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ARE BIG CITIES REALLY BAD PLACES TO LIVE? IMPROVING QUALITY-OF-LIFE ESTIMATES ACROSS CITIES

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ABSTRACT

The standard revealed-preference hedonic estimate of a city's quality of life is proportional to that city's cost-of-living relative to its wage-level. Adjusting the standard hedonic model to account for federal taxes, non-housing costs, and non-labor income produces quality-of-life estimates different from the existing literature. The adjusted model produces city rankings positively correlated with those in the popular literature, and predicts how housing costs rise with wage levels, controlling for amenities. Mild seasons, sunshine, and coastal location account for most quality-of-life differences; once these amenities are accounted for, quality of life does not depend on city size, contrary to previous findings.

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1 Introduction

While it has long been established that nominal wage levels increase with city size (e.g. Klarman 1944, Fuchs 1967), it has also long been argued that higher wages in cities compensate workers for the disamenities of urban life, such as congestion and pollution (Hoch 1972). Nordhaus and Tobin (1972) argue that the loss in quality of life (QOL) from urbanization is a major cost of economic growth, and that this loss should be subtracted from national income growth when measuring gains in economic welfare over time. Elgin et al. (1974) argue that because QOL is low in larger cities, policy makers should consider "national population redistribution policy aimed at greater population balance," which would depopulate large cities and populate the hinterland.

The hedonic theoretical model of Rosen (1979) – extended by Roback (1982), and Heohn et. al. (1987) – establishes that *real* wages, netting out local cost-of-living, should be used to measure how workers are compensated for urban disamenities. Stated in reverse, a city's QOL can be measured according to how high its cost-of-living is relative to its wage level. Yet, QOL indices based on this hedonic methodology seen in Blomquist et. al. (1988), Gyourko and Tracy (1991), and other research – which all account for cost-of-living through differences in housing costs – are still negatively related with city size (Burnell and Galster 1992).[1]

For those familiar with American cities, the hedonic QOL indices found in this literature often appear counter-intuitive: they do not seem to reflect where individuals would prefer to live if local wage levels or cost-of-living could be ignored. This had led researchers such as Rappaport (2008) to doubt the validity of these estimates, and to call them "misplaced." Ranking 185 metropolitan areas in the United States, Berger et. al. (1987) find Pueblo, CO, to be the best city, Binghamton, NY, the 5th best, and Sioux Falls, SD, 34th. On the other hand, San Francisco, CA, is 105th; Portland, OR, 138th; Seattle, WA, 144th; and New York, NY, 165th. Ranking the states, Gabriel et. al. (2003) give the top three places to Wyoming, South Dakota, and Arkansas, but rank Hawaii 35th, Washington 41st, and California 42nd.[2] These rankings are not positively correlated with

[1] Gyourko, Kahn, and Tracy (1999) and Lambiri et al. (2007) are excellent guides to this literature.

[2] These differences persist when measured at the county level in Blomquist et al. (1988) where suburban Marin County is ranked 142nd (out of 253 counties), even lower than the City and County of San Francisco, ranked 105th.

QOL rankings found in popular works such as the *Places Rated Almanac* (Savageau 1999), where many large cities score quite favorably in overall "livability" in spite of their high cost-of-living.[3]

As argued here, the hedonic model of Rosen (1979), which has long dominated the QOL literature, produces much more sensible QOL estimates once three adjustments are made. First, cost-of-living measures should incorporate cost differences beyond housing alone. Second, wage differences across cities should be measured after accounting for federal taxes. Third, income from sources other than labor - including income from investments, real estate, or transfers - should be considered in determining a household's buying power, since all income is worth less in more expensive areas.

These three adjustments imply that cost-of-living differences are greater and disposable income differences smaller across cities than previous measures implied. In determining QOL, previous measures put too much weight on wage differences, and too little weight on housing-cost differences. Thus, in large cities, where both wages and cost-of-living are high, they overestimated real incomes and underestimated QOL. The adjustments proposed here put more weight on housing-cost differences and less weight on wage differences, implying that real incomes in large cities are lower, and QOL higher, than previously thought. Interestingly, adjusted QOL estimates no longer fall with city size; in fact, they increase slightly. Furthermore, the adjusted QOL measures produce more believable city rankings: the top two cities in the United States are Honolulu, HI, and Santa Barbara, CA, followed closely by San Francisco. Several large cities such as Boston, Chicago, Los Angeles and New York are above the national average, and the top five states are Hawaii, California, Vermont, Colorado, and Oregon. The adjusted QOL rankings are positively correlated with the rankings found in the *Places Rated Almanac*.

The three proposed adjustments not only produce more believable city rankings, but they also pass a novel empirical test developed below. Namely, the adjusted model successfully predicts

[3] Burnell and Galster (1992) note that, according to *Places Rated*, QOL peaks at a city size of 4 million, while quality-of-life decreases monotonically using hedonic indices found in Berger et al. (1987). Oppositely, Clark et al. (1992) find that QOL reaches a minimum at 4 million. Their measures are based on nominal, rather than real, wage measures, arguing that this should hold in a monocentric city model with free mobility, where – paradoxically – cities are of fixed size. Heohn et al. (1987), allow city size to be endogenous in a system of monocentric cities, and re-establish the need to use real, rather than nominal, wage differences.

how housing costs rise with wage levels across cities, controlling for various amenities that should influence QOL. The predicted housing costs of the unadjusted model, on the other hand, are soundly rejected by this empirical test.

The adjusted QOL model is used to estimate how households value individual amenities. The estimates indicate that households have a substantial willingness-to-pay to live in coastal areas, areas with sunshine, and areas free of excessive temperatures. In fact, a parsimonious model using only four variables for weather and coastal-location explains over 60 percent of the variation in QOL across cities. The positive cross-sectional relationship between QOL and city size is due to the fact that cities are larger in areas with nicer weather and along the coasts, reflecting the location choices of households previously noted by Rappaport and Sachs (2003) and Rappaport (2007). Once these amenities are controlled for, the relationship between QOL and city size is flat, suggesting that increasing urbanization in the United States has no effect on economic welfare.

With the bias against larger cities gone, the adjusted model finds that households are willing to pay to live near cultural amenities and to avoid air pollution and urban sprawl. Interestingly, regulations which restrict the use of residential land do not have much of an effect on QOL at the metropolitan level.

Besides fixing the standard economic model of QOL to produce more sensible rankings and amenity valuations, this paper makes a number of other methodological contributions. First, it provides an intuitive graph that explains how wage and housing-cost differentials across cities are converted into QOL estimates. Second, it establishes theoretically that aggregate QOL estimates are an average of household QOL valuations, with each household weighted by their share of national income. Third, it provides evidence that a log-linear specification, whereby QOL and amenity values are measured in terms of income percentages, rather than in dollar amounts, fits the data better than a linear specification. Fourth, it establishes a single-equation method to infer amenity valuations from the QOL estimates, a method which also reports the proportion of QOL variation explained by a given set of amenities. Finally, it proposes a theoretical extension of the standard Rosen model to simultaneously account for taste-heterogeneity and imperfect household mobility using a single parameter. This extension is used to theoretically establish downward-sloping demand curves for city-specific amenities, upward-sloping local labor-supply curves, as well as to model how restrictions on housing supply can raise the cost of housing, but reduce the value of land.

2 Model Set-up

To explain how QOL differences are reflected in local wages and prices, this paper uses the canonical model of Rosen (1979) and Roback (1982), developed further by Albouy (2008a, 2008b). The national economy is closed and contains many cities, indexed by j, which trade with each other and share a homogenous population of mobile households. These households consume a traded good, x, with a national price of one, and a non-traded "home" good, y, with local price, p^j. In application, the local price of home goods is equated with the local cost of housing services, and is used to determine the local cost-of-living.

Cities differ in quality of life, Q^j, which is a function of a vector of amenities, $\mathbf{Z}^j$, such as weather, crime, scenic beauty, or cultural opportunities, so that $Q^j = \tilde{Q}\left(\mathbf{Z}^j\right)$ for some function $\tilde{Q}$. Firm productivity in either traded or home goods may also vary across cities. However, because households are homogenous, and data on wage levels and cost-of-living are observed, quality-of-life can be estimated without modeling the behavior of firms (see Roback 1980 and Albouy 2008b for further detail on production).

Households are assumed to be fully mobile between cities, but they must work in the city in which they live, where they supply a single unit of labor and receive a local wage w^j.[4] Each households holds an identical, fully-diversified share of land and capital in the economy, which pays an income I that is independent of the household's location. This assumption is meant to capture the situation of an average potential migrant, who may own property anywhere in the country, and will likely sell it when moving. Total income, $m^j \equiv I + w^j$, varies across cities only

[4] Roback (1980) models the case of elastic labor supply, and concludes that it has no first-order effects on QOL estimation.

as wages vary.

Out of this income, households pay a federal income tax of $\tau(m)$. As explained in Albouy (2008a), federal expenditures are not correlated with federal taxes, and most federal public goods, such as national defense, benefit households across areas fairly equally. Therefore, differences in the disposable income of households across cities should be measured after federal taxes. Tax deductions for expenditures such as housing and local government-provided goods are modeled in the Appendix: their effects on QOL estimates are relatively minor.[5]

Household preferences are modeled by a utility function, $U(x, y; Q)$, that is quasi-concave, and increasing in x, y, and Q. The after-tax net expenditure necessary to obtain utility u, given local prices, p^j,w^j, QOL, Q^j, and tax schedule, τ, can be written as

$$e(p^j, w^j, \tau, u; Q^j) \equiv \min_{x,y} \left\{x + p^j y - w^j - I + \tau(w^j + I) : U\left(x, y; Q^j\right) \geq u\right\}$$

Since households are fully mobile, their utility must be the same across all inhabited cities. Therefore, in an equilibrium across all inhabited cities, no household requires any additional compensation to live in its city of residence, given the income it already earns

$$e(p^j, w^j, \tau, \bar{u}; Q^j) = 0 \tag{1}$$

where $\bar{u}$ is the national level of utility. This mobility condition need not apply to all households, but only a sufficiently large subset of mobile "marginal" households.[6] It is the set of marginal

[5]The local public sector does not need to be explicitly modeled. If local government goods are provided efficiently, as in the Tiebout (1956) model, these goods can be treated as consumption goods, part traded and part non-traded. Efficiency differences in local public sectors may be captured by differences in Q (Gyourko and Tracy 1989).

[6]It is a strong assumption to assume that markets are all in equilibrium. Greenwood et al. (1991) estimate equilibrium real wages separately from actual real wages, and find that in only 7 out of 51 cases are the two the statistically different at the 90 percent significance level (Hunt 1991). Interestingly, the QOL estimates from Greenwood et al. (1991), which depend on migration patterns, as well as real wages, are not adjusted for federal taxes or non-labor income, and are higher for Arkansas, Mississippi, and South Dakota than they are for Hawaii and California. In an out-of-equilibrium setting, in-migration should occur in cities where QOL is high relative to the cost-of-living net of local income differences. Other things equal, cities experiencing above-average levels of in-migration may have higher levels of QOL than the estimates here suggest. However, population movements are also influenced greatly by productivity changes in traded or home goods, which affect the availability of local jobs and housing. In-migration may then reflect workers moving to take advantage of available jobs or housing, rather than higher QOL.

households that determines the QOL values observed, just as marginal consumers determine prices in other competitive markets.

To see how wage and prices should vary with QOL, fully differentiate equation (1) to get

$$\frac{\partial e}{\partial p}dp^j + \frac{\partial e}{\partial w}dw^j + \frac{\partial e}{\partial Q}dQ^j = 0$$

This first-order approximation is taken around a city with average prices and QOL, so that we ignore superscripts j on the derivatives, which are evaluated at the national average $\bar{p}, \bar{w}$,and $\bar{Q}$. Applying Shepard's Lemma and rearranging this formula

$$y \cdot dp^j - (1-\tau') \cdot dw^j = p_Q \cdot dQ^j \tag{2}$$

where τ' is the marginal tax rate on income and $p_Q \equiv -\partial e/\partial Q = (\partial U/\partial Q)/(\partial U/\partial x)$ is the willingness-to-pay to increase QOL by one unit. Log-linearizing this formula, so that $\hat{p}^j \equiv dp^j/p$, $\hat{w}^j \equiv dw^j/w$ and, normalizing appropriately, $\hat{Q}^j \equiv p_Q \cdot dQ^j/m$, it follows

$$s_y \hat{p}^j - (1-\tau') s_w \hat{w}^j = \hat{Q}^j \tag{3}$$

where $s_y \equiv py/m$ is the share of income spent on home goods and $s_w \equiv w/m$ is the share of income received from labor. In percentage terms, $s_y \hat{p}^j$ represents how high cost-of-living is in city j relative to the national average, while $(1-\tau')s_w \hat{w}^j$ represents how high after-tax nominal income is relative to the national average. Thus (3) equates local QOL with the degree to which local cost-of-living exceeds after-tax nominal income levels, or how low after-tax real incomes are relative to the national average. The resulting QOL measure is cardinal, and represents what percent of total income households are willing to sacrifice to live in city j rather than an average city. In cities with below-average QOL, in which case $-\hat{Q}^j$ represents how much households need to be paid to live in city j, rather than a city with average QOL.[7]

[7]Equation (3) is based on a first-order approximation of the mobility condition. As shown in Appendix A.4, a second-order approximation has only a minute impact on QOL estimates. Furthermore, Davis and Ortalo-Magne

3 Choosing the Right Parameters

Equation (3) makes it clear that measures of QOL depend heavily on the parameters s_y, τ', and s_w used to weight the wage differential, $\hat{w}^j$, and the home-good price differential, $\hat{p}^j$. Most previous studies interpret home goods to include housing services alone, and choose an s_y of approximately 25 percent.[8] Furthermore, they do not adjust for federal taxes or non-labor income, so that τ' is effectively set to zero and s_w set to one. Applying these choices to equation (3),

$$\hat{Q}^j = 0.25\hat{p}^j - \hat{w}^j$$

which implies that a one-percent lower wage level is weighted four times more in calculating QOL than a one-percent higher housing cost. A more realistic parametrization, argued for here, accounts for non-housing differences in cost-of-living, federal taxes, and non-labor income is $s_y = 0.36, \tau' = 0.32$ and $s_w = 0.75$. These three adjustments all place more weight on housing costs relative to wages. This parametrization weights a one-percent lower wage level only one-and-a-half times as much as a one-percent higher housing cost:

$$\hat{Q}^j = 0.36\hat{p}^j - 0.51\hat{w}^j$$

All three adjustments are discussed in greater detail below.

Households are aggregated by weighting each by their respective income. As discussed in Appendix A.1, this produces the most sensible results when we wish to determine how QOL differences across cities affect wages and housing costs. Thus, the three parameters and the calculated wage and cost differentials should be based on income-weighted averages of households.

(2007) provide empirical evidence that s_{hous} is fairly constant across time and metropolitan areas, justifying the use of a single number for s_y.

[8] This includes Berger et al. (1987), Blomquist et al. (1988), Beeson and Eberts (1989), Gyourko and Tracy (1991), Gabriel and Rosenthal (2004), and Davis and Orthalo-Magne (2007).

3.1 The Expenditure Share for Home Goods

In the previous literature – with the exception of Gabriel et al. (2003) and Shapiro (2006) – the cost-of-living differential $s_y \hat{p}^j$ is limited to cost differences in shelter and utilities, with an expenditure share, s_y, between 18 and 28 percent used to weight housing-cost differentials across cities.[9] Yet, cost differences for non-housing goods also affect household consumption and utility, and therefore need to be included. Thus, the cost-of-living differential is recast in terms of housing and non-housing goods, rather than in terms of home and traded goods:

$$s_y \hat{p}^j = s_{hous} \hat{p}^j_{hous} + s_{oth} \hat{p}^j_{oth} \tag{4}$$

s_{hous} and s_{oth} are the expenditure shares for housing and for other goods, and $\hat{p}_{hous}$ and $\hat{p}_{oth}$ are the cost differentials for housing and for other goods. Income not spent on goods is saved or paid in taxes, including Social Security. Expenditure shares are taken from the Consumer Expenditure Survey (CEX), which reports the share of income spent on shelter and utilities, s_{hous}, is 0.22, and the share of income spent on other goods, s_{oth} is 0.56 (Bureau of Labor Statistics 2002).

While data on regional differences in housing costs, used for $\hat{p}_{hous}$, are of good quality, data on regional differences in the cost of other goods, used for $\hat{p}_{oth}$, are limited. The most commonly used data come from the ACCRA Cost-of-Living Index, which measures price differences across expenditure categories, and is meant to be used to measure cost-of-living differences for working professionals. There are several problems with this data, discussed by Koo et al. (2000): it covers a limited number of goods, is collected by volunteers, and may exaggerate housing-cost differences across areas. A more practical problem here is that these data are not available at the metropolitan level and they cover only a limited number of areas.

Rather than use the ACCRA data directly – as in Gabriel et al. (2003) – I use these data to infer how housing costs predict other prices, so that housing costs alone may be used to infer cost-of-

[9] The term "housing cost" is used here to refer to the cost of housing services for households. This refers to rent or, for homeowners, an imputed rent based on housing prices, which in standard practice includes the cost of utilities. This practice is followed here since contract rents often include utilities, which make it difficult to disentangle utilities.

living differences. Writing the regression formula for non-housing costs as a function of housing costs $\hat{p}^j_{oth} = b\hat{p}^j_{hous} + e^j$, the cost-of-living equation (4) becomes

$$s_y \hat{p}^j = (s_{hous} + s_{oth} b)\hat{p}^j_{hous} + s_{oth} e^j \quad (5)$$

Indices for housing costs and other costs are calculated from the ACCRA data in 2004, reweighted using expenditure weights from the CEX.[10] A regression using this data in natural logarithms reveals that housing costs predict other prices well:

$$\ln p^j_{oth} = \underset{(0.043)}{3.57} + \underset{(0.012)}{0.263} \ln p_{hous} + e^j \qquad R^2 = 0.66$$

With $s_{hous} = 0.22$, $s_{oth} = 0.56$, and the estimated coefficient of $b = 0.26$ in (5), the cost-of-living differential based on the housing-cost differential is $0.36\hat{p}^j_{hous}$. Thus if housing costs are used to measure $\hat{p}^j$ in (3), then this implies an effective share of $s_y = 0.36$. On average, goods other than housing account for $(s_{oth}b)/s_y = 41$ percent of the cost-of-living differences in this formulation. Assuming no measurement error, the $R^2 = 0.66$ implies that only a third of the variance in non-housing costs is not predicted by housing costs, and therefore only 14 percent of all cost-of-living variation is lost from using the proposed approximation. Given that the ACCRA data do not cover many cities and are somewhat noisy, using this approximation is a reasonable method of calculating cost-of-living differences across cities. The approximation also implies that previous studies, which used smaller values of s_y, systematically underestimated cost-of-living differences across cities.[11]

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[10] Results using 1999 ACCRA data are almost identical.

Theoretically, this methodology can be justified by assuming that households consume a housing good, y_{hous}, and a non-housing good, x_{oth}, according to the utility function $U = Q\,(y_{hous})^{s_{hous}}\,(x_{oth})^{s_{oth}}$. This non-housing good is produced from the traded good x and the remainder of the home good not devoted to housing, $y_{oth} = y - y_{hous}$, according to the production function $x_{oth} = (x)^{1-b}\,(y_{oth})^{b}$.

[11] Gabriel et al. (2003) use the ACCRA data directly. Because the data do not cover enough cities, the authors aggregate and perform their analysis by state. They claim that cost-of-living differences within state should be small relative to differences between states, although this may be problematic in large states such as California, Illinois, Michigan, and New York. According to my calculations, the authors used an effective $s_{hous} = 0.22$ and $s_{oth} = 0.38$, leading to an effective s_y of approximately 0.27, quite similar to the other literature.

3.2 The Federal Marginal Tax Rate on Labor Income

Federal taxes reduce the disposable income households gain from moving to a city offering higher wages, thereby narrowing disposable income differences across cities. A wage differential of $\hat{w}^j$ that a worker gains from moving to city j is accompanied by the burden of the tax differential of $\tau'\hat{w}^j$, a burden which comes with no additional benefits.

To calculate the marginal tax rate that workers face on their labor income, a base federal income tax rate is taken from TAXSIM (Feenberg and Coutts 1993), which for 2000 calculates a marginal rate of 25.1 percent. This tax rate applies to the average dollar earned from labor, or equivalently, the average household weighted by income. Federal payroll taxes paid on the employee side are added to this rate, including 1.45 percent for Medicare (Congressional Budget Office 2005) and half of the 6.2 percent tax for Social Security (OASDI), based on the simulation in Boskin et al. (1987, Table 4). This increases the effective federal tax rate to 29.6 percent.[12]

As housing is a major determinant of cost-of-living, it is worth considering the tax advantages to owner-occupied housing that the federal tax code provides (see Rosen 1985). As shown in Albouy (2008a), these tax advantages, modeled as a tax deduction for home goods, serve to reduce tax burdens in high-cost areas. Yet, for given housing costs, these advantages tend to penalize those in high QOL areas, where people consume less of all goods, including housing, and thus take smaller deductions. Adjustments for these tax advantages are made according to a formula given in Appendix A.2: their effects on QOL measurement are minor.

Furthermore, state taxes need should be included since, according to the data below, 44 percent of inter-metropolitan wage differences occur within state. On average, state income and sales

Shapiro (2006) does not use the ACCRA data directly, but does use it to compute his effective s_y. He regresses the total ACCRA composite index on the index for housing alone, finding a slope of 0.34, which is used for s_y in conjunction with housing prices. This is similar to the methodology used here, except that I provide a more explicit formula and use weights taken from the CEX rather than the weights provided by ACCRA.

Moretti (2008) runs a regression similar to (5) across cities over time using local Consumer Price Index data from major cities,supplied by the Bureau of Labor Statistics. He estimates a larger value of $b = 0.35$. Moretti's estimate is somewhat larger than the one here mainly because the CPI expenditure shares do not include income saved or paid in taxes. Once these expenditures are taken into account, the adjusted $b = 0.25$, which is very close to the estimate used here of 0.26.

[12]This accounts for the 15 percent of labor earnings that are above the OASDI earnings cap and are not taxed.

taxes combined reduce labor earnings by 8.8 percent on the margin.[13] State tax differentials for each city are computed by calculating the within-state wage differential and multiplying it be the corresponding state tax rate, accounting for deductions. Factoring in state taxes increases the effective marginal tax rate to 35.1 percent on average for households comparing cities within a state. At the national level, since only 44 percent of wage differences occur within state, state taxes can be approximated by a federal tax rate of 32 percent, 2.4 percent higher than the effective federal tax rate imposed by the national government. This approximation is not used in the actual QOL estimates, but is used to simplify the equations shown here.[14]

3.3 The Share of Income from Labor

Conceptually, the term s_w in equation (3) needs to account for how much a household's income will change if the household moves to a city with a different wage level. A value of $s_w = 1$ implies that, before taxes, household income changes one-for-one with the local wage level. This ignores a number of income sources, such as from investments in capital or real estate, or intrafamily transfers. These other sources of income are especially important since s_w is an income-weighted average, and since high-income individuals derive a substantial fraction of their income from non-labor sources.[15]

Allowing for non-labor income allows us to include households whose incomes need not depend on the wage levels available in their city, such as retirees. For instance, if retirees decide to locate close to their children, and families share income, then it makes sense to model retirees and their working children together in the location decision in a kind of "dynasty" (Barro 1974).

[13] State income tax rates from 2000 are taken from TAXSIM, which, per dollar, fall at an average marginal rate of 4.5 percent. State sales tax data in 2000 is taken from the Tax Policy Center, originally supplied by the Federation of Tax Administrators. The average state sales tax rate is 5.2 percent. Sales tax rates are reduced by 10 percent to accomodate untaxed goods and services other than food or housing (Feenberg et al. 1997), and by another 8 percent in states that exempt food. State-level deductions for housing expenditures, explicit in income taxes, and implicit in sales taxes, are discussed in Appendix A.2.

[14] A move from a low-wage city to a high-wage city could potentially increase a household's marginal tax rate. A preliminary adjustment for progressivity used in the second-order approximations in Appendix A.4, suggests that the impact of progressive taxes is very small.

[15] In a sense, the term s_w is a product of the log-linearization. It disappears if s_y expresses the share of *labor*, not total, income spent on home goods, which according to this parametrization is 48 percent.

Even if the location decision of retirees is independent of their children, the approximation used may still be valid if sorting issues are not severe. As shown in Appendix A.1, QOL estimates may reflect a weighted average of the valuations of working and retired households. This provides a more realistic representative agent setting than in previous work, e.g. Roback (1982), where cities are inhabited by workers who receive all of their income from labor, while absentee landlords, who receive capital and land labor income, live somewhere offshore.

Based on information from several sources, Krueger (1999) finds that labor's share of income is close to 0.75; this estimate is used here as it is fairly conservative relative to the previously assumed value of one. Accordingly, an average household moving to a city with 10 percent higher wages sees its before-tax nominal income rise by 7.5 percent.

The figure of 75 percent is corroborated by survey data on individuals' net worth and income in the Survey of Consumer Finances (SCF) in 2001. The average net worth of households is $341,300, 6.9 times the average household income of $49,500. At a modest real interest rate of 3.5 percent, the flow value of this worth is $11,946, or 24.1 percent of income.[16]

4 The Calculation of Wage and Housing-Cost Differences

4.1 Data

Wage and housing-cost differentials are estimated using the 5 percent sample of U.S. Census data from the 2000 Integrated Public Use Microdata Series (IPUMS). Cities are defined at the Metropolitan Statistical Area (MSA) level using 1999 OMB definitions. A consolidated MSA is treated as a single city (e.g. "San Francisco" includes Oakland and San Jose) so that commuting patterns can be ignored. Non-metropolitan areas within each state are also grouped together as a single "city." This classification produces a total of 290 "cities" of which 241 are actual metropolitan areas and 49 are non-metropolitan areas of states. More details are provided in Appendix

[16] There are a number of complications with all of the parameter choices since we need to know the parameters for the set of potential movers who determine how quality-of-life in different cities is valued. These movers may be younger and more educated than the households represented by the parameters.

C.

The 5 percent Census sample is used in its entirety for the first time in this type of study, guaranteeing the precision of the wage and price and differentials: the average city has 14,199 wage and 11,119 housing-price observations; the smallest city has 1093 wage and 817 housing-price observations.

Data on amenities are taken from various sources, and are described in greater detail in Appendix C. Amenities are divided into two categories. The first are natural site-specific characteristics such as climate and geography, which are exogenous to a city's inhabitants. These include inches of precipitation, heating degree days and cooling degree days per year, sunshine as a fraction of the possible total, and whether a metropolitan area is adjacent to a coast, either on the sea or the Great Lakes. The second category of amenities contains those that depend on a city's population. These amenities are measured using violent crimes per capita, the median Air Quality Index over the year, restaurants and bars per capita, the Arts & Culture Index from *Places Rated*, an index of residential land use regulation, an index of urban sprawl, local expenditures net of local taxes, and the number of federal dollars spent locally, with the last two expressed as a fraction of income.

4.2 Estimation

Inter-urban wage differentials are calculated from the logarithm of hourly wages for full-time workers, ages 25 to 55. In keeping with the methodology of Rosen (1979), these differentials control for skill differences across cities to provide a meaningful analogue to the representative worker in the model. Adopting the variant of this methodology by Gabriel et al. (2003), log wages are regressed on city-indicators (μ^j) and on extensive controls (X_i^{wj}) – interacted with gender – education, experience, race, occupation, industry, and veteran, marital, and immigrant status, in an equation of the form

$$\log w_i^j = X_i^{wj}\beta^w + \mu^j + e_i^{wj} \tag{6}$$

The coefficients μ^j are used as the wage differentials, and are interpreted as the causal effect of city j's characteristics on a workers wages.

To identify these differentials correctly, workers cannot sort across cities according to their unobserved skills, an assumption which is unlikely to hold completely. Glaeser and Maré (2001) argue that the urban-rural wage gap is largely unaffected by selection bias, with no more than a third of the gap being due to unobserved selection. If there is unobserved selection in this direction, then measured wage differentials in larger cities are biased upwards, causing QOL in these cities to be underestimated. It is also possible that the estimated wage differentials are too small as some of the worker characteristics controlled for, such as occupation or industry, could depend on where the worker locates. In practice these additional controls do not have a large effect on the estimates.[17]

Both housing values and gross rents, including utilities, are used to calculate housing-cost differentials. To be consistent with previous studies, imputed rents are converted from housing values using a discount rate of 7.85 percent (Peiser and Smith 1985), to which utility costs are added: this makes imputed rents comparable to the gross rents available for rental units. To avoid measurement error from imperfect recall or rent control, the sample includes only units that were acquired in the last ten years. Housing-cost differentials are calculated in a manner similar to wage differentials, using a regression of gross rents on flexible controls (X_i^{pj}) - interacted with tenure - for size, rooms, acreage, commercial use, kitchen and plumbing facilities, type and age of building, and the number of residents per room.

$$\log p_i^j = X_i^{pj} \beta^p + \nu^j + e_i^{pj} \tag{7}$$

[17]Adjustment for unionization rates was also considered based on data from Hirsch and Macpherson (2003). MSA unionization rates in 2000 range from 34.4 percent MN in Duluth to 0.6 percent in Hickory, NC. Lewis (1986) concludes that unions raise wages by approximately 15 percent. If somehow these higher wages are not absorbed by a higher cost-of-living – perhaps through restricted entry into union jobs – then this could cause after-tax real incomes to be up to 2.5 percent higher in Duluth relative to Hickory for reasons independent of local amenities. Thus, omitting unionization could cause quality-of-life to be underestimated in highly unionized areas. Adjusted estimates quality-of-life estimates were calculated using an adjustment for unionization: the resulting measures were only slightly different than the ones reported. Since it is unclear whether or not unions actually raise wages (Dinardo and Lee 2004), and whether or not higher wages from unions are absorbed by cost-of-living, the estimates are not adjusted for unionization.

The coefficients ν^j are used as the housing-cost differentials, and is interpreted to measure how much costlier a standard unit of housing in city j is relative to the national average. Proper identification of housing-cost differentials requires that average unobserved housing quality does not vary systematically across cities.[18]

4.3 Functional Form

Wage and housing-cost differentials are measured logarithmically, so that $\hat{Q}^j$ in (3) is measured as the fraction of income a household is willing to pay (or to accept if negative) to live in city j, rather than an in an average city. Most studies have measured QOL in dollar terms, as in (2). As explained in Appendix A.3, when aggregating across households with different incomes, the choice of logarithms applies best when households value amenities proportionally to their income, rather than in stable dollar amounts regardless of income.

Empirically, the semi-logarithmic functional form in (6) and (7) is supported by work in Blomquist et al. (1988), who use maximum likelihood estimation with a Box-Cox transformation of the form $(w^\gamma - 1)/\gamma$. They find that a value of $\gamma = 0.1$ best fits the data for wages, and $\gamma = 0.2$ for housing costs, both of which are fairly close to $\gamma = 0$, which corresponds to the logarithm. Similar estimates (not shown) using much larger samples from the 2000 Census, and with MSA dummy variables on the right-hand side (rather than measured amenities), result in estimates of γ close to 0.1 for both wages and housing costs. This is not dependent on the control variables, as a similar value of γ is estimated if predicted effects of the controls are first subtracted from wages and prices, with the residuals then regressed on the MSA dummies. Thus, city wage and housing-cost differentials across worker and housing types are best expressed in percentage terms rather than in dollar amounts.

[18]This issue may not be grave as Malpezzi et. al. (1998) determine that housing-price indices derived from the Census in this way perform as well or better than most other indices.

There is also the question of whether housing prices reflect differences in housing costs as accurately as rents do. This issue is addressed in Appendix C.2.

5 Quality-of-Life Estimation and Rankings

5.1 Calculating and Visualizing Quality-of-Life Estimates

With these wage and housing-cost differentials and the chosen parameters, QOL can be estimated directly from (3). Figure 1 graphs the wage and cost differentials for different cities, with $\hat{w}$ on the horizontal axis and $\hat{p}$ on the vertical axis. This figure can be used to see how QOL is estimated by rewriting (3) as

$$\hat{p}^j = \frac{(1-\tau')\, s_w}{s_y}\hat{w}^j + \frac{1}{s_y}\hat{Q}^j \tag{8}$$

This is an equation for the mobility condition for households for a given QOL differential, $\hat{Q}^j$. The solid line in Figure 1 corresponds to the mobility condition with $\hat{Q}^j = 0$: it passes through the origin and has a slope equal to 1.46. Along this line prices rise with wage levels in the right proportion so that after-tax real incomes remain constant, as does the inferred QOL. Cities above this line have a high cost-of-living relative to local income levels, and thus a higher inferred QOL, equal to s_y times the vertical distance from the solid line. The opposite is true of cities below the line.

Table 1 lists wage, housing-cost, and quality-of-life differentials for several metropolitan areas, the nine Census divisions, and for metropolitan areas of different population sizes. Appendix Table A1 presents estimates for all 241 metro areas and 49 non-metropolitan areas of states; Appendix Table A2 presents estimates for all of the states. These estimates are favorable to locations near the Pacific Coast, with Honolulu and Santa Barbara almost tied for first place. Other large cities in the West do quite well: San Francisco, San Diego, Los Angeles, Seattle, and Portland are all in the top 40. On the East Coast, Naples, FL ranks highest, with Boston the best among large cities, although Miami and New York are still in the top 40. Cities in the Midwest and in the South generally fare poorly, although New Orleans and Chicago are above average.

QOL estimates using the unadjusted parametrization, typical of the previous literature, may be visualized using the dashed line in Figure 1. This line has a slope of 4, implying that housing costs in this parametrization must rise more quickly with wages to keep households indifferent. Unlike the solid line, the dashed line passes under most of the smaller cities in the sample, giving them a higher inferred QOL than in the adjusted case, and above most of the larger cities, giving them a lower inferred QOL.

The adjusted QOL, using the favored parametrization, are graphed against the unadjusted QOL estimates in Figure 2. Cities above the diagonal have higher adjusted estimates than unadjusted estimates. The choice of the parametrization is obviously important as these estimates are substantially different. When cities are weighted according to their population, the correlation between the adjusted and unadjusted QOL estimates is actually negative.[19]

5.2 Quality of Life and City Size

The largest discrepancies between adjusted and unadjusted estimates occur in large cities, where wages and costs are high, and smaller cities, where the opposite is true. The relationship between QOL and city size is shown in Figure 3a for adjusted estimates and 3b for unadjusted estimates. While the adjusted estimates indicate a small positive relationship between population size and QOL, the unadjusted estimates indicate a starkly negative relationship.[20]

Because of agglomeration economies, worker productivity increases with city size, so that larger cities pay higher wages, which, holding quality of life constant, are neutralized via higher costs-of-living. As seen in (8), workers bid up the cost-of-living in a city either to enjoy its amenities or to be close to a well-paying job.

The unadjusted parametrization overstates the income gains that households receive from moving to larger cities, and understates the higher cost-of-living they endure. This causes real incomes

[19] In essence, most previous studies used the projection of the unadjusted QOL estimates onto the space of individual amenities used in their regression analysis, a procedure which may have mitigated some of the problems with the unadjusted parametrization. Beeson and Eberts (1989) were the first authors to use the aggregate QOL measure seen here, although their study was limited to the 35 largest cities, largely obscuring the implied negative relationship between QOL and city size. My analysis using 1980 Census data – the same data used by Blomquist et al. (1988), Beeson and Eberts (1989), and Gyourko and Tracy (1991) – suggests that adjusted and unadjusted QOL estimates are more positively correlated in 1980 than they are in 2000, although the differences in 1980 are still very substantial.

[20] Adjusted QOL estimates from 1980 still reveal a positive, albeit statistically insignificant, relationship between QOL and city size. Whether this is because urban disamenities, such as pollution, were more severe in 1980 deserves further investigation.

to be overestimated and QOL to be underestimated in larger cities. Explained in reverse, this logic also explains why real incomes were previously underestimated, and QOL overestimated, in smaller cities with lower wages and costs-of-living.

5.3 An Empirical Test of the Indifference Slope

The dotted line in Figure 1 shows a regression line of housing-cost differentials predicted by wage differentials. Controlling for amenities, the slope of this line can be used to test the parametrization used to measure QOL.

The difference between the regression line and the calibrated mobility condition implies a statistical relationship between QOL and wage levels. The linear projection of QOL on wages may be written $\hat{Q}^j = b_Q \hat{w}^j + \eta^j$, where by construction $E\left[\eta^j | \hat{w}^j\right] = 0$. The expectation of $\hat{p}^j$ conditional on $\hat{w}^j$ in equation (8) is then

$$E\left[\hat{p}^j | \hat{w}^j\right] = \left[\frac{(1-\tau')\, s_w}{s_y} + \frac{b_Q}{s_y}\right] \hat{w}^j \equiv b_w \hat{w}^j$$

The slope of the regression line in Figure 1, reported in Table 2, is the slope of the mobility condition under the true parametrization, whatever it truly is, *plus* a term which depends on the correlation of QOL with wage levels. If wages and QOL are uncorrelated, then $b_Q = 0$, and the mobility condition is given by the regression line.[21] If instead the correct parametrization is known, then b_Q/s_y can be estimated by subtracting $(1-\tau')\, s_w/s_y$ from b_w; estimates of b_Q/s_y are reported in the bottom row of Table 2. The adjusted parametrization implies a positive relationship between nominal wage levels and QOL; the unadjusted parametrization implies a highly negative one.

The parametrization test is inspired by equation (8), which implies that if actual QOL, or all of the amenities that affect it, could be perfectly observed and included in the regression of $\hat{p}^j$ on $\hat{w}^j$ as control variables, then b_w would provide an unbiased estimate of the true value of $(1-\tau')\, s_w/s_y$.

[21] This corresponds to the case implicitly assumed in Glaeser, Kolko, and Saiz (2002).

Since actual QOL cannot be observed directly, a second-best approach is to include amenities that are likely to affect QOL as control variables in a regression of of $\hat{p}^j$ on $\hat{w}^j$ and to test whether the estimated b_w is significantly different from the slope implied by the parametrization. The results of this procedure are shown in columns 3 and 4 of Table 2. The estimates of b_w are very close to the slope of the mobility condition implied by the adjusted parametrization, lending support to the resulting QOL estimates. On the other hand, this test soundly rejects the unadjusted parametrization, which can only be correct if the QOL residual not explained by the included amenities is very negatively correlated with wage levels.[22]

5.4 Comparison with *Places Rated Almanac* Rankings

Another check on the validity of the hedonic QOL estimates is to consider how they correlate with other estimates of quality-of-life based on non-hedonic methods, such as those in the *Places Rated Almanac* by Savageau (1999). As explained in Becker et al. (1992), *Places Rated* determines its overall livability index by ranking cities along nine dimensions: climate, crime, health care, transportation, education, arts and culture, recreation, housing costs, and job outlook. These nine rankings are then averaged geometrically to determine an overall "livability" ranking. The choices made to compute these rankings involve a number of subjective decisions, leading many to question their results. Yet at the same time the final results have a certain plausibility that help account for their popularity. Previous hedonic QOL estimates are generally uncorrelated with these rankings, casting doubt on both methodologies.

As seen in columns 1 and 2 of Table 3, the correlation between the adjusted hedonic ranking and *Places Rated* QOL rankings is in fact positive, with correlation coefficient of 0.29. At the same time, the correlation with the unadjusted hedonic measures is negative at -0.25.

One issue with comparing these rankings is that *Places Rated* incorporates cost-of-living and job-market components in its ranking, elements which do not belong in the hedonic QOL ranking

[22]It is worth noting that the parameters were intially chosen in order to predict the effect of federal taxes in Albouy (2008a), and not to estimate QOL. Also, most of the amenity measures in the regression were chosen prior to the development of this test. Thus, this test does not suffer from conventional pre-test bias.

since these components are used to infer the value of the other amenities in the city. The two methodologies are quite different: the hedonic method assumes that in equilibrium, no city is better than any other once cost-of-living and labor-market opportunities are accounted for; the *Places Rated* method attempts to find the cities which offer the most valuable amenities at the lowest cost, producing recommendations similar to the "Best Value" recommendations seen in *Consumer Reports*. The *Places Rated* rankings can be recalculated by removing the housing cost and job outlook components. As seen in columns 3 and 4, these recalculated *Places Rated* rankings are more positively correlated with the adjusted hedonic ranking and more negatively correlated with the unadjusted ranking.[23]

6 Quality of Life and Individual Amenities

6.1 Estimation

The QOL estimates may be used to determine how much value households put on particular amenities simply by estimating the city-level regression

$$\hat{Q}^j = \sum_k \pi_k Z_k^j + \varepsilon^j \tag{9}$$

where

$$\pi_k = -\frac{p_Q}{m}\frac{\partial \tilde{Q}}{\partial Z_k}$$

π_k measures the percentage of income an individual is willing to sacrifice to live in a city with one more unit of this amenity. The error term ε^j contains measurement error, unobserved amenities, differences in housing quality (which raise the error term), and differences in worker ability (which lower it).

Beginning with Rosen (1979), previous studies have typically estimated amenity values by

[23] An additional support for the adjusted QOL estimates is provided by Carlino and Saiz (2008), who find that the adjusted QOL estimates are positively correlated with the number of tourist visits in a city.

directly estimating individual-level wage and housing-cost equations of the form (6) and (7), except with a vector of amenity variables in place of MSA dummy variables. An amenity's value is calculated by subtracting its coefficient in the wage equation from its coefficient in the housing-cost equation, using the same weights in (3) implied by the parametrization. This one-step method produces almost the exact same estimates of π_k as the two-step method outlined above, as long as the same control variables are used in the individual wage and housing-cost equations, and $\hat{Q}^j$ is calculated with the same weights in both. Standard errors from the one-step method tend to be too small, as amenities only vary across cities, and not across individuals within a city, so that the effective sample size is the number of cities, not the number of individuals in the sample (Gyourko, Kahn, and Tracy 1999). The two-step method, on the other hand, provides conservative standard errors (Wooldridge 2003).[24] Furthermore, the two-step method reports an R-squared (or coefficient of multiple correlation) from the second regression (9), giving the fraction of QOL variation that is explained by the vector of amenities $\mathbf{Z}$.

Because previous work over-weighted wage differences and under-weighted price differences, previous amenity value estimates using this methodology should be revised. Regardless of the innovations introduced here, inferring amenity values from inter-city differences in wages and housing costs faces a number of potential pitfalls. Across cities, there is a high degree of collinearity between the different amenity variables, making it difficult to obtain precise estimates, and limiting the number of amenity valuations that can be calculated. There are a number of amenities, such as the presence of a charming downtown quarter, that are difficult to measure, and problems from omitted variable bias are potentially severe. Furthermore, artificial amenities may be highly endogenous, and estimates of their values should be subject to additional skepticism.

[24] Clustering at the city level in the one-step method produces standard errors for amenity values similar to those in the two-step method.

6.2 Dependence of Quality of Life on Amenities

Means and standard deviations of the amenity variables are shown in Appendix Table A3. Regression results using both the adjusted and unadjusted QOL estimates as dependent variables are reported in Table 4. Columns 1 and 2 give results using only natural amenity variables. In column 1 we see that the estimates based on adjusted QOL indicate that households pay substantially to live in areas with sunshine, close to a coast, or free of extreme temperatures. The R-squared of 61 percent indicates that these four variables alone are enough to explain a majority of the variation in QOL.[25] The results based on unadjusted QOL estimates, in column 2, are often counter-intuitive. They imply that individuals are indifferent towards sunshine and excessive heat, and pay heavily to avoid coasts. These natural amenities also have much less explanatory power in the unadjusted model.

Columns 3 and 4 add artificial amenities that depend on a city's population. In column 3, using adjusted QOL, estimates reveal a high willingness-to-pay to avoid urban disamenities such as air pollution, urban sprawl and violent crime, although the latter's value is not measured precisely. Households also pay to be near cultural amenities, such as restaurants and bars, as well as arts and culture. Interestingly, high levels of residential land-use regulation have only a mild and statistically weak effect on QOL, at least at the metropolitan level. Federal spending in one's city is valued by households, although only by roughly half its dollar cost. Local expenditures net of taxes have a positive but insignificant effect on QOL. Most of the estimates based on unadjusted QOL in column 4 are insignificant, while the significant estimates pose problems: households have a strong aversion to art and culture, as this is typical of big cities; on the other hand, urban sprawl appears to be an amenity.

The estimated value of the weather amenities is considerably stable across both specifications. From the estimates on heating and cooling degree days, it appears that households are willing to

[25] Excluding precipitation does not affect the R-squared figure. Other variables related to climate and geography, including latitude, wind speed, and humidity are not significant in these regressions. Separating Great Lake coasts from salt-water coasts results in slightly higher, but insignificantly different, valuations for sea coasts, although even these differences disappear once artificial amenities are included.

pay even more to avoid hot summers than to avoid cold winters. If climate change increases the number of cooling degrees by the same number that it reduces the number of heating degree days, the estimates imply that households will be worse off. The estimated value for sunshine says that households are willing to sacrifice 3.7 percent of their income for one additional sunny day a week. The estimated value for living near the coast is halved from 3.6 percent in column 1 to 1.9 percent in column 3 since valuable artificial amenities are disproportionately located along the coast: while it is difficult to be sure of this value, the estimate appears plausible.[26]

6.3 Amenities and City Size

It is well established that certain amenities and disamenities vary strongly with population size: crime rates, pollution, and congestion typically increase with population, as do cultural opportunities and the variety of consumption goods (Rosen 1979; Glaeser, Kolko and Saiz 2001). Adding population as a control variable in (9) serves to control for many of the amenities, observed or not, that are correlated with city size.

The results of this approach are presented in Table 5. Columns 1 and 2 report the slopes of the regression lines in Figure 3 that show how population is positively related to the adjusted QOL estimates, but is very negatively related with the unadjusted QOL estimates. Adding natural amenities in column 3, the relationship between population and adjusted QOL disappears. These natural amenities explain the small but positive relationship observed between QOL and city size. Column 5, which presents how the log of population depends on these amenities, reveals that the key natural amenity is coastal location, as coastal cities are on average 3 times as large as non-coastal cities.

Results in columns 6, 7, and 8 do not change these conclusions. The amenity valuations from the adjusted parametrization are largely unaffected by including population, although certain valuations are less precisely estimated, such as those for cultural amenities and land-use regulation,

[26] Commuting time is not entered as an independent variable as this is an endogenous variable from the individual's viewpoint. Workers should be willing to commute longer hours in order to live in a more desirable metropolitan area. The possibility of using commuting time to infer QOL deserves serious consideration in further research.

as these are highly correlated with population size.

7 Taste Heterogeneity and Housing-Supply Restrictions

Recent work by Quigley and Raphael (2005), Glaeser et al. (2005), and Gyourko et al. (2006) argues that supply restrictions on housing in certain areas, such as California, have caused housing costs in these areas to increase disproportionately. Yet, in the traditional hedonic framework with homogenous households, supply restrictions in a single city raise housing costs everywhere uniformly; restrictions do not affect the relative price in that city, holding wages constant, although it should affect population size.

7.1 Modeling Heterogeneity and Imperfect Mobility

Although modeling heterogenous households can produce perplexing results, it is possible to incorporate a continuous form of heterogeneity into the standard hedonic model that is fairly tractable and elegant. Suppose that QOL in city j is dependent on a universal component Q_0^j and an a component that varies by household i, ξ_i^j, so that overall QOL for household i in city j is given by $Q_i^j = Q_0^j \xi_i^j$. Furthermore, assume that ξ_i^j is Pareto distributed with parameter $1/\psi$

$$F(\xi_i^j) = 1 - (\underline{\xi}^j / \xi_i^j)^{1/\psi},\ \xi_i^j \geq \underline{\xi}^j$$

A higher ψ implies greater heterogeneity in preferences, with $\psi = 0$ corresponding to the standard model with homogenous households. For simplicity, assume that the outside utility for households is given by a constant $\bar{u}$. For some given constant, $N_{\max}^j$, and some marginal household k with taste parameter ξ_k^j, the population in city j is $N^j = N_{\max}^j \Pr(\xi_i^j \geq \xi_k^j) = N_{\max}^j [1 - F(\xi_k^j)] = N_{\max}^j (\underline{\xi} / \xi_k^j)^{1/\psi}$. Hence,

$$\log N^j = \ln N_{\max}^j + \frac{1}{\psi} [\log \underline{\xi} - \log \xi_k^j] \tag{10}$$

Fully differentiating the equilibrium condition (1), treating N as an endogenous variable, and noting that (10) implies $\hat{N}^j = -\hat{\xi}_k^j/\psi$, leads to an extended version of equation (3)

$$s_y \hat{p}^j - s_w(1-\tau')\hat{w}^j = \hat{Q}_0^j - \psi \hat{N}^j \tag{11}$$

This says that the QOL for the marginal household of city j decreases with population size, as more marginal households enter a city. In order to decrease the city population by a full one percent, city residents need to see their real income drop by ψ percent.

Holding $\hat{w}^j$ and $\hat{Q}_0^j$ constant, (11) provides a downward-sloping demand curve for residence in city j given in terms of home-good prices

$$\hat{N}^j = -(s_y/\psi)\hat{p}^j \tag{12}$$

Holding $\hat{p}^j$ and $\hat{Q}_0^j$ constant, (11) provides an upward-sloping local-labor supply curve

$$\hat{N}^j = \left[s_w\left(1-\tau'\right)/\psi\right]\hat{w}^j \tag{13}$$

In general, ψ parametrizes household mobility: $\psi = 0$ implies perfect mobility, as in the standard model, while $\psi = \infty$ implies perfect immobility. The greater the amount of heterogeneity, the greater the willingness-to-pay to live in a city varies across individuals, and the less mobile are inframarginal households when housing costs rise or wages fall. Mobility may be thought to increase with time, so that ψ decreases with the time elapsed after the change-inducing event in question.

7.2 Effect of a Quality-of-Life Improvement

This model has several applications. Two simplified cases are examined here: the effect of an exogenous increase in an amenity, and the effect of a supply restriction on housing supply. For ease, assume that the total amount of traded good produced in city j is $X^j = A_X^j N^j h^j$, so that wages are determined exogenously by productivity in the traded sector, $w^j = A_X^j$. The total amount of the home good $Y^j = N^j y^j$ is produced directly from land $\bar{L}_j$, which is fixed in supply. Each city may differ in productivity in the home-good sector, A_Y^j, so that supply $Y^j = A_Y^j \bar{L}^j$. Because markets are competitive, all payments to home goods go to land, and so $r^j \bar{L}^j = p^j Y^j = p^j A_Y^j \bar{L}^j$, implying $r^j = p^j A_Y^j$.

Now assume that there is an exogenous increase in quality-of-life given by $d\hat{Q}_0^j > 0$, so that $s_y d\hat{p}^j = d\hat{Q}_0^j - \psi \hat{N}^j$. Since Y^j is fixed, $d\hat{N}^j = -d\hat{y}^j = -\eta^u \hat{p}^j = |\eta^u| \hat{p}^j$ where $\eta^u < 0$ is the uncompensated price elasticity of housing. As a result, both home-good prices and population size increase

$$d\hat{p}^j = \frac{1}{s_y + \psi |\eta^u|} d\hat{Q}_0^j$$
$$d\hat{N}^j = \frac{|\eta^u|}{s_y + \psi |\eta^u|} d\hat{Q}_0^j$$

In this case, the value of the amenity improvement is not fully captured by the price change. Migrants compelled to move into the city to take advantage of the improved amenity value the city less in other ways. Thus prices are lower relative to the case where all households are homogenous. Welfare of inframarginal residents of city j increases by

$$d\hat{Q}_0^j - s_y d\hat{p}^j = \psi d\hat{N}^j = \frac{\psi |\eta^u|}{s_y + \psi |\eta^u|} d\hat{Q}_0^j$$

In the case where $\psi \to \infty$, no inflow of population occurs, prices do not rise, and residents receive a welfare gain of $d\hat{Q}_0^j$.

7.3 Effect of Supply Restrictions

Suppose that housing supply restrictions reduce the amount of home goods that can be produced from land, causing $d\hat{A}_Y^j < 0$. It then follows that $d\hat{A}^j = d\hat{Y}^j = d\hat{y}^j + d\hat{N}^j = \eta^u d\hat{p}^j + d\hat{N}^j$.

Combining this with $s_y d\hat{p}^j = -\psi dN^j$ produces the results

$$d\hat{p}^j = -\frac{\psi}{s_y + \psi |\eta^u|} d\hat{A}_Y^j$$
$$d\hat{N}^j = \frac{s_y}{s_y + \psi |\eta^u|} d\hat{A}_Y^j$$

Thus, without heterogeneity $\psi = 0$, prices will not increase with supply restrictions and the population will decrease proportionally with the home-good supply.[27] The value of land, r^j, will likely decrease as $d\hat{r}^j = d\hat{p}^j - dA_Y^j$, implying

$$d\hat{r}^j = \frac{s_y + \psi (|\eta^u| - 1)}{s_y + \psi |\eta^u|} d\hat{A}_Y^j$$

With heterogenous households, supply restrictions can make housing relatively more expensive by essentially limiting the supply of city-specific amenities. For example, high levels of regulation in California, effectively lower the supply of coastal sunsets, raising their relative price. Comparatively lax housing policies in other parts of the Sunbelt (Glaeser and Tobio 2007) have increased the supply of mild winters, which may lower their relative price.

8 Conclusion

The population size of a metropolitan area does not appear to have an impact on its QOL: it appears that the amenities of urban life, such as those from cultural and consumption opportunities, largely compensate for the disamenities, such as pollution and crime. Thus, in measuring welfare changes over time, there is no need to subtract QOL losses due to urbanization from national-income growth, at least not currently in the United States. Furthermore, the lack of a relationship between QOL and city size suggests that negative externalities from greater urban density are likely

[27] This corresponds closely to the result of Aura and Davidoff (forthcoming) who calibrate the elasticity of prices with respect to housing supply. Establishing this equivalence requires noting that $f(\xi_j)\xi_j/[1 - F(\xi_j)] = 1/\psi$ and that $\xi_j = \theta_j/s_y$ in the Aura-Davidoff model. The parameter ψ can be adapted to their calibrations by using $\psi = s_y \ln r/(\ln 2f)$, where r is "Median Valuation θ/price q" and f is "Market Size/National Population."

few, or that such externalities are typically mitigated through urban management. Empirically, this seems to undermine the idea that cities are too large and that federal policies should create greater population balance by inducing households to leave larger cities. Such policies may be welfare-reducing as they would discourage individuals from living in areas where they most prefer. This may be said of federal taxes (Albouy 2008a), which discourage individuals from living in larger cities, where nominal wages are high, but real wages are no higher than in the rest of the county.

Methodologically, it is encouraging that hedonic estimates, based on economic theory, are not at odds with popular notions of what cities are nice places to live. Estimates of the value of individual amenities suggest that popular ratings such as *Places Rated* should consider placing additional weight on factors such as weather and geographic location when producing their rankings. These estimates also raise additional concern over climate change as they find that households have a higher willingness-to-pay to avoid heat than to avoid cold.

The fact that a majority of QOL differences are explained by natural amenities has interesting policy implications. Perhaps greater attention should be placed on land-use policies which allow households to move to areas where they can enjoy the amenities they value most. Restrictions on housing development, such as in the clement, coastal areas of California, deprive households nationwide from living in areas that would make them better off. While these restrictions may help to bolster local housing prices by making local amenities more scarce, ultimately they may lower the value of local land. Furthermore, although restrictions that limit urban growth may limit congestion, they are unlikely to improve the QOL of their residents in the long run as they prevent the creation of consumption and cultural opportunities that arise in larger cities.

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TABLE 1: WAGE, HOUSING-COST, AND QUALITY-OF-LIFE DIFFERENTIALS, 2000

	Population Size	Adjusted Differentials: Wages	Housing Cost	Quality-of Life	QOL Rank	Unadj. QOL Rank
Main city in MSA/CMSA						
Honolulu, HI	876,156	-0.01	0.49	0.178	1	18
Santa Barbara, CA	399,347	0.11	0.67	0.176	2	90
Salinas, CA	401,762	0.09	0.53	0.140	3	112
San Francisco, CA	7,039,362	0.26	0.75	0.132	4	232
San Luis Obispo, CA	246,681	0.02	0.40	0.123	5	67
Santa Fe, NM	147,635	-0.05	0.25	0.123	6	23
San Diego, CA	2,813,833	0.06	0.44	0.120	7	105
Los Angeles, CA	16,373,645	0.13	0.40	0.073	15	205
Seattle, WA	3,554,760	0.08	0.28	0.056	26	184
Boston, MA	5,819,100	0.14	0.35	0.053	30	219
Miami, FL	3,876,380	-0.01	0.13	0.051	33	122
Denver, CO	2,581,506	0.05	0.20	0.049	34	169
Portland, OR	2,265,223	0.03	0.17	0.045	36	156
New York, NY	21,199,865	0.21	0.42	0.042	39	238
Phoenix, AZ	3,251,876	0.03	0.10	0.021	59	179
Tampa, FL	2,395,997	-0.06	-0.05	0.012	66	113
Chicago, IL	9,157,540	0.13	0.22	0.010	70	234
Washington, DC	7,608,070	0.13	0.17	-0.008	98	235
Cleveland, OH	2,945,831	0.01	-0.04	-0.017	118	194
Minneapolis, MN	2,968,806	0.09	0.06	-0.020	125	231
Dallas, TX	5,221,801	0.07	0.01	-0.031	160	228
Atlanta, GA	4,112,198	0.08	0.02	-0.032	164	233
St. Louis, MO	2,603,607	0.01	-0.09	-0.033	170	206
Detroit, MI	5,456,428	0.13	0.09	-0.035	174	239
Philadelphia, PA	6,188,463	0.12	0.07	-0.035	176	237
Pittsburgh, PA	2,358,695	-0.04	-0.17	-0.040	185	177
Houston, TX	4,669,571	0.07	-0.08	-0.062	216	236
Census Division						
Pacific	45,042,272	0.10	0.36	0.08	1	6
Mountain	18,174,904	-0.05	0.02	0.03	2	1
New England	13,928,540	0.07	0.18	0.03	3	7
Middle Atlantic	39,668,438	0.08	0.11	0.00	4	9
South Atlantic	51,778,682	-0.03	-0.06	0.00	5	5
West North Central	19,224,096	-0.11	-0.25	-0.03	6	2
East North Central	45,145,135	0.00	-0.09	-0.03	7	8
West South Central	31,440,101	-0.07	-0.21	-0.03	8	4
East South Central	17,019,738	-0.12	-0.30	-0.04	9	3
MSA Population						
MSA, Pop > 5 Million	81,606,427	0.16	0.32	0.03	1	5
MSA, Pop 1.5-4.9 Million	55,543,090	0.03	0.05	0.00	2	4
MSA, Pop 0.5-1.4 Million	40,499,870	-0.03	-0.07	-0.01	3	3
MSA, Pop < 0.5 Million	36,417,747	-0.09	-0.15	-0.01	4	2
Non-MSA areas	67,354,772	-0.14	-0.28	-0.03	5	1
United States	281,421,906	0.13	0.29	0.05		
	total	*standard deviations*				

Wage and housing price data are taken from the U.S. Census 2000 IPUMS. Wage differentials are based on the average logarithm of hourly wages for full-time workers ages 25 to 55. Housing price differentials based on the average logarithm of rents and housing prices for units first occupied within the last 10 years. Adjusted differentials are city-fixed effects from individual level regressions on extended sets of worker and housing covariates. Quality-of-life is calculated according to equation (A.9) from price and wage differentials, using the share parameters s_y =0.36, s_x =0.42, s_w =0.75 extended to deal with state tax dfferences. Unadjusted share parameters are s =0.25, s_x =0.75, τ' = 0, δ = 0, s_w = 1. City rankings are out of 241.

TABLE 2: REGRESSION OF HOUSING COSTS ON WAGE LEVELS, AND A TEST OF THE CALIBRATED SLOPE COEFFECIENT FOR THE MOBILITY CONDITION

		Cities Only		
	No Controls (1)	No Controls (2)	Controls for Natural Amenities (3)	Controls for Natural and Artificial Amenities (4)
Panel A: Slope Estimates				
Wage differential	2.04	2.04	1.57	1.26
(robust s.e.)	(0.06)	(0.17)	(0.11)	(0.14)
R-squared	0.82	0.74	0.89	0.93
Number of Observations	290	241	230	193
Panel B: p-value of test that the regression slope equals the mobility-condition slope				
Adjusted slope = 1.46	0.00	0.00	0.34	0.16
Unadjusted slope = 4.00	0.00	0.00	0.00	0.00
Panel C: Implied relationship between wages and (residual) quality of life, b_Q				
Adjusted	0.58	0.58	0.11	-0.20
Unadjusted	-1.96	-1.96	-2.44	-2.74

Natural amenities, listed in Tables 4, 5, and A3, include heating degree days, cooling degree days, percent of sunshine possible, inches of precipitation, and proximity to a coast. Artificial amenities include violent crime rate per capita, median air quality index, bars and restaurants per capita, *Places Rated* arts and culture index, residential land-use regulation and sprawl indices, local government expenditures net of local taxes, and federal spending differentials.

TABLE 3: COMPARISON OF HEDONIC QUALITY-OF-LIFE AND *PLACES RATED ALMANAC "LIVABILITY"* RANKINGS, 2000

	Places Rated Score		Revised *Places Rated* Score	
	Adjusted QOL	Unadj. QOL	Adjusted QOL	Unadj. QOL
	(1)	(2)	(3)	(4)
Rank Correlation	0.28	-0.25	0.34	-0.32

240 cities in sample. Places rated ranking used for first city in CMSA. Revised *Places Rated* Score eliminates cost-of-living and job-market components. All ranking correlations are highly significant, with *p*- values less than 0.001.

TABLE 4: QUALITY-OF-LIFE ESTIMATES AND INDIVIDUAL AMENITIES

Type of Amentiy Variables	Natural Amenities: Climate & Geography Only		Natural and Artificial Amenities + Crime, Cultural, and Fiscal	
Dependent Variables	Adj. QOL	Unadj. QOL	Adj. QOL	Unadj. QOL
	(1)	(2)	(3)	(4)
Heating-Degree Days (1000s)	-0.012***	-0.010*	-0.017***	-0.005
	(0.004)	(0.006)	(0.003)	(0.006)
Cooling-Degree Days (1000s)	-0.040***	0.004	-0.034***	0.006
	(0.009)	(0.011)	(0.005)	(0.012)
Sunshine (fraction possible)	0.316***	-0.053	0.259***	0.089
	(0.076)	(0.134)	(0.056)	(0.107)
Precipitation (10s of inches)	0.004	-0.002	0.002	-0.011*
	(0.004)	(0.007)	(0.003)	(0.006)
Proximity to Coast (salt or fresh water)	0.037***	-0.044***	0.019**	0.000
	(0.007)	(0.014)	(0.008)	(0.013)
Violent Crimes per Capita			-1.922	2.470
			(2.235)	(3.121)
Median Air Quality Index (/100)			-0.081***	-0.110*
			(0.026)	(0.056)
Restaurants and Bars per Capita			0.036***	0.024
			(0.013)	(0.031)
Places Rated Arts & Culture Index (/100)			0.036***	-0.092***
			(0.013)	(0.024)
Residential Land Use Regulatory Index			0.010*	-0.013
			(0.006)	(0.008)
Sprawl Index (/10)			-0.008**	0.014**
			(0.003)	(0.007)
Local Expenditures net of Local Taxes			0.009	-0.063
			(0.021)	(0.041)
Federal Spending Differential			0.507*	0.342
			(0.272)	(0.552)
Constant	-0.112	0.079	-0.059	0.001
	(0.072)	(0.123)	(0.057)	(0.120)
R-squared	0.61	0.24	0.76	0.54
Number of Observations	230	230	193	193

Robust standard errors shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Regressions weighted by the sum of individuals in a city, each according to their predicted income in an average city.

TABLE 5: QUALITY-OF-LIFE ESTIMATES, INDIVIDUAL AMENITIES, AND CITY SIZE

Type of Amentiy Variables	Population Only		Natural Amenities: Climate & Geography Only			Natural and Artificial Amenities + Crime, Cultural, and Fiscal		
Dependent Variables	Adj. QOL	Unadj. QOL	Adj. QOL	Unadj. QOL	Log(Pop)	Adj. QOL	Unadj. QOL	Log(Pop)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Logarithm of Population	0.014***	-0.032***	0.003	-0.036***		0.002	-0.041***	
	(0.004)	(0.004)	(0.002)	(0.002)		(0.004)	(0.007)	
Heating-Degree Days (1000s)			-0.012***	-0.009**	0.025	-0.016***	-0.010*	-0.112**
			(0.004)	(0.004)	(0.131)	(0.003)	(0.005)	(0.053)
Cooling-Degree Days (1000s)			-0.040***	-0.003	-0.198	-0.034***	-0.006	-0.288***
			(0.009)	(0.009)	(0.194)	(0.005)	(0.011)	(0.104)
Sunshine (fraction possible)			0.307***	0.058	3.085	0.261***	0.063	-0.634
			(0.071)	(0.074)	(3.306)	(0.057)	(0.086)	(1.447)
Precipitation (10s of inches)			0.004	-0.003	-0.022	0.002	-0.003	0.196
			(0.004)	(0.004)	(0.195)	(0.003)	(0.005)	(0.132)
Proximity to Coast (salt or fresh water)			0.032***	0.017**	1.683***	0.018**	0.020*	0.492***
			(0.007)	(0.008)	(0.321)	(0.008)	(0.010)	(0.151)
Violent Crimes per Capita						-1.845	0.947	-37.379
						(2.239)	(2.594)	(44.474)
Median Air Quality Index (/100)						-0.089***	0.032	3.476***
						(0.029)	(0.051)	(0.648)
Restaurants and Bars per Capita						0.036**	0.013	-0.254
						(0.014)	(0.022)	(0.355)
Places Rated Arts & Culture Index (/100)						0.030*	0.013	2.561***
						(0.016)	(0.024)	(0.293)
Residential Land Use Regulatory Index						0.009	0.004	0.401***
						(0.007)	(0.008)	(0.104)
Sprawl Index (/10)						-0.007*	-0.004	-0.448***
						(0.004)	(0.006)	(0.130)
Local Expenditures net of Local Taxes						0.008	-0.043	0.476
						(0.021)	(0.031)	(0.527)
Federal Spending Differential						0.516*	0.176	-4.079
						(0.276)	(0.414)	(5.246)
Constant	-0.192***	0.456***	-0.148*	0.519***	12.159***	-0.089	0.550***	13.458***
	(0.048)	(0.055)	(0.080)	(0.067)	(3.085)	(0.084)	(0.135)	(1.556)
R-squared	0.15	0.54	0.62	0.67	0.37	0.76	0.67	0.85
Number of Observations	241	241	230	230	230	193	193	193

Robust standard errors shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Regressions weighted by the sum of individuals in a city, each according to their predicted income in an average city.

Figure 1: Housing Costs versus Wage Levels across Metro Areas, 2000

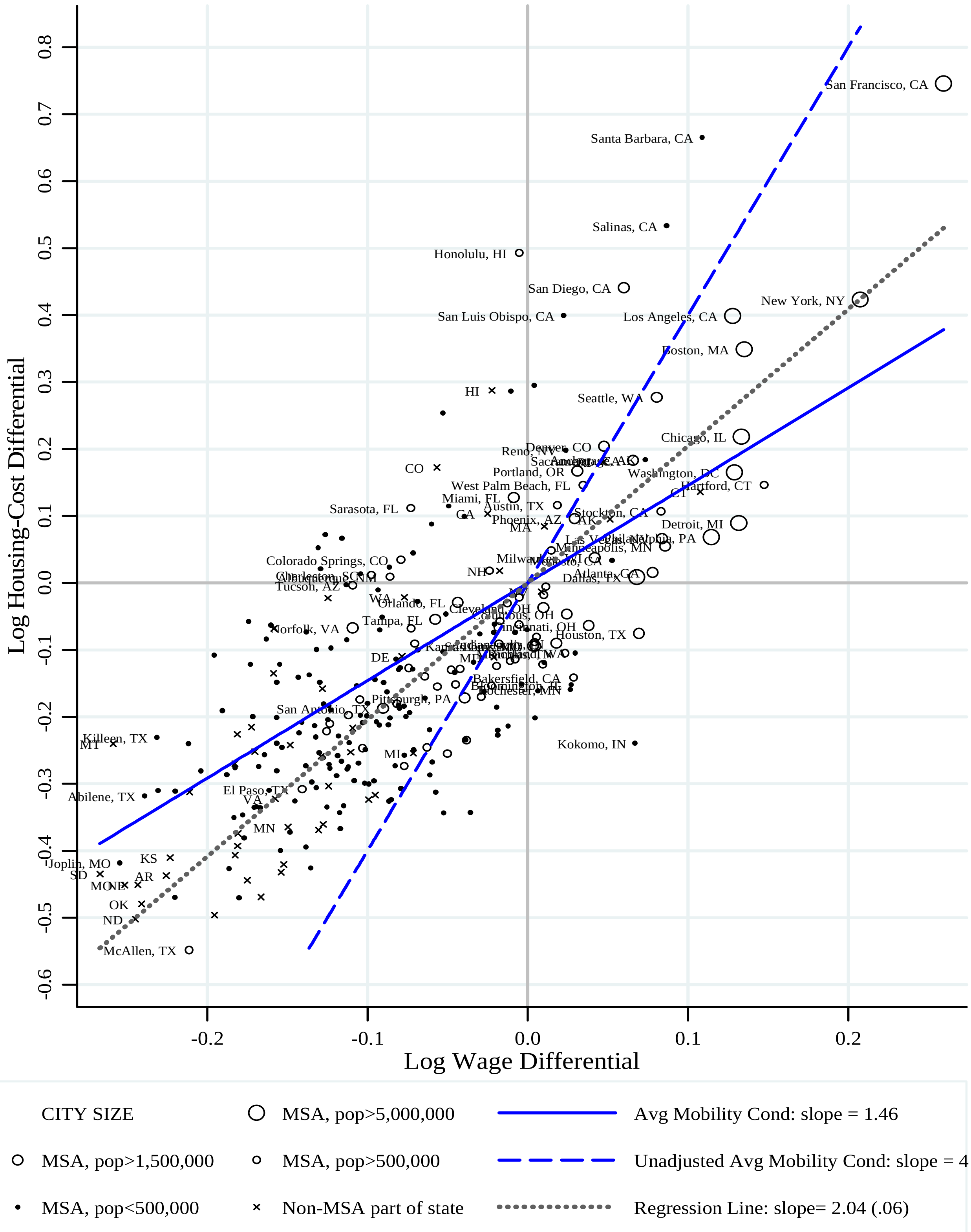


Figure 2: Quality-of-life Estimates: Adjusted vs. Unadjusted

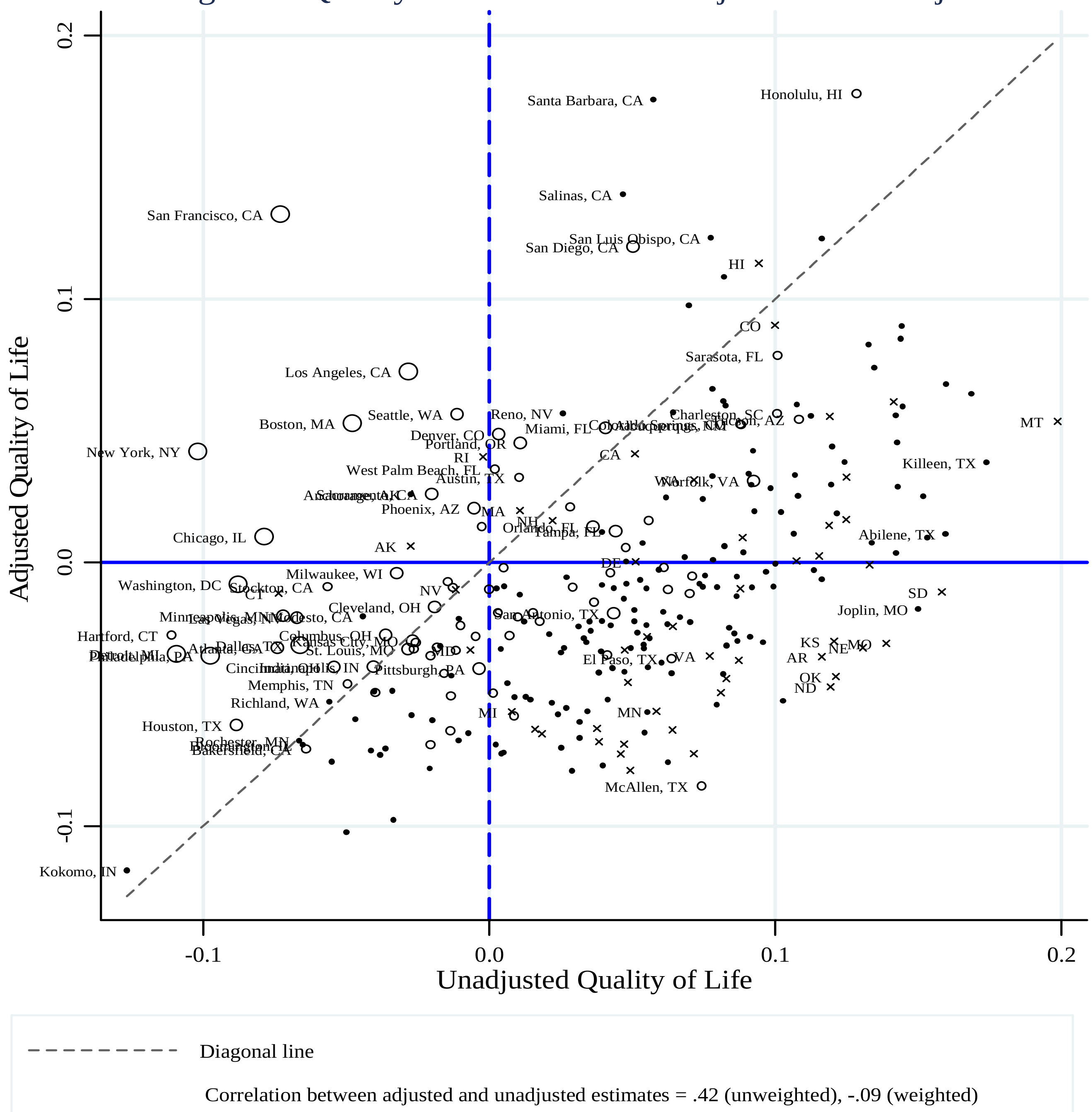


Figure 3: Quality of Life and City Size

Figure 3a: Adjusted Quality of Life

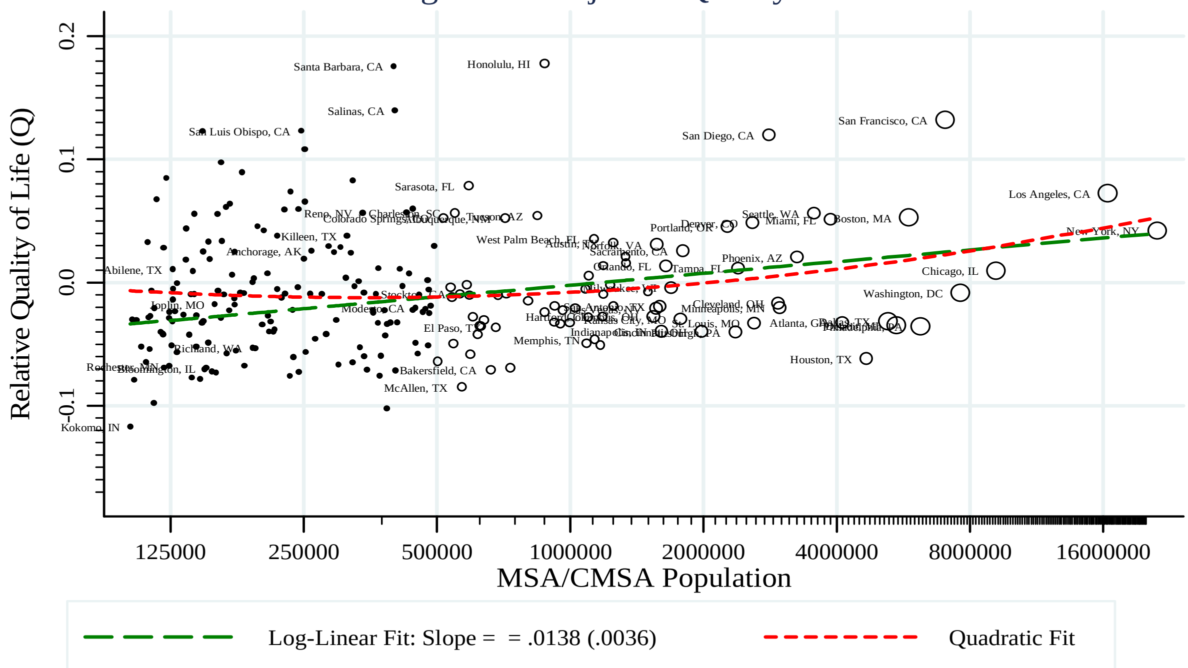
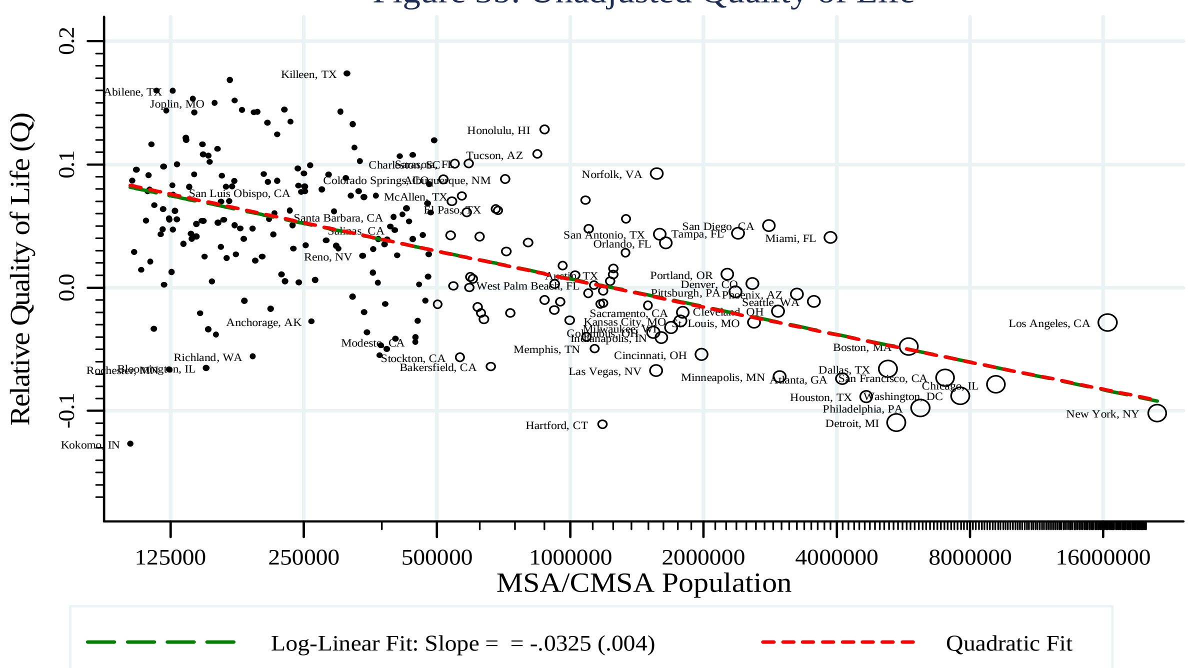


Figure 3b: Unadjusted Quality of Life



Appendix

A Additional Theoretical Details

A.1 Aggregation of Types

Assume there are two types of fully mobile households, referred to as "a" and "b," and that some members of each type lives in every city. The mobility conditions for each type of household are

$$e^a(p^a, w^a, \tau^a, u; Q^a) = 0 \tag{A.1a}$$
$$e^b(p^b, w^b, \tau^b, u; Q^b) = 0 \tag{A.1b}$$

A third equation is used to model production of the tradable good x, which has a unit price. Production is assumed to have constant returns to scale in labor, which can differ by household, together with capital and home-goods, which can be used as inputs. In equilibrium, because firms are mobile, the unit cost function for x must equal the price of x, which is one

$$c_X(w^a/A_X^a, w^b/A_X^b, p) = 1 \tag{A.2}$$

The terms A_X^a and A_X^b give the relative productivity of each worker type in the city. Log-linearizing equations (A.1a), (A.1b), and (A.2),

$$s_y^a\hat{p} - (1 - \tau^{a\prime})s_w^a\hat{w}^a = \hat{Q}^a \tag{A.3a}$$
$$s_y^b\hat{p} - (1 - \tau^{b\prime})s_w^b\hat{w}^b = \hat{Q}^b \tag{A.3b}$$
$$\theta_N^a\hat{w}^a + \theta_N^b\hat{w}^b + \theta_Y\hat{p} = \theta^a\hat{A}_X^a + \theta^b\hat{A}_X^b \equiv \hat{A}_X \tag{A.3c}$$

where θ is used to denote the cost-shares of each factor. This is similar to the models seen in Roback (1988) and Beeson (1991), although these authors assume that $s_w^a = s_w^b = 1$, and do not include taxes. Let the share of total income accruing to type a worker be $\mu^a = N^a m^a / \left(N^a m^a + N^b m^b\right)$, with the other share $\mu^b = 1 - \mu^a$, and define the following income-weighted averages

$$s_y = \mu^a s_y^a + \mu^b s_y^b \tag{A.4a}$$
$$\hat{Q} = \mu^a\hat{Q}^a + \mu^b\hat{Q}^b \tag{A.4b}$$

and let $s_x = 1 - s_y$.

A case worth considering is one where type-a households receive all of their income from wages, and type-b households receive all their income from capital and land. This approximates the situations of prime-age workers, whose incomes are fully tied to local-wage levels, and retirees, whose incomes are completely independent of local-wage levels. Thus $\mu^a = s_w = s_x\theta_N^a$ and $\mu^b = 1 - s_w = s_y + s_x\left(1 - \theta_N^a\right)$. In this situation, we expect a-types to sort into high-wage cities, and b-types into low-wage cities. Nevertheless, approximating around the average city where sorting effects are neutralized, (A.3a) and (A.3b) become

$$s_y^a \hat{p} - (1-\tau^{a\prime})\hat{w}^a = \hat{Q}^a$$
$$s_y^b \hat{p} = \hat{Q}^b$$

Averaging these two equations according to their shares of total income, s_w and $1 - s_w$, produces equation (3) in the main text. This result is more approximate in cities with prices and wages far from the average, where sorting is more of an issue. In high-wage cities labor income should be weighed more heavily, while in low-wage cities, non-labor income should be weighed more heavily.

An advantage of using income-weighted averages is that it produces sensible comparative statics results when considering the effect of differences in QOL and productivity for either household-type on wages and home-good prices. Ignoring taxes for expositional ease, solving the system reveals the wage differential for a type a household:

$$s_w^a \hat{w}^a = \frac{\mu^b}{s_R}\left(s_y^a \hat{Q}^b - s_y^b \hat{Q}^a\right) - \frac{s_x \theta_Y}{s_R}\hat{Q}^a + \frac{s_x}{s_R}s_y \hat{A}_X \tag{A.5}$$

where $s_R = s_y + s_x \theta_Y$. An analogous expression holds for $\hat{w}^b$. The term beginning with μ^b explains how a-type are paid less in cities with amenities they value, $\hat{Q}^a > 0$, but are paid more in cities with amenities that b-types value, $\hat{Q}^b > 0$. Both types are paid more in productive cities, $\hat{A}_X$, regardless of which type of labor is made more productive. The home-good and average wage differential, weighted by wage-income shares, aggregate neatly into:

$$\hat{p} = \frac{1}{s_R}\hat{Q} + \frac{s_x}{s_R}\hat{A}_X \tag{A.6}$$
$$\hat{w} \equiv \frac{1}{s_w}\left(s_w^a \mu^a \hat{w}^a + s_w^b \mu^b \hat{w}^b\right) = -\frac{\theta_Y}{\theta_N s_R}\hat{Q} + \frac{s_y s_x}{s_R}\hat{A}_X \tag{A.7}$$

A.2 Housing Deduction and State Taxes

Incorporating the home goods deduction requires amending some of the formulas in the main text. Modeling the income tax now as $\tau = \tau(m - \delta p y)$, where δ is a deduction applied to home-good expenditures, the mobility condition and the log-linearized budget constraint are given by

$$\hat{Q} = (1 + \delta\tau')\, s_y \hat{p} - \delta\tau' s_y \hat{y} - (1-\tau')\, s_w \hat{w} \tag{A.8}$$
$$s_x \hat{x} = -(1-\delta\tau')\, s_y \hat{p} - (1-\delta\tau')\, s_y \hat{y} + (1-\tau')\, s_w \hat{w}$$

where $s_x = x/m$. Adding these expressions

$$\hat{Q} + s_x \hat{x} = -s_y \hat{y}$$

Assuming homothetic preferences, $\hat{x} = \hat{y} + \sigma_D \hat{p}$, where σ_D is the elasticity of substitution between traded goods and home goods. The uncompensated elasticity is then $\eta^c = -s_x^* \sigma_D$, where $s_x^* =$

$s_x/(s_x+s_y)$ Substituting this in

$$\hat{y} = -(\hat{Q} + s_x\sigma_D\hat{p})/(s_x+s_y) = \eta^c\hat{p} - \frac{1}{s_x+s_y}\hat{Q}$$

Substituting back into (A.8) and using $s_y^* \equiv s_y/(s_x+s_y)$ we have the adjusted mobility condition in terms of wages and prices alone, used to estimate the quality-of-life.

$$\left(1-\delta\tau' s_y^*\right)\hat{Q} = \left[1-\delta\tau'\left(1+\eta^c\right)\right]s_y\hat{p} - \left(1-\tau'\right)s_w\hat{w} \tag{A.9}$$

State taxes are incorporated by including a second tax differential which depends on wage and housing-cost differences within state, so that the additional tax differential on labor income due to state taxes is given by $d\tau^s/m = \tau^s s_w \hat{w}^{js}$, where τ^s is the effective tax rate on labor income from state taxes and $\hat{w}^{js}$ is the within-state wage differential for city j in state s, equal to the wage differential for city j, $\hat{w}^j$, minus the wage differential for the entire state, $\hat{w}^s$, i.e., $\hat{w}^{js} = \hat{w}^j - \hat{w}^s$. A working assumption is that state income taxes are redistributed lump sum or spent on state-level public goods or publicly-provided private goods that are valued exactly at cost and uniformly by residents everywhere. For computational purposes it is easier to first compute the federal tax differentials by state and then to compute the additional differential within state due to state and federal taxes combined. Although the formulas for the tax differentials are fairly straightforward to derive once this insight is taken into account, taking into account the housing deduction makes them too long and unwieldy to present here. Those formulas are available upon request from the author.

The state tax rate on labor is calculated by combining state income taxes with sales taxes. The effective sales tax rate is equal to the statutory rate reduced by 10 percent to account for percent of non-housing expenditures that escape the tax (Feenberg et al. 1997). In states where food is exempt from sales taxes, this rate is reduced by another 8 percent, equal to the share of expenditures spent on groceries.

A.3 Functional Form and Aggregation over Incomes

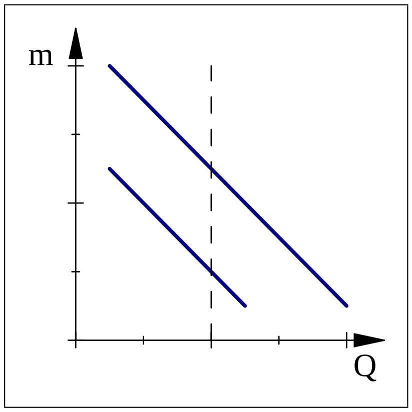
Assume that utility takes the following form with separable labor supply and σ_Q representing the elasticity of substitution between Q and the composite commodity $\phi(x,y)$, where ϕ is homothetic:

$$U(x,y;Q) = \left[\omega Q^{\frac{\sigma_Q-1}{\sigma_Q}} + \phi\left(x,y\right)^{\frac{\sigma_Q-1}{\sigma_Q}}\right]^{\frac{\sigma_Q}{\sigma_Q-1}}$$

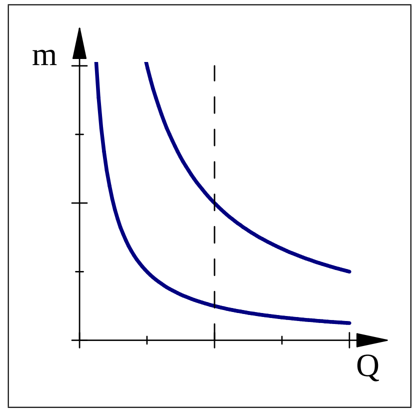
Then it is possible to show that

$$p_Q = \frac{\partial V/\partial Q}{\partial V/\partial m} = \frac{\omega}{\lambda}\left(\frac{m\lambda}{Q}\right)^{\frac{1}{\sigma_Q}}$$

where $\lambda =$ the marginal utility of consumption. In the case where quality-of-life and consumption are perfect substitutes, $\sigma_Q \to \infty$, then $p_Q = \omega/\lambda$, which is constant If instead, preferences are Cobb-Douglas, $\sigma_Q = 1$, then, $p_Q = \omega m/Q$, and $\hat{Q} = \omega \cdot dQ$. Indifference curves for the two cases are illustrated below



Perfect Substitutes



Cobb-Douglas

In the perfect substitutes case, the willingness to pay for quality-of-life remains constant with income. In the Cobb-Douglas case, the willingness to pay rises proportionally with income. It is this latter case which more consistent with the theoretical presentation and empirical evidence presented in the main text.

A.4 Second-Order Approximation of the Mobility Condition

The first-order approximation of QOL in equation (3) may be expanded into a second order approximation, given by

$$\hat{Q}^j = s_y \hat{p}^j \left[1 + \frac{1}{2} s_x \left(1 - \sigma_D\right) \hat{p}^j \right] - \left(1 - \tau'\right) s_w \hat{w}^j \left[1 - \frac{1}{2} \left(1 - s_w \left(1 - \varepsilon_{(1-\tau')}\right)\right) \hat{w}^j \right] \quad \text{(A.10)}$$

where $\varepsilon_{(1-\tau')}$ is the elasticity of the marginal net of tax rate $(1 - \tau')$ with respect to income, m, or

$$\varepsilon_{(1-\tau')} = \frac{d \ln \left(1 - \tau'\right)}{d \ln m} = \frac{-\tau''}{1 - \tau'} m$$

In a progressive tax system the marginal tax rate is increasing, so $\tau'' > 0$, implying that this elasticity should be negative. Equation (A.10) accounts for three phenomena. First, if $\sigma_D < 1$, then the home-good expenditure share, s_y, increases with $\hat{p}^j$, as the demand for home goods is inelastic. Second, because of progressivity, households who move to higher-wage areas pay a higher tax rate, reducing the net-of tax rate $(1 - \tau')$. Third, households in higher-wage areas derive a larger fraction of income from labor sources, seen in an increasing s_w.

The impact of using the second-order approximation is considered using parameter values of σ_D and $\varepsilon_{(1-\tau')}$ that lead to the largest plausible deviation from the first-order approximation. From the discussion in Section B below, a value of $\sigma_D = 0.5$ is close to the lower bound of plausible values. Estimates of $\varepsilon_{(1-\tau')}$ that I obtained using data from Piketty and Saez (2007) are small, with a value of $\varepsilon_{(1-\tau')} = -0.1$ being the furthest plausible value away from zero. Using these values, mobility conditions for $\hat{Q}^j$ levels of 0.1, 0, and -0.1 are plotted in Figure A1 using the first-order approximation, shown by the solid lines, and the second-order, shown by the dashed lines. Overall, the first and second-order approximations are similar. However, the second-order approximation suggests that the first-order QOL estimates may be slightly overestimated in low-wage and low-cost areas and slightly underestimated in high-wage and high-cost areas. Thus, using a second-order approximation would tend to improve QOL estimates in larger cities slightly, albeit not by much.

B Parameter Calibration

In summary, the following values are taken for the calibration

$$\begin{array}{lll} s_y = 0.36 & \tau' = 0.32 & s_w = 0.75 \\ \delta = 0.31 & s_x = 0.42 & \eta^c = -0.5 \end{array}$$

The parameters s_y , τ', and s_w are explained in Section 3. The remaining parameters are only needed to account for the housing deduction and are explained below.

B.1 Expenditure Share for Traded Goods

As mentioned in Section 3.1, 22 percent of income is spent on housing and 56 percent on other goods. Since the share spent on home goods is taken at 36 percent, and the two should still sum to 78 percent, the share of income spent on tradable goods, s_x, is calibrated at 42 percent.

B.2 Tax Deduction Level

Determining the deduction level requires taking into account the fact that many households do not itemize deductions. According to the Statistics on Income, although only 33 percent of tax returns itemize, they account for 67 percent of reported Adjusted Gross Income (AGI). Since the income-weighted share is what matters, 67 percent is multiplied by the effective tax reduction given in TAXSIM, in 2000 of 21.6 percent. Thus, on average these deductions reduce the effective price of eligible goods by 14.5 percent. Since eligible goods only include housing, this deduction applies to only 59 percent of home goods. Multiplying 14.5 percent times 59 percent gives an effective price reduction of 8.6 percent for home goods. Divided by a federal tax rate of 29.6 percent, this produces a federal deduction level of 29 percent.

At the state level, deductions for income taxes are calculated in an equivalent way using TAXSIM data. Furthermore, all housing expenditures are deducted from the sales tax. Overall this produces an effective deduction level of $\delta = 0.31$.

B.3 Compensated Elasticity of Housing Demand

The compensated elasticity of housing demand with respect to its price, η^c, is needed to determine the extent of indexation conferred through a home goods tax deduction. The Slutsky equation for the compensated price elasticity is $\eta^c = \eta + s_y^* \varepsilon_{y,m}$, where η is the uncompensated price elasticity and $\varepsilon_{y,m}$ is the income elasticity. There is a large literature devoted to trying to estimate these parameters, including Rosen (1985), Goodman and Kawai (1986), Goodman (1988) Ermisch et al. (1996), Goodman (2002), and Ionnides and Zabel (2003). The range of plausible estimates in this literature is large, with uncompensated price elasticities ranging from -1 to -0.3, and income elasticities from 1 to 0.4, implying compensated elasticities in the range of -0.25 to -0.75. QOL estimates are not highly affected by the choice of parameter within this range; a value of $\eta^c = -0.5$ is adopted here.

C Data and Estimation

C.1 Wage and Housing Cost Data

I use United States Census data from the 2000 Integrated Public-Use Microdata Series (IPUMS), from Ruggles et al. (2004), to calculate wage and housing price differentials. The wage differentials are calculated for workers ages 25 to 55, who report working at least 30 hours a week, 26 weeks a year. The MSA assigned to a worker is determined by their place of residence, rather than their place of work. The wage differential of an MSA is found by regressing log hourly wages on individual covariates and indicators for a worker's MSA of residence, using the coefficients on these MSA indicators. The covariates consist of

- 12 indicators of educational attainment;
- a quartic in potential experience, and potential experience interacted with years of education;
- 9 indicators of industry at the one-digit level (1950 classification);
- 9 indicators of employment at the one-digit level (1950 classification);
- 4 indicators of marital status (married, divorced, widowed, separated);
- an indicator for veteran status, and veteran status interacted with age;
- 5 indicators of minority status (Black, Hispanic, Asian, Native American, and other);
- an indicator of immigrant status, years since immigration, and immigrant status interacted with black, Hispanic, Asian, and other;
- 2 indicators for English proficiency (none or poor).

All covariates are interacted with gender.

I first run the regression using census-person weights. From the regressions a predicted wage is calculated using individual characteristics alone, controlling for MSA, to form a new weight equal to the predicted wage times the census-person weight. These new income-adjusted weights are needed since workers need to be weighted by their income share (see Appendix A.1). The new weights are then used in a second regression, which is used to calculate the city-wage differentials from the MSA indicator variables. In practice, this weighting procedure has only a small effect on the estimated wage differentials.

Housing-cost differentials are calculated using the logarithm of rents, whether they are reported gross rents or imputed rents derived from housing values. Only housing units moved into within the last 10 years are included in the sample to ensure that the price data are fairly accurate. The differential housing cost of an MSA is calculated in a manner similar to wages, except using a regression of the actual or imputed rent on a set of covariates at the unit level. The covariates for the adjusted differential are

- 9 indicators of building size;
- 9 indicators for the number of rooms, 5 indicators for the number of bedrooms, number of rooms interacted with number of bedrooms, and the number of household members per room;
- 2 indicators for lot size;
- 7 indicators for when the building was built;
- 2 indicators for complete plumbing and kitchen facilities;
- an indicator for commercial use;
- an indicator for condominium status (owned units only).

I first run a regression of housing values on housing characteristics and MSA indicator variables using only owner-occupied units, weighting by census-housing weights. A new value-adjusted weight is calculated by multiplying the census-housing weights by the predicted value from this first regression using housing characteristics alone, controlling for MSA. A second regression is run using these new weights for all units, rented and owner-occupied, on the housing characteristics fully interacted with tenure, along with the MSA indicators, which are not interacted. The house-price differentials are taken from the MSA indicator variables in this second regression. As with the wage differentials, this adjusted weighting method has only a small impact on the measured price differentials.

C.2 Comparing Housing Costs and Rents

In measuring housing costs, it is sensible to use both rental and owner-occupied units, since together these capture the housing costs of residents in a city. Nevertheless, across cities the ratio of housing prices to rents can vary substantially. Figure A2 graphs the housing-cost differentials used above, which are based on both actual rents and imputed rents of owner-occupied units, against actual rents. Across most cities, rent and housing-price differences are fairly similar, and so the two measures are fairly close. In cities with housing-cost differentials above 0.2, such as Boston, Los Angeles, New York, and San Francisco, these housing-cost differentials are significantly larger than rent differentials. Since housing prices should reflect the present value of the stream of future rents, this suggests that relative rents in these cities were expected to rise, although it is not clear whether rents were expected to rise because of improvements in QOL, improvements in the local job-market, or for other reasons.

Using only rent differentials would result in lower QOL estimates for these higher-cost cities. However, there are a number of problems with using only rent differentials. First, rent control in cities such as San Francisco and New York may artificially depress rents. Second, as seen in Figure A3, home-ownership rates decline significantly as price-to-rent ratios rise, which implies that the share of rental units in the sample is larger in high-price cities. Using both rental and owner-occupied units avoids the issue of having to deal with changes in the sample composition due to changes in the home-ownership rate. In order to avoid these problems, and to preserve comparability with QOL estimates in the existing measure, the traditional measure of housing costs is used in the analysis here.

C.3 Amenity Data

Heating and cooling degree days (Annual) Degree day data are used to estimate amounts of energy required to maintain comfortable indoor temperature levels. Daily values are computed from each days mean temperature (max + min/2). Daily heating degree days are equal to $\max\{0, 65 - meantemp\}$ and daily cooling degree days are $\max\{0, meantemp - 65\}$. Annual degree days are the sum of daily degree days over the year. The data here refer to averages from 1970 to 2000 (National Climactic Data Center 2008).

Sunshine Average percentage of possible. The total time that sunshine reaches the surface of the earth is expressed as the percentage of the maximum amount possible from sunrise to sunset with clear sky conditions. (National Climactic Data Center 2008).

Precipitation (Inches) The normal precipitation is the arithmetic mean for each month over the 30-year period, adjusted as necessary, and includes the liquid water equivalent of snowfall (National Climactic Data Center 2008).

Coastal proximity Equal to one if one or more counties in the MSA is adjacent to an ocean coast or great lake; zero otherwise. Coded by author.

Violent crimes (per capita) These consist of aggravated assaults, robbery, forcible rape, and murder (*City and County Data Book 2000*).

Air quality index (Median) An AQI value is calculated for each pollutant in an area (ground-level ozone, particle pollution, carbon monoxide, sulfur dioxide, and nitrogen dioxide). The highest AQI value for the individual pollutants is the AQI value for that day. An AQI over 300 is considered hazardous; under 50, good; values in between correspond to moderate, unhealthy, and very unhealthy (Environmental Protection Agency, 2008).

Bars and restaurants Number of establishments classified as eating and drinking places (NAICS 722) in *County Business Patterns 2000*.

Arts and Culture Index from *Places Rated Almanac* (Savageau 1999). Based on a ranking of cities, it ranges from 100 (New York, NY) to 0 (Houma, LA).

Sprawl index Percentage of land not developed in the square kilometer around an average residential development in each metropolitan area in 1992. Calculated by Burchfield et al. (2006)

Local government expenditures and taxes Taken from the *City and County Data Book 2000.*

Wharton Residential Land Use Regulatory Index an aggregate measure of regulatory constraint on development (Gyourko et al., forthcoming).

Federal spending differential Dollars in federal spending to MSA excluding wages, contracts, and transfers to non-workers. Expressed as a percentage of average income (Albouy 2008).

TABLE A1: LIST OF METROPOLITAN AND NON-METROPOLITAN AREAS BY ESTIMATED QUALITY OF LIFE

				Adjusted		Unadjusted	
Full Name of Metropolitan Area	Population Size	Wages	Housing Cost	Quality of Life	QOL Rank	Quality of Life	QOL Rank
Honolulu, HI MSA	876,156	-0.005	0.493	0.178	1	0.128	18
Santa Barbara--Santa Maria--Lompoc, CA MSA	399,347	0.109	0.665	0.176	2	0.057	90
Salinas, CA MSA	401,762	0.087	0.533	0.140	3	0.047	112
San Francisco--Oakland--San Jose, CA CMSA	7,039,362	0.260	0.746	0.132	4	-0.073	232
San Luis Obispo--Atascadero--Paso Robles, CA MSA	246,681	0.022	0.399	0.123	5	0.077	67
Santa Fe, NM MSA	147,635	-0.053	0.254	0.123	6	0.116	23
San Diego, CA MSA	2,813,833	0.060	0.441	0.120	7	0.050	105
non-metropolitan areas, HI	335,651	-0.022	0.287	0.114	.	0.094	.
Naples, FL MSA	251,377	-0.010	0.287	0.108	8	0.082	59
Barnstable--Yarmouth, MA MSA	162,582	0.004	0.295	0.098	9	0.070	76
non-metropolitan areas, CO	924,086	-0.057	0.172	0.090	.	0.100	.
Medford--Ashland, OR MSA	181,269	-0.126	0.072	0.090	10	0.144	9
Flagstaff, AZ--UT MSA	122,366	-0.131	0.053	0.085	11	0.144	10
Eugene--Springfield, OR MSA	322,959	-0.116	0.067	0.083	12	0.133	17
Sarasota--Bradenton, FL MSA	589,959	-0.073	0.112	0.079	13	0.101	34
Wilmington, NC MSA	233,450	-0.129	0.021	0.074	14	0.135	15
Los Angeles--Riverside--Orange County, CA CMSA	16,400,000	0.128	0.399	0.073	15	-0.028	205
Grand Junction, CO MSA	116,255	-0.174	-0.058	0.068	16	0.160	3
Fort Collins--Loveland, CO MSA	251,494	-0.049	0.115	0.066	17	0.078	66
Fort Walton Beach, FL MSA	170,498	-0.196	-0.108	0.064	18	0.169	2
Bellingham, WA MSA	166,814	-0.060	0.088	0.061	19	0.082	60
non-metropolitan areas, VT	608,387	-0.158	-0.068	0.061	.	0.141	.
Fort Myers--Cape Coral, FL MSA	440,888	-0.104	0.014	0.060	20	0.108	29
Portland, ME MSA	243,537	-0.071	0.045	0.060	21	0.083	57
Asheville, NC MSA	225,965	-0.160	-0.063	0.059	22	0.145	8
Madison, WI MSA	426,526	-0.039	0.099	0.057	23	0.064	79
Reno, NV MSA	339,486	0.024	0.198	0.057	24	0.026	145
Charleston--North Charleston, SC MSA	549,033	-0.098	0.012	0.056	25	0.101	35
Seattle--Tacoma--Bremerton, WA CMSA	3,554,760	0.081	0.277	0.056	26	-0.011	184
Punta Gorda, FL MSA	141,627	-0.163	-0.084	0.056	27	0.142	14
Charlottesville, VA MSA	159,576	-0.113	-0.003	0.056	28	0.113	26
non-metropolitan areas, OR	1,194,699	-0.125	-0.023	0.055	.	0.119	.
Tucson, AZ MSA	843,746	-0.109	-0.003	0.054	29	0.108	27
non-metropolitan areas, MT	774,080	-0.259	-0.240	0.054	.	0.199	.
Boston--Worcester--Lawrence, MA--NH--ME--CT CMSA	5,819,100	0.135	0.349	0.053	30	-0.048	219
Colorado Springs, CO MSA	516,929	-0.079	0.035	0.053	31	0.088	50
Albuquerque, NM MSA	712,738	-0.086	0.009	0.052	32	0.088	49
Miami--Fort Lauderdale, FL CMSA	3,876,380	-0.009	0.128	0.051	33	0.041	122
Denver--Boulder--Greeley, CO CMSA	2,581,506	0.048	0.204	0.049	34	0.003	169
Myrtle Beach, SC MSA	196,629	-0.173	-0.121	0.046	35	0.143	12
Portland--Salem, OR--WA CMSA	2,265,223	0.031	0.167	0.045	36	0.011	156
State College, PA MSA	135,758	-0.138	-0.073	0.044	37	0.120	21
Chico--Paradise, CA MSA	203,171	-0.086	0.024	0.043	38	0.092	43

TABLE A1: LIST OF METROPOLITAN AND NON-METROPOLITAN AREAS BY ESTIMATED QUALITY OF LIFE

				Adjusted		Unadjusted	
Full Name of Metropolitan Area	Population Size	Wages	Housing Cost	Quality of Life	QOL Rank	Quality of Life	QOL Rank
New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA	21,200,000	0.208	0.423	0.042	39	-0.102	238
non-metropolitan areas, CA	1,249,739	-0.025	0.103	0.041	.	0.051	.
non-metropolitan areas, RI	258,023	0.047	0.181	0.040	.	-0.002	.
Gainesville, FL MSA	217,955	-0.155	-0.121	0.038	40	0.124	19
Killeen--Temple, TX MSA	312,952	-0.231	-0.231	0.038	41	0.174	1
West Palm Beach--Boca Raton, FL MSA	1,131,184	0.035	0.146	0.035	42	0.002	173
Redding, CA MSA	163,256	-0.093	-0.010	0.034	43	0.091	47
Bryan--College Station, TX MSA	152,415	-0.132	-0.099	0.033	44	0.107	30
Iowa City, IA MSA	111,006	-0.091	-0.051	0.033	45	0.078	65
non-metropolitan areas, AZ	942,343	-0.159	-0.135	0.032	.	0.125	.
Austin--San Marcos, TX MSA	1,249,763	0.019	0.116	0.032	46	0.010	158
non-metropolitan areas, WA	1,063,531	-0.077	-0.021	0.031	.	0.072	.
Norfolk--Virginia Beach--Newport News, VA--NC MSA	1,569,541	-0.109	-0.067	0.031	47	0.092	42
Daytona Beach, FL MSA	493,175	-0.157	-0.148	0.030	48	0.120	22
Tallahassee, FL MSA	284,539	-0.113	-0.085	0.030	49	0.092	45
Fayetteville, NC MSA	302,963	-0.191	-0.191	0.029	50	0.143	11
Bloomington, IN MSA	120,563	-0.123	-0.097	0.028	51	0.098	38
Sacramento--Yolo, CA CMSA	1,796,857	0.066	0.183	0.026	52	-0.020	196
Anchorage, AK MSA	260,283	0.073	0.184	0.026	53	-0.027	204
Panama City, FL MSA	148,217	-0.143	-0.141	0.025	54	0.108	28
Las Cruces, NM MSA	174,682	-0.212	-0.240	0.025	55	0.152	6
Savannah, GA MSA	293,000	-0.069	-0.028	0.025	56	0.062	85
Fort Pierce--Port St. Lucie, FL MSA	319,426	-0.092	-0.070	0.024	57	0.075	69
Salt Lake City--Ogden, UT MSA	1,333,914	-0.024	0.018	0.021	58	0.028	141
Phoenix--Mesa, AZ MSA	3,251,876	0.029	0.096	0.021	59	-0.005	179
non-metropolitan areas, MA	569,691	0.010	0.084	0.020	.	0.011	.
Lincoln, NE MSA	250,291	-0.130	-0.148	0.019	60	0.093	41
Athens, GA MSA	153,444	-0.136	-0.137	0.019	61	0.102	33
Columbia, MO MSA	135,454	-0.171	-0.200	0.019	62	0.122	20
non-metropolitan areas, ME	1,033,664	-0.181	-0.226	0.016	.	0.125	.
non-metropolitan areas, NH	1,011,597	-0.018	0.018	0.016	.	0.022	.
New Orleans, LA MSA	1,337,726	-0.073	-0.068	0.016	63	0.056	92
non-metropolitan areas, FL	1,222,532	-0.173	-0.215	0.014	.	0.119	.
Raleigh--Durham--Chapel Hill, NC MSA	1,187,941	0.015	0.049	0.014	64	-0.003	176
Orlando, FL MSA	1,644,561	-0.044	-0.029	0.014	65	0.036	130
Tampa--St. Petersburg--Clearwater, FL MSA	2,395,997	-0.058	-0.054	0.012	66	0.044	113
Provo--Orem, UT MSA	368,536	-0.051	-0.046	0.012	67	0.039	125
Pensacola, FL MSA	412,153	-0.157	-0.201	0.011	68	0.106	31
Abilene, TX MSA	126,555	-0.239	-0.318	0.011	69	0.160	4
Chicago--Gary--Kenosha, IL--IN--WI CMSA	9,157,540	0.133	0.219	0.010	70	-0.079	234
non-metropolitan areas, UT	531,967	-0.128	-0.158	0.010	.	0.089	.
Wichita Falls, TX MSA	140,518	-0.231	-0.310	0.009	71	0.153	5
Clarksville--Hopkinsville, TN--KY MSA	207,033	-0.204	-0.281	0.007	72	0.134	16

TABLE A1: LIST OF METROPOLITAN AND NON-METROPOLITAN AREAS BY ESTIMATED QUALITY OF LIFE

				Adjusted		Unadjusted	
Full Name of Metropolitan Area	Population Size	Wages	Housing Cost	Quality of Life	QOL Rank	Quality of Life	QOL Rank
Boise City, ID MSA	432,345	-0.082	-0.114	0.007	73	0.054	100
non-metropolitan areas, AK	367,124	0.051	0.095	0.006	.	-0.028	.
Sioux Falls, SD MSA	172,412	-0.127	-0.181	0.006	74	0.082	58
Jacksonville, FL MSA	1,100,491	-0.070	-0.091	0.006	75	0.048	109
Fayetteville--Springdale--Rogers, AR MSA	311,121	-0.141	-0.208	0.004	76	0.089	48
Laredo, TX MSA	193,117	-0.220	-0.311	0.004	77	0.142	13
non-metropolitan areas, WY	493,849	-0.183	-0.270	0.002	.	0.115	.
Melbourne--Titusville--Palm Bay, FL MSA	476,230	-0.107	-0.153	0.002	78	0.068	77
Montgomery, AL MSA	333,055	-0.124	-0.183	0.001	79	0.078	64
non-metropolitan areas, ID	863,855	-0.170	-0.252	0.001	.	0.107	.
non-metropolitan areas, DE	158,149	-0.078	-0.110	0.000	.	0.051	.
Cedar Rapids, IA MSA	191,701	-0.080	-0.127	0.000	80	0.048	108
Billings, MT MSA	129,352	-0.164	-0.256	0.000	81	0.100	36
non-metropolitan areas, NM	783,050	-0.211	-0.312	-0.001	.	0.133	.
Little Rock--North Little Rock, AR MSA	583,845	-0.105	-0.174	-0.002	82	0.061	86
Nashville, TN MSA	1,231,311	-0.013	-0.030	-0.002	83	0.005	166
Spokane, WA MSA	417,939	-0.095	-0.144	-0.003	84	0.059	89
Springfield, MO MSA	325,721	-0.182	-0.276	-0.003	85	0.114	25
Lubbock, TX MSA	242,628	-0.157	-0.239	-0.004	86	0.097	39
Columbia, SC MSA	536,691	-0.074	-0.127	-0.004	87	0.042	119
Milwaukee--Racine, WI CMSA	1,689,572	0.042	0.038	-0.004	88	-0.032	207
La Crosse, WI--MN MSA	126,838	-0.123	-0.190	-0.005	89	0.075	68
Oklahoma City, OK MSA	1,083,346	-0.123	-0.210	-0.005	90	0.071	73
Amarillo, TX MSA	217,858	-0.143	-0.224	-0.005	91	0.087	52
Lexington, KY MSA	479,198	-0.053	-0.103	-0.006	92	0.027	142
Goldsboro, NC MSA	113,329	-0.188	-0.286	-0.006	93	0.116	24
Yuma, AZ MSA	160,026	-0.090	-0.149	-0.007	94	0.053	101
Charlotte--Gastonia--Rock Hill, NC--SC MSA	1,499,293	0.010	-0.018	-0.007	95	-0.014	190
Champaign--Urbana, IL MSA	179,669	-0.080	-0.130	-0.008	96	0.048	107
Hickory--Morganton--Lenoir, NC MSA	341,851	-0.125	-0.204	-0.008	97	0.074	72
Washington--Baltimore, DC--MD--VA--WV CMSA	7,608,070	0.129	0.165	-0.008	98	-0.088	235
Lafayette, IN MSA	182,821	-0.072	-0.129	-0.009	99	0.039	124
Stockton--Lodi, CA MSA	563,598	0.083	0.107	-0.009	100	-0.057	225
Green Bay, WI MSA	226,778	-0.021	-0.062	-0.009	101	0.005	164
Ocala, FL MSA	258,916	-0.168	-0.274	-0.009	102	0.099	37
Biloxi--Gulfport--Pascagoula, MS MSA	363,988	-0.132	-0.230	-0.009	103	0.075	70
Columbus, GA--AL MSA	274,624	-0.133	-0.213	-0.009	104	0.080	62
Pueblo, CO MSA	141,472	-0.153	-0.246	-0.009	105	0.092	44
Omaha, NE--IA MSA	716,998	-0.064	-0.140	-0.009	106	0.029	139
Providence--Fall River--Warwick, RI--MA MSA	1,188,613	0.011	-0.006	-0.009	107	-0.013	186
Yuba City, CA MSA	139,149	-0.069	-0.100	-0.010	108	0.044	114
Tuscaloosa, AL MSA	164,875	-0.100	-0.180	-0.010	109	0.055	95
Des Moines, IA MSA	456,022	-0.021	-0.074	-0.010	110	0.003	171

TABLE A1: LIST OF METROPOLITAN AND NON-METROPOLITAN AREAS BY ESTIMATED QUALITY OF LIFE

				Adjusted		Unadjusted	
Full Name of Metropolitan Area	Population Size	Wages	Housing Cost	Quality of Life	QOL Rank	Quality of Life	QOL Rank
non-metropolitan areas, NC	2,632,956	-0.148	-0.242	-0.010	.	0.088	.
Springfield, MA MSA	591,932	-0.005	-0.022	-0.010	111	0.000	175
non-metropolitan areas, NV	285,196	0.008	-0.013	-0.010	.	-0.012	.
Knoxville, TN MSA	687,249	-0.112	-0.197	-0.010	112	0.063	82
non-metropolitan areas, SD	629,811	-0.267	-0.435	-0.011	.	0.158	.
non-metropolitan areas, CT	1,350,818	0.108	0.136	-0.012	.	-0.074	.
Mobile, AL MSA	540,258	-0.125	-0.221	-0.012	113	0.070	75
Yakima, WA MSA	222,581	-0.030	-0.076	-0.012	114	0.011	157
Fargo--Moorhead, ND--MN MSA	174,367	-0.157	-0.280	-0.013	115	0.087	53
Dover, DE MSA	126,697	-0.088	-0.163	-0.014	116	0.047	111
Tulsa, OK MSA	803,235	-0.082	-0.180	-0.015	117	0.037	129
Cleveland--Akron, OH CMSA	2,945,831	0.010	-0.037	-0.017	118	-0.019	194
Joplin, MO MSA	157,322	-0.254	-0.418	-0.018	119	0.150	7
Tyler, TX MSA	174,706	-0.100	-0.198	-0.018	120	0.051	104
Lakeland--Winter Haven, FL MSA	483,924	-0.118	-0.229	-0.019	121	0.061	87
Fresno, CA MSA	922,516	-0.017	-0.057	-0.019	122	0.003	170
Greensboro--Winston-Salem--High Point, NC MSA	1,251,509	-0.048	-0.130	-0.019	123	0.015	152
San Antonio, TX MSA	1,592,383	-0.090	-0.187	-0.019	124	0.043	115
Modesto, CA MSA	446,997	0.053	0.034	-0.020	125	-0.044	217
Minneapolis--St. Paul, MN--WI MSA	2,968,806	0.086	0.055	-0.020	126	-0.072	231
Louisville, KY--IN MSA	1,025,598	-0.042	-0.128	-0.021	127	0.010	159
Auburn--Opelika, AL MSA	115,092	-0.130	-0.253	-0.021	128	0.067	78
Las Vegas, NV--AZ MSA	1,563,282	0.084	0.066	-0.021	129	-0.067	230
Lancaster, PA MSA	470,658	-0.008	-0.074	-0.021	130	-0.011	182
Jackson, MS MSA	440,801	-0.093	-0.212	-0.022	131	0.039	126
Roanoke, VA MSA	235,932	-0.103	-0.209	-0.022	132	0.051	103
Greenville--Spartanburg--Anderson, SC MSA	962,441	-0.056	-0.155	-0.022	133	0.018	151
Appleton--Oshkosh--Neenah, WI MSA	358,365	-0.046	-0.133	-0.022	134	0.012	155
Corpus Christi, TX MSA	380,783	-0.081	-0.182	-0.022	135	0.035	132
Topeka, KS MSA	169,871	-0.138	-0.273	-0.023	136	0.070	74
Waterloo--Cedar Falls, IA MSA	128,012	-0.128	-0.261	-0.023	137	0.062	84
Glens Falls, NY MSA	124,345	-0.104	-0.197	-0.024	138	0.055	96
Chattanooga, TN--GA MSA	465,161	-0.094	-0.207	-0.024	139	0.043	118
Albany--Schenectady--Troy, NY MSA	875,583	-0.005	-0.062	-0.024	140	-0.010	181
non-metropolitan areas, SC	1,616,255	-0.129	-0.259	-0.024	.	0.064	.
Davenport--Moline--Rock Island, IA--IL MSA	359,062	-0.077	-0.184	-0.024	141	0.031	138
Johnson City--Kingsport--Bristol, TN--VA MSA	480,091	-0.161	-0.310	-0.025	142	0.084	55
Greenville, NC MSA	133,798	-0.086	-0.202	-0.026	143	0.036	131
Rocky Mount, NC MSA	143,026	-0.111	-0.238	-0.027	144	0.052	102
Fort Smith, AR--OK MSA	207,290	-0.169	-0.334	-0.027	145	0.086	54
Sheboygan, WI MSA	112,646	-0.064	-0.172	-0.027	146	0.021	150
Columbus, OH MSA	1,540,157	0.024	-0.047	-0.027	147	-0.036	210
Hartford, CT MSA	1,183,110	0.148	0.146	-0.028	148	-0.111	240

TABLE A1: LIST OF METROPOLITAN AND NON-METROPOLITAN AREAS BY ESTIMATED QUALITY OF LIFE

				Adjusted		Unadjusted	
Full Name of Metropolitan Area	Population Size	Wages	Housing Cost	Quality of Life	QOL Rank	Quality of Life	QOL Rank
Baton Rouge, LA MSA	602,894	-0.045	-0.152	-0.028	149	0.007	162
Rochester, NY MSA	1,098,201	-0.018	-0.091	-0.028	150	-0.005	178
non-metropolitan areas, NY	1,744,930	-0.109	-0.217	-0.028	.	0.055	.
Hattiesburg, MS MSA	111,674	-0.178	-0.346	-0.028	151	0.091	46
Benton Harbor, MI MSA	162,453	-0.080	-0.187	-0.029	152	0.033	135
Sioux City, IA--NE MSA	124,130	-0.124	-0.271	-0.029	153	0.056	91
Kansas City, MO--KS MSA	1,776,062	0.003	-0.094	-0.030	154	-0.027	202
St. Joseph, MO MSA	102,490	-0.171	-0.335	-0.030	155	0.087	51
non-metropolitan areas, KS	1,366,517	-0.223	-0.410	-0.030	.	0.121	.
Sumter, SC MSA	104,646	-0.183	-0.350	-0.030	156	0.096	40
Evansville--Henderson, IN--KY MSA	296,195	-0.087	-0.212	-0.030	157	0.034	134
Allentown--Bethlehem--Easton, PA MSA	637,958	0.005	-0.081	-0.030	158	-0.026	200
non-metropolitan areas, MO	1,798,819	-0.251	-0.451	-0.031	.	0.139	.
Eau Claire, WI MSA	148,337	-0.119	-0.258	-0.031	159	0.054	99
Dallas--Fort Worth, TX CMSA	5,221,801	0.068	0.009	-0.031	160	-0.066	228
Merced, CA MSA	210,554	0.000	-0.070	-0.032	161	-0.017	192
Alexandria, LA MSA	126,337	-0.167	-0.336	-0.032	162	0.083	56
Birmingham, AL MSA	921,106	-0.011	-0.117	-0.032	163	-0.018	193
non-metropolitan areas, NE	878,760	-0.243	-0.451	-0.032	.	0.131	.
Atlanta, GA MSA	4,112,198	0.078	0.016	-0.032	164	-0.074	233
Canton--Massillon, OH MSA	406,934	-0.076	-0.199	-0.032	165	0.026	144
Shreveport--Bossier City, LA MSA	392,302	-0.116	-0.266	-0.033	166	0.050	106
Monroe, LA MSA	147,250	-0.123	-0.277	-0.033	167	0.054	98
Visalia--Tulare--Porterville, CA MSA	368,021	-0.034	-0.118	-0.033	168	0.004	168
Richmond--Petersburg, VA MSA	996,512	0.004	-0.088	-0.033	169	-0.026	201
St. Louis, MO--IL MSA	2,603,607	0.005	-0.094	-0.033	170	-0.028	206
non-metropolitan areas, MD	666,998	-0.021	-0.111	-0.033	.	-0.007	.
non-metropolitan areas, WI	1,866,585	-0.111	-0.253	-0.033	.	0.047	.
Dayton--Springfield, OH MSA	950,558	-0.019	-0.124	-0.033	171	-0.012	185
Lafayette, LA MSA	385,647	-0.101	-0.249	-0.034	172	0.039	127
Springfield, IL MSA	201,437	-0.074	-0.194	-0.034	173	0.025	147
Detroit--Ann Arbor--Flint, MI CMSA	5,456,428	0.132	0.089	-0.035	174	-0.109	239
Scranton--Wilkes-Barre--Hazleton, PA MSA	624,776	-0.103	-0.247	-0.035	175	0.041	121
Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA	6,188,463	0.115	0.068	-0.035	176	-0.098	237
Harrisburg--Lebanon--Carlisle, PA MSA	629,401	-0.008	-0.114	-0.035	177	-0.020	197
non-metropolitan areas, VA	1,640,567	-0.158	-0.322	-0.035	.	0.077	.
non-metropolitan areas, AR	1,607,993	-0.226	-0.437	-0.036	.	0.116	.
El Paso, TX MSA	679,622	-0.141	-0.308	-0.036	178	0.064	81
non-metropolitan areas, IA	1,863,270	-0.181	-0.374	-0.037	.	0.087	.
Lynchburg, VA MSA	214,911	-0.135	-0.297	-0.038	179	0.060	88
Indianapolis, IN MSA	1,607,486	0.018	-0.090	-0.040	180	-0.040	215
Cincinnati--Hamilton, OH--KY--IN CMSA	1,979,202	0.038	-0.064	-0.040	181	-0.054	222
Longview--Marshall, TX MSA	208,780	-0.132	-0.306	-0.040	182	0.055	93

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				Adjusted		Unadjusted	
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Waco, TX MSA	213,517	-0.113	-0.278	-0.040	183	0.043	117
Muncie, IN MSA	118,769	-0.112	-0.275	-0.040	184	0.043	116
Pittsburgh, PA MSA	2,358,695	-0.039	-0.172	-0.040	185	-0.003	177
Williamsport, PA MSA	120,044	-0.119	-0.288	-0.042	186	0.047	110
Erie, PA MSA	280,843	-0.106	-0.269	-0.042	187	0.038	128
Sharon, PA MSA	120,293	-0.145	-0.326	-0.042	188	0.064	80
Toledo, OH MSA	618,203	-0.023	-0.153	-0.042	189	-0.016	191
Dothan, AL MSA	137,916	-0.177	-0.381	-0.042	190	0.082	61
York, PA MSA	381,751	-0.027	-0.162	-0.043	191	-0.013	187
non-metropolitan areas, OK	1,862,951	-0.241	-0.479	-0.043	.	0.121	.
non-metropolitan areas, TN	2,123,330	-0.181	-0.393	-0.044	.	0.083	.
non-metropolitan areas, GA	2,744,802	-0.124	-0.303	-0.046	.	0.048	.
South Bend, IN MSA	265,559	-0.061	-0.219	-0.046	192	0.006	163
Memphis, TN--AR--MS MSA	1,135,614	0.023	-0.105	-0.046	193	-0.049	220
non-metropolitan areas, ND	521,239	-0.245	-0.502	-0.047	.	0.119	.
Janesville--Beloit, WI MSA	152,307	-0.004	-0.151	-0.049	194	-0.034	209
Lansing--East Lansing, MI MSA	447,728	0.010	-0.119	-0.049	195	-0.040	214
Grand Rapids--Muskegon--Holland, MI MSA	1,088,514	0.010	-0.121	-0.049	196	-0.040	213
non-metropolitan areas, TX	4,030,376	-0.183	-0.407	-0.049	.	0.081	.
Wichita, KS MSA	545,220	-0.063	-0.245	-0.050	197	0.001	174
Buffalo--Niagara Falls, NY MSA	1,170,111	-0.029	-0.170	-0.051	198	-0.013	188
Wausau, WI MSA	125,834	-0.077	-0.257	-0.051	199	0.013	154
Augusta--Aiken, GA--SC MSA	477,441	-0.071	-0.249	-0.051	200	0.009	160
Florence, AL MSA	142,950	-0.125	-0.335	-0.052	201	0.041	120
Jackson, TN MSA	107,377	-0.083	-0.273	-0.052	202	0.014	153
Brownsville--Harlingen--San Benito, TX MSA	335,227	-0.220	-0.470	-0.053	203	0.103	32
Richland--Kennewick--Pasco, WA MSA	191,822	0.030	-0.105	-0.053	204	-0.056	224
Houma, LA MSA	194,477	-0.096	-0.296	-0.053	205	0.022	149
Anniston, AL MSA	112,249	-0.186	-0.427	-0.054	206	0.080	63
Mansfield, OH MSA	175,818	-0.102	-0.299	-0.055	207	0.027	143
non-metropolitan areas, MN	1,565,030	-0.150	-0.365	-0.056	.	0.058	.
Binghamton, NY MSA	252,320	-0.108	-0.295	-0.057	208	0.034	133
non-metropolitan areas, MI	2,178,963	-0.071	-0.254	-0.057	.	0.008	.
Altoona, PA MSA	129,144	-0.148	-0.372	-0.057	209	0.055	94
St. Cloud, MN MSA	167,392	-0.099	-0.300	-0.058	210	0.024	148
Kalamazoo--Battle Creek, MI MSA	452,851	-0.019	-0.186	-0.058	211	-0.027	203
Youngstown--Warren, OH MSA	594,746	-0.077	-0.274	-0.058	212	0.009	161
Reading, PA MSA	373,638	0.006	-0.161	-0.060	213	-0.047	218
Huntsville, AL MSA	342,376	-0.039	-0.234	-0.060	214	-0.020	195
Odessa--Midland, TX MSA	237,132	-0.117	-0.343	-0.061	215	0.032	137
Houston--Galveston--Brazoria, TX CMSA	4,669,571	0.069	-0.075	-0.062	216	-0.088	236
non-metropolitan areas, PA	2,023,193	-0.128	-0.360	-0.063	.	0.038	.
non-metropolitan areas, IN	1,791,003	-0.095	-0.317	-0.063	.	0.016	.

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				Adjusted		Unadjusted	
Full Name of Metropolitan Area	Population Size	Wages	Housing Cost	Quality of Life	QOL Rank	Quality of Life	QOL Rank
non-metropolitan areas, WV	1,809,034	-0.175	-0.444	-0.064	.	0.064	.
Fort Wayne, IN MSA	502,141	-0.050	-0.255	-0.064	217	-0.014	189
Danville, VA MSA	110,156	-0.154	-0.400	-0.065	218	0.054	97
Macon, GA MSA	322,549	-0.060	-0.267	-0.065	219	-0.007	180
non-metropolitan areas, OH	2,548,986	-0.099	-0.323	-0.065	.	0.018	.
Utica--Rome, NY MSA	299,896	-0.115	-0.333	-0.067	220	0.032	136
Lake Charles, LA MSA	183,577	-0.061	-0.287	-0.068	221	-0.011	183
Rochester, MN MSA	124,277	0.027	-0.159	-0.068	222	-0.066	229
non-metropolitan areas, IL	2,202,549	-0.131	-0.369	-0.068	.	0.038	.
non-metropolitan areas, LA	1,415,540	-0.152	-0.420	-0.069	.	0.047	.
Syracuse, NY MSA	732,117	-0.038	-0.235	-0.069	223	-0.021	198
Albany, GA MSA	120,822	-0.079	-0.307	-0.069	224	0.002	172
Bloomington--Normal, IL MSA	150,433	0.027	-0.152	-0.069	225	-0.065	227
Terre Haute, IN MSA	149,192	-0.117	-0.367	-0.070	226	0.025	146
Peoria--Pekin, IL MSA	347,387	-0.019	-0.220	-0.071	227	-0.036	211
Bakersfield, CA MSA	661,645	0.029	-0.141	-0.071	228	-0.064	226
Saginaw--Bay City--Midland, MI MSA	403,070	-0.012	-0.214	-0.071	229	-0.041	216
Lima, OH MSA	155,084	-0.087	-0.326	-0.072	230	0.005	165
Duluth--Superior, MN--WI MSA	243,815	-0.085	-0.323	-0.073	231	0.004	167
non-metropolitan areas, MS	1,869,256	-0.196	-0.496	-0.073	.	0.072	.
non-metropolitan areas, KY	2,828,647	-0.154	-0.432	-0.073	.	0.046	.
Jackson, MI MSA	158,422	-0.019	-0.227	-0.073	232	-0.038	212
Rockford, IL MSA	371,236	0.005	-0.202	-0.076	233	-0.055	223
Johnstown, PA MSA	232,621	-0.180	-0.470	-0.076	234	0.063	83
Jamestown, NY MSA	139,750	-0.138	-0.395	-0.077	235	0.040	123
Decatur, AL MSA	145,867	-0.057	-0.313	-0.078	236	-0.021	199
non-metropolitan areas, AL	1,504,381	-0.166	-0.469	-0.079	.	0.049	.
Gadsden, AL MSA	103,459	-0.135	-0.426	-0.079	237	0.029	140
McAllen--Edinburg--Mission, TX MSA	569,463	-0.211	-0.548	-0.085	238	0.074	71
Decatur, IL MSA	114,706	-0.052	-0.344	-0.098	239	-0.033	208
Beaumont--Port Arthur, TX MSA	385,090	-0.036	-0.343	-0.102	240	-0.050	221
Kokomo, IN MSA	101,541	0.067	-0.239	-0.117	241	-0.127	241

Populations in non-metropolitan areas are approximate.

TABLE A2: LIST OF STATES BY ESTIMATED QUALITY OF LIFE

State	Population	Wages	Housing Cost	Adjusted Quality of Life	Adjusted QOL Rank	Unadjusted Quality of Life	Unadjusted QOL Rank
Hawaii	1,211,717	-0.010	0.431	0.159	1	0.118	5
California	33,884,660	0.134	0.435	0.083	2	-0.025	40
Vermont	608,387	-0.158	-0.068	0.061	3	0.141	3
Colorado	4,300,832	-0.007	0.157	0.060	4	0.046	22
Oregon	3,424,928	-0.042	0.089	0.054	5	0.064	15
Montana	902,740	-0.246	-0.242	0.047	6	0.186	1
Massachusetts	6,353,449	0.103	0.277	0.043	7	-0.034	42
Washington	5,894,780	0.030	0.165	0.043	8	0.011	31
New Mexico	1,818,615	-0.144	-0.119	0.035	9	0.114	8
Arizona	5,133,711	-0.030	0.036	0.029	10	0.039	26
Florida	15,986,890	-0.065	-0.019	0.028	11	0.060	18
New Jersey	8,416,753	0.189	0.350	0.023	12	-0.101	50
Maine	1,275,357	-0.166	-0.188	0.022	13	0.119	4
New Hampshire	1,234,816	0.003	0.062	0.021	14	0.013	30
Utah	2,230,835	-0.061	-0.047	0.016	15	0.049	20
Alaska	626,187	0.059	0.127	0.013	16	-0.027	41
New York	18,976,061	0.093	0.166	0.009	17	-0.052	46
Rhode island	1,048,463	0.022	0.048	0.006	18	-0.010	35
Connecticut	3,408,068	0.153	0.244	0.005	19	-0.092	49
Idaho	1,294,016	-0.143	-0.209	0.003	20	0.091	12
Wyoming	493,849	-0.183	-0.270	0.002	21	0.115	6
North Carolina	8,047,735	-0.073	-0.115	-0.002	22	0.044	23
Nevada	2,000,306	0.061	0.079	-0.005	23	-0.041	43
South Dakota	753,887	-0.249	-0.402	-0.009	24	0.148	2
Virginia	7,080,588	-0.016	-0.051	-0.009	25	0.004	32
South Carolina	4,013,644	-0.099	-0.177	-0.010	26	0.054	19
District of Columbia	571,753	0.129	0.165	-0.011	.	-0.088	.
Maryland	5,299,635	0.109	0.129	-0.013	27	-0.077	48
Wisconsin	5,357,182	-0.054	-0.133	-0.018	28	0.021	29
Illinois	12,417,190	0.045	0.013	-0.020	29	-0.042	44
Nebraska	1,709,804	-0.181	-0.329	-0.020	30	0.099	10
Arkansas	2,672,286	-0.186	-0.346	-0.023	31	0.099	9
Delaware	783,216	0.046	-0.002	-0.026	32	-0.047	45
Missouri	5,595,490	-0.110	-0.245	-0.028	33	0.049	21
Iowa	2,923,345	-0.146	-0.300	-0.028	34	0.071	13
Tennessee	5,688,335	-0.100	-0.231	-0.028	35	0.042	24
Oklahoma	3,450,058	-0.186	-0.365	-0.030	36	0.095	11
Louisiana	4,469,586	-0.105	-0.251	-0.033	37	0.042	25
Kansas	2,687,110	-0.138	-0.301	-0.033	38	0.062	17
Georgia	8,186,187	-0.015	-0.125	-0.036	39	-0.016	39
Texas	20,848,171	-0.034	-0.155	-0.037	40	-0.005	33
Ohio	11,353,531	-0.024	-0.148	-0.039	41	-0.012	36
Minnesota	4,912,048	-0.024	-0.147	-0.039	42	-0.013	38
North Dakota	642,412	-0.230	-0.464	-0.041	43	0.114	7
Pennsylvania	12,275,624	-0.027	-0.161	-0.043	44	-0.013	37
Indiana	6,081,521	-0.039	-0.185	-0.045	45	-0.007	34
Michigan	9,935,711	0.033	-0.080	-0.046	46	-0.054	47
Alabama	4,446,543	-0.112	-0.309	-0.050	47	0.035	27
Kentucky	4,040,856	-0.110	-0.321	-0.055	48	0.030	28
Mississippi	2,844,004	-0.164	-0.403	-0.055	49	0.063	16
West Virginia	1,809,034	-0.175	-0.444	-0.064	50	0.064	14

TABLE A3: DESCRIPTIVE STATISTICS ON INDIVIDUAL AMENITIES FOR CITIES

	Observations	Mean	Std Dev	Min	Max
Heating-Degree Days (1000s)	239	4.221	2.039	0.173	9.687
Cooling-Degree Days (1000s)	239	1.344	0.948	0.059	4.218
Sunshine (fraction possible)	232	0.606	0.086	0.410	0.900
Precipitation (10s of inches)	239	3.920	1.321	0.399	6.637
Proximity to Coast (salt or fresh water)	241	0.592	0.493	0.000	1.000
Violent Crimes per Capita	241	0.005	0.002	0.000	0.011
Median Air Quality Index (/100)	224	0.495	0.127	0.040	0.970
Restaurants and Bars per Capita	239	1.426	0.276	0.655	4.030
Places Rated Arts & Culture Index (/100)	240	0.815	0.241	0.000	1.000
Residential Land Use Regulatory Index	213	0.251	0.682	-1.677	4.103
Sprawl Index (/10)	239	4.00	0.99	2.07	7.33
Local Expenditures net of Local Taxes	241	0.000	0.159	-0.743	0.609
Federal Spending Differential	241	-0.002	0.009	-0.030	0.054

Figure A1: Linear vs Quadratic Approximation of Quality of Life

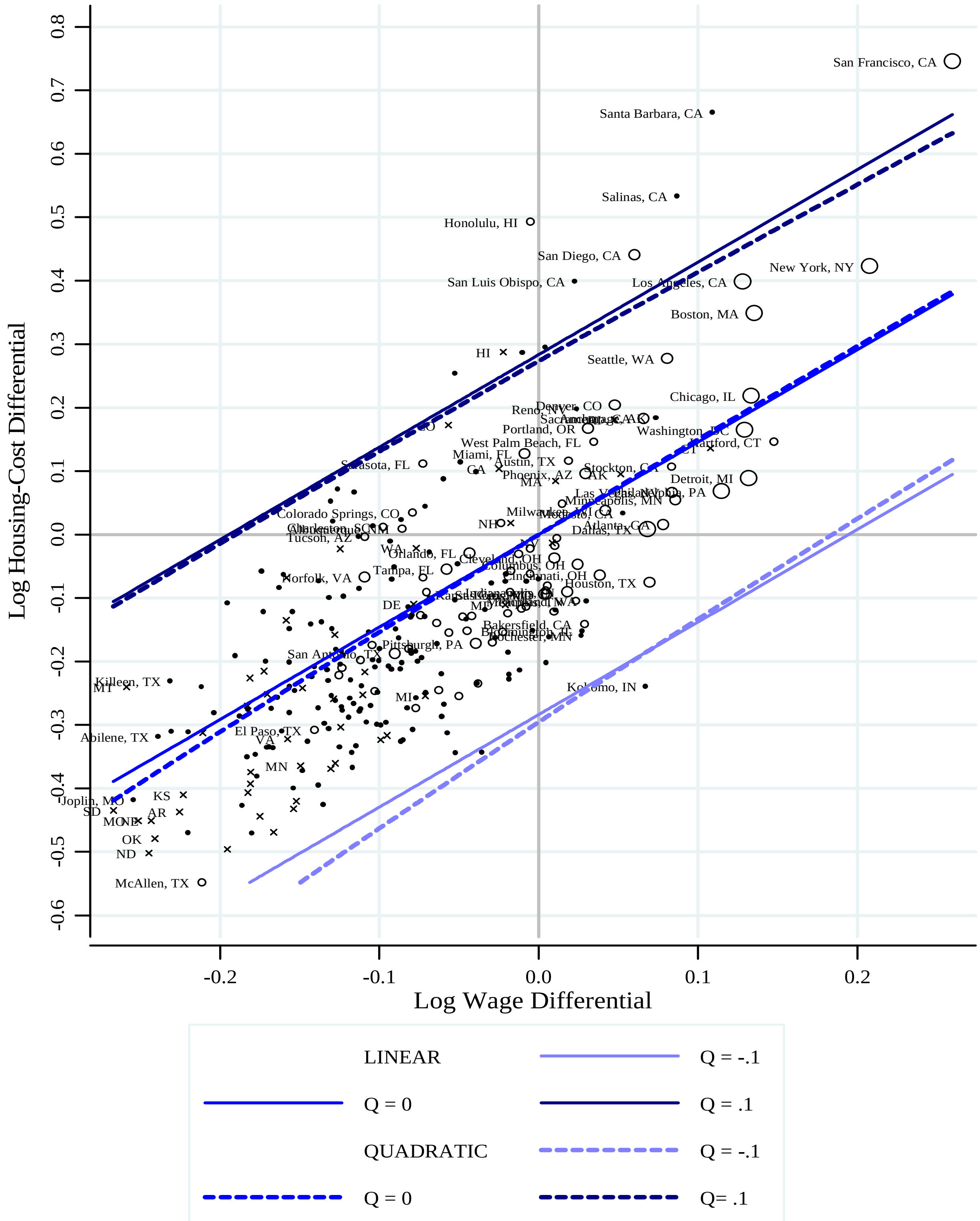

Table A2: Housing-Cost Measure versus Rent

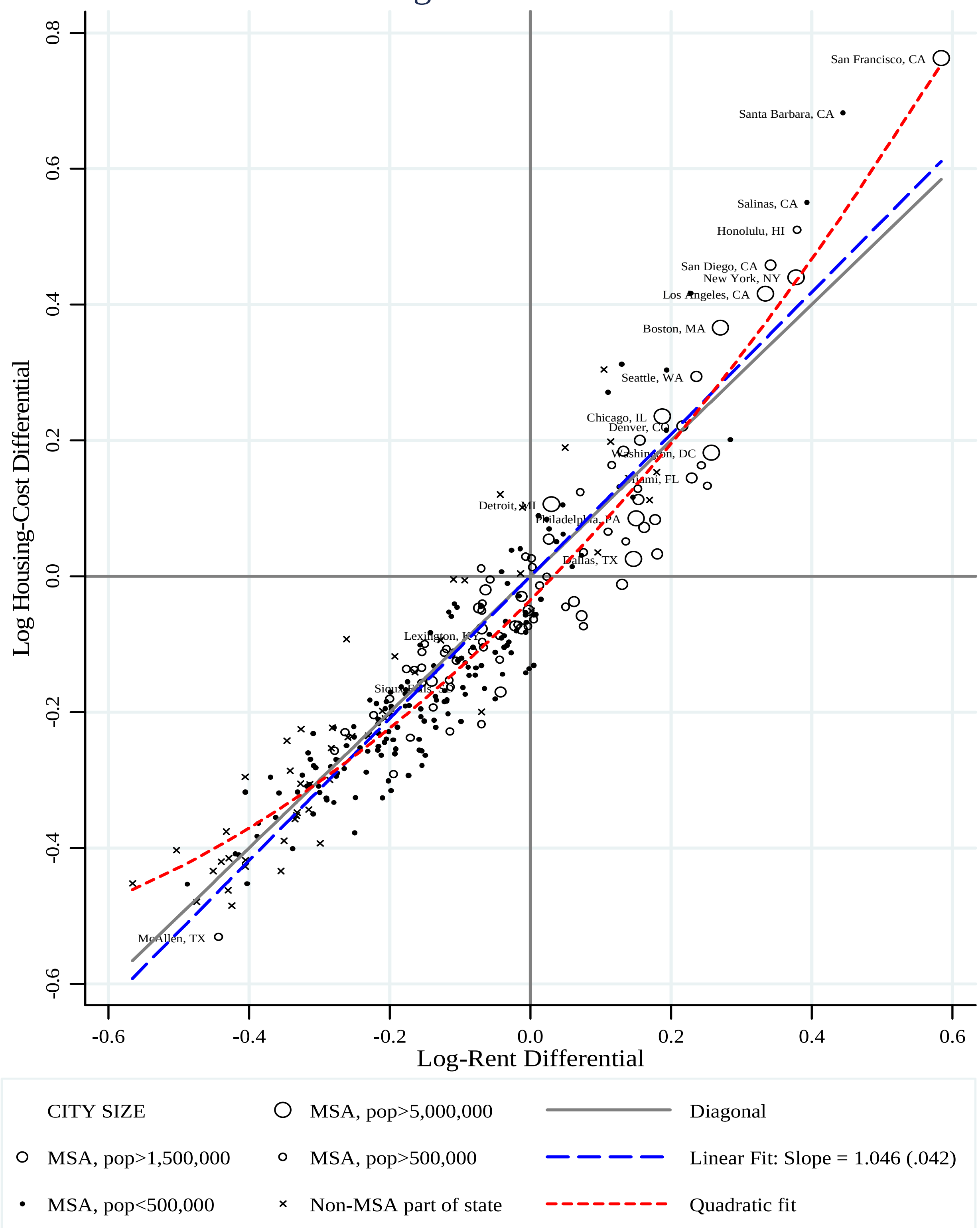

Table A3: Ownership Rates versus the Housing-Price-to-Rent Ratio