variations in the cost of living. In 1999, the national average poverty rate is about 14%.

High-income households are defined as the households whose pre-tax income is above $75,000. This definition is following Mallett (2001) who defined household of members over 5 with annual income above $75,000 in 1995 as high income household. In 1999, the national average household size is 2.26, and the maximum county average household size is 4.48, lower than 5. Consequently, taking into account household size and cost of living in 1999, $75,000 is a reasonable threshold to defined high income households. The share of high income household is the ratio of total high income households to total households in a community. The mean of share of high income households is about 12% at national average, in 1999. The maximum share of high income is as high as 55%, and the minimum is only about 1.5%, an indication of dramatic variation in income across communities.

Median income households are difference between the total households and sum of low and high income households in a community. Median income group is a rough concept, because

it consists of households with income both lower and higher than mean income, $36,222 in 1999. The mean of share of median income is about 74%.

Community pubic services are one of important community characteristics affecting income segregation, and are multidimensional (education, public safety, public welfare, etc.). Since the level of public services is not directly observed and there is no officially available index to measure the quality and quantity of public services, we have to rely on proxy variables. As previous studies (Epple and Sieg 1999b;Bergstrom and Goodman 1973;Borcherding and Deacon 1972), we approximate the quantity of community public services by dollars of local direct general expenditure per capita. The direct general expenditure mainly consists of spending in education, social service, transportation, public safety, environment and housing, government administration, and interest on general debt. The local government finances data at county level are from Census of Governments and for the year 1997. It would be ideal to use local government finance data for the year 1999, but such data are not available since a Census of Governments is taken at 5-year intervals as required b law under Title 13, United State Code, Section 161. The mean of local direct general spending per capita in 1999 is $2,506.

Alternatively, public education is taken as a proxy of local public service quality not only because local spending on education is the largest category of local expenditure, but also public education is likely the central concern in locational choices of most households. According to Census of Government, education includes local government-operated elementary and secondary schools, and any universities, colleges, junior, or community colleges operated by the local government. Ideally, a measure of average test scores in the community would be a good proxy of education quality in the community. However, these types of measurements are not available at county-level. Hence, following Alesina et al. (1999), and Nechyba and Strauss (1998), we use

local expenditure on education per capita to approximate local education quality. One of the limitations of such a measurement in the literature is that increasing expenditure on education does not necessarily translate into greater student achievement. The education expenditure is also collected from the Census of Governments 1997. The mean of education spending per capita is about $1,128 in 1997, and the minimum and maximum are roughly $40 and $6, 539, respectively.

Explanatory Variables

As stated in theoretical model, household location decision is affected by natural amenities and other community characteristics Z_j, which consists of demographic, economic, geographic, and political variables.

Natural amenity is an attribute that enhance a location as a place to live, thereby it affects a household's location decision. We draw on amenity index developed by Economic Research Service (ERS) to measure the natural amenity. The ERS amenity index is created to capture the physical rather than social or economic environment, thus, man-made amenities such as historical building, golf courses, and casino are excluded. Six measures are selected to reflect the physical beauty of a location in terms of climate, topography and water area. They are warm winter (average January temperature), winter sun (average January days of sun), temperate summer (low winter-summer temperature gap), summer humidity (low average July humidity), topographic variation (topography scale), and water area (water area as proportion of total county area). The greater the index, the higher amenity level is in a community. More details about the amenity index is available in ERS web site.

Demographic composition in a county is likely to affect the income segregation and the demand for public goods as well. In this study, education, age composition, household structure, and local housing tenure are used to measure the demographic composition. Education attainment affects income and demand for public goods directly. We use the percent of population 25-year old and over with college and above degree as a proxy of the education attainment in a county.

Age not only affects one's income, but more importantly age structure is a determinant of preference for public goods (Alesina, Baqir, and Easterly 1999). In this study, share of population older than 65 is used to estimate the effect of age composition on income mix and demand for public goods. The elder may depend more on retirement pension and public welfare program as income source. Thus, community having high percent of old people is more likely to have high share of low income group. On the public service size, the life cycle hypothesis would predict that persons over 65 years of age tend to spend a large portion of their current income on current consumption than younger people, thus they may demand more public services than younger people, but different types of public goods. Poterba (1997) finds that the larger the share of elderly in a jurisdiction is, the lower the public spending on education is. However, the elder prefer aging-related public service such as public health, medical care, and senior recreation service.

Household structure is measured by percent of households headed by women. The reason why female-headed household is taken into account is because female family heads are usually disproportionately young, lesser educated and less skilled, female-headed family is more likely to live under poverty (Levernier, Partridge, and Rickman 2000).

Housing tenure is measured by the percent of housing occupied by owners. It is believe that renters have different tastes in public goods from the remainder of the population, because renters do not believe that they pay the entire property tax on their housing, and tend to vote for more public expenditures than home-owners with the same income (Bergstrom and Goodman 1973;Bergstrom and Goodman 1973). Therefore, it is expected that high percent of owner occupied is negatively associated with public services. Also, it is anticipated that the share of owner occupied is positively relate to the share of high income group, but negatively related to low income group because wealthier households tend to buy house rather than rent houses as low income households usually do.

Economic situation in a community directly affect the employment opportunity of households, and the public services as well. Economic situation is approximated by local labor market. Previous studies have used variables such as employment rate, job growth rate, industrial composition, and occupational structure.[5] In our study, employment rate is used as the measurement of local labor market. It is expected that community with high value of this variable would tend to have large share of high income group but small share of low income group, and a large amount of commercial and industrial activities. As a result, it may be that larger amounts of public services must be provided in order to attract and retain such activities (Bergstrom and Goodman 1973). However, the types of public services needed for commercial and industrial sectors may vary from residential need. For example, residents may put heavy weight on education quality in the community, while commercial and industrial activities may put emphasis on public safety and transportation service. Data of employment rate is obtained from US Department of Labor Bureau of Labor Statistics.

[5] However, as Weber (2005) states "each of these variables captures some aspects of local labor conditions that may affect poverty, but none is without flaws."

Community public services are funded largely through property tax revenues in U.S., which are raised mainly from tax on real property (building and lands) with the remainder derived from personal property tax. However, county-level property tax data are not directly available. Instead, we calculate the ratio of county property tax revenue to the population in a community as a proxy of property tax per capita. It is expected that public service is positively related to property tax. County property tax revenue data are also from Census of Government 1997.

Urban Influence Codes 1993 (UIC) from Economic Research Service is taken as the measurement of geographic adjacency to a metropolitan area. Since adjacency to a metropolitan is an important factor determining the location decision of a household. UIC divide counties into 9 categories, with 1 representing a metropolitan, 9 representing a remote area not adjacent to any metropolitan and town. It is expected that location close to a metropolitan area is positively associated with high income group, but negatively with low income group.

Political factors can affect the income mix and provision of public goods. Political competitiveness in a county is utilized to measure the political leadership's commitment to economic development and political issue. We construct political competitiveness variable based on the method developed by Levitt and Poterba (1999). The variable is created as the differences in the number of votes for the democratic presidential candidate Gore between county and national average in 2000. Counties with vote outcomes equal to the national average are more highly competitive politically. Positive and negative values of this variable reflect that the county is democratic or conservative, respectively.

Results

Equations (9)-(11) are estimated for the two proxies of public services, local direct general expenditure per capita and public education spending per capita separately. For convenience, the simultaneous equation system with the measurement of local direct general expenditure per capita is named Model 1, and the one of public education spending per capita Model 2. Test of spatial autocorrelation is conducted for both models. In model 1, spatial autocorrelations are identified for equation (9) and (10) but not for equation (11), and the estimated spatial autocorrelation parameters are 0.227 and 0.162, both of which are statistically significant at 1% level. In model 2, spatial autocorrelations are identified and statistically significant at 1% level for all three equations(9)-(11). The estimated spatial autocorrelation parameters are 0.242, 0.157, and 0.079, respectively. The highly significant spatial parameters suggest that a random shock that affects the income segregation and public services level in a particular county triggers a change not only in that county but also in its neighboring counties. In addition, LM test rejects the hypothesis that no cross-equation correlation exists across three equations. Consequently, the simultaneous equation system is estimated by GS3SLS. Results show that the data fit models quite well, since the system weighted R-Square for Model 1 and 2 are 68.14% and 67.88%, respectively. Most coefficients are statistically significant at 1% level. Estimated results are reported in Table 2 and 3 with standard deviation in the parenthesis for both models.

Because each independent variable has a nonlinear effect on the range of the dependent variable in equation (9) and (10), it is difficult to interpret the effect directly. Instead, marginal effect is calculated using equation (8) to evaluate the effect of unit change of each independent variable on the probability of change in the share of alternative income groups. Table 4 reports marginal effects of explanatory variables in model 1 and 2, with elasticity in the parentheses.

Marginal effect of public services, measured by the local direct general expenditure and public education per capita, is negative with respect to the proportion of low-income households, but positive with respect to the share of median- and high- income groups in both models. In model 1 and 2, a 1% increase in public service is associated with 0.26% and 0.24% reduction in the share of low-income group, but 0.28% and 0.18% rise in the proportion of high-income group. This result supports the argument that public services are a determinant of income segregation because middle and upper class households value public services more than the poor. Feld and Kirchgässner (2001) obtain the similar result using ranks of education, medical services and pubic traffic as the proxy of public services.

Marginal effect of natural amenity in the share of high income group is positive, indicating high income households prefer location with better natural amenities. Surprisingly, marginal effect of natural amenity in the share of low income group is also positive. The possible explanation is that low income households prefer low living cost location, usually the rural areas, where natural amenity index is high because natural amenity index reflect amenity in climate, topography and water. However, the magnitude of marginal effects in the share of alternative income groups is quite small, so is the elasticity.

Educational attainment, measured as the percent of population with bachelors and above degrees, increases the proportion of high-income group, while reduce the share of median and low income groups. Marginal effect is statistically significant at 1% level. 1% increases in the percent of population with college and above degree increase the share of high income group by 0.54% and 0.65% in model 1 and 2, and cause a reduction in the share of low-income group by 0.22% and 0.26%. This result is consistent with other empirical evidences (Levernier, Partridge, and Rickman 2000;Rupasingha and Goetz 2003), which suggest that increasing educational

attainment is effective in reducing poverty rate. Consistent with other empirical evidences in the literature in poverty that improved technical skill effectively removes people out of poverty.

Marginal effect of employment rate is negatively and significantly related to the share of low income households. A 1% increase in the employment rate decreases the share of low-income group by 0.57%. This indicates that job accessibility plays a key role in poverty reduction. In contrast, communities with high employment rate tend to have more median and high income households. A 1% increase in employment rate cause a rise in the shares of median- and high-income group by 0.12% and 0.21% in model 1, and 0.13% and 0.16% in model 2.

Household structure, approximated by the percent of female-headed households, has a positive and significant effect on the share of low income group, but negative and significant effect on the proportion of median and high-income groups. This finding supports the convention that female-headed households tend to have higher poverty rate across all racial groups (Blank and Hanratty 1992), because female heads, as stated by Levernier et al. (2000), are usually the sole wage earner for the family, and disproportionately young, less educated, and less skilled. Marginal effect of female-headed households on the share of low-income group is the largest among all explanatory variables in both models. A 1% rise in the female-headed households causes about 1.1% increase in the share of low-income households, a finding similar to previous studies (Weinberg 1987;Lichter and Mclaughlin 1995). Conversely, a 1% rise in female-headed households decreases the share of middle- and high-income group by over 0.11% and 0.55% in both models, respectively.

The housing tenure, measured by the percent of owner occupied housing, affects the share of low- and median income group negatively, but the share of high-income group

positively in both models. This result is expected because median- and low-income households are more likely to rent a place rather than purchasing a house as the high income households do, communities with higher percent of owner occupied houses tend to have less median and low income households, but more high income households. A 1% increases in the percent of owner occupied housing cause over 1.50% reduction in the share of low income households, but over 2.0% rise in the share of high income households.

The percent of aged 65 or older has negative effect on both high and low income group, but positive effect on the fraction of median income group. It is expected that the marginal effect of the elder in the share of high income group is negative because the elder mainly rely on retirement pension or social security as their financial support. A 1% increase in the elder results in over 0.34% reduction in the proportion of high income households in a community in both models. A 1% increase in the share of the aged is associated with about 0.20% decrease in the proportion of low-income group. Traditional poverty literature often suggests that the elder are more likely to live under poverty. However, recent several empirical evidences (Levernier, Partridge, and Rickman 2000) reach similar results. Lichter and MaLaughlin (1995) find that the increase in the elderly population is the strongest predictors of declines in county poverty rate, 1 percent increase in the elderly population leading to 0.32 percent reduction in county poverty between 1980 and 1990.

The marginal effect of Urban Influence Codes (UIC) is positive regarding to the proportion of low and median income groups, but positive regarding to the share of high income group. A 1% increase in the UIC results in about 0.27% rise in the share of low income group, but a 0.43% reduction in the share of high income groups in both models. UIC not only represent adjacency to a metropolitan, but also may implicitly reflect other two types of

amenities- historical and modern amenities such as museum, restaurants, and theaters. Hence, low income households tend to live far away from metropolitan area to avoid high living cost, but high income households prefer communities close to a metropolitan, where historical and modern amenities are better. This finding is consistent with Brueckner et al. (1999) who find that the wealthy live in the central Paris because of rich historical and modern amenities there, while the poor live in suburb.

Marginal effect of political factor in the share of low income group is negative, but positive with respect to the share of median and high income group. But both effects are not statistically significant.

Effects of Income Mix on Public Services

Our empirical evidence shows that public services indeed are a factor that influences income mix. The share of low income household is negatively associated with public services in terms of local direct general expenditure and public education. A 1% increase in the share of low income group in a community is associated with 0.46% and 0.23% decrease in local direct public expenditure and public education spending, respectively. This finding is not surprised because public services are funded mainly through property tax and low-income households usually inhabit in low value housing, property tax revenue is low in communities with a high share of low-income households. In contrast, public services are positively associated with the share of high-income households. A 1% increase in the share of high-income group in a community results in a 0.05% and 0.12% increase in general public expenditure and public education spending, respectively. This reveals that local public education expenditures are more responsive to the local income level than other types of public services. It is hard to state which

is the cause and which is the consequence. However, the interaction between the income mix and public services is worth attention from local policy makers.

Property tax is positively related to public service, and the marginal effects are statistically significant in both models. This is expected because public services are funded primarily by local property tax. Natural amenity is positively associated with public services. This indicates that location with better natural amenity tends to have better public services as well, because natural amenity enhances a place as a residence and households may be willing to pay more to live in a community with better natural amenity.

Educational attainment is negatively related to public services in both models. This result is unexpected because communities with more educated residents tend to demand better public education and other public services.

The effect of employment rate has positive and statistically significant effect on local direct public service, but negative and statistically significant effect on public education. A 10% increase in employment rate in a community results in 1% increase in general public expenditure, but a 1.3% decrease in public education. This implies that the increased commercial and industry activities from higher employment rate demand more public services such as public transportation and safety to support such activities.

Female-headed households are positively related with public services in both models. A 1% increase in the percent of female-headed households leads to a 0.88% and 0.41% increase in model 1 and 2, respectively. The reason is that female-headed households are usually single mother, and more likely to rely on public welfare, thereby community with high percent of female-headed household tend to have high expenditure in public service.

The percent of owner occupied housing is negatively associated with public services in both models. This result is consistent with (Bergstrom and Goodman 1973) and supports the hypothesis that renters tend to vote for more public expenditure than homeowners with same income.

As discussed, the elderly may have different demands for public services in terms of the quantities and types. As expected, the percent of the aged is negatively associated with public education, a 10% increase in the percent of the elder lead to 1 percent decrease in public education expenditure. Although life cycle hypothesis suggests that the elderly may spend more on public services especially aging-related public goods, our results show that the higher the share of the elderly in a community, the lower the local direct general expenditure is. The reason may be that despite the elderly may demand more for aging-related public services such as public welfare, the effect on general public services is washed out by their less demands for other public services, particularly the public education.

Urban Influence Codes (UIC) is negatively related to public services. Large value of UIC implies that community is far away from a metropolitan area. There are fewer population reside in the remote area, thereby the spending on public services per capita is larger in the remote area. This may reflect that there is an economics of scale in the provision of public services.

The effect of political factor on public service is positive with respect to the local direct public service, but negative with respect to the public education. However, both effects are not statistically significant. The marginal effect of the size of a county on the public services is positive and statistically significant.

Conclusions

This study concentrates on the question how community characteristics explain the income mix. Specifically, we are interested in the relationship between income mix and local public services. Our results show that income mix indeed interacts with the local public services in the communities. Public services are measured by both the local direct general expenditure and public education per capita in our study. The finding suggests that a 1% increase in public education expenditure is associated with a 0.26% decrease in the share of low-income household in a county, but it is associated with 0.28% increase in the share of high-income households. Likewise, a 1% increase in the share of low-income group is associated with a 0.46% decrease in the general public expenditure and a 0.23% decrease in public education expenditure, while a 1% increase in the share of high-income households is associated with a 0.05% increase in general public expenditure and a 0.12% increase in public education expenditure. Communities with better natural amenities, higher education attainment, and higher share of owner occupied housing, and higher employment rates tend to have more high-income households. Communities far away from the metropolitan and with more female-headed households tend to have more low-income households.

Our results also have important policy implication, particularly in the poverty reduction. The results show that higher educational attainment is associated with lower poverty rate. This suggests that increasing education is effective in poverty reduction. Policies that increase labor force participation are effective in alleviating poverty as well. This is particularly true to life low income households out of poverty. Our findings reveal that the familial status of women is strongly associated with poverty. Consequently, it is important for policy makers to develop local economic strategies that promote the entry of women into labor market.

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Table 1, Variable Description and Statistics

Variable	Description	Mean	Std Dev	Min	Max
Low	Share of low income household (%)	0.14	0.06	0.02	0.48
Median	Share of median income household (%)	0.74	0.06	0.43	0.90
High	Share of high income household (%)	0.12	0.07	0.02	0.55
School	Public expenditure on local education (thousand $/per capita)	1.13	0.36	0.40	6.54
Public	General public expenditure (thousand $/ per capita)	2.51	1.10	0.18	21.41
Tax	Local property tax ($/per capita)	0.63	0.50	0.03	10.50
Amenity	ERS amenity index	0.04	2.29	-6.40	11.17
College	Percent of population 25+ with college or higher degree (%)	0.10	0.04	0.03	0.39
Old	Percent of population 65+ (%)	0.15	0.04	0.02	0.35
Fehu	Percent of female-headed household (%)	0.22	0.05	0.04	0.43
UIC	ERS urban influence code	5.56	2.73	1.00	9.00
Size	Total areas of a county (thousand acres)	630.56	836.88	28.60	12868.20
Political	Political competition	0.09	0.07	0.00	0.45
Emprate	Employment rate	0.46	0.07	0.14	0.89
Occupied	Percent of owner-specified occupied houses (%)	0.85	0.09	0.23	0.98

Table 2, GS3SLS Results for Model 1

Variables	LNLM	LHHM	Public
Intercept	-0.327*	-2.781*	2.916*
	(0.053)*	(0.055)	(0.350)
Sli			-8.184*
			(0.796)
Shi			1.106
			(1.946)
Tax			1.106*
			(0.042)
Public	-0.106*	0.055*	
	(0.008)	(0.008)	
Amenity	0.021*	0.004	0.061*
	(0.002)	(0.002)	(0.009)
College	-1.894*	5.001*	-4.420**
	(0.141)	(0.131)	(1.809)
Emprate	-1.463*	0.116	0.562***
	(0.081)	(0.076)	(0.289)
Fehu	6.278*	-1.499*	10.078*
	(0.137)	(0.126)	(1.196)
Occ	-1.863*	2.083*	-3.039*
	(0.072)	(0.068)	(0.708)
Old	-2.043*	-2.564*	-1.895*
	(0.132)	(0.123)	(0.667)
UIC	0.049*	-0.069*	0.109*
	(0.002)	(0.002)	(0.020)
Political	-0.286*	0.181*	0.061
	(0.047)	(0.044)	(0.187)
Size	3.5E-5*	-3.0E-5*	1.9E-4*
	(3E-6)	(6E-6)	(2E-5)
ρ	0.227*	0.162*	

System Weighted R-Square: 68.14%; $\lambda_{LM} = 234$

* significant at 1%, ** at 5%, and ***at 10%

Table 3, GS3SLS Results for Model 2

Variables	LNLM	LHHM	School
Intercept	-0.209*	-2.901*	1.453
	(0.056)	(0.059)	(0.105)
Sli			-1.843*
			(0.262)
Shi			1.100***
			(0.644)
Tax			0.373*
			(0.014)
School	-0.256*	0.168*	
	(0.025)	(0.023)	
Amenity	0.017*	0.006**	0.004*
	(0.003)	(0.002)	(0.003)
College	-2.244*	5.162*	-2.366*
	(0.138)	(0.126)	(0.597)
Emprate	-1.521*	0.144***	-0.326*
	(0.081)	(0.075)	(0.096)
Fehu	6.040*	-1.372*	2.097*
	(0.139)	(0.126)	(0.392)
Occ	-1.833*	2.089*	-0.901*
	(0.073)	(0.068)	(0.232)
Old	-2.217*	-2.469*	-0.708*
	(0.133)	(0.122)	(0.222)
UIC	0.048*	-0.068*	0.036*
	(0.002)	(0.002)	(0.007)
Political	-0.316*	0.208*	-0.195
	(0.047)	(0.044)	(0.062)
Size	3.0E-5*	-3.0E-5*	6.4E-5*
	(6E-6)	(6E-6)	(7E-6)
ρ	0.242*	0.157*	0.079*

System Weighted R-Square: 67.88%; $\lambda_{LM} = 262$

* significant at 1%, ** at 5%, and ***at 10%

Table 4, Results of Marginal Effect and Elasticity of Explanatory Variables

Variables	Marginal Effect for Model 1			Marginal Effect for Model 2		
	Low	Median	High	Low	Median	High
Amenity	0.0024	-0.0024	0.0001	0.0017*	-0.0022*	0.0005*
	(0.0008)	(-0.0001)	(3E-5)	(0.0006)	(-0.0002)	(0.0002)
Public	-0.0133*	0.0047*	0.0087*	-0.0319*	0.0024*	0.0295*
	(-0.2393)	(0.0158)	(0.1819)	(-0.2570)	(0.0037)	(0.2769)
Old	-0.1885	0.4614*	-0.2729*	-0.1911*	0.4943*	-0.3031*
	(-0.2019)	(0.0935)	(-0.3411)	(-0.2047)	(0.1002)	(-0.3789)
College	-0.3148*	-0.3291*	0.6439*	-0.3597*	-0.4233*	0.7830*
	(-0.2249)	(-0.0445)	(0.5366)	(-0.2569)	(-0.0572)	(0.6525)
Fehu	0.7572*	-0.4558*	-0.3014*	0.6964*	-0.37012*	-0.3232*
	(1.1890)	(-0.1355)	(-0.5526)	(1.0944)	(-0.1100)	(-0.5981)
UIC	0.0070*	0.0023*	-0.0093*	0.0068*	0.0039*	-0.0107*
	(0.2778)	(0.0174)	(-0.4317)	(0.2689)	(0.0296)	(-0.4965)
Occ	-0.2558*	-0.0328*	0.2886*	0.2476*	-0.0893*	0.3370*
	(1.5714)	(-0.0381)	(2.0682)	(1.5212)	(-0.1038)	(2.4149)
Emprate	-0.1720*	0.1302	0.0419	-0.1710*	0.1175***	0.05349***
	(0.5653)	(0.0809)	(0.1605)	(-0.5618)	(0.0730)	(0.2050)
Political	-0.0366*	0.0092*	0.0274*	-0.0394	0.0029*	0.0364*
	(-0.0003)	(1.5E-5)	(0.0003)	(0.0003)	(4E-6)	(0.0004)
Size	5E-6*	-3E-7*	-4E-6*	4E-6	10E-7*	-4E-6*
	(0.0209)	(-0.0003)	(-0.0227)	(0.0179)	(0.0008)	(-0.0259)

* significant at 1%, ** at 5%, and ***at 10%