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Summary. This article presents a wage inequality analysis for 158 large US metropolitan statistical areas (MSAs). The analysis is concerned with whether public transport has a detectable influence on 1990 levels of wage equality. Because public transport systems are generally designed to link residences with employment locations, higher levels of service provision, all other factors being equal, should be associated with higher employment rates and more uniform distributions of earnings. Few analyses, however, have attempted to evaluate public policies that affect wage distributions. The results of this research provide a macroscopic view of the effectiveness of urban transport investments with respect to urban wage inequality.

Introduction

Evidence shows that the level of income inequality in the US is increasing. The trend suggests that the problem is worsening, with the US ranking at the bottom compared with other industrialised countries (McFate, 1991). Trends at the national level are symptomatic of income distribution disparities at the state, regional and local levels and have far-reaching social and economic implications (Galbraith, 1998). The Kerner Commission reported that these inequalities played a significant role in the civil unrest experienced during the 1960s (National Advisory Commission on Civil Disorders, 1968). Today, certain indicators suggest that the US is enjoying robust economic prosperity with sharp declines in reliance on welfare, low levels of unemployment, optimistic capital markets and surging corporate profits. On the other hand, there is evidence of increasing poverty levels, shrinking health care coverage, declining real wages and unstable employment related to corporate restructuring. Thirty years after the Kerner Commission reported that the US is becoming "two separate societies", income data suggest that the gap between rich and poor is becoming more pronounced (Milton S. Eisenhower Foundation, 1998).

Naturally, these national trends are rooted in the social, economic and political conditions of urban and metropolitan areas. Research stretching over the past 50 years has focused on how national and metropolitan income distributions are influenced by the size and rate of urban development. For metropolitan areas, 'development' encompasses the composition and scale of economic activities as well as population settlement. Influenced by Kuznets' (1955) research on national development and subsequent research by others on urban income

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distribution (see, for example, Duncan and Reiss, 1956; Richardson, 1973; Farbman, 1975; Danziger, 1976; Haworth *et al.*, 1978), many analyses have considered income and wage distribution as a function of metropolitan size and population growth rates. Kuznets explained the relationship between population size, population growth and income inequality as following stages of industrial development. Early and later stages are characterised by broader participation (i.e. employment opportunities) with less concentration of income and earnings. He also saw larger, established urban populations as being more efficient in meeting the demands of industrial production. In addition, he theorised that, in large urban populations, low-income persons would achieve sufficient political support to improve and protect their social and economic status.

While Kuznets was speaking of developing countries, the notion that lower-income classes would be able to apply pressure on upper-income classes is interesting at the metropolitan scale. He states that

> in democratic societies the growing political power of the urban lower-income groups led to a variety of protective and supporting legislation, much of it aimed to counteract the worst effects of rapid industrialization and urbanization and to support the claims of the broad masses for more adequate shares of the growing income of the country (Kuznets, 1955, p. 17).

Public transport services can be seen as a product of upper-income groups (business owners) responding to the mobility needs (demands) of lower-income groups, as well as perhaps a collective view that transport mobility is an important factor in economic opportunity. There is little evidence, however, that public transport system development in the US has resulted from the organised efforts of low-income persons.

Other explanations focus on shifting labour demand as urban areas increase in size. With increased size, urban economies become more specialised, accentuating wage differentials between skilled and unskilled labour (Alperovich, 1995). Some argue that labour supply conditions play a prominent role in the structure of income distribution. The in-migration of low-skilled workers seeking greater economic opportunities bids down wage rates at the lower levels, leading to increased differences in income allocations (Farbman, 1975; Haworth *et al.*, 1978; Hirsch, 1982). An underlying, while not always explicitly stated, explanation includes racial and ethnic discrimination. Discrimination has direct and indirect implications on labour conditions in terms of skill/education levels, job opportunities and potential for advancement (i.e. higher wages) (Betz, 1972). Detecting the impacts of discrimination on income and wage inequality is complex due to far-reaching social implications that are not easily quantified or are difficult to interpret. As discussed by Blinder (1974), the outcomes of discrimination by race, gender and union membership may often be more severe within these groups rather than between the groups.

Chakravorty (1996) recently provided a conceptual framework for urban income distribution analysis. His analytical framework was drawn from an extensive review of prior literature and related four groups of factors from which variables are derived for quantitative analysis. Of the four groups of variables (social and demographic, economic, spatial, and public policy), policy variables are most obviously missing from many prior analyses. This is likely to be the case because social and demographic, economic and spatial variables tend to be easier to quantify compared with policy variables (Chakravorty, 1996). For this reason, the research on urban income inequality is descriptive and exploratory rather than being applied for policy analysis purposes. The outcomes of prior research efforts may indirectly address policy issues related to perhaps educational services and economic development as they influence income distribution. These efforts also appear to be appropriate for assessing the long-term impacts of taxation, social services and other public goods and services. With this in mind, an objective of the current study is to test the significance of public transport as a public policy mechanism with possible implications for urban income and wage inequality in the US.

Analyses of urban income and wage inequality have generally attempted to describe cross-sectional trends, while controlling for labour supply, labour demand, social and demographic factors. Similar methodologies have been used for many urban income distribution studies. Typically, ordinary least squares regression (OLS) is used with measures of income or wage inequality as dependent variables. Income levels, industry mix and other demographic characteristics are commonly used as explanatory variables. In some cases, regression models are estimated separately for MSA (or SMSA) population size categories to capture differential effects for small, medium and large urban or metropolitan areas (see Kennedy and Nord, 1984). In many cases, regional identifiers (as dummy variables) are used to control for suspected regional differences including industrial composition, economic vitality and racial discrimination (Levernier, 1999; Persky and Tam, 1994).

Wage Inequality Measures

The Gini ratio is a traditional measure of income and wage inequality (Gillis *et al.*, 1992; Paglin, 1975). The Gini ratio estimates the degree to which the income or wage distribution for a population varies from absolute equality. The Gini ratio is the relationship between the cumulative proportion of population (CPP) and the cumulative proportion of earnings (CPE). Plotting CPP versus CPE for an equal earnings distribution produces a 45-degree line. Unequal earnings distributions result in a more curved line (i.e. a Lorenz curve), with the difference in areas between the line of equality and the Lorenz curve indicating the degree of earnings inequality. A ratio of zero indicates a perfectly equal distribution, while a ratio of one indicates the highest level of inequality.

While the Gini ratio is an accepted measure for estimating income and wage inequality, some argue that, although it quantifies the level of inequality, it fails to indicate the structure of inequality or account for other life-cycle dynamics (Paglin, 1975; Garofalo and Fogarty, 1979). In other words, the Gini ratio does not express how incomes are concentrated by class or income category. Alternative measures that have been used in income distribution analyses include the percentage of income within percentile rankings (Garofalo and Fogarty, 1979), poverty rates (Haworth *et al.*, 1978), median income levels (Danziger, 1976) and income ratios (Nord, 1984). Some income ratios include white to non-white (Nord, 1984), male to female (Soroka, 1987) or percentile group comparisons (Cloutier, 1997). While ratios are useful measures for structural income inequality, they fail to provide an overall assessment of a population's income distribution, as does the Gini ratio. The current analysis relied on the Gini ratio as a measure of wage inequality because the emphasis was on whether higher levels of public transport accessibility are related to the wage levels of individual workers. Madden (2000) distinguishes between analysing household income and wage inequality at the metropolitan scale, noting the essential differences as a function of household structure and income source.

Public Transport

One objective of public transport services is to link workers with employment locations. Along with the transit network, origins (residential locations) and destinations (non-residential locations) create zones of travel demand and supply. In addition to considering observed travel patterns, transit routing can also take into account the propensity of residents to use transit for work-related and non-work-related trip-making (Black, 1995). Demand tends to be a function of socio-economic characteristics most closely related to income levels (i.e. vehicle ownership rates) and population density. Limited transport mobility is often seen as a contributing factor to unemployment and low-income status.

To address this problem, a variety of current policy efforts have focused on improving mobility to help low-income persons find and maintain employment (Sanchez, 1999). It seems logical that if transport mobility affects employment opportunity, then income and wage levels should also be positively affected by improved transport mobility. While other benefits such as time savings, reduced operating and capital costs can result from transit services (see Dajani and Egan, 1974), the largest potential benefit for most low-income persons would be the ability consistently to reach their workplace as well as to conduct other daily activities (for example, shopping, health services, child care and recreation). In terms of overall impacts, however, transport mobility cannot be looked at in isolation from other challenges faced by the urban poor (Hughes, 1989).

Wage Effects

Transport mobility affects various aspects of a worker's employment situation. The spatial mismatch literature has identified the importance of transport mobility during the job search process, work commute and competition for higher-paying jobs. Given that new job locations tend to be located outside central cities, a certain level of mobility is required to obtain information about job openings as well as to apply and interview for these openings (Ihlanfeldt and Sjoquist, 1990). To maintain employment, reliable personal transport is needed on a consistent basis. In addition to simply finding and maintaining employment, research has shown that the level of job access has an impact on earnings levels (Ong and Blumenberg, 1998), especially for low-income persons who own cars (Wachs and Taylor, 1998).

The income effects of public transport investments intimate transfer payments or subsidies. Equity concerns often arise because transit users and non-users contribute to system operations at varying rates through fares and taxes with no direct transaction linking payment with a market good (Black, 1995). In 1969, Altshuler argued that mobility inequality is strongly tied to income inequality, producing detectable negative social impacts (Altshuler, 1969). Nearly 30 years later, the issue of mobility continues to be cited as a major social and economic problem (Wilson, 1997). The degree of income redistribution resulting from mobility increases will be greatly dependent on the efficiency of service delivery by transit providers (Black, 1995). However, an economically efficient transit operation may still not meet the overall social and political demands for publicly provided transport (Gómez-Ibáñez and Meyer, 1993).

Methodology

Most previous analyses rely on OLS regression to predict measures of urban income and wage inequality. Specifications tend to be linear, except in cases of population size, population growth rate and income variables, where squared terms are introduced (Danziger, 1976). While many researchers note the interaction among variables most commonly used to predict urban income and wage inequality, few account for these effects within their specifications. Exceptions are Danziger (1976) and Galster *et al.* (1988) who used a system of equations to predict income inequality. Nearly all other authors describe how income distributions are simultaneously determined by other economic, social, and demographic variables; however, with the exception of Danziger and Galster *et al.*, all treat income levels as exogenous factors. To address this issue, the first step in this analysis is to test for the endogeneity of key socioeconomic characteristics. A Hausman test was used to test the endogeneity of metropolitan income levels, household structure and levels of transit supply. The initial model specified three endogenous variables influenced by previous income distribution analyses and by Galster's (1998) econometric model of urban opportunity. The following is a brief description of the variables included.

As previously mentioned, there are four primary groups of factors that influence ur-

Table 1. Regression variables

Name	Description
GINI	Gini concentration ratio based on 1990 wages (dependent)
AREA	Geographical size of MSA (square miles)
CRIMEPC	Serious crimes reported per capita
EMPPC	Full-time-equivalent workers (weighted by average weeks worked)
FEMHEAD	Proportion of female-headed households with children
FEMHEAD	Proportion of female-headed households with children (predicted)
HINDEX	Home price index (percentage of mean from all MSAs)
INCOME	Median household income
INCOME	Median household income (predicted)
JOBSPC	Number of jobs per 100 population aged 15–64 years
MFRATIO	Male to female ratio (aged 15–64 years)
PAGRI	Proportion of persons employed in agriculture
PCAROWN	Proportion of households owning automobiles
PCOLL	Proportion of persons over 25 years with college degree or higher
PFIRE	Proportion of persons employed in finance, insurance or real estate
RJOBSCC	Ratio of the proportion of MSA jobs in CC to proportion of MSA population in CC
PM15_64	Proportion of population that is male, aged 15–64 years
PMANUF	Proportion of persons employed in manufacturing
POP1990	Population in millions
POPGROW	Population growth rate, 1970–90
PTRANSIT	Proportion of persons using transit for work commute
PWELFARE	Proportion of households receiving welfare payments in 1989
PWHITE	Proportion of population that is white
TRANSITS	Transit supply/density (directional miles per 100 square miles)

Notes: All data are from 1989, 1990 or 1991 sources. Bold indicates endogenous variables.

ban income distribution: social and demographic; economic; spatial; and, public policy. Household income levels are typically considered an important factor affecting the distribution or concentration of income. Most studies have specified income as an exogenous variable when most agree that the variation of average (or median) incomes between metropolitan areas is a function of labour supply and demand characteristics. This includes the mix of industry types, scale of industry and labour pool characteristics, along with other metropolitan factors that influence economic output (see Table 1 for variable definitions). The first-stage equation to estimate household income levels was

INCOME = f(*EMPPC, JOBSPC, FEMHEAD, PWELFARE, PM15_64, PAGRI, PMANUF, PFIRE, PWHITE, PCOLL, HINDEX, POP1990*)

The ratio of employment supply and demand indicates the level to which a metropolitan area is capable of attracting and retaining employers and employees. The attractiveness of a labour market should be reflected in incomes, controlling for household size and structure (Henderson, 1994). The model also accounts for the wage disparity between males and females, and that race/ethnicity and education levels also impact income levels (Sale, 1974). While the proportion of jobs in the manufacturing sector is expected to have negative impacts on income inequality, it is not expected to have a positive influence on household income levels. In addition, economies relying on agricultural output will also be associated with lower-paying jobs compared with professional services in finance, insurance and real estate. Finally, income levels should reflect higher costs of living such as housing costs in metropolitan areas, especially for larger metropolitan areas.

The prevalence of female-headed households in urban areas is closely related to many social and economic dynamics. The presence of single-parent households typically indicates a variety of hardship conditions with implications for labour force participation, educational attainment, residential mobility and crime (Nielsen and Alderson, 1997; Galster, 1998; Madden, 2000). Consequently, female-headed households are more likely to have low incomes, most notably for non-whites in central cities. Persisting economic difficulties for these types of families are barriers to social and economic mobility, which limit their chances to improve their economic status. It has also been found that children from single-parent households are more likely to be exposed to drugs and crime, and to experience unstable marriages as adults (Hogan and Kitagawa, 1985; Spain and Bianchi, 1996). The following equation was used to predict the proportion of female-headed households in metropolitan areas.

FEMHEAD = f(*PAGRI, PMANUF, PWHITE, PCOLL, HINDEX, PFIRE, MFRATIO, POP1990*)

As discussed earlier, industry mix should have an influence on income levels, job stability and income inequality, all correlated with a family's economic well-being—especially for single-parent/worker households. There are strong demographic components to the likelihood of female-headed households in relation to race and education levels (Levernier *et al.*, 1995; Brem *et al.*, 1989). The cost of housing and overall population size of a metropolitan area are typically associated with concentrations of low-income households as represented by single-parent families.

In particular, this research tests the influence of public transport supply on metropolitan wage inequality. The previous literature has practically ignored public policy variables, which decreases the relevance of research results for planning and policy-making purposes. It was assumed that public transport service levels are endogenously determined because of the dynamic relationship between travel supply and demand at the metropolitan scale. There can be no observed demand for public transport without services being provided. In addition, there is ample evidence that the social, economic and spatial characteristics of urban areas have an impact on public transit ridership levels. Transit is more likely to be provided and used in more densely populated urban areas that have more centralised concentrations of employment (Hendrickson, 1986). Some of the same variables that have been shown significant in predicting urban income distribution are also significantly related to transit ridership levels. For this reason, transit supply was initially specified as an endogenous variable as follows:

TRANSITS = f(*INCOME, PCAROWN, AREA, PTRANSIT, POP1990, RJOBSCC, PAGRI, PFIRE, PMANUF)*

The size of each metropolitan area, both in terms of geographical area and population, is expected to be an important predictor of transit supply levels. Greater numbers of people, controlling for geographical area, are associated with demand for fixed-route, mass transit. Along with overall size, the urban structure of metropolitan areas determines the need for transit. The mix of industries and level of central-city job concentration are also expected to be important factors related to public transit provision. Metropolitan areas with high-density employment locations, such as financial districts, are expected to have more investment in transit compared with metropolitan areas with higher proportions of low-density land uses and employment based on agricultural activity. In addition, lower-income persons and especially those with low levels of access to automobiles are the predominant users of public transit. Metropolitan areas that have experienced higher levels of transit patronage are also expected to reinvest in transit to increase capacity (as indicated by *PTRANSIT*).

Urban population sizes and growth rates are treated as exogenous variables in the initial specification. While it has been argued that there may be non-linear relationships between population size and income or wage distributions, previous empirical research did not obtain statistically significant coefficients for polynomial terms for population size (see, for example, Galster *et al.*, 1988; Danziger, 1976). For this reason, it was assumed that there is a linear relationship between population size and wage inequality. In addition, the percentage increase in population size over the 20-year period from 1970 to 1990 was also used as an exogenous variable in the initial specifications. No alternative measures have otherwise been identified by previous studies to account for short-term economic cycles that influence population and business location patterns.

The resulting 2SLS model takes the form

$$GINI = \alpha + \boldsymbol{INCOME} + \boldsymbol{FEMHEAD} + \boldsymbol{TRANSITS} + POP1990 + POPGROW + \varepsilon$$

The empirical model specified above used the MSA as the unit of analysis. Data for 158 large MSAs were derived primarily from the 1990 census with the exception of transit capacity information (US Bureau of Transport Statistics), per capita serious crime rates and employment information (State and Metropolitan Area Data Books). The MSAs included in the analysis represented approximately 66 per cent of the 1990 US population. The Gini coefficients to measure wage inequality were calculated by Madden (2000) using the 5 per cent Public Use Microsample (PUMS) data from the 1990 US Census.

The coefficients for ***INCOME*** and ***TRANSITS*** were expected to be negative with the coefficients for ***FEMHEAD*** and *POP1990* expected to be positive. A negative sign indicates decreasing levels of wage inequality (Gini ratio closer to zero) while a positive sign indicates increasing levels of income inequality (Gini ratio closer to one). It is uncertain whether the variable for population growth rate (*POPGROW*) should be positive or negative because changes in size are dependent on a range of urban conditions. Rapid population change is also associated with disequilibrium conditions that are likely to include complex social, economic and environmental disturbances.

Results

The descriptive statistics for all variables are shown in Table 2. Variables such as population size and median household income were scaled to make interpretation simpler. The equations estimating median household income (***INCOME***), the proportion of female-headed households (***FEMHEAD***) and transit supply (***TRANSITS***) performed well, explaining 72, 73 and 63 per cent of respective variation (see Tables 3, 4 and 5). Most of the signs and magnitudes of significant coefficients represent anticipated relationships.

The first-stage models predicted a significant proportion of respective variation and were expected to capture endogenous relationships with wage inequality. The Hausman specification error test is commonly used to detect endogeneity within regression models (Maddala, 1992). The results of the Hausman test did not reject the null hypotheses that *INCOME*, *FEMHEAD* and *TRANSITS* were endogenous to metropolitan wage inequality with test statistics being significant at 0.280, 0.762 and 0.348 respectively.

Although the Hausman test for endogeneity failed, the results of the 2SLS were retained for comparison purposes. The results of three models are shown—an OLS model which takes the same functional form as the 2SLS model, the 2SLS model and a stepwise model which initially included all of the variables used in the first stage of the 2SLS model (see Table 6). In each case, Gini coefficients for metropolitan wage inequality were the dependent variables.

OLS Model

The results of the OLS model confirm the positive relationship typically found between urban hierarchies and income/wage inequality in metropolitan areas. As expected, increases in median income reduce wage in

Table 2. Descriptive statistics

Description	Mean	Standard deviation
Gini concentration ratio based on 1990 wages (dependent)	0.467	0.022
Serious crimes reported per capita	61.739	18.755
Geographical size (square miles)	2639.32	3117.16
Population density	367.31	268.66
Full-time-equivalent workers (weighted by average weeks worked)	0.445	0.038
Proportion of female-headed households with children	0.158	0.029
Home price index (percentage of mean from all MSAs)	0.735	0.347
Median household income ($000s)	29.364	4.558
Number of jobs per 100 population aged 15–64 years	0.532	0.130
Male to female ratio (aged 15–64 years)	0.977	0.045
Ratio of the percentage of MSA jobs in CC to percentage of MSA population in CC	0.443	0.185
Proportion of persons employed in agriculture	0.025	0.025
Proportion of persons over 25 years with college degree or higher	0.204	0.054
Proportion of persons employed in finance, insurance or real estate	0.065	0.018
Proportion of population that is male, aged 15–64 years	0.325	0.019
Proportion of persons employed in manufacturing	0.167	0.065
Population (millions)	1.088	2.099
Population growth rate, 1970–90	0.379	0.521
Proportion of persons using transit for work commute	0.026	0.031
Proportion of households owning automobiles	0.905	0.031
Proportion of households receiving welfare payments in 1989	0.072	0.027
Proportion of population that is white	0.828	0.101
Transit capacity (directional miles per 100 square miles)	1.760	4.722

Table 3. Regression results for ***INCOME*** ($N = 158$)

Variable	*B*	SE *B*	Beta	*T*	Sig *T*
EMPPC	3.839	7.394	0.033	0.519	0.604
JOBSPC	3.803	2.032	0.109	1.871	0.063
FEMHEAD	11.455	16.933	0.074	0.677	0.500
PWELFARE	− 31.404	13.775	− 0.191	− 2.280	0.024
PAGRI	15.710	13.056	0.088	1.203	0.231
PMANUF	23.165	4.014	0.330	5.772	< 0.001
PM15_64	6.162	16.575	0.024	0.372	0.711
PWHITE	1.023	4.220	0.023	0.242	0.809
PCOLL	15.091	6.222	0.181	2.425	0.017
HINDEX	6.703	0.794	0.509	8.444	< 0.001
POP1990	0.140	0.119	0.065	1.177	0.241
PFIRE	55.662	15.010	0.224	3.708	< 0.001
(Constant)	7.175	8.074		0.889	0.376
Adjusted R^2	0.718				

Table 4. Regression results for ***FEMHEAD*** ($N = 158$)

Variable	*B*	SE *B*	Beta	*T*	Sig *T*
PAGRI	− 0.277	0.057	− 0.242	− 4.822	< 0.001
PMANUF	0.004	0.023	0.009	0.172	0.864
PWHITE	− 0.227	0.014	− 0.791	− 16.651	< 0.001
PCOLL	− 0.622	0.028	− 0.116	− 2.240	0.027
HINDEX	0.001	0.005	0.012	0.202	0.840
POP1990	− 0.0002	0.001	− 0.014	− 0.262	0.794
PFIRE	− 0.038	0.087	− 0.024	− 0.438	0.662
MFRATIO	− 0.197	0.030	− 0.311	− 6.518	< 0.001
(Constant)	0.560	0.032		17.708	< 0.001
Adjusted R^2	0.726				

Table 5. Regression results for ***TRANSITS*** ($N = 158$)

Variable	*B*	SE *B*	Beta	*T*	Sig *T*
AREA	− 0.001	0.001	− 0.482	− 5.121	< 0.001
POP1990	1.656	0.338	0.566	4.903	< 0.001
PAGRI	6.998	10.325	0.038	0.678	0.499
PFIRE	− 43.249	17.996	− 0.165	− 2.403	0.018
PMANUF	− 13.436	4.882	− 0.184	− 2.752	0.007
INCOME	0.173	0.085	0.164	2.035	0.044
PCAROWN	− 36.720	11.876	− 0.205	− 3.092	0.002
PTRANSIT	71.938	18.585	0.362	3.871	< 0.001
RJOBSCC	− 0.461	1.295	− 0.018	− 0.356	0.722
(Constant)	33.631	10.296		3.266	0.001
Adjusted R^2	0.627				

Table 6. Comparison of three models (wage Gini as dependent variable) ($N = 158$)

	OLS		2SLS		Step-wise	
Variable	*B*	*T*	*B*	*T*	*B*	*T*
1990 population (millions)	0.003	2.167	0.003	1.927	0.002	2.301
1970–90 population change	0.003	1.173	0.002	0.740		
Median income (thousands)†	− 0.002	− 4.634	− 0.002	− 3.584	− 0.002	− 5.066
Percentage of female-headed households†	0.091	1.617	0.061	0.896		
Transit supply†	− 0.001	− 2.039	− 0.001	− 1.662	− 0.001	− 3.138
Percentage of adults with college degrees					0.227	6.854
Percentage of males aged 15–64 years					− 0.437	− 5.030
Percentage of households on welfare					0.255	4.473
(Constant)	0.506	30.898	0.509	25.262	0.603	21.530
Adjusted R^2	0.192		0.096		0.406	

†denotes predicted values used in 2SLS equation.

equalities while the coefficient for percentage of female-headed households was not statistically significant. The coefficient for transit supply was negative and significant at the $p < 0.05$ level. These results suggest that increased transit service density (supply) is negatively correlated with wage inequality levels for the metropolitan areas in the sample. Overall, the model predicted approximately 19 per cent of the variation in MSA wage inequality.

2SLS Model

The results of the 2SLS model were notably different from those of the OLS model. Besides the constant, only the coefficient for income was statistically significant at an acceptable level in the 2SLS model. This is in contrast to the constant, ***INCOME***, ***TRANSITS*** and *POP1990* being significant in the OLS model. The magnitude of the coefficient for ***INCOME*** was similar to that in the OLS model. Not only did the identified variables prove not to be endogenous determinants of wage inequality, they also performed poorly in the 2SLS model. This is an interesting result given that the specification attempted to capture the dynamic relationship between the social and economic factors that are commonly seen as influencing metropolitan structure.

Step-wise Model

It is likely that putting all of the independent variables from the first stage of the 2SLS in a single OLS equation would result in biased estimates due to high levels of collinearity. This is especially true for income-related variables such as median household income, percentage of households receiving welfare and median house values. For this reason, a step-wise regression was used to identify significant variables in the equation and therefore reduce the likelihood of over-specification. As expected, compared with the other two equations, the step-wise model had greater explanatory power (adjusted R^2 of 0.41) (see Table 6). Again, population size had a positive correlation with wage inequality, with a similar magnitude as in the OLS model. The magnitudes of these coefficients were very similar to comparable specifications (see Garofalo and Fogarty, 1979; Kennedy and Nord, 1984; Chakravorty, 1996; Cloutier, 1997). The coefficient for median household income was negative and also similar to the other estimates. Like the other two equations, the coefficient for percentage of female-headed households was not statistically significant. It was anticipated that this variable would be positively associated with wage inequality because it is an indicator of intervening social, economic and spatial forces (Levernier, 1999).

The transit supply measure was also significant and negative in the third model with the magnitude of the coefficient being similar to the OLS model. One unanticipated result was a positive coefficient for the percentage of adults with college degrees. It was assumed that a higher proportion of adults with college degrees would have an equalising effect on wages. Instead, the effect may be that there remains a significant socio-economic divide between degree-holders and those without. In addition, the variable for metropolitan racial composition (percentage white) was not retained by the step-wise regression model. This is perhaps explained by the interaction between income, need for public assistance and likelihood of a college education which all have a racial dimension in US metropolitan areas.

The variable of most interest to this study is the measure of transit supply. It was hypothesised that increased levels of transit service provision could have wage distribution impacts through increasing employment related mobility and accessibility—especially for lower-income persons. In each model shown, the transit supply coefficient was statistically significant and of a similar magnitude. This means that the 1990 levels of transit service were correlated with levels of wage inequality. Transit supply was measured as the number of transit route directional miles per 100 square miles for each MSA. This density measure was used in order to control for MSA size and as an indicator of geographical concentration of transit service. Higher transit supply densities were considered to represent higher levels of service. This is a simplified measure of transit service provision that ignores other factors related to service quality, such as service frequency, reliability and route connectivity. The measure does not explicitly account for the difference between bus and rail transit systems which tend to have different ridership characteristics. It is likely, however, that the presence of urban rail is indirectly accounted for in the population size variable because existing urban rail systems are in the largest metropolitan areas. Areas with the lowest transit service densities were MSAs with less than 100 000 persons and the highest were for MSAs having millions of residents. Only 2 MSAs reported no formal public transport service.

The highest estimated Gini ratio was 0.537 (Provo, UT), with the average for the MSAs in the sample at 0.467, a difference of 0.070. On average, using the resulting coefficient of − 0.001 for ***TRANSITS*** (from the step-wise model), it would take an increase of approximately 70 directional route miles per 100 square miles to create a 0.070 change in the Gini ratio (with all other variables at the means). While statistically significant, it is obvious that the marginal contribution of transit supply to wage inequality is very small. Because the average level of transit supply is 1.76 directional miles per 100 square miles for the metropolitan areas included in the analysis, using public transit alone to address wage distribution issues would obviously not be feasible.

Using the same data and specifications, there was no statistical relationship between metropolitan income inequality (household) and public transit supply. One explanation is that levels of transit accessibility have a more direct impact on individuals than they do on entire households. In addition, income is a function of wage and non-wage sources, the latter having no logical connection to transport mobility levels. Many of the variables included in the analysis more closely reflect circumstances for individual persons and may influence earning capacity (for example, the likelihood of having a college degree, likelihood of being a female head of household or likelihood of being employed in a particular industry).

Conclusions

This research focused on incorporating a public policy variable to predict levels of metropolitan wage inequality. The research hypothesis tested whether mobility increases from public transport influenced the wage distribution of metropolitan areas. The results of three separate regression models suggest that social and demographic, economic and spatial characteristics are significant determinants of wage inequality. The public policy variable tested, public transport supply, was also a significant factor and had detectable effects on wage inequality across large US MSAs.

These findings are interesting due to the fact that only a small per centage of travel at the metropolitan level is by public transit. Only about 2 per cent of all MSA work trips were made by transit in 1990. It is also true that transport service providers are experiencing substantial difficulties linking residential locations with the increasingly dispersed locations (i.e. suburban) of new employment. The results of this analysis could be different if the unit of analysis were central cities instead of metropolitan areas. However, analysing only central cities may produce misleading wage distribution results because central cities, urbanised areas and suburban rings are linked economically and socially. Further research on the spatial concentration of income and metropolitan fiscal disparities would be especially relevant, given the continuing economic and social segregation resulting from current urban development patterns.

This research could be extended by comparing MSA wage inequality and public transport service levels over time. While the cross-sectional approach presented here provides insights across MSAs, analyses comparing two or more points in time would control for characteristics unique to particular MSAs. Along with other socioeconomic data, more data on public transport service levels for MSAs are also becoming more readily available and would make this research more feasible. Many metropolitan and urban areas have made large public transport investments over the past 20 years that, given the results of this analysis, should have detectable effects on social welfare.

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