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Abstract: The Rosen-Roback spatial equilibrium theory states that cross-city variations in wages and housing prices reflect urban residents' willingness to pay for urban amenities or quality of life. This paper is the first to quantify and rank the quality of life in Chinese cities based on the Rosen-Roback model. Using the 2005 1% Population Intercensus Survey data, we estimate the wage and housing hedonic models. The coefficients of urban amenity variables in both hedonic models are considered the implicit prices of amenities and are used as the weights to compute the quality of life for each prefecture city in China. In general, provincial capital cities and cities with nice weather, convenient transportation, and better public services have a higher quality of life. We also find that urban quality of life is positively associated with the subjective well-being of urban residents.

Key words: Spatial equilibrium, hedonic model, urban amenity, quality of life, life satisfaction

JEL Codes: H44, J31, J61, R13, R23, R31

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1 Introduction

Quality of life refers to “the satisfaction that a person receives from surrounding human and physical conditions” (Mulligan et al., 2004). Different from individual satisfaction derived from private consumption, quality of life reflects people’s value for “social goods”—quasi-market and non-market goods (Wingo, 1973). It is considered an economic good and varies largely across locations (Wingo, 1973; Gillingham and Reece, 1979). Urban amenities, which are location-specific goods and services that make cities attractive for living and working, are the primary determinants of quality of life in cities (Rosen, 1979; Diamond and Tolley, 1982). Urban amenities can be natural (nice weather, good air quality), human-made (museums, restaurants, public services), or social (tolerant social milieu, safety); they can also be utility generating to households (consumption amenities) or productive to firms.

Quality of life in cities affects directly not only individual well-being, but also location choices of households and firms and urban growth (Mulligan et al., 2004; Shapiro, 2006; Mulligan and Carruthers, 2011). Taken American cities as an example, cities with rich consumption amenities and nice weather also have high population density and high growth in population, employment, and housing value and rents (Rappaport, 2007, 2008; Carlino and Saiz, 2019). With persistent income growth and rapid urbanization in China during the past few decades, people migrate not only for better job opportunities but also for better public services, consumption amenities, and environmental qualities in cities (Xing and Zhang, 2017). The general public and policy makers have been paying increasing attention to urban quality of life in China.

Surprisingly, to the best of our knowledge, so far there is no rigorous study that quantifies and ranks urban quality of life in China. A few available rankings either used survey data by asking people’s subjective ranking via phone interviews or internet questionnaires or calculate a quality of life index by weighted sum of a set of indicators measuring different urban amenities where the selection of indicators and weights is arbitrary and not grounded in economic theory. The rankings of some cities are often counter-intuitive and inconsistent with the consensus in the popular press. For example, The Report on Quality of Life in 35 Cities in China, released by the Research Center for Urban Quality of Life (RCUQL) at Capital University of Economics and Business, ranked Xiamen 29 among the 35 cities in 2017, while it is often ranked among the top in the popular press.¹

In contrast, many empirical studies have estimated the quality of life in cities of many other countries, including Canada (Giannias, 1998; Albouy et al., 2013), England (Srinivasan and Stewart, 2004), Russia (Berger et al., 2008), Germany (Buettner and Ebertz, 2009), Italy (Colombo et al., 2014), and notably the USA (Rosen, 1979; Roback, 1982; Kahn, 1995; Gabriel et al., 2003; Rappaport, 2007, 2008, 2009; Winters,

¹ The report is published in a Chinese journal “*Economic Perspectives*,” 2017, no.9, 4-19.

2013; Albouy et al., 2016). These studies are well grounded in the commonly accepted theory of spatial equilibrium developed by Rosen (1979) and Roback (1982).

The Rosen-Roback spatial equilibrium model states that with free mobility, compensating differentials in wages and housing prices (rents) across cities reflect people's willingness to pay for urban amenities or quality of life in cities to achieve the spatial equilibrium under which utility are equalized across cities. To put it another way, people are willing to pay higher housing prices or rents, or are willing to accept lower wages, to live in cities with better amenities. By estimating a wage hedonic model and a housing hedonic model including both individual (worker or housing unit) attributes and city amenity variables, we can use the coefficients of amenities as their implicit prices. The quality of life index for a city can then be calculated by the weighted sum of amenity quantities in that city, where the weights are the implicit prices. This approach, well grounded in the Rosen-Roback model, has been the standard application in the empirical literature on evaluating quality of life in cities (Gyourko et al., 1999; Lambiri et al., 2007).

The purpose of this paper is to apply the Rosen-Roback framework and hedonic models to quantify the quality of life in Chinese cities. We use the 2005 1% Population Intercensus Survey data, the only available micro dataset so far with both labor income and housing costs information for all cities in China, and city amenity data to estimate compensating differentials in wages and housing prices and rents for 287 prefecture level cities. We then compute and rank the quality of life index for these cities. Following Blomquist (2006), we select three types of amenities: climate, environmental quality, and urban conditions (city characteristics). We find that quality of life varies tremendously across cities. In general, cities with a high quality of index are provincial capital cities or cities with nice weather, convenient transportation, or good medical and educational public services. The quality of life index is positively associated with the self-reported subject well-being of urban residents, suggesting that urban quality of life indeed to some degree measures happiness in cities. Not surprisingly, our ranking of quality of life in cities is very different from those not based on economic theory.

Our findings have important public policy implications for city governments. As human capital is crucial for urban growth (Simon, 1998), many city governments in China have been striving to attract high-skilled workers but their policies are rather simple and narrow. The main policies are relaxing residence (*Hukou*) restrictions and offering lump-sum housing or relocation subsidies (Zhang et al., 2019). Since high-skilled workers have a higher willingness to pay for urban amenities, our study suggests that local governments can attract talents by improving city amenities, particularly educational and medical public services, transportation and commuting, and environmental qualities.

The next section introduces briefly the intuition of the Rosen-Roback spatial equilibrium model and outlines the steps for empirical implementation. Section 3

describes the data and Section 4 specifies the empirical models. Section 5 presents our evaluation and ranking of quality of life in Chinese cities and Section 6 concludes.

2 The Rosen-Roback model and urban quality of life

Rosen (1979) developed a theoretical framework to estimate a wage-based index of urban quality of life where the implicit price weights for urban consumption amenities are estimated from a wage hedonic model including both individual worker attributes and urban amenity variables. Roback (1982) extended Rosen's model by incorporating further housing markets and productive amenities. The model has a set of standard assumptions: Households have the identical preference and derive utility from a composite consumption good, housing services, and location-specific amenities. Each household supplies one unit of homogenous labor and wage is the only income source. Workers can move freely across cities. For a given city j , the indirect utility function of a representative household can be written as

$$v^j = v(w_j, r_j; a_j), \quad (1)$$

where v^j indicates the highest utility level that households can achieve given wage level w_j , housing rent r_j , and a vector of urban amenities a_j with elements a_{ij} .² Higher wage increases utility ($\frac{\partial v}{\partial w} > 0$, where “ ∂ ” denotes partial derivative) and higher rent reduces utility ($\frac{\partial v}{\partial r} < 0$), ceteris paribus. The sign of $\frac{\partial v}{\partial a_{ij}}$ is positive if a_{ij} is an amenity (for example, fresh air or cool summer) and negative if it is a disamenity (say, congestion or crime).

Firms are assumed to have the identical, constant-returns-to-scale technology with capital, labor, and land as the inputs to produce the composite consumption good. Capital is freely mobile and the composite good is tradable in a nationwide, competitive market whose price is normalized to be one. To ease the notations and to simplify the analysis, we further assume that the land rents paid by the firms are the same as the housing rents by households.³ The unit cost function of firms located in city j is given as follows:

² We use housing rent in equation (1); alternatively, we can use housing price. Since housing price is the present value of future housing rents flow, we use housing price and rents interchangeably in this paper.

³ It is consistent to assume that households “consume” land. This requires land rents or land prices data be used in the empirical part as in Roback (1982). However, households consume housing services and housing price or housing rents data can also be used to estimate the implicit prices of amenities. This approach is commonly used in the recent literature (Blomquist, 2006) and we follow suit in this study.

$$c^j = c(w_j, r_j; a_j), \quad (2)$$

where c^j denotes the lowest cost of producing one unit of output by firms given wage level w_j , land rent r_j , and urban amenities a_j . High input prices increase unit cost:

$\frac{\partial c}{\partial w} > 0$ and $\frac{\partial c}{\partial r} > 0$. Similarly, the sign of $\frac{\partial c}{\partial a_{ij}}$ depends on whether the specific

amenity a_{ij} is productive to firms or not. For example, being located along a navigable river or in coastal area can reduce transport costs of shipping inputs and outputs while clean air increases production cost as firms need to install equipment to reduce emissions of air pollutants.

The equilibrium of the model requires no spatial arbitrage meaning that in the spatial equilibrium both households and firms are indifferent between which city to locate: utility levels are equalized across cities (equilibrium utility level is denoted by \bar{u}); so are unit costs.⁴ This can be stated by the following conditions:

$$\bar{u} = v(w_j, r_j; a_j); \quad (3)$$

$$1 = c(w_j, r_j; a_j). \quad (4)$$

The intuition of the spatial equilibrium with urban amenities can be demonstrated by Figure 1. The horizontal axis denotes wages in different cities; the vertical axis, rents. The iso-utility curve is upward sloping, meaning that for a given distribution of amenities across cities, a_0 , workers need to receive higher wages in cities with higher rents so that utility levels can be equalized across cities. Similarly, the iso-cost curve is downward sloping: for a given spatial distribution of amenities, firms are willing to pay higher rents with in cities with lower wages, or higher wages in cities with lower rents to maintain the same unit cost across cities. The intersection of the two curves determines the equilibrium wage and rent.

(Insert Figure 1 here)

Figure 1 can also be used to show the comparative static analysis. For example, if some amenities are improved in all cities ($a_1 > a_0$), then the iso-utility curve will move upward from $v(w, r; a_0)$ to $v(w, r; a_1)$ because now for a given wage level workers are willing to pay even higher rents to enjoy better amenities (or for given rents workers are now willing to accept lower wages). The story would end here if the improved amenities do not affect firm productivity. However, if they enhance firm productivity, by the same token, the iso-cost curve will shift up because now for a given wage level

⁴ Given the production technology has constant returns to scale and the output price is normalized to be one, the unit cost equals one in the competitive equilibrium.

firms are willing to pay higher rents to benefit from the more productive amenities. In the new spatial equilibrium, equilibrium rent will be higher but the equilibrium wage can be higher or lower depending on the degree of shift of the iso-cost curve. This has a very important implication: in the wage hedonic regression the effect of an urban amenity can be positive or negative depending on how productive the amenity is to firms.

The variations in housing rents and wages across cities reflect households' willingness to pay for local amenities or quality of life. The monetary value or the implicit prices of local amenities can be derived from these compensating differentials in wages and rents. Taking total differentials with respect to both sides of equations (3) and using the Roy's identity, we can derive equation (5) as follows:

$$f_i = \frac{\partial v}{\partial a_i} / \frac{\partial v}{\partial w} = h \cdot \frac{dr}{da_i} - \frac{dw}{da_i}, \quad (5)$$

where $\frac{dr}{da_i}$ and $\frac{dw}{da_i}$ denote the compensating differentials in rent and wage due to a small change in a particular amenity a_i around the spatial equilibrium, h is the optimal housing consumption of a representative household. The sum of both compensating differentials in rent and wage is the monetary value of the amenity and is defined as the implicit price of amenity, f_i . Note that the sign of the implicit price is indeterministic. A negative sign means that households need to be subsidized or compensated to bear the disamenity (say air pollution or very cold winter).

The compensating differential in rent ($\frac{dr}{da_i}$) and in wage ($\frac{dw}{da_i}$) can be estimated from a housing hedonic model and a wage hedonic model with urban amenity variables included. Then, the implicit price f_i can be calculated based on equation (5). The quality of life (QOL) index for city j is the weighted sum of all amenities in city j where the weights are the implicit prices of amenities:

$$QOL_j = \sum_i f_i a_{ij}. \quad (6)$$

This QOL index can be considered a household's willingness to pay for amenities in city j and can also be used to rank cities in terms of quality of life.

Two caveats are worth noting before we proceed to the empirical part. First, since the publication of Rosen (1979) and Roback (1982), the spatial equilibrium framework has been extended in different directions. For example, Blomquist et al. (1988) incorporate agglomeration economies; Gyourko and Tracy (1991) consider the effect of local taxation on quality of life; Graves and Waldman (1991) focus on retirees' preference toward urban quality of life; Gabriel and Rosenthal (2004) and Chen and Rosenthal

(2008) extend the framework to evaluate business environment of cities; Albouy and Lue (2015) allow for commute cost. Our goal in this paper is rather modest: we focus on only quality of life from the perspective of average households and consider only a set of commonly studied amenities.

Second, does the spatial equilibrium framework apply to China? Our simple answer is yes. There are two main reasons. First, the spatial equilibrium mechanism applies to any allocation in space to reduce arbitrage across locations as long as factors can move across locations. Although moving goods and people across cities is costly, this does not prevent spatial allocation from converging to the spatial equilibrium as long as economic agents seek to maximize utility or profits so that any spatial arbitrage opportunities will be fully explored eventually. Second, some empirical evidence supports the existence of spatial equilibrium. Greenwood et al. (1991) conclude that the American regional economies (at the state level) during 1971~1988 are not in disequilibrium by comparing the income in equilibrium and actual income. Berger et al. (2008) find that compensating differentials exist in both the planned economy regime and the transition period in Russia. Chauvin et al. (2017) argue that no evidence shows that the spatial equilibrium hypothesis does not hold in China and Brazil. Although it is well known that rural-urban and inter-city migration barriers exist in China, notably the residence regulation (*Hukou* system), the massive rural-urban migration and rapid urbanization during the past few decades do suggest that inter-regional labor mobility is relatively high. It is not unreasonable to apply the spatial equilibrium framework to evaluate urban quality of life in China.

3. Data

3.1 Main dataset

Estimating the implicit prices for urban amenities based on the Rosen-Roback framework requires not only data for urban amenities, but also a sample of individual workers with demographic and income variables and a sample of individual housing units with housing price (rent) and housing attributes variables for each city. The only such a dataset available in China that meets these requirements, to the best of our knowledge, is the 2005 1% Population Intercensus Survey (sometimes also called the 2005 minicensus), provided by the State Statistical Bureau of China. A few nationally representative household survey datasets with rich demographic information are available in China for recent years, such as the China Family Panel Survey, China Household Finance Survey, China Household Income Project Survey, but the number of households in each city is small and city identity is not publicly released without special request and approval. City governments host and maintain housing transaction data and a few large real estate brokers also collect housing transaction data for many cities, but we are unable to access these data. The dataset we are using is a bit outdated but it enables us to conduct the first evaluation of urban quality of life in China.

Our sample includes 287 prefecture level cities because for the purpose of this study, the selected urban amenity variables are available only for these cities. Below we describe the variable definitions and other data sources.

3.2 Housing and wage

The 2005 1% Population Intercensus Survey data provide information on “costs of purchasing or building a housing unit” for each home owner. We exclude those housing units built by households themselves and use “costs of purchasing a housing unit” as the proxy for housing price because it closely reflects the transaction price. We winsorize housing price at the top and bottom 1%. Housing attributes variables include structure, number of floors, building age, number of rooms, floor area, whether the unit has a kitchen, bathroom, tap water, cooking fuel, and full or partial ownership. Detailed location information of a housing unit in a city is not available. To control for unobserved neighborhood attributes of housing units, we assign each housing unit into a group with homogenous attributes in terms of structure, floor, building age, and floor area (see Table A1 in the Appendix) and add group fixed effects to the housing hedonic model. The rationale is that observationally identical individuals are very likely to have similar unobservables (Bayer and Ross, 2006; Altonji and Mansfield, 2018; Oster, 2019).⁵

The data also provide “monthly rental payment” information and we use this to measure housing rent. Rental markets are not well developed in Chinese cities given the very high home ownership in urban China.⁶ Many rental units are in “urban villages” accommodating rural migrants (Song et al., 2008) and the rental data may be noisy. Since housing price is the present value of future rents cash flow, we also estimate the housing rent hedonic model as a robustness check for implicit prices of amenities but evaluate urban quality of life based on only housing price hedonic model.

We select workers of prime-age (16~65 for males and 16~60 for females) who are employed or have a job. Wage is measured by monthly labor income calculated from the data and is also winsorized at the top and bottom 1%. Individual demographic variables include gender, age, education, marital status, ethnicity, self-employed or not, and occupation (see Appendix Table A2). To control for unobserved individual abilities that could affect income, we also assign each worker into a homogenous group in terms of the main demographic traits and include these group fixed effects in the wage hedonic model.

3.3 Urban amenities

⁵ Housing hedonic models in the literature of urban quality of life generally do not consider neighborhood attributes. In our study, including these group fixed effects generates similar results to the model without group fixed effects.

⁶ The home ownership rate is 81.26% in 2005 urban China. Web source (in Chinese): http://www.stats.gov.cn/tjsj/tjgb/qttjgb/qgqttjgb/200607/t20060704_30621.html.

Following Blomquist (2006), we select three types of urban amenities: climate, environmental quality, and urban conditions (city attributes), to capture the main aspects of urban quality of life. We admit that our selection is a bit subjective. Given there are dozens of or even hundreds of amenity variables, a more sophisticated selection criteria may involve new techniques such as machine learning or high-dimensional econometrics. We leave this extension for future research.

3.3.1 Climate variables

We select three variables to measure a city's climate characteristics: monthly precipitation, average daily sunshine duration (hours), and temperature. These data are directly from China Meteorological Data Service Center. Instead of using the raw temperature data, we follow Zheng et al. (2009) and construct a city temperature index to measure the degree of comfortableness in terms of temperature based on the maximum and minimum temperature of each city in 2005:

$$\text{Temperature index} = \sqrt{(Temp_{max}^{lowest} - Temp^{lowest})^2 + (Temp^{highest} - Temp_{min}^{highest})^2}, \quad (7)$$

where $Temp^{lowest}$ and $Temp^{highest}$ are the annual minimum and maximum temperature of each city in our sample, respectively. $Temp_{max}^{lowest}$ and $Temp_{min}^{highest}$ are the maximum of $Temp^{lowest}$ and the minimum of $Temp^{highest}$ in the sample of 287 cities, measuring comfortable temperature (e.g., warm winter and cool summer). This index quantifies the degree of comfortableness in terms of a city's temperature; the smaller the value, the more comfortable the city's temperature is.

3.3.2 Environmental quality variables

We construct three variables to measure urban environmental quality: annual mean concentration of PM_{2.5}, coastal location, and green coverage ratio. Annual mean concentration of PM_{2.5} are derived using the GIS software from the grid level data provided by the Atmospheric Composition Analysis Group at Dalhousie University, Canada.⁷ We create a dummy variable "costal city" to indicate whether a city is located in the coastal area based on the coastal city list specified in *China Ocean Yearbook* 2006. Coastal cities have location and transport advantage but also have nice beach view and better environmental quality. Green coverage ratio is the ratio of greened land area to the total built land area of a city and the data are from *China Urban Statistical Yearbook* 2006.

3.3.3 Urban condition variables

⁷ The web link is http://fizz.phys.dal.ca/~atmos/martin/?page_id=140. The State Environmental Protection Administration of China publishes daily air pollution index including PM₁₀ concentration in 2005 but only for 72 cities; PM_{2.5} data become available only since 2013.

Numerous city attributes or urban condition variables are available and there is no consensus which set of variables should be used to measure quality of life. Following the literature, we select a set of variables to measure urban public services, transportation as well as city sizes. The data are also from *China Urban Statistical Yearbook 2006*.

City size is measured by both population density and population size. Large cities generate strong agglomeration economies and knowledge spillovers and thus improve quality of life (Glaeser, 1999; Rotemberg and Saloner, 2000; Duranton and Puga, 2004) but may also reduce social trust and increase social and occupational segregation (Benabou, 1993; Glaeser, 1998). Following the literature (Colombo et al., 2014), we consider population density an amenity but keep population size as a control variable to avoid ranking bias toward large cities.

The number of theatres per one hundred thousand population in a city is used to measure the cultural and entertainment amenities. The number of hospital beds per ten thousand population in a city measures the availability of medical services. Public education quality is measured by the teacher-student ratio in high schools and the number of higher education institutions (colleges and universities). Transportation accessibility is measured by road area ratio (total road area divided by total urban area) and the number of airline routes, reflecting intra- and inter-city mobility. Given the important role of urban hierarchy in China (Chan and Zhao, 2002; Li, 2011; Bo, 2020; Jia et al., 2021), we also create a dummy variable “capital city” set to be one if a city is a provincial capital, a sub-provincial city, or is directly under the central government.

Many empirical studies include unemployment rate and crime rate to measure social amenities (Roback, 1982; Blomquist, 2006). These are very important urban conditions and factors that affect location choice of households and businesses. Unfortunately, the data for these variables are not publicly available for Chinese cities.⁸ We also deliberately omit some important amenity variables to avoid high collinearity with the selected variables such as concentration of other air pollutants, highway mileage or railway length.

The summary statistics of the key variables in estimation are reported in Table 1.

(Insert Table 1 here)

4 Model specification

The implicit prices of urban amenities can be obtained from the housing price and wage hedonic regression models:

⁸ Unemployment rate data based on registered unemployment are available but underestimate actual unemployment rate and also lack variation across cities.

$$\ln p_{hj} = \beta_0 + \beta_1 X_{hj} + \beta_2 a_j + \varepsilon_{hj}; \quad (8)$$

$$\ln w_{kj} = \gamma_0 + \gamma_1 Z_{kj} + \gamma_2 a_j + \eta_{ij}. \quad (9)$$

The dependent variable in the housing hedonic regression is $\ln p_{hj}$, the logarithm of price of housing unit h located in city j ; we also estimate the housing hedonic model using monthly rent. X_{hj} is the vector of housing attributes as listed in Table A1. a_j is the vector of urban amenity variables for city j and the full list is presented in Table 1.

In the wage hedonic model, w_{kj} is the monthly income of worker k who is located in city j ; Z_{kj} is the vector of individual demographic traits and the full list is presented in Table A2. ε_{hj} and η_{kj} are error terms. The estimated coefficient vector β_2 and γ_2 are the marginal effects of urban amenities on housing price and wage, respectively,

corresponding to $\frac{dr}{da}$ and $\frac{dw}{da}$ in equation (5).⁹

The premise of estimating the implicit prices of urban amenities from these hedonic models is that after controlling for individual housing attributes and individual worker attributes, there are no individual unobservables that correlate with urban amenity variables. This is unlikely due to spatial sorting based on individual unobservables. For example, high ability workers prefer living in cities with rich amenities. Our remedy is to include a large set of group fixed effects as described in the Data section under the rationale that individuals who belong to the same group are likely to have similar unobservables.

We estimate Models (8) and (9) using the ordinary least squares method. The samples include 421,660 housing units and 1,157,385 workers. To allow for the possible spatial correlation within a city, we cluster the standard errors at the city level.

To calculate a household's annual willingness to pay for an urban amenity using equation (5), we also need to have data for the number of working adults in and the annual housing expenditure by a representative household.¹⁰ To simplify the calculation, we impute these data only for a "nationally" representative household. The labor force participation rates of men and women in 2005 are 77.5% and 64.3%, respectively, based on the 2005 1% Population Intercensus Survey. If we assume that an employed male household member represents one full-time worker, then an employed female household member can be considered equivalently 0.83 full-time worker. Assuming a representative household has a working couple, this means 1.83 effective full-time wage earners. The monthly income is 625 CNY in Table 1. Therefore, the annual wage compensating differential for a representative household for a particular amenity i is $\text{CNY} - \gamma_{i2} \times 1.83 \times 625 \times 12$. Note here we add a negative sign because a negative value of γ_{i2} in the wage model means that the household is willing to accept a

⁹ Strictly speaking, β_2 corresponds to $\frac{dp}{da}$. We slightly abuse the notations here.

¹⁰ The housing hedonic model implies that $d \ln p = \beta_{i2} da_i$ or $dp = \beta_{i2} p da_i$; this also implies that $dr = \beta_{i2} r da_i$ assuming $p = \frac{r}{i}$ where r is the annual housing rents and i is the constant, annual capitalization rate.

lower wage for that amenity, or put it in another way, willing to pay more for that amenity.

Imputing monthly housing expenditure is tricky. Monthly rental payment in our data is ready for use but is very likely noisy and underestimated given the under-developed rental markets and many “urban villages” in cities. Imputing the capitalization rate for housing market involves more parameters such as growth rate of rents. We decide to use the monthly mortgage payment for a typical long-term mortgage transaction in 2005. Based on the *Report on China’s Monetary Policy Implementation* for the first quarter of 2005, released by the People’s Bank of China (also the central bank of China), in a sample of 10 cities surveyed, the average borrowing term is 17 years with the average down payment ratio of 37% and long-term interest rate of 6%. Given the mean housing price of CNY74,010 in Table 1, the monthly mortgage payment is CNY365, which is higher than the mean monthly rental payment of CNY261 in Table 1.¹¹ The annual compensating differential in housing price or housing expenditure for a particular amenity is $\text{CNY}\beta_{iz} \times 365 \times 12$. Adding up the compensating differentials in both housing price and wages, we can compute the implicit price f_i for amenity a_i . The quality of life index for each city can then be calculated using equation (6).

5. Results

5.1 Implicit prices for urban amenities

Table 2 reports the results of estimating Models (8) and (9) where the coefficients of individual attributes are suppressed. Column (1) is the housing price hedonic model. The coefficients of amenity variables are jointly statistically significant ($F=35.7$). Including amenity variables improves the model fitting by about 3.2% in terms of change in R-squared. Of the amenity variables with statistically significant coefficients, we can see that households are willing to pay a higher housing price for more sun shining days, coastal location, cultural facilities such as theatres, convenient inter-city transportation (more airline routes), and for higher urban hierarchy status (provincial capital). These findings are intuitive and consistent with life experience in reality. For the coefficients insignificant, many of them have the expected sign, for example, people are willing to pay a higher housing price for better medical and education services. The coefficient of PM_{2.5} concentration is insignificant possibly because households are not well aware of air pollution problem back in 2005. Not until 2013 did the public become alert to air pollution when “smog” caught the public attention (Zhang et al., 2019). Another possible interpretation of insignificant coefficients is that some amenities are not fully capitalized into housing values (and wages) in the transition economy due to

¹¹ This also implies an annual capitalization rate of 5.92%, which is in the range of between 4.35% and 7.85% used in other empirical studies (Blomquist et al., 1988; Berger et al., 2008).

institutional barriers to inter-city mobility. Column (2) uses housing rent as the dependent variable and the pattern of the results is very similar.

(Insert Table 2 here)

Column (3) presents the wage hedonic model results. Including amenity variables improves the model fitting by about 2.7% and most of the coefficients are significant. The sign of a coefficient in the wage hedonic model is worth noting. If an amenity does not affect firm productivity but improves household utility, then households are willing to sacrifice some wage compensation to enjoy more of the amenity. In this case the coefficient of this amenity in the wage model should be negative. However, if an amenity enhances firm productivity, firms then will be willing to pay higher wages for given rents (referring to Figure 1), which could more than offset households' willingness to sacrifice, resulting in a positive coefficient. Column (3) suggests that most of the amenities are also productive.

Table 3 shows how the implicit price of each type of amenity is calculated based on the results in Table 2. Column (1) calculate the housing price compensating differential—by how much more annual housing expenditure households are willing to trade for a marginal increase in a particular type of amenity. It equals the monthly housing expenditure (CNY365) multiplied by the coefficient in Column (1) of Table 2 (β_2) and then multiplied by 12 months. For example, households are willing to pay CNY 245.28 more on housing expenditure each year to enjoy one more hour sunshine every day and CNY 779.64 more on housing expenditure to live in a coastal city. The negative sign means that households are willing to pay less on housing to live with that disamenity. For example, to attract households to a city with temperature index ten unit higher, annual local housing rents must be CNY43.8 lower.

(Insert Table 3 here)

Column (2) of Table 3 calculates the wage compensating differential—by how much annual income households are willing to give up to enjoy a particular amenity. It equals the average monthly household income (CNY625.2×1.83) multiplied by the coefficient in Column (3) of Table 2 (γ_2) and then multiplied by 12 months. Note that in Column (2) of Table 3 we also add a negative sign to this number so that a positive wage compensating differential means that households are willing to pay more (by means of accepting a lower wage) to enjoy that consumption amenity while a negative number means that households are willing to pay less (by means of demanding for higher wage compensation) to live with the disamenity. For example, households require CNY1035.34 more annual income to live in coastal cities; this is likely due to much higher firm productivity and firms' higher willingness to pay for workers in coastal cities.

Column (3) reports the implicit price of each amenity (f_i in Equation (3)) which is the sum of compensating differentials in housing expenditure and wage, reflecting a

representative household's total willingness to pay for each amenity in 2005. A negative number in Column (3) can be understood as the compensation or subsidy that a household requires. Overall households are willing to pay more to live in a capital city and cities with high population density, to enjoy more sunshine, better cultural and medical public services, and more convenient transportations.

5.2 Ranking cities by quality of life index

Using the implicit prices for amenities computed in Table 3 as the weights and equation (6), we can calculate the quality of life index for 287 cities in our sample. It is a household's aggregate willingness to pay for living a city with a particular set of urban amenities. The larger the QOL index, the higher the quality of life in that city. To facilitate comparison, we standardize the QOL index for each city by subtracting the mean value of the QOL index in the sample. A positive number means households are willing to pay more for living in a city with better than average amenities and vice versa. The top and bottom 20 cities in terms of QOL are listed in Table 4 and the full list is in Table A4.

The four first-tier cities, Shanghai, Beijing, Guangzhou, and Shenzhen are ranked among the top 5 highest quality of life; Xiamen, a coastal city best known as "the Garden of the Sea", where the authors are currently (and luckily) living, is ranked the 9th. Most of the top 20 cities are also provincial capital cities. The ranking of the top 20 cities is roughly consistent with the informal rating in the air or from the popular press. The bottom 20 cities are in general small and medium size cities located all around the country.

(Insert Table 4 here)

We also decompose the QOL index into three components: climate, environmental quality, and urban conditions. Their correlation coefficients are presented in Table 5. Notably, urban condition index is highly correlated with the overall QOL index (correlation coefficient is 0.96), suggesting that accessibility and quality of public services, transportation, and political status of a city are the most important determinants of QOL. Climate amenities are also important (correlation coefficient is 0.24). Surprisingly, environmental quality index is not correlated with the overall QOL index (correlation coefficient is 0.03 and insignificant), possibly because people are not well aware of the environmental issues fifteen years ago; it is negatively correlated with urban condition index, implying that urban development is coupled with agglomeration diseconomies such as environmental pollution.

(Insert Table 5 here)

5.3 Urban quality of life and subjective well-being

Whether cities can make people happy has attracted much attention. Many studies use residents' self-reported life satisfaction or subjective well-being (SWB) to measure happiness and connect this with urban amenities such as air quality, climate, and urban growth (Luechinger, 2009; Ferreira and Moro, 2010; Glaeser et al., 2016). Moro et al. (2008) use subjective well-being data to rank quality of life in counties in Ireland. Oswald and Wu (2010) find that in the USA the state-level life satisfactions adjusted by demographic traits are highly correlated with the QOL ranking estimated by Gabriel et al. (2003), with a correlation coefficient of 0.6, suggesting that self-reported subject well-being does correlate with locational amenities. In this subsection, we also attempt to test whether our ranking of QOL in cities is highly correlated with the subject well-being reported by urban residents.

We use the 2010 China Family Panel Survey because its questionnaire asks interviewees to rate their degree of happiness.¹² The question asks "How much do you feel happy?" with optional answers "very unhappy", "unhappy", "okay", "happy", "very happy" that are coded as the integers between 1 and 5. Following Oswald and Wu (2010)'s approach, we first regress individual reported happiness ratings on city dummy variables and a set of individual demographic traits including gender, age, ethnicity, education, marital status, and working status. The coefficient of each city dummy variable is treated as the subjective well-being of that city.

Assuming QOL change only smoothly from 2005 and 2010, we can correlate 2010 SWB of cities and 2005 QOL indexes in cities. Column (1) of Table 6 regresses the SWB on the overall QOL indexes across cities and the coefficient is positive and statistically significant at the 5% level, suggesting positive association between subjective well-being and quality of life in cities. This is also demonstrated in the scatter plot with a fitted line in Figure 2. The other columns in Table 6 show that SWB is positively correlated with the QOL indexes in terms of climate and urban conditions but not environmental quality. Figure 3 also shows the statistically significant negative correlation between city level SWB and our ranking of the same cities based on the QOL index; that is, the cities in the top list of QOL are also happier.¹³

12 The CFPS is a nationally representative survey of Chinese households and focuses on both economic and non-economic well-being of each household member. It is conducted by the Institute of Social Science Survey at Peking University every other year since 2010. It uses a multistage, probability proportional to size sampling method with implicit stratification to better represent Chinese population. The 2010 baseline sample covers 25 provinces and 118 prefecture level cities. The official web site is <http://www.iss.pku.edu.cn/cfps/en/index.htm>.

13 Note that the R^2 's in Table 6 and Figures 2-3 are very small compared with 0.36 in Oswald and Wu (2010). This is probably because our city-level SWB is less precisely estimated due to the much smaller number of workers in each city in the CFPS data (on average about 300 workers per city) while Oswald and Wu (2010) used the data with 1.3 million people in the 50 states in the USA.

(Insert Table 6 here)

(Insert Figure 2 here)

(Insert Figure 3 here)

5.4 Comparison of QOL rankings

The Research Center for Urban Quality of Life at Capital University of Economics and Business started publishing QOL report for 35 large and medium size cities since 2011.¹⁴ The RCUQL constructs two indexes to rank cities: subjective satisfaction index and objective index. The subjective index is calculated based on computer assisted telephone interviews that ask interviewees to report their satisfaction of life living in their city. The effective sample size on average is about 13,000 residents. The objective index is an aggregated index from a set of variables that measure income, costs of living, public services, air quality, and other amenities in a city using factor analysis method.

Table 7 lists the ranking of the 35 cities based on our QOL index and also the rankings based on the subjective and objective indexes created by the RCUQL. There is a large difference between our ranking and the RCUQL's rankings. For example, nine of the top 10 cities in our list are ranked beyond the top 20 by the RCUQL based on the subjective satisfaction index; on the other hand, a few cities ranked in the bottom of their list are listed in the top in our list. The ranking based on their objective index is more consistent with ours but still about two thirds are not closely matched.

(Insert Table 7 here)

Table 8 presents the Spearman's rank correlation coefficients between our ranking and the rankings by the RCUQL for each year for the 35 cities. The correlation between our ranking and their ranking in terms of subjective satisfaction index is very low and even negative for some years (between -0.303 and 0.192) and statistically insignificant. The correlation between our ranking and their ranking in terms of objective index is moderate and positive, between 0.047 and 0.523, and is statistically significant for six of the eight years. This further confirms that urban amenities are important determinants of quality of life.

(Insert Table 8 here)

6 Conclusion

This paper provides the first evaluation and ranking of urban quality of life in China, based on the well-established Rosen-Roback spatial equilibrium framework that compensating differentials in wages and housing prices or rents reflect people's

¹⁴ The Center ranked only 30 cities in 2011 and 35 cities since 2012.

willingness to pay for urban amenities or quality of life. Due to data availability, we use the 2005 1% Population Intercensus Survey data in China. We estimate both wage and housing hedonic models and then calculate the implicit prices for a set of urban amenities, including climate, environmental quality, and urban conditions. Using these imputed prices as weights, we calculate and rank the quality of life for 287 prefecture level cities. Consistent with existing empirical evidence, we also find that in China cities in high urban hierarchy (provincial capital) and cities with nice weather, convenient transportation, and good public services have high quality of life. We also provide suggestive evidence that our estimated quality of life is positively correlated with urban residents' subjective well-being. Our ranking is significantly different from other rankings that are not grounded in economic theory.

Our findings have important urban policy implications. With the gradual relaxing of Hukou restrictions (Zhang et al., 2018), Chinese people become more mobile. Cities with rich natural amenities have the natural advantage to attract immigrants, but local city governments can also improve human-made and social amenities to gain competitive advantages, such as alleviating air pollution and traffic congestion, strengthening medical and educational public services, creating job opportunities, and keeping cities safe. Notably, given the current COVID-19 pandemic situation, improving the capacity and quality of public health services is a pressing task for city governments to improve quality of life in cities.

Our study has paved the way for many research directions on urban quality of life in China. We outline briefly a few possible extensions. First, new data should be utilized to update the evaluation and ranking of urban quality of life in China. Various nationally representative household survey data are available for recent years and can be used to estimate wage models, such as China Household Income Project Survey. Housing transaction data managed by local city governments can be combined to estimate housing hedonic models. Second, different groups have different willingness to pay for urban amenities. People at different life cycle stage may care more about certain amenities, for example, retirees may move to nice weather while power couples value labor market thickness and city bigness (Graves and Regulska, 1982; Graves and Waldman, 1991; Costa and Kahn, 2000; Gabriel and Rosenthal, 2004; Chen and Rosenthal, 2008); rural migrants care more about job opportunities and wage level and new immigrants may care more about education and medical public services and affordable housing (Wang and Chen, 2019; Liao and Wang, 2019). Our study can be replicated for heterogenous groups with some modifications. Third, our selection of urban amenities is neither exhaustive nor objective and new urban amenity categories can be included if available, such as crime rate, open and tolerant social milieu. New statistical methods such as machine learning or high-dimensional econometrics, can be employed to select the most relevant amenities (Glaeser et al., 2016). Fourth, in addition to the traditional reduced form to estimate hedonic models, structural models or quantitative spatial models (Holmes and Sieg, 2015; Redding and Rossi-Hansberg, 2017) can also be applied to urban quality of life (Diamond, 2016; Ahlfeldt et al., 2020).

Last but not least important, our study can be extended to evaluate the quality of business environment in Chinese cities.

References:

- Ahlfeldt, G. M., Bald, F., Roth, D., & Seidel, T. (2020). Wages, rents, and the quality of life in the stationary spatial equilibrium with migration costs. Working Paper (https://personal.lse.ac.uk/ahlfeldg/WP/GA_FB_DR_TS_SEMC.pdf).
- Albouy, D., & Lue, B. (2015). Driving to opportunity: Local rents, wages, commuting, and sub-metropolitan quality of life. *Journal of Urban Economics*, 89, 74-92. <https://doi.org/10.1016/j.jue.2015.03.003>.
- Albouy, D., Graf, W., Kellogg, R., & Wolff, H. (2016). Climate Amenities, climate change, and American quality of life. *Journal of the Association of Environmental and Resource Economists*, 3(1), 205-246. <https://doi.org/10.1086/684573>.
- Albouy, D., Leibovici, F., & Warman, C. (2013). Quality of life, firm productivity, and the value of amenities across Canadian cities. *Canadian Journal of Economics*, 46(2), 1-33. <https://doi.org/10.1111/caje.12017>.
- Altonji, J. G., & Mansfield, R. K. (2018). Estimating group effects using averages of observables to control for sorting on unobservables: School and neighborhood effects. *American Economic Review*, 108(10), 2902-2946. <https://doi.org/10.1257/aer.20141708>.
- Bayer, P., & Ross, S. L. (2006). Identifying individual and group effects in the presence of sorting: A neighborhood effects application. NBER Working paper, No.12211. <https://www.nber.org/papers/w12211>.
- Benabou, R. (1993). Working of a city: Location, education and production. *Quarterly Journal of Economics*, 108(4), 619–652. <https://doi.org/10.2307/2118403>.
- Berger, M. C., Blomquist, G. C., & Peter, K. S. (2008). Compensating differentials in emerging labor and housing markets: Estimates of quality of life in Russian cities. *Journal of Urban Economics*, 63(1), 25-55. <https://doi.org/10.1016/j.jue.2007.01.006>.
- Blomquist, G. C. (2006). Measuring quality of life. In R. C. Arnott, & D. P. McMillen (Eds.), *A Companion to Urban Economics*, Vol. 3 (pp. 483-501). Boston: Blackwell.
- Blomquist, G. C., Berger, M. C., & Hoehn, J. P. (1988). New estimates of quality of life in urban areas. *American Economic Review*, 78(1), 89–107.
- Bo, S. (2020). Centralization and regional development: Evidence from a political hierarchy reform to create cities in china. *Journal of Urban Economics*, 115, 103182.

- Buettner, T., & Ebertz, A. (2009). Quality of life in the regions: results for German Counties. *The Annals of Regional Science*, 43(1), 89-112. <https://doi.org/10.1007/s00168-007-0204-9>.
- Carlino, G., & Saiz, A. (2019). Beautiful city: Leisure amenities and urban growth. *Journal of Regional Science*, 59, 369-408. <https://doi.org/10.1111/jors.12438>.
- Chan, R., & Zhao, X.B. (2002). The relationship between administrative hierarchy position and city size development in China. *GeoJournal*, 56, 97-112. <https://doi.org/10.1023/A:1022463615129>.
- Chauvin, J., Glaeser, E., Ma, Y., & Tobio, K. (2017). What is different about urbanization in rich and poor countries? Cities in Brazil, China, India and the United States. *Journal of Urban Economics*, 98, 17-49. <https://doi.org/10.1016/j.jue.2016.05.003>.
- Chen, Y., & Rosenthal, S. S. (2008). Local amenities and life-cycle migration: Do people move for jobs or fun? *Journal of Urban Economics*, 64(3), 519-537. <https://doi.org/10.1016/j.jue.2008.05.005>.
- Colombo, E., Michelangeli, A., & Stanca, L. (2014). La Dolce Vita: Hedonic estimates of quality of life in Italian cities. *Regional Studies*, 48(8), 1404-1418. <https://doi.org/10.1080/00343404.2012.712206>.
- Costa, D., & Kahn, M. (2000). Power couples: changes in the locational choice of the college educated, 1940-1990. *Quarterly Journal of Economics*, 115(4), 1287-1315. <https://doi.org/10.1162/003355300555079>.
- Diamond, D., & Tolley, G. (1982). The economic roles of urban amenities. In D. Diamond & G. Tolley (eds). *The Economics of Urban Amenities* (pp3-54), New York: Academic Press.
- Diamond, R. (2016). The determinants and welfare implications of US workers? Diverging location choices by skill: 1980-2000. *American Economic Review*, 106(3), 479-524. <https://doi.org/10.1257/aer.20131706>.
- Duranton, G., & Puga, D. (2004). Micro-foundations of urban agglomeration economies. In J. V. Henderson, & J. F. Thisse (Eds.), *Handbook of Regional and Urban Economics*, Vol. 4 (pp. 2063-2117). Amsterdam: North-Holland.
- Ferreira, S., & Moro, M. (2010). On the use of subjective well-being data for environmental valuation. *Environmental and Resource Economics*, 46, 249-273. <https://doi.org/10.1007/s10640-009-9339-8>.
- Gabriel, S., Matthey, J. P. & Wascher, W. L. (2003). Compensating differentials and evolution in the quality-of-life among U.S. states. *Regional Science and Urban Economics*, 33(5), 619-649. [https://doi.org/10.1016/S0166-0462\(02\)00007-8](https://doi.org/10.1016/S0166-0462(02)00007-8).
- Gabriel, S., & Rosenthal, S. S. (2004). Quality of the business environment versus quality of life: Do firms and households like the same cities? *Review of Economics and Statistics*, 86(1), 438-444. <https://doi.org/10.1162/003465304774201879>.

- Giannias, D. A. (1998). A quality of life based ranking of Canadian cities. *Urban Studies*, 35(12), 2241-2251. <https://doi.org/10.1080/0042098983863>.
- Gillingham, R., & Reece, W.S. (1979). A new approach to quality of life measurement. *Urban Studies*, 16(3), 329-332. <https://doi.org/10.1080/713702532>.
- Glaeser, E. L. (1998). Are cities dying? *Journal of Economic Perspectives*, 12(2), 139-160. <https://doi.org/10.1257/jep.12.2.139>.
- Glaeser, E. L. (1999). Learning in cities. *Journal of Urban Economics*, 46(2), 254-277. <https://doi.org/10.1006/juec.1998.2121>.
- Glaeser, E. L., Gottlieb, J. D., & Ziv, O. (2016). Unhappy cities. *Journal of Labor Economics*, 34(2), 129-182. <https://doi.org/10.1086/684044>.
- Glaeser, E. L., Kominers, S. D., Luca, M., & Naik, N. (2016). Big data and big cities: The promises and limitations of improved measures of urban life. *Economic Inquiry*, 56(1), 114–137. <https://doi.org/10.1111/ecin.12364>.
- Graves, P., & Regulska, J. (1982). Amenities and migration over the life-cycle. 211-221. In D. Diamand & G. Tolley (eds.), *The Economics of Urban Amenities* (pp211-221), New York: Academic Press.
- Graves, P. E., & Waldman, D. M. (1991). Multimarket amenity compensation and the behavior of the elderly. *American Economic Review*, 81(5), 1374-1381.
- Greenwood, M. J., Hunt, G. L., Rickman, D. S., & Treyz, G. I. (1991). Migration, regional equilibrium, and the estimation of compensating differentials. *American Economic Review*, 81(5), 1382-1390.
- Gyourko, J., & Tracy, J. (1991). The Structure of Local Public Finance and the Quality of Life. *Journal of Political Economy*, 99(4), 774-806. <https://doi.org/10.1086/261778>.
- Gyourko, J., Kahn, M. E., & Tracy, J. (1999). Quality of life and environmental comparisons. In P. C. Cheshire, & E. S. Mills (Eds.), *Handbook of Regional and Urban Economics*, Vol. 3 (pp. 1413-1454). Amsterdam: North-Holland.
- Holmes, T., & Sieg, H. (2015). Structural estimation in urban economics. In G. Duranton, J. V. Henderson, & W. C. Strange (Eds.), *Handbook of Regional and Urban Economics*, Vol.5 (pp. 69-114), Elsevier.
- Jia, J., Liang, X., & Ma, G. (2021). Political hierarchy and regional economic development: Evidence from a spatial discontinuity in China. *Journal of Public Economics*, 194, 104352. <https://doi.org/10.1016/j.jpubeco.2020.104352>.

- Kahn, M. E. (1995). A revealed preference approach to ranking city quality of life. *Journal of Urban Economics*, 38(2), 221-235. <https://doi.org/10.1006/juec.1995.1030>.
- Lambiri, D., Biagi, B. & Royuela, V. (2007). Quality of Life in the economic and urban economic literature. *Social Indicators Research*, 84, 1-25. <https://doi.org/10.1007/s11205-006-9071-5>
- Li, L. (2011). The incentive role of creating “cities” in China. *China Economic Review*, 22(1), 172-181. <https://doi.org/10.1016/j.chieco.2010.12.003>.
- Liao, L., & Wang, C. (2019). Urban amenity and settlement intentions of rural–urban migrants in China. *PLOS ONE*, 14(5), e0215868. <https://doi:10.1371/journal.pone.0215868>.
- Luechinger, S. (2009). Valuing air quality using the life satisfaction approach. *Economic Journal*, 119(536), 482–515. <https://doi.org/10.1111/j.1468-0297.2008.02241.x>.
- Moro, M., Brereton, F., Ferreira, S., & Clinch, J. P. (2008). Ranking quality of life using subjective well-being data. *Ecological Economics*, 65(3), 448–460. <https://doi.org/10.1016/j.ecolecon.2008.01.003>.
- Mulligan, G., & Carruthers, J. (2011). Amenities, quality of life, and regional development. In R. W. Marans, & R. J. Stimson (Eds.), *Investigating Quality of Urban Life: Theory, Methods, and Empirical Research* (pp. 107-133). Dordrecht: Springer.
- Mulligan, G., Carruthers, J., & Cahill, M. (2004). Urban quality of life and public policy: A survey. In R. Capello, & P. Nijkamp (Eds.), *Urban Dynamics and Growth: Advances in Urban Economics* (pp. 729-802). Amsterdam: Elsevier.
- Oster, E. (2019). Unobservable selection and coefficient stability: theory and evidence. *Journal of Business & Economic Statistics*, 37(2), 187–204. <https://doi.org/10.1080/07350015.2016.1227711>.
- Oswald, A., & Wu, S. (2010). Objective confirmation of subjective measures of human well-being: Evidence from the U.S.A. *Science*, 327(5965), 576–579. <https://doi.org/10.1126/science.1180606>.
- Rappaport, J. (2007). Moving to nice weather. *Regional Science and Urban Economics*, 37(3), 375-398. <https://doi.org/10.1016/j.regsciurbeco.2006.11.004>.
- Rappaport, J. (2008). Consumption amenities and city population density. *Regional Science and Urban Economics*, 38(6), 533-552. <https://doi.org/10.1016/j.regsciurbeco.2008.02.001>.
- Rappaport, J. (2009). The increasing importance of quality of life. *Journal of Economic Geography*, 9(6), 779–804. <https://doi.org/10.1093/jeg/lbp009>.
- Redding, S. J., & Rossi-Hansberg, E. (2017). Quantitative Spatial Economics. *Annual Review of Economics*, 9(1), 21-58. <https://doi.org/10.1146/annurev-economics-063016-103713>.

- Roback, J. (1982). Wages, rents, and the quality of life. *Journal of Political Economy*, 90(3), 1257–1278. <https://doi.org/10.1086/261120>.
- Rosen, S. (1979). Wage-based indexes of urban quality of life. In P. Mieszkowski, & M. Staratzeim (Eds.), *Current Issues in Urban Economics* (pp. 74-104). Baltimore: John Hopkins Press.
- Rotemberg, J., & Saloner, G. (2000). Competition and Human Capital Accumulation: A Theory of Interregional Specialization and Trade. *Regional Science and Urban Economics*, 30 (4), 373–404. [https://doi.org/10.1016/S0166-0462\(99\)00044-7](https://doi.org/10.1016/S0166-0462(99)00044-7).
- Srinivasan, S., & Stewart, G. (2004). The quality of life in England and Wales. *Oxford Bulletin of Economics and Statistics*, 66(1), 1-22. <https://doi.org/10.1046/j.0305-9049.2003.00081.x>.
- Shapiro, J. M. (2006). Smart cities: Quality of life, productivity, and the growth effects of human capital. *Review of Economics and Statistics*, 88(2), 324-335. <https://doi.org/10.1162/rest.88.2.324>.
- Simon, C. (1998). Human capital and metropolitan employment growth. *Journal of Urban Economics*, 43(2), 223-243. <https://doi.org/10.1006/juec.1997.2048>.
- Song, Y., Zenou, Y., & Ding, C. (2008). Let's not throw the baby out with the bath water: the role of urban villages in housing rural migrants in China. *Urban Studies*, 45(2), 313-330. <https://doi.org/10.1177/0042098007085965>.
- Wang, Z., & Chen, L. (2019). Destination choices of Chinese rural-urban migrant workers: Jobs, amenities and local spillovers. *Journal of Regional Science*, 2019, 586-609. <https://doi.org/10.1111/jors.12444>.
- Wingo, L. (1973). The quality of life: Toward a microeconomic definition. *Urban Studies*, 10 (1), 3-18. <https://doi.org/10.1080/00420987320080011>.
- Winters, J. V. (2013). Differences in quality of life estimates using rents and home values. *The Annals of Regional Science*, 51, 377-409. <https://doi.org/10.1007/s00168-013-0551-7>.
- Xing, C., & Zhang, J. (2017). The preference for larger cities in China: Evidence from rural-urban migrants. *China Economic Review*, 43, 72-90. <https://doi.org/10.1016/j.chieco.2017.01.005>.
- Zhang, J., Wang, R., & Lu, C. (2019). A quantitative analysis of *Hukou* reform in Chinese cities: 2000–2016. *Growth and Change*, 50(1), 201-221. <https://doi.org/10.1111/grow.12284>.
- Zhang, Q., Zheng, Y., & Tong, D., et al. (2019). Drivers of improved PM_{2.5} air quality in China from 2013 to 2017. *PNAS*, 116(49), 24463-24469. <https://doi.org/10.1073/pnas.1907956116>.
- Zheng, S., Fu, Y., & Liu, H. (2009). Demand for urban quality of living in China: Evolution in compensating land-rent and wage-rate differentials. *Journal of Real Estate Finance and Economics*, 38, 194-213. <https://doi.org/10.1007/s11146-008-9152-0>.

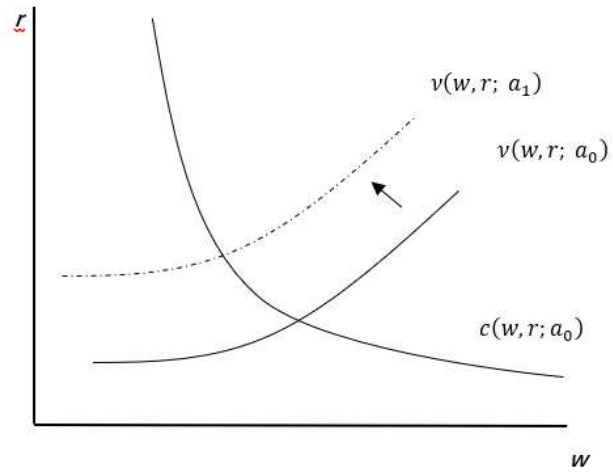


Figure 1: Wage and rents in the spatial equilibrium

Note. The horizontal and vertical axes denote wages and rents in different cities, respectively. $v(w, r; a_0)$ is the iso-utility curve for a given distribution of amenities across cities, a_0 ; $c(w, r; a_0)$, the iso-cost curve. $a_0 < a_1$.

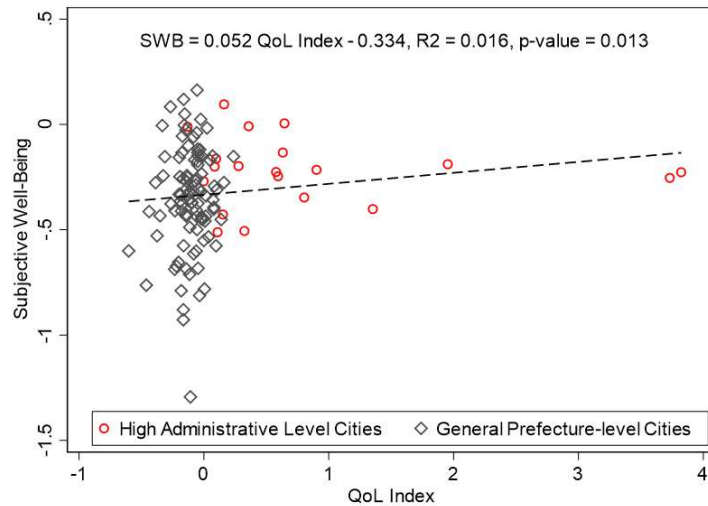


Figure 2: Subjective well-being and quality of life in cities

Note. The horizontal axis denotes the quality of life index for each city (see Table A4 in the Appendix for the data). The vertical axis denotes the subject well-being for each city, which are the coefficients of city dummy variables from regressing individual self-reported life satisfaction on individual characteristics and city dummy variables using the 2010 CFPS data.

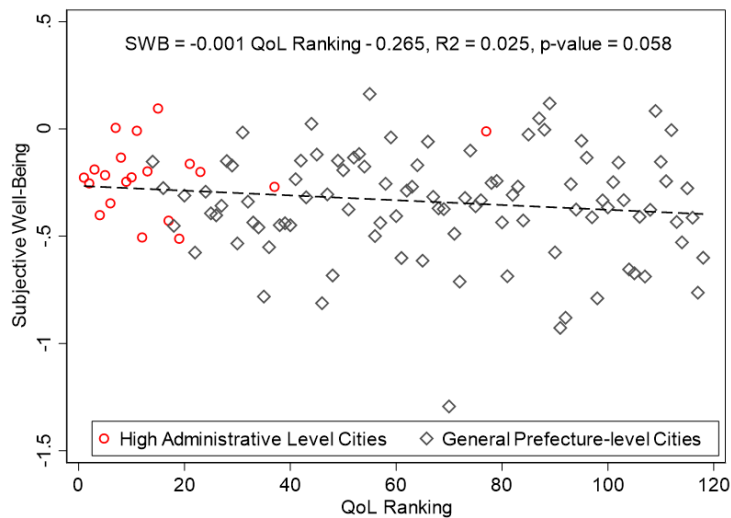


Figure 3 Subjective well-being and ranking of quality of life in cities

Note. The horizontal axis denotes the ranking of cities in terms of the quality of life index (see Table A4 in the Appendix for the data). The vertical axis denotes the subject well-being for each city, which are the coefficients of city dummy variables from regressing individual self-reported life satisfaction on individual characteristics and city dummy variables using the 2010 CFPS data.

Table 1 Summary statistics

	Obs.	Mean	Std. Dev.	Min	Max
Month income (CNY)	1157385	625.203	544.221	60	3800
Housing price (10,000 CNY)	421660	7.401	10.386	0.1	70
Monthly rent (CNY)	227594	261.456	336.597	8	2000
Temperature index	287	29.364	8.131	15.3	56.64
Average monthly precipitation (mm/month)	287	80.918	43.63	4.73	232.72
Average daily sunshine duration (hour/day)	287	5.578	1.431	2.48	9.19
Annual mean of PM _{2.5} concentration (ug/m ³)	287	43.097	17.352	4.13	82.83
Green coverage ratio (%)	287	32.139	9	1	51
Coastal city	287	0.185	0.389	0	1
Population density (100 people/square km)	287	9.64	8.548	.131	49.156
Population size (10,000 persons)	287	41.493	29.157	1.722	316.916
Number of theatres (per 100,000 population)	287	0.624	0.781	0	7.608
Number of hospital beds (per 10,000 population)	287	47.637	20.04	9.54	100.87
Teacher-student ratio in high schools (‰)	287	58.141	10.411	21.87	91.3
Number of higher-education institutions	287	6.537	11.491	0	79
Road area ratio (%)	287	11.213	5.205	2.16	51.94
Number of airline routes	287	3.589	13.636	0	131
Capital city (dummy variable)	287	0.122	0.328	0	1

Table 2 Results from hedonic models

Variables	(1) Housing price	(2) Housing rent	(3) Monthly income
Temperature index	-0.001 (0.00)	-0.005 (0.00)	0.007*** (0.00)
Mean monthly precipitation	0.001 (0.00)	0.002*** (0.00)	0.002*** (0.00)
Mean daily sunshine duration	0.056*** (0.02)	0.078*** (0.02)	0.025** (0.01)
Annual mean concentration of PM _{2.5}	-0.000 (0.00)	-0.002 (0.00)	0.001** (0.00)
Green coverage ratio	0.002 (0.00)	0.002 (0.00)	0.003** (0.00)
Coastal city	0.178*** (0.04)	0.019 (0.05)	0.138*** (0.03)
Population density	-0.002 (0.00)	-0.003 (0.00)	-0.003*** (0.00)
Population size	-0.001*** (0.00)	-0.000 (0.00)	-0.000 (0.00)
Number of theatres	0.055*** (0.02)	0.108*** (0.03)	0.032* (0.02)
Number of hospital bed	0.001 (0.00)	0.003*** (0.00)	0.000 (0.00)
Teacher-student ratio in high schools	0.001 (0.00)	-0.003 (0.00)	0.001 (0.00)
Number of higher education institutions	0.001 (0.00)	0.001 (0.00)	0.002** (0.00)
Road area ratio	-0.003 (0.00)	0.006 (0.00)	0.003 (0.00)
Number of airline routes	0.003*** (0.00)	0.002* (0.00)	0.001** (0.00)
Capital city	0.163*** (0.06)	0.107* (0.06)	0.029 (0.03)
R ² (full model)	0.734	0.542	0.616
R ² (excluding amenities)	0.702	0.511	0.589
Obs.	421660	227594	1157385

Note. The dependent variables in Columns (1)-(3) are ln(housing price), ln(housing rents), and ln(wage), respectively. Standard errors are in the parentheses and clustered at the city level. “*”, “**”, “***”, “****” denote significance at the 10%, 5%, and 1% levels, respectively. The housing hedonic models in Columns (1) and (2) also include housing attributes and group fixed effects as listed in Table A1; the wage hedonic model in Column (3) also include worker attributes and demographic group fixed effects as listed in Table A2.

Table 3: Compensating differentials and implicit prices for amenities (CNY)

Amenity	(1) Compensating differential: housing	(2) Compensating differential: Wage	(3) Implicit price
Temperature index	-4.38	-52.512	-56.90
Mean monthly precipitation	4.38	-15.01	-10.63
Mean daily sunshine duration	245.28	-187.56	57.72
Annual mean concentration of PM _{2.5}	0	-7.50	-7.50
Green coverage ratio	8.76	-22.51	-13.75
Coastal city	779.64	-1035.34	-255.70
Population density	-8.76	22.51	13.75
Number of theatres	240.9	-240.08	0.82
Number of hospital bed	4.38	0	4.38
Teacher-student ratio in high schools	4.38	-7.50	-3.12
Number of higher education institutions	4.38	-15.01	-10.63
Road area ratio	-13.14	-22.51	-35.65
Number of airline routes	13.14	-7.50	5.64
Capital city	713.94	-217.57	496.37

Note. Column (1) = Monthly housing expenditure (CNY365) $\times \beta_2 \times 12$; Column (2) = $(-1) \times$ Average monthly income (CNY625.20) $\times \gamma_2 \times 1.83 \times 12$; Column (3) = Column (1) + Column (2). β_2 and γ_2 are coefficients in Models (8) and (9).

Table 4 Quality of life index for top and bottom 20 cities

Rank	City	Quality of life index	Rank	City	Quality of life index
1	Shanghai	38222.67	268	Taian	-2716.05
2	Beijing	37309.63	269	Weifang	-2755.83
3	Guangzhou	19530.3	270	Sanming	-2833.74
4	Kunming	18100.72	271	Shaoxing	-2864.55
5	Shenzhen	14810.61	272	Qinzhou	-2915.72
6	Chengdu	13526.59	273	Dongguan	-3124.04
7	Xi'an	9017.757	274	Dongying	-3149.64
8	Haikou	8519.219	275	Lianyungang	-3262.05
9	Xiamen	8420.132	276	Rizhao	-3325.73
10	Urumqi	8215.632	277	Huizhou	-3449.11
11	Chongqing	8029.263	278	Jiangmen	-3507.3
12	Shenyang	6448.967	279	Longyan	-3685.41
13	Dalian	6319.896	280	Putian	-3744.6
14	Qingdao	6311.292	281	Heze	-3760.75
15	Changsha	5940.088	282	Taizhou (Zhejiang)	-3864.86
16	Hangzhou	5776.82	283	Zhangzhou	-3997.25
17	Nanjing	4836.258	284	Zhongshan	-4194.05
18	Harbin	3583.89	285	Zhuhai	-4384.87
19	Wuhan	3237.379	286	Fangchenggang	-4613.36
20	Guiyang	2941.529	287	Ningde	-6021.31

Table 5 Correlation matrix for QOL index and its components

QOL indexes	Climate	Environmental quality	Urban condition
Environmental quality	0.154** (0.009)		
Urban condition	0.009 (0.875)	-0.162*** (0.006)	
Overall	0.244*** (0.000)	0.027 (0.573)	0.960*** (0.000)

Note. “*”, “**”, and “***” denote statistical significance at the 10%, 5%, and 1% levels, respectively. *p* values are in the parentheses.

Table 6 Subjective well-being and quality of life in cities

	(1)	(2)	(3)	(4)	(5)
QOL	0.052** (0.02)				
QOL: Climate		0.580*** (0.20)			0.625*** (0.20)
QOL: Environmental quality			-0.513 (0.36)		-0.593 (0.36)
QOL: Urban condition				0.043** (0.02)	0.028 (0.02)
R^2	0.016	0.054	0.018	0.011	0.085
adj. R^2	0.008	0.045	0.009	0.002	0.061
<i>N</i>	117	117	117	117	117

Note. The dependent variable is subjective well-being of cities, which are the coefficients of city dummy variables from regressing individual self-reported life satisfaction on city dummy variables and a set of individual demographic traits using the 2010 CFPS data. The quality of life index has been divided by 10,000. Robust standard errors are in the parentheses. “*”, “**”, and “***” denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Comparison between our ranking and the ranking by The Research Center for Urban Quality of Life

City	Ranking by authors	Ranking by RCUQL	
		Average rank between 2011 and 2018	
		Ranking based on subjective satisfaction index	Ranking based on objective index
Shanghai	1	19	6
Beijing	2	24	2
Guangzhou	3	22	3
Kunming	4	24	11
Shenzhen	5	31	4
Chengdu	6	10	22
Xi'an	7	23	8
Haikou	8	12	27
Xiamen	9	14	13
Urumqi	10	19	23
Chongqing	11	10	32
Shenyang	12	16	11
Dalian	13	20	19
Qingdao	14	10	20
Changsha	15	22	16
Hangzhou	16	6	8
Nanjing	17	18	3
Harbin	18	21	28
Wuhan	19	21	11
Guiyang	20	25	18
Zhengzhou	21	19	32
Nanning	22	23	28
Yinchuan	23	15	14
Xining	24	11	33
Fuzhou	25	16	26
Shijiazhuang	26	16	20
Taiyuan	27	24	24
Lanzhou	28	25	28
Huhehaote	29	23	9
Ningbo	30	7	13
Jinan	31	9	21
Hefei	32	9	22
Changchun	33	10	15
Nanchang	34	23	27
Tianjin	35	16	23

Note. The ranking by the subjective satisfaction index in 2018 is not provided by the RCUQL.

Table 8 Spearman's rank correlation coefficients between our and the RCUQL's rankings for 35 cities

	(1) Ranking based on subjective satisfaction index	(2) Ranking based on objective index
2011年	-0.075 (0.694)	0.047 (0.807)
2012年	-0.230 (0.221)	0.382** (0.037)
2013年	-0.303 (0.104)	0.292 (0.117)
2014年	-0.202 (0.285)	0.401** (0.028)
2015年	0.192 (0.308)	0.471*** (0.009)
2016年	0.037 (0.846)	0.445** (0.014)
2017年	0.023 (0.903)	0.455** (0.012)
2018年		0.523*** (0.003)

Note. The ranking by the subjective satisfaction index in 2018 is not provided by RCUQL. *P* values are in the parentheses. “*”, “**”, and “***” denote statistical significance at the 10%, 5%, and 1% levels.

Online Appendix:

Table A1 Housing attributes of owner-occupied units (housing price equation)

Variable	Description	Mean	Standard deviation
Number of rooms		2.473	0.917
Floor area (sq. meter)		79.763	36.431
Building age	year 2005 minus completed year	13.382	10.554
Residential	Dummy variable, 1= houses for both residential and business	0.015	0.121
Building type	Dummy variable, 1= storied building	0.877	0.328
Structure	Dummy variable, 1= reinforced-concrete	0.448	0.497
Tap water	Dummy variable, 1= with tap water	0.947	0.224
Kitchen	Dummy variable, 1= with kitchen	0.983	0.128
Cooking fuel	Dummy variable, 1= with gas/electricity	0.862	0.345
Toilet	Dummy variable, 1=with toilet	0.940	0.237
Bathroom	Dummy variable, 1= with bathroom	0.745	0.436
Commodity housing	Dummy variable, 1= commodity housing	0.401	0.490
Public housing	Dummy variable, 1= new public housing	0.150	0.357
Old public housing	Dummy variable, 1= old public housing	0.449	0.497

Sample size: 421,660. We create the following categorical variables from the data: urban status (city, county, town); building structure (reinforced-concrete, mixed, other); number of floors (one, two to six, seven or more floors); building age (less than 5, 5~10, 10~20, more than 20 years); floor area (less than 60, 60~75, 75~90, more than 90 square meters). Combining these categories, we create $3 \times 3 \times 3 \times 4 = 432$ groups for all housing units and include these group fixed effects in the housing hedonic model.

Table A2 Housing attributes of rental units (rent equation)

Variable	Description	Mean	Standard deviation
Number of rooms		1.806	1.240
Floor area (sq. meter)		47.120	41.490
Building age	year 2005 minus completed year	19.502	19.319
Residential	Dummy variable, 1=houses for both residential and business	0.089	0.285
Building type	Dummy variable, 1= storied building	0.695	0.460
Structure	Dummy variable, 1= reinforced-concrete	0.315	0.464
Co-tenancy	Dummy variable, 1= co-tenancy	0.136	0.343
Tap water	Dummy variable, 1= with tap water	0.907	0.290
Kitchen	Dummy variable, 1= with kitchen	0.727	0.445
Cooking fuel	Dummy variable, 1= with gas/electricity	0.765	0.424
Toilet	Dummy variable, 1= with toilet	0.731	0.443
Bathroom	Dummy variable, 1= with bath	0.457	0.498
Public housing	Dummy variable, 1= public housing	0.393	0.488
Commodity housing	Dummy variable, 1= commodity housing	0.607	0.488

Sample size: 227,594.

Table A3 Individual worker characteristics

Variable	Description	Mean	Standard deviation
Age		37.991	11.345
Age squared		1572.067	890.059
Gender	Dummy variable, 1=male	0.552	0.497
Ethnicity	Dummy variable, 1=Han	0.941	0.237
Health status	Dummy variable, 1=good health	0.986	0.119
Marital status	Dummy variable, 1=married	0.833	0.373
Unschooling	Dummy variable, 1=unschooling	0.050	0.219
Elementary school	Dummy variable, 1=elementary school	0.268	0.443
Junior high school	Dummy variable, 1=junior high school	0.462	0.499
Senior high school	Dummy variable, 1=senior high school	0.142	0.349
Associate degree	Dummy variable, 1=associate degree	0.052	0.221
Bachelor degree	Dummy variable, 1=bachelor degree	0.025	0.155
Graduate degree	Dummy variable, 1=postgraduate	0.002	0.041
Labor contract	Dummy variable, 1=signed a contract	0.170	0.376
Employment status	Dummy variable, 1=employer	0.019	0.137

Sample size: 1,157,385. We create the following categorical variables from the data: ethnicity (Han, other); gender (male, female); marital status (married, other); education (unschooling, elementary school, junior high school, senior high school, associate degree, bachelor degree, graduate degree); age (less than 25, 25~40, 40~50, above 50 years old). Combining these categories, we create $2 \times 2 \times 2 \times 7 \times 4 = 224$ groups for all workers and include these group fixed effects in the wage hedonic model.

Table A4 Quality of life index for all cities

Rank	City	QOL index	Rank	City	QOL index
1	Shanghai	38159.67	41	Ningbo	1026.748
2	Beijing	37246.63	42	Guangyuan	961.89
3	Guangzhou	19467.3	43	Mianyang	918.704
4	Kunming	18037.72	44	Jinan	916.447
5	Shenzhen	14747.61	45	Yibin	909.058
6	Chengdu	13463.59	46	Ziyang	907.801
7	Xi'an	8954.757	47	Anshun	889.496
8	Haikou	8456.219	48	Sanmenxia	860.817
9	Xiamen	8357.132	49	Hefei	798.834
10	Urumqi	8152.632	50	Neijiang	788.878
11	Chongqing	7966.263	51	Dingxi	770.695
12	Shenyang	6385.967	52	Leshan	733.882
13	Dalian	6256.896	53	Baiyin	731.312
14	Qingdao	6248.293	54	Changchun	672.488
15	Changsha	5877.089	55	Guang'an	668.996
16	Hangzhou	5713.82	56	Xingtai	662.04
17	Nanjing	4773.258	57	Pingliang	631.324
18	Harbin	3520.89	58	Ulanqab	553.477
19	Wuhan	3174.379	59	Laibin	476.714
20	Guiyang	2878.529	60	Zhongwei	456.71
21	Zhengzhou	2710.556	61	Yilinz	451.66
22	Nanning	2511.239	62	Xuchang	434.604
23	Longnan	2308.721	63	Wuhai	407.038
24	Yinchuan	2215.634	64	Shangluo	406.087
25	Baoshan	2207.506	65	Shizuishan	396.702
26	Xining	2083.545	66	Hanzhong	385.26
27	Foochow	1988.858	67	Baoding	369.292
28	Qijing	1967.121	68	Wuzhong	364.355
29	Lijiang	1831.057	69	Puer	306.9
30	Lhasa	1732.538	70	Jiayuguan	296.174
31	Liupanshui	1601.159	71	Dazhou	283.086
32	Lincang	1593.293	72	Panzhihua	229.474
33	Zhangjiajie	1563.446	73	Sanya	192.223
34	Shijiazhuang	1551.307	74	Meishan	191.256
35	Taiyuan	1540.414	75	Qitaihe	158.664
36	Lanzhou	1459.331	76	Wenzhou	111.341
37	Suining	1396.826	77	Jinchang	105.12
38	Guilin	1322.657	78	Yuxi	99.939
39	Zhaotong	1319.507	79	Deyang	82.311
40	Hohhot	1149.358	80	Heihe	53.406

Table A4 continued

Rank	City	QOL index	Rank	City	QOL index
81	Guyuan	21.937	121	Lvliang	-540.687
82	Yulin	20.315	122	Jixi	-543.401
83	Tongchuan	16.976	123	Hechi	-559.957
84	Zunyi	-11.981	124	Shangqiu	-562.819
85	Xinxiang	-47.426	125	Tianshui	-563.021
86	Yuncheng	-65.683	126	Hengshui	-609.927
87	Datong	-90.373	127	Anyang	-613.565
88	Zigong	-92.111	128	Ganzhou	-617.205
89	Luzhou	-98.823	129	Anshan	-628.32
90	Chifeng	-110.127	130	Dandong	-641.433
91	Baicheng	-120.19	131	Baise	-658.62
92	Chaoyang	-130.081	132	Shuangyashan	-666.131
93	Tongliao	-155.123	133	Xinzhou	-673.041
94	Yan'an	-174.078	134	Weinan	-680.826
95	Zhoukou	-216.459	135	Liaoyuan	-690.229
96	Nanchong	-242.626	136	Yichang	-719.241
97	Pingdingshan	-247	137	Changzhi	-744.519
98	Zhangjiakou	-249.673	138	Maanshan	-782.499
99	Yangquan	-252.508	139	Huai nan	-801.268
100	Zhangye	-258.586	140	jiuquan	-802.662
101	Ya'an	-282.333	141	linfen	-806.634
102	Langfang	-285.515	142	Chaohu	-831.672
103	Nanchang	-293.501	143	Jinzhong	-835.981
104	Kaifeng	-303.611	144	Huaibei	-867.534
105	Fuxin	-321.223	145	Yantai	-871.217
106	Shaoyang	-341.265	146	Wuhu	-888.494
107	Bayan Nur	-365.354	147	Wuxi	-895.186
108	Chengde	-373.276	148	Jiaozuo	-916.909
109	Ordos	-375.585	149	Chongzuo	-921.829
110	Luoyang	-389.6	150	Jingzhou	-976.779
111	Wuwei	-410.376	151	Shiyan	-1010.08
112	Bazhong	-444.609	152	Baotou	-1013.26
113	Jincheng	-445.282	153	Nanyang	-1019.37
114	Xianyang	-467.227	154	Huangshi	-1034.62
115	Handan	-476.609	155	Jingmen	-1035.91
116	Qiqihar	-500.012	156	Qingyang	-1042.92
117	Ankang	-512.384	157	Jiamusi	-1048.63
118	Yunfu	-529.448	158	Bengbu	-1054.09
119	Siping	-530.707	159	Hezhou	-1098.66
120	Liaoyang	-540.197	160	Chuzhou	-1109.61

Table A4 continued

Rank	City	QOL index	Rank	City	QOL index
161	Jingdezhen	-1132.88	201	Benxi	-1589.78
162	Yangjiang	-1138.76	202	Xianning	-1593.67
163	Mudanjiang	-1154.69	203	Dezhou	-1595.62
164	Loudi	-1199.53	204	Chizhou	-1609.14
165	Wuzhou	-1207.67	205	Yinchun	-1617.38
166	Fuyang	-1219.87	206	Heyuan	-1631.15
167	Taizhou(Jiangsu)	-1230.98	207	Daqing	-1635.01
168	Hengyang	-1245.61	208	Zhoushan	-1638.31
169	Chenzhou	-1265.55	209	Panjin	-1651.29
170	Quanzhou	-1269.53	210	Tongling	-1672.92
171	Zhuzhou	-1276.51	211	Cangzhou	-1682.96
172	Huzhou	-1292.92	212	Anqing	-1689.38
173	Karamay	-1300.32	213	Suizhou	-1700.85
174	Hegang	-1307.36	214	Zhanjiang	-1705.69
175	Hebi	-1328.41	215	Changde	-1706.99
176	Huaihua	-1329.28	216	Linyi	-1706.99
177	Tieling	-1336.56	217	Meizhou	-1708.16
178	Bozhou	-1338.58	218	Yingkou	-1712.89
179	Hulun Buir	-1350.74	219	Tangshan	-1747.18
180	Foshan	-1351.76	220	Nanping	-1752.07
181	Tianjin	-1372.65	221	Lu'an	-1756.67
182	Suihua	-1381.47	222	Shuozhou	-1760.77
183	Yueyang	-1382.71	223	ZaoZhuang	-1763.14
184	Xuancheng	-1421.06	224	Jinzhou	-1782.2
185	Binzhou	-1438.81	225	Ezhou	-1804.16
186	Baoji	-1442.5	226	Huai'an	-1809.42
187	Puyang	-1451.56	227	Huludao	-1815.08
188	Zibo	-1463.16	228	Zhaoqing	-1816.23
189	Yongzhou	-1465.22	229	Baishan	-1828.04
190	Xinyang	-1483.92	230	Zhenjiang	-1831.68
191	Songyuan	-1484.03	231	Quzhou	-1835.92
192	Tonghua	-1484.97	232	Jilin	-1844.13
193	Fushun	-1486.67	233	Ji'an	-1862.34
194	Qinhuangdao	-1497.61	234	Changzhou	-1862.52
195	Guigang	-1503.5	235	Nantong	-1872.43
196	Yichun	-1507.45	236	Shaoguan	-1877.27
197	Liuzhou	-1510.83	237	Xiangyang	-1898.19
198	Chaozhou	-1554.25	238	Soochow	-1947.14
199	Xuzhou	-1560.28	239	Jieyang	-1960.29
200	Lishui	-1565.68	240	Shanwei	-1968.47

Table A4 continued

Rank	City	QOL index	Rank	City	QOL index
241	Shantou	-1981.97	281	Heze	-3823.75
242	Jinhua	-2000.37	282	Taizhou(Zhejiang)	-3927.86
243	Jining	-2026.45	283	Zhangzhou	-4060.25
244	Luohe	-2034.96	284	Zhongshan	-4257.05
245	Weihai	-2042.32	285	Zhuhai	-4447.86
246	Jiaxing	-2044.28	286	Fangchenggang	-4676.36
247	Zhumadian	-2050.04	287	Ningde	-6084.31
248	Huanggang	-2056.5			
249	Pingxiang	-2070.04			
250	Liaocheng	-2088.78			
251	Qingyuan	-2091.33			
252	Shangrao	-2147.4			
253	Xiaogan	-2154.45			
254	Huangshan	-2239.18			
255	Jiujiang	-2246.27			
256	Maoming	-2260.8			
257	Suzhou	-2267.86			
258	Yingtian	-2347.8			
259	Xiangtan	-2376.22			
260	Fuzhou	-2398.78			
261	Xinyu	-2408.6			
262	Yiyang	-2465			
263	Suqian	-2477.8			
264	Yancheng	-2685.84			
265	Yangzou	-2690.61			
266	Laiwu	-2737.65			
267	Beihai	-2763.56			
268	Taian	-2779.05			
269	Weifang	-2818.83			
270	Sanming	-2896.74			
271	Shaoxing	-2927.55			
272	Qin Zhou	-2978.72			
273	Dongguan	-3187.04			
274	Dongying	-3212.64			
275	Lianyungang	-3325.05			
276	Rizhao	-3388.73			
277	Huizhou	-3512.11			
278	Jiangmen	-3570.3			
279	Longyan	-3748.41			
280	Putian	-3807.6			