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Intra – urban Spatial Inequality across Chinese Cities

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Intra-urban Spatial Inequality across Chinese Cities

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Abstract

We use the street neighbourhood (*Juweihui*) data from the 2007 Chinese Urban Household Survey to examine the extent that urban income and education inequalities are manifested in the spatial structure of Chinese cities. We find spatial inequality measures with respect to education, household income and home value to rise with urban size and density, which elevate urban land rent gradients, and with the mean education attainment, which strengthens the preferences for location qualities. New construction of market-based commodity housing helps to diversify the neighbourhood-level education mix inherited from previous work-unit based urban housing provision, but the education and income gaps between the new arrivals to a city and the old residents contribute to increased education and income spatial-inequality measures. Furthermore, we find the spatial inequalities in education and income by themselves to have little impact on the spatial inequality in land rents.

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1. Introduction

Income inequality is not only observed across cities but also manifested spatially within cities. The intra-urban spatial inequality is often shaped by the workings of the residential market that produce sorting equilibrium: the tradeoff between commuting cost and demand for land varies with income (Wheaton 1977), the willingness to pay for unequal local amenities differs by income (Brueckner, Thisse and Zenou 1999), residents of certain shared attributes—education, age, occupation, ethnic background, or income—cluster in order to share differentiated indivisible local public and consumer services (Tiebout 1956; Rosen 2002; de Bartolome and Ross 2007), and people have social preferences regarding their neighbors' social and economic background (Schelling 1978; Bayer, McMillan and Rueben 2004). Inadequate housing opportunities and public services for the poor also contribute to the intra-urban spatial inequality (for a recent survey, see Kilroy (2008)); inadequate provision of public transportation, for example, contributes to the concentration of the poor in American central cities (Glaeser, Kahn and Rappaport 2008). The intra-urban spatial inequality is of important policy concern because it not only makes inequality more visible but also hinders economic development (Kilroy 2008). The spatial inequality often reinforces income inequality by reducing the learning, employment and other social opportunities for the poor (*e.g.*, Glaeser, Resseger and Tobio 2008; Ioannides and Loury 2004; Bayer, Ross and Topa 2008; Glaeser, Laibson and Sacerdote 2002; Glaeser and Mare 2001; Glaeser and Sacerdote 2000; Glaeser, Sacerdote and Scheinkman 1996).

This paper documents and examines the current pattern of intra-urban spatial inequality across Chinese cities after two decades of rapid urbanization, taking advantage of a large sample of urban household data collected by the 2007 Urban Household Survey (UHS). The extant literature offers few theories predicting the dominant forces shaping the spatial inequality within Chinese cities. Hence we take a reduced-form approach, focusing on a broad set of urban attributes, such as urban size, density, growth, migration, employment structure, housing supply and income inequality, which can impact on intra-urban spatial inequality through the various market and institutional mechanisms described above. Our approach, therefore, is not designed to isolate specific mechanisms such as racial segregation and sorting equilibrium in the provision of local public services (*e.g.*, Banzhaf and Walsh 2008; Boustan 2007; Bayer, Ferreira and McMillan 2007; and Davidoff 2005). Although income inequality among urban residents is itself affected by urban attributes, as shown in recent studies by Glaeser, Resseger and Tobio (2008), Korpi (2008), and

Wheeler (2004a, 2004b), our objective is to study the spatial manifestation of the inequality, as in Wheeler (2008), who examines the evolution in spatial income inequality across US metropolitan areas. Wheeler (2008) finds that the intra-urban spatial inequality is little affected by urban decentralization, although it varies across metropolitan areas according to the local population and employment mix. Given the current dearth of empirical studies of intra-urban spatial inequality in developing economies (Kilroy 2008), the findings of this study would help to establish stylized facts, against which economic models can be developed to advance our understanding of the market and institutional mechanisms shaping the evolution of urban forms in developing economy cities.

In addition to documenting the extent that social economic inequalities among urban households are manifested spatially within the Chinese cities, we seek to examine the influence of urban development—the size and the mix of population growth and the change in urban density and housing mix—on the spatial inequality measures. We further examine the extent to which the spatial income and education inequalities engender spatial inequalities in social and economic opportunities that are capitalized in land rents (hence contribute to the spatial inequality in home values). We find considerable spatial inequality in Chinese cities. The spatial inequality with respect to income, for example, is at least comparable to that found in US metropolitan areas (Davidoff 2005), even though Chinese cities are largely free from the racial segregation and local fiscal fragmentation often associated with spatial inequality in US cities. Several interesting findings emerge from our empirical analysis. The spatial inequality measures with respect to education, household income and home value rise with urban size and density, which elevate urban land rent gradients, and with the mean education attainment, which strengthens the preferences for location qualities. New construction of market-based commodity housing helps to diversify the neighbourhood-level education mix inherited from previous work-unit based urban housing provision, but the education and income gaps between the new arrivals to a city and the old residents contribute to increased education and income spatial-inequality measures. Furthermore, we find the spatial inequalities in education and income by themselves to have little impact on the spatial inequality in land rents.

The next section, Section 2, reports the data employed in this study and our spatial inequality measures. Section 3 presents the empirical analysis. We conclude in Section 4.

2. Data and Spatial Inequality Measures

We employ the data from 2007 Urban Household Survey (UHS) to measure and analyze the intra-urban spatial inequality across Chinese cities. The 2007 UHS samples households by street neighbourhoods, or *Juweihui* (*JWH*), in 255 cities of prefecture level or above. A *JWH* is the smallest administrative unit in cities, comprising 500 to 1,000 households. 7 to 568 *JWH*s are sampled randomly in each city according to city size, to represent about 20 percent of the *JWH*s in each city; about 4 percent of the households in each *JWH* are randomly selected for the survey. The appendix provides more details about the 2007 UHS sample and sampling method.

We measure spatial inequality with respect to four household-level attributes, namely, the education attainment of the household head, household employment income, home value (estimated by the UHS interviewer using simple market comparison method) and home size (total floor area). We adopt the variation-ratio approach to measuring the intra-urban spatial inequality with respect to household attribute *x* (*i.e.* years of schooling, log employment income, log home value, and log home size), defined as the ratio of the between-*JWH* variation in mean *x* value to the population variation in *x* within the city. When the variation is measured by variance, the ratio can be interpreted as the R^2 in a regression of the variable *x* on a full set of dummy variables indicating individual residence in each of the *JWH*s (see Kremer and Maskin 1996; Davidoff 2005; and Reardon *et al.* 2006).[1] Hence, indexing households by *h* and neighborhoods (*JWH*) by *j*, we define our spatial inequality index with respect to variable *x* as:

$$R_x^2 \equiv \frac{\sum_{j=1}^{J} \frac{H_j}{H}\left(\bar{x}_j - \bar{x}\right)^2}{\frac{1}{H}\sum_{h=1}^{H}\left(x_h - \bar{x}\right)^2} = \frac{\sum_{j=1}^{J} \frac{H_j}{H}\left(\bar{x}_j - \bar{x}\right)^2}{\frac{1}{H}\sum_{j=1}^{J}\left(\sum_{h=1}^{H_j}\left(x_h - \bar{x}_j\right)^2 + H_j\left(\bar{x}_j - \bar{x}\right)^2\right)} \tag{1}$$

where $\bar{x}_j$ is mean *x* in *JWH j*, $\bar{x}$ is the city population mean, and *J* and *H* are respectively the total number of *JWH*s and population sampled in a city. According to this measure, the intra-urban spatial inequality is high if the variation in *x* among the city population can be largely explained by the variation in *JWH* means (hence a high R_x^2).[2]

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[1] Reardon *et al* (2006) provide a critical review of various approaches to measuring spatial inequality and of the variation-ratio approach based on different variation measures.

[2] We are somewhat hampered by various constraints in accessing the 2007 UHS data. We have to compute the R_x^2 index based on *JWH*-level means and standard deviations of household employment income, home value and home size. Thus these R_x^2 indexes are calculated assuming equal number of households (H_j) across *JWH*s and using approximations $x_h - \bar{x}_j \approx X_h / \bar{X}_j - 1$ and $\bar{x}_j - \bar{x} \approx \bar{X}_j / \bar{X} - 1$, where X denote the level of

*** Insert Figure 1 about here ***

Figure 1 plots the distribution of R^2_{EDU} (for years of schooling of household head), R^2_{WAGE} (for log household employment income) and R^2_{HV} (for log home value) across 255 cites against city urban population size. Note that the home values (in logarithm) are generally more variable across *JWH*s (relative to the total variance) than years of schooling, which, in turn, is somewhat more variable across *JWH*s than household employment income (in logarithm), suggesting the diversity of locations in land rent level occupied by households of similar income and education attainment and the greater income variation within *JWH*s than year-of-schooling variation. Figure 1 shows that the spatial inequality measures generally rise with city urban population size and they are positively correlated with each other (with a correlation coefficient of around 0.3). Interestingly, the distribution of R^2_{WAGE} appears fairly similar to that of the R squared index for household income within 279 US Metropolitan Statistical Areas reported in Davidoff (2005).[3]

To investigate the pattern of intra-urban spatial inequalities across cities, we include as determinants city-specific variables indicating urban physical form: population size (*POP*), population density (*DENSITY*), and the population growth from 1997 to 2006 (*g_POP*) and the built-up area growth (*g_BUILT*); variables indicating urban social characteristics: mean years of schooling (*EDU_m*) of household heads, population standard deviation in years of schooling (*EDU_std*), mean household employment income (*WAGE_m*), population coefficient of variation in household employment income (*WAGE_cv*), share of households arrived within the past 5 years (%*NEW*), share of households with local urban Hukou (entitlement to local public services and social welfare, %*HUKOU*), the mean year of schooling of the newly arrived versus that of the old population (*EDU_NEW* and *EDU_OLD*, respectively), the mean employment income of the newly arrived versus that of the old population (*WAGE_NEW* and *WAGE_OLD*), and the share of urban households whose head has post graduate education (%*HIGH_EDU*); variables indicating urban housing conditions: the share of households living in newly private-built homes, or commodity housing as they are called in China (%*HOUSING_COM*), the share of households living in newly built

household employment income, home value, and home size respectively. The R^2_x for years of schooling is computed using the regression method, but is based on a partial sample of *JWH*s in each city. The correlation coefficient between the year-of-schooling R^2_x index based on the regression method and that based on the approximation method is over 0.85.

[3] Our measure of the income spatial inequality is somewhat greater but our geographic unit of measure (jurisdiction) is finer, causing R^2_x to be somewhat higher mechanically.

subsidized low-cost housing projects (*%HOUSING_LOW*), average home value (*HV_m*), average home size (*HSIZE_m*), and the average length of residence in present home (*YEAR_RES*); and finally, variables indicating urban economic characteristics: growth in per-capita GDP (*g_GDPPC*), share of employment in finance, insurance, and information technology (*%EMP_FIIT*), share of employment in consumer services (*%EMP_SERVICE*), share of employment in manufacturing (*%EMP_MANU*), and a Herfindahl index of employment specialization (*EMP_SPECIAL*). In addition, we include the number of buses per 10 thousand people (*TRANSIT*) to reflect the quality of public transport service in the city and the number of *JWH*s sampled in 2007 UHS (*N_JWH*) to control for potential bias in spatial inequality measures due to the variation in the number of geographic units involved in the calculation). The definition of these variables and the source of data are summarized in Table 1, whereas Table 2 provides the sample statistics.

*** Insert Table 1 and Table 2 about here ***

Since the late 1990s, when both urban housing market and labor market were liberalized, most Chinese cities have experienced remarkable transformation—as the summary statistics in Table 2 indicate: urban population in the 200 cities in our study sample grew on average by 27% from 1997 to 2006, the urban built-up area expanded even faster, by about 48.5% on average, half of the urban households in a typical city have moved within the past 9 years (the mean length of residence in current home is about 9 years) and 30 percent of the households in 2007 was living in commodity-housing homes built since mid 1990s.

3. Determinants of Cross-city Differences in Spatial Inequality

Intra-urban spatial inequality is the spatial expression of inequalities among residents in a city. Over the past three decades of transition from a central planning economy to a market economy, urban inequality in China has risen considerably as reflected by a rising urban income Gini, from 0.20 in the late 1970s, risen modestly to 0.23 in 1988 and then rapidly 0.40 in 1999 (Knight, Shi and Song 2006). Little has been documented, however, about how the rising urban inequality is manifested spatially in Chinese cities and how the spatial inequality measures are influenced by the urban development in the past decade. Zheng, Fu and Liu (2006) examine the spatial structure in five Chinese cities. They find some evidence of residential sorting by income, as high-income households tend to have a greater willingness to pay to live closer to city center and housing opportunities for low and middle income households in central urban areas are inadequate. Their findings suggest that both the location preferences and the government land supply policies have contributed to residential spatial inequality. The small sample of cities in their study, however, prevents them from examining the variation in intra-urban spatial inequality across cities.

*** Insert Table 3 about here ***

We will examine three measures of inequality in Chinese cities in sequence: the spatial inequality with respect to education attainment by household heads (R^2_{EDU}), household employment income (R^2_{WAGE}), and home value (R^2_{HV}). The regression analysis results are reported in Table 3. We examine education spatial inequality first, as education inequality and the rising returns to schooling in Chinese cities (Zhang *et al*. 2005) are important sources of the urban income inequality. Furthermore, the education spatial inequality would have much to do with the legacy of work-unit based urban housing allocation prior to 1998, during which period state employers were obliged to provide housing flats to their employees. More educated workers would have better access to their work-unit built homes near the work unit. In Table 3 under OLS equation for R^2_{EDU} (column (1)), we find the education spatial inequality strongly positively correlated with the standard deviation in years of schooling among the households in the city; the effect of *EDU_std* is convex with a threshold value of 3 (slightly below the average value of *EDU_std*), below which *EDU_std* has little influence on R^2_{EDU} . In addition, the education spatial inequality is greater in cities with a higher mean year of schooling *EDU_m* (indicating perhaps more generous work-unit based housing welfare prior to 1998 to the educated state workers) and it is greater in cities where location matters more, as indicated by the positive influence of home-value spatial inequality measure R^2_{HV} . The effect of R^2_{HV} on R^2_{EDU} could be upwardly biased if R^2_{HV} is itself affected by the spatial inequality in education within the city; but as shown later, R^2_{HV} is not sensitive to the variations in R^2_{EDU} predicted by its other determinants, suggesting R^2_{HV} to be largely exogenous with respect to the spatial inequality in education. Furthermore, larger cities (according to the 1998 urban non-agricultural population, to allow time lags in residential location adjustment in response to urban physical environment), where location often matters more, have higher R^2_{EDU} . Cities with a more dominant single employment sector, as indicated by a higher *EMP_SPECIAL* measure, have a higher R^2_{EDU} , probably due to greater work-unit housing clustering according to education within employment sectors.

The spatial inequality in education is affected also by the urban growth experience. Cities with a large share of commodity housing (privately built and sold at market prices in recently years) have more diversified neighbourhoods (*JWH*s) and hence a lower R^2_{EDU} ; the effect is convex, becoming significant as the share exceeds about one third (slightly above the average value of *%HOUSING_COM*). The low-cost housing in cities (*%HOUSING_LOW*), generally quite small in quantity (half of the cities have a *%HOUSING_LOW* below 2%), often built in urban fringe to accommodate low-income families displaced by redevelopment in more central urban locations, contributes to a greater spatial inequality in education. The recent arrival of relatively more educated households contributes to a greater the spatial inequality in education in the city, but the arrival of new households with Hukou (indicated by the amount of new arrivals relative to amount of households without Hukou in the city, *%NEW*-0.85(1-*%HUKOU*)) lowers R^2_{EDU} . These results are obtained after controlling for *N_JWH* to account for potential statistical bias in the computation of the spatial inequality measures.

Turning to the regression results in Table 3 regarding the spatial inequality in income R^2_{WAGE} (column (2)), we find that the income inequality measure *WAGE_cv* in excess of its value predicted by education inequality and mean education level ($WAGE\_cv - 0.1154 \times EDU\_std + 0.0688 \times EDU\_m$) strongly predicts R^2_{WAGE} in excess of the influence of R^2_{EDU} . The spatial inequality in income is greater in cities where location matters more (higher R^2_{HV} and *DENSITY*) and preferences for amenities are stronger (higher *EDU_m*).[4] Greater population growth (*g_POP*, with nonlinear transformation to account for positive skewness and negative growth due possibly to reclassification of urban population) facilitates income sorting and the spatial inequality in income rises more when the mean earning of the new arrivals deviates more from the locals (greater $\exp(WAGE\_NEW/WAGE\_OLD-1)-1)^2 \times \%NEW \times ((g\_POP>0) \times g\_POP)^{0.3}$).

We next examine the spatial inequality in home value R^2_{HV} (column (3)), controlling for the influence of the spatial inequality in home size R^2_{HSIZE} so that the other determinants would chiefly explain the spatial inequality in land rents. As shown in Table 3, the spatial inequality in land rents increases with current urban size log(*POP*06), suggesting greater land rent gradients in larger cities. In addition, cities with employment concentrated in finance, insurance and information technology (top 9 cities in terms of *%EMP_FIIT*) have higher values of R^2_{HV} possibly due to the importance of CBD in these cities, but cities with a higher share of employment in consumer services *%EMP_SERVICE* would have a more dispersed employment location pattern and hence smaller land rent gradients. Higher

[4] Wheeler (2008) also finds that urban decentralization (decreasing density) in the US in the 1990s increased income inequality within residential communities but not between communities (hence reduced R squared measure of spatial inequality).

levels of public transit service log(*TRANSIT*) contribute to lower land rent gradients in large cities (with 2006 population larger than 2.5 million). Cities with more affordable homes, indicated by a higher ratio of mean employment income to mean home value *WAGE_m*/*HV_m* or a larger average home size *HSIZE_m*, have smaller land rent gradients. A higher *WAGE_m*/*HV_m* ratio may suggest relatively poor urban amenities, which contribute to smaller land rent gradients in the city. Growth in urban density and a high per-capita urban GDP growth rate produce high land prices and land price gradients, contributing to increased spatial inequality in home values. We further find a higher residential turnover (1/*YEAR_RES*) to contribute to a higher spatial inequality R^2_{HV} as more attractive locations are more likely to get bidden up in the presence of more mobile urban households. We have included two variables, *g_POP*>0.25 and *g_BUILT*<0, to compensate for possible inflation in urban population growth measure arising from urban population reclassification and for changes in density statistics arising from political boundary readjustments.

Lastly we examine the extent to which the spatial inequality in land rents is influenced by the spatial inequality in education and income. Such influences would arise when local population mix in terms of education and income generates external benefits, such as human capital spillover in learning and employment activities and enhancement in local public goods and services, or external costs, such as environmental hazards and social disruptions generated by slums. These external benefits and costs would be capitalized in differential land rents. To estimate these influences, we include R^2_{EDU} and R^2_{WAGE} in the regression equation for R^2_{HV}. However, both R^2_{EDU} and R^2_{WAGE} are endogenous as they respond to the spatial inequality in location qualities and land rents as shown earlier. Therefore we instrument R^2_{EDU} and R^2_{WAGE} with their determinants reported in columns (1) and (2) other than R^2_{HV}. The 2SLS results in column (3) of Table 3 show that the variations in R^2_{EDU} and R^2_{WAGE} predicted by these other determinants have little additional influence on differential land rents in the city. The finding is perhaps not surprising in view of the basically top-down local public finance and expenditure model, so that changes in local residential composition would not immediately affect the local public goods and services, and the general absence of slums that depress local land rents. The finding also suggests a general lack of the type of social interactions that benefit from local concentration of educated and high-income households.

Conclusions

Although widening urban income inequality in Chinese cities during China's rapid economic growth and urbanization in the past the decades has been widely reported, few studies have sought to measure and examine the spatial manifestation of the inequality. We take advantage of the 2007 Urban Household Survey (UHS) covering households in large numbers of street neighbourhoods (*JWH*s) in 255 cities, to document the substantial intra-urban spatial inequality in Chinese cities. Our cross-city regression analysis shows that the spatial manifestation of urban inequality generally rises with city size and population density, which increases the heterogeneity of locations, and with the average education level, which would serve to strengthen location preferences. We find local employment specialization to be associated with a higher spatial inequality in education, possibly due to the legacy of work-unit based housing provision prior to the urban housing market liberalization in 1998, but a higher level of market-based commodity housing construction to help reducing the spatial inequality in education. In addition, the education and income gaps between the new arrivals and the old urban residents contribute to increased spatial inequality. Finally we find the spatial inequality in home values to be largely unaffected by the exogenous variations in the education and income spatial-inequality measures holding other urban attributes affecting land rent gradients constant. This finding appears consistent with the top-down local public finance and expenditure structure in Chinese cities that is relatively independent of neighbourhood (*JWH*) education and income mix. It also suggests the relatively weak role of residential human capital in adding value to neighbourhood-level social interactions.

The residential spatial inequality within cities not only affects the delivery of local public and private consumer services, the demand for which will continue to rise as Chinese urban households become richer, but also shapes residential social interactions that are instrumental for social capital and human capital formation. This study has shown the significance of residential spatial inequality in Chinese cities and some of the important covariates in terms of urban size, growth, employment and population mix attributes. Further research is called for in order to gain fuller understanding of the mechanisms driving the evolution of spatial inequality in the context of Chinese local urban public finance and expenditure structure and land use policies. Useful also are further studies to understand the welfare implications of the spatial inequality in Chinese cities.

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Appendix. 2007 UHS Sampling Method

Urban Household Survey (UHS) is conducted annually by the Urban Survey Department of the State Statistic Bureau of China (SSBC). The 2007 UHS covers all of the 255 prefecture-level cities in China (shown in Map 1) and has a sample size of 300 thousand households. Chinese cities have a 3-tier sub-municipal administrative structure: the first tier is district, or *Qu*, the second tier is street block, or *Jiedao* (*JD*), and the third tier is street neighbourhood, or *Juweihui* (*JWH*). Beijing, for example has 18 *Qu's*, 130 *JD*s and 2,625 *JWH*s in 2006. The 2007 UHS employed the 3-stage stratified sampling method. First, *JD*s in each city are sorted by their identification (ID) numbers and sampled at fixed distances; Next, *JWH*s in each selected *JD* are sorted by their ID number and are sampled at fixed distances; Finally, 20-40 households are randomly sampled in each selected *JWH*. The number of *JWH*s selected in each city depends on the city size and other criterion set by SSBC; it ranges from 7 to 568, with an average number of 49.

Map 1. 255 Cities of prefecture level or above in China

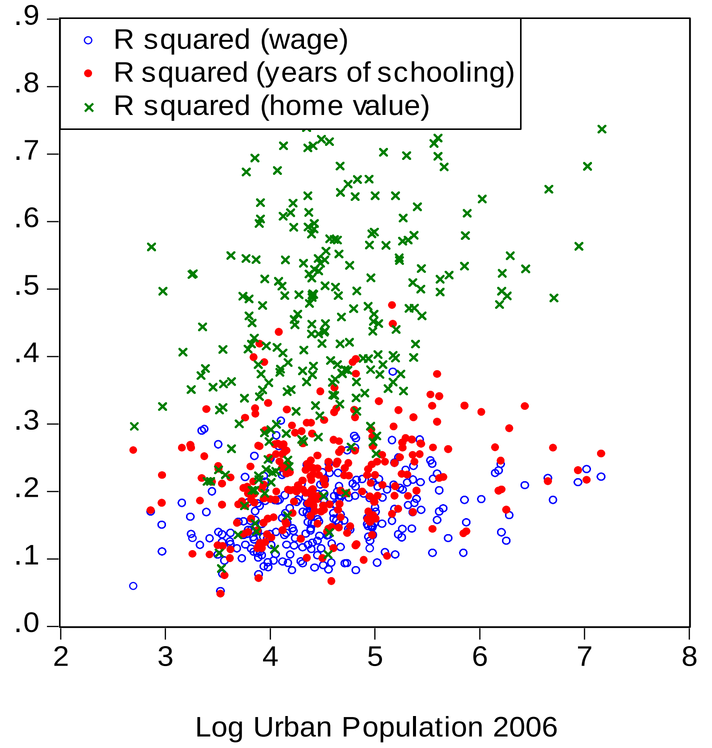

Figure 1. Distribution of spatial inequality measures across 255 cities by urban population Sizes

Table 1. Description of city-level variables

Data sources: [1] calculation based on 2007 UHS, [2] *Urban Statistical Yearbooks* (State Statistic Bureau of China); [3] *City and County Population Statistics* (State Statistic Bureau of China)

Variables	Description
R^2_{EDU}	R^2 of years of schooling of household heads [1].
R^2_{WAGE}	R^2 of log household employment income [1].
R^2_{HV}	R^2 of log home value, based on appraisal home value [1].
R^2_{HSIZE}	R^2 of log home size [1].
POP2006; POP1998	2006 urban population, 10k people [3]; 1998 urban non-agricultural population [2].
DENSITY	1998 urban non-agricultural population over 1997 urban built-up area, 10k people per sqkm, [2].
g_POP	log urban population growth, 1997 to 2006 [3].
G_BUILT	log urban built-up area growth, 1997 to 2006 [2]
TRANSIT	Number of buses per 10k people, 2006 [2]
EDU_m	Mean years schooling of household head [1]
EDU_std	Standard deviation of years schooling of household heads [1]
WAGE_m	Mean household employment income, Rmb/year [1]
WAGE_cv	Coefficient of variation of household employment income [1]
%NEW	Households arrived within 5 years, % total households [1]
%HUKOU	Households with local Hukou, % of total households [1]
EDU_NEW; *EDU_OLD*	Mean years of schooling of the newly arrived; mean years of schooling of the old residents [1]
WAGE_NEW; *WAGE_OLD*	Mean household employment income of the newly arrived; mean household employment income of the old residents [1]
%HOUSING_COM	Households living in newly built commodity housing as % of total households [1]
%HOUSING_LOW	Households living in newly built subsidized low-cost housing as % of total households [1]
HV_m	Mean market value of homes [1]
HSIZE_m	Mean home size, sqm [1]
YEAR_RES	Mean length of residence in current home, years [1]
%EMP_FIIT	Employment in finance, insurance, and information technology as % of total employment, 2006 [2]
%EMP_SERVICE	Employment in consumer service sector as % of total employment, 2006 [2]
EMP_SPECIAL	Urban employment specialization measured by Herfindahl index (sum of squares of sectoral employment shares) [2]
g_GDPPC	log per-capita urban GDP growth, 1997 to 2006 [2]
N_JWH	Number of street neighbourhoods, or *JWH*s, sampled [1]

Table 2. Summary statistics of the city-level variables

The sample includes 200 cities (197 cities for *g_GDPPC*). Cities in the 2007 UHS sample with missing city-level data are dropped; further 4 cities with fewer than 10 *JWH*s sampled are dropped.

Variables	Mean	Median	Maximum	Minimum	Std. Dev.
R^2_{EDU}	0.2292	0.2221	0.4745	0.0703	0.0721
R^2_{WAGE}	0.1703	0.1680	0.3759	0.0758	0.0501
R^2_{HV}	0.4886	0.4905	0.8903	0.1144	0.1561
R^2_{HSIZE}	0.4717	0.4627	0.9561	0.0942	0.1640
POP1998	76.31	46.62	893.72	11.07	100.01
POP2006	151.05	96.20	1298.10	17.61	175.51
DENSITY	1.184	1.100	5.732	0.3135	0.6459
g_POP	0.2734	0.1602	2.0482	-0.6063	0.3663
G_BUILT	0.4854	0.4667	1.7984	-1.0352	0.4117
TRANSIT	7.635	6.540	99.030	1.190	7.398
EDU_m	10.69	10.69	12.90	8.645	0.6092
EDU_std	3.138	3.116	3.918	2.631	0.2481
WAGE_m	12821	11460	41610	5862	5275
WAGE_cv	1.349	1.338	1.914	0.8682	0.1638
%NEW	0.0731	0.0601	0.3727	0.0034	0.0538
%HUKOU	0.8879	0.9089	0.9853	0.4968	0.0737
EDU_NEW/ EDU_OLD	0.9957	0.9913	1.1976	0.7334	0.0708
WAGE_NEW/ WAGE_OLD	1.077	1.037	2.866	0.5808	0.2768
%HOUSING_COM	0.3128	0.2900	0.7300	0.0100	0.1441
%HOUSING_LOW	0.0401	0.0200	0.2800	0.0000	0.0480
HV_m	20.76	15.57	347.38	5.02	26.27
HSIZE_m	90.73	88.58	168.96	54.37	20.67
YEAR_RES	9.319	9.110	15.900	4.590	1.993
%EMP_FIIT	0.0503	0.0480	0.1070	0.0180	0.0187
%EMP_SERVICE	0.4684	0.4750	0.7400	0.1710	0.1205
EMP_SPECIAL	0.3811	0.3687	0.6048	0.3032	0.0547
g_GDPPC	0.9214	0.9216	1.9990	-0.1883	0.3114
N_JWH	56.04	43.00	568.00	12.00	61.21

Table 3. Regression Estimates of Residential Spatial Inequality

T-statistics based on White heteroskedasticity-consistent standard errors and covariance are in brackets. ***, **, and * denote respectively statistical significance at 1%, 5% and 10% level. The 2SLS instruments for R^2_{EDU} and R^2_{WAGE} in column (3) are the determinants in column (1) and (2) other than R^2_{HV}.

(1) OLS Dependent variable: R^2_{EDU}		(2) OLS Dependent variable: R^2_{WAGE}		(3) 2SLS Dependent variable: R^2_{HV}	
(EDU_std>3)*(EDU_std-3)	0.1143 (4.6)***	R^2_{EDU}	0.2013 (4.0)***	R^2_{HSIZE}	0.2378 (4.5)***
EDU_m	0.0195 (2.5)**	WAGE_cv–0.1154×EDU_std +0.0688×EDU_m	0.0691 (3.7)***	ln(POP2006)	0.0584 (3.2)***
R^2_{HV}	0.1133 (3.5)***	R^2_{HV}	0.0891 (4.1)***	%EMP_FIIT>0.1	0.0999 (2.5)**
ln(POP1998)	0.0252 (3.2)***	DENSITY	0.0153 (3.4)***	%EMP_SERVICE	-0.2680 (3.3)***
(EMP_SPECIAL>0.4) ×(EMP_SPECIAL-0.4)	0.4473 (3.2)***	EDU_m	0.0130 (2.5)**	ln(TRANSIT)×(POP2006>250)	-0.0659 (2.5)**
(%HOUSING_COM>0.33) ×(%HOUSING_COM-0.33)	-0.2228 (4.8)***			POP2006>250	0.1672 (2.5)**
$\%HOUSING\_LOW^{0.1}$	0.0284 (1.8)*			ln(WAGE_m/ HV_m)	-0.1000 (3.4)***
(exp(EDU_NEW/EDU_OLD –1)–1)×%NEW	2.0514 (2.1)**	(exp(WAGE_NEW/WAGE_OLD–1)-1)^2×%NEW×((g_POP>0)×g_POP)$^{0.3}$	0.0290 (6.9)***	ln(HSIZE_m)	-0.2797 (6.6)***
%NEW–0.85×(1-%HUKOU)	-0.2718 (2.4)**	((g_POP>0)×g_POP)$^{0.3}$	0.0434 (4.2)***	g_POP – g_BUILT	0.0804 (4.0)***
				((g_GDPPC>0.25) ×(g_GDPPC–0.25))$^{0.3}$	0.1139 (2.5)**
				1/YEAR_RES	1.0140 (2.6)**
				g_POP>0.25	-0.0391 (2.2)**
				g_BUILT<0	-0.0626 (1.4)
				R^2_{EDU}	0.2031 (0.7)
				R^2_{WAGE}	0.1480 (0.4)
ln(N_JWH)	-0.0310 (3.4)***	ln(N_JWH)	-0.0158 (3.2)***	ln(N_JWH)	-0.0390 (1.8)*
Constant	-0.0557 (0.7)	Constant	-0.1622 (2.4)**	Constant	2.035 (5.4)***
No. of observations	200	No. of observations	200	No. of observations	197
R^2	0.3725	R^2	0.4072	R^2	0.5666