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Institut für Wirtschaftspolitik und Quantitative Wirtschaftsforschung

Diskussionspapier
Discussion Papers

No. 01/2012

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ISSN 1867-6707

Friedrich-Alexander-Universität
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Wages, Rents, Unemployment, and the Quality of Life

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This version: June 2012

Abstract

Combining a spatial equilibrium model with a search-matching unemployment model, this paper analyzes the willingness to pay for regional amenities and the regional quality of life when wages, rents, and unemployment risk compensate for local amenities and disamenities. The results are compared with those obtained from the Rosen-Roback approach. Furthermore, the paper shows that the wage curve is negatively sloped for quasi-linear utility. Specifically, the wage rate increases and the unemployment ratio decreases in response to an increase in the amenity level if the amenity is marginally more beneficial to producers than to consumers. As an illustration of the unemployment-adjusted quality-of-life measure, the quality of life in West German counties is estimated.

JEL Classification: R12, R13, R14, H73, J61, J64.

Keywords: Quality of life, residential mobility, unemployment, job search, matching.

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1 Introduction

Although the total population growth has been declining in many OECD countries, the demographic burden is not uniformly distributed among or within countries. Although populations have declined in some regions (such as East Germany, southern Italy, western Spain, northern Sweden), during the same period, other regions have experienced enormous population increases (such as the western U.S., eastern Spain, southern Germany, northern Italy, and southern Sweden). Generally, the populations of these countries are geographically mobile, although they are more mobile in some countries, such as the U.S., than in others. The willingness of households and firms to migrate induces competition among cities, counties, and states for mobile workers and firms. Migration is driven by differences in labor market conditions, land markets, natural amenities, and publicly provided goods. By considering price differences, households and firms move to locations in which they expect to encounter better living and working conditions.

The value that households attach to local amenities can be calculated from the wages and prices of non-tradable goods, especially land prices, by employing a neoclassical model with perfect competition and perfect geographical household and firm mobility, (see Rosen, 1979; Roback, 1982; Blomquist, Berger, and Hoehn, 1988; Blomquist, 2006). The quality of life in a certain location is measured by the amount of labor income minus expenditures for the non-tradable goods that workers are willing to forego for the opportunity to live in the respective region. Since the 1980s, the theoretical model and empirical strategies have been modified to account more consistently for local public finance (Gyourko and Tracy, 1991), federal taxation (Albouy, 2009), differences between home values and rents (Winters, 2010), and migration costs (Bayer, Keohane, and Timmins, 2009). Gabriel and Rosenthal (2004) and Chen and Rosenthal (2008) calculated a quality-of-business-environment index and used location-specific fixed effects rather than a long list of local amenities. Other researchers have estimated regional utility levels based on interregional migration data (see Greenwood, Hunt, Rickman, and Treyz, 1991; Wall, 2001; Douglas and Wall, 1993, 2000; Nakajima and Tabuchi, 2011).

In the underlying neoclassical spatial-equilibrium full-employment model, only price differences compensate households for differences in local amenities. To account for unemployment in empirical models, unemployment must be considered as a local disamenity. Unemployment either is a right-hand variable in price regressions or is indirectly considered through location-specific fixed effects. However, unemployment cannot be considered exogenous because it results from individual decisions, institutions, and market forces. Furthermore, wages, land prices, and employment are determined simultaneously. Given the presence of imperfect labor markets, unemployment risk must be added to local wages and local prices as a variable to compensate households for differences in location-specific resources.

Hence, the purpose of this paper is to develop a general equilibrium model with unemployment that can be used to calculate the willingness of households to pay for the opportunity to live in attractive regions. More specifically, a search-matching model of unemployment (see, e.g., Mortensen and Pissarides, 1994; Diamond, 1984; Pissarides, 2000; Petrongolo and Pissarides, 2001) will be incorporated into a spatial equilibrium model with local amenities. In contrast with Lee (2008), who models rural-urban migration, and Zenou (2009), who focuses on continuous space, we consider one small region. From the steady-state equilibrium conditions, we determine the effect of changes in the level of any amenity with respect to rents, wages, and unemployment rates. By referring to the present value of the expected income stream of perfectly mobile unemployed individuals, we calculate a quality-of-life measure. Quality of life is determined as the land rent that mobile unemployed individuals are willing to pay for the opportunity to live in the respective region – adjusted for wages and unemployment risk.

Using German county data, we calculate the quality of life in West German counties and compare our results with the results that were obtained using the standard approach, in which unemployment is considered an exogenous disamenity. We also use these data to test several predictions from the underlying model.

The paper offers several important contributions: first, by merging a spatial mobility model with a search-matching model, this research develops a general equilibrium model with unemployment and geographic mobility that can be used to determine regional quality of life. As such, the paper overcomes the inconsistency of the standard quality-of-life approach that assumes perfect labor markets in the theoretical model but uses data on apparently involuntary unemployment in the empirical application and considers unemployment an exogenous parameter. Second, for quasi-linear utility, we analyze the relationship between regional amenities and the negative slope of the wage curve (see, e.g., Blanchflower and Oswald, 1994), that is, regions with higher unemployment also show lower wages. We show that the sign of the slope is independent of the properties of local amenities. Third, we calculate quality of life in West German counties and compare the unemployment-adjusted quality-of-life measure that is proposed in this paper with the standard quality-of-life measure. In contrast with the measures that were employed by Buettner and Ebertz (2009), our quality-of-life measures for West German counties are not entirely based on land rents.

This paper is organized as follows. Section 2 develops the theoretical model, and Section 3 calculates the quality of life in West German counties. Section 4 concludes the paper.

2 Theoretical model

A dynamic model in discrete time, in which one small region out of many regions is considered, is established.[1] Each region is characterized by its land endowment, L, and many possible non-excludable and non-rival amenities. However, without loss of generality only a single amenity, A, is explicitly modeled. This amenity may affect both output and individual well-being either positively or negatively and is modeled as a time invariant flow variable.

Homogeneous land is used for either consumptive or productive purposes. Each individual inelastically demands one unit of land, and firms optimally adjust their land demand to land rents, R. The land market is perfectly competitive, and land rents are adjusted to equalize demand and exogenously given supplies.

Individuals rationally choose regions under conditions of perfect foresight and perfect mobility to maximize lifetime utility. In any given period, each individual supplies one unit of labor and demands one unit of land, which is used as a proxy for housing. Instantaneous utility is additively separable, and the indirect utility function is as follows:

$$v(y, A) = \psi(y) + \phi(A), \quad \text{with } \psi'' \leq 0 < \psi' \text{ and } \phi'' < 0 < \phi', \tag{1}$$

[1]When possible, the time index t is omitted.

where y denotes income minus housing costs. In the comparative statics, we restrict ourselves to quasi-linear utility: $\psi(y) = y$. The production technology exhibits constant returns to scale regarding labor and land, and the per-capita-production function is denoted as $f(l, A)$, with $f_l(l, A) > 0 > f_{ll}(l, A)$,[2] where l is land per worker. Both the utility function and the production function are monotonic functions of A. Firms are units of production with per-capita profits $\pi = f(l, A) - w - Rl$ if filled by a worker. The output price is normalized to 1, and w denotes the wage rate. Profit maximization implies $f_l(l, A) = R$. If unfilled, firms encounter only the flow opportunity costs of a vacant job, c.

Frictions and imperfect information in the labor market are modeled by employing a standard search-matching model (see Pissarides, 2000). Normalizing search intensity at 1, the region's concave and linear-homogeneous matching function is defined as $M(U, V)$, where U is the number of unemployed people and V is the number of vacancies. Defining labor market tightness as $\theta = V/U$, we can express the worker arrival rate, i.e., the probability that a firm posting a vacancy finds a worker, as $q(\theta) := M(1/\theta, 1)$. According to the properties of the matching process, $q'(\theta) < 0$ and $0 > \eta(\theta) > -1$, where $\eta(\theta) := q'(\theta)\theta/q(\theta)$ is the matching elasticity. The job-arrival rate, i.e., the probability that an unemployed individual finds a job, is $\theta q(\theta)$. To simplify the formal analysis, we exclude on-the-job searching and cross-border searching from the analysis. This assumption implies that immigrants are always initially unemployed. Finally, workers encounter the risk of being fired with the time-invariant (exogenous) probability λ.

As absentee landlords and entrepreneurs are assumed, neither profits nor land rents are considered as sources of financing worker consumption. Furthermore, we assume that landlords could be taxed in a lump sum manner to balance the government budget, which allows to fix unemployment benefits. Alternatively, the federal government could establish tax rates and unemployment benefits and balances its budget at the national rather than the regional level.

[2]Partial derivatives are indicated by subscripts.

2.1 Present discounted values of utility and profit

Denoting the present discounted value of utility flows of an employed worker and an unemployed individual in the region at time t by $J_N(t)$ and $J_U(t)$, the Bellman equations for employed and unemployed individuals are as follows:

$$\begin{aligned}(1+r)J_N(t) &= v(w(t)-\tau(w(t))-R(t),A)+(1-\lambda)\max[J_N(t+1),J_U(t+1),\bar{J}_U(t+1)] \\ &\quad +\lambda\max[J_U(t+1),\bar{J}_U(t+1)]\,, \qquad (2)\\ (1+r)J_U(t) &= v(b(t)-R(t),A)+\theta(t+1)q(\theta(t+1))\max[J_N(t+1),J_U(t+1),\bar{J}_U(t+1)] \\ &\quad +(1-\theta(t+1)q(\theta(t+1)))\max[J_U(t+1),\bar{J}_U(t+1)]\,, \qquad (3)\end{aligned}$$

where r is the common constant interest rate. An employed worker achieves instantaneous utility $v(w(t)-\tau(w(t))-R(t),A)$, where τ denotes the wage tax burden with $\tau(0)=0$, $0 \le \tau < w$, and $0 \le \tau' < 1$.[3] With probability $1-\lambda$, this worker not lose her job and has the opportunity to choose between continued work, unemployment in the same region, or migration into unemployment in another region. The maximum present value of utility that is encountered by an unemployed individual in any other region is denoted by $\bar{J}_U$. When this individual loses her job, she may choose between only the last two options. An unemployed individual receives unemployment benefits, b, with $0 < b < \bar{b} < f - f_l\, l - \tau(f - f_l\, l)$, and thus achieves utility $v(b(t)-R(t),A)$. In the next period, she receives the maximum present value of utility of unemployment inside and outside of the region. With probability $\theta(t+1)q(\theta(t+1))$ she finds a job and is able to opt for the present value of utility that is gained from employment. When production occurs in period $t+1$, the present value of employment cannot fall short of the present value of unemployment: that is, $J_N(t+1) \ge \max[J_U(t+1), \bar{J}_U(t+1)]$. Similarly, migration is not a dominant strategy of the unemployed if $J_U(t+1) \ge \bar{J}_U(t+1)$. In equilibrium, the absence of mobility costs implies $J_U(t+1) = \bar{J}_U(t+1)$.

With the same procedure the Bellman equations of active and non-active firms can be

[3] All flow variables are measured at the end of the period.

written as follows

$$
\begin{aligned}
(1+r)J_F(t) &= f(l(t),A) - w(t) - R(t)l(t) + (1-\lambda)\max[J_F(t+1), J_F(t+1)] \\
&\quad +\lambda J_V(t+1)\,, \qquad (4) \\
(1+r)J_V(t) &= -c + q(\theta(t+1))\max[J_F(t+1), J_V(t+1))] \\
&\quad +(1-q(\theta(t+1)))J_V(t+1)\,, \qquad (5)
\end{aligned}
$$

where $J_F(t)$ and $J_V(t)$ are the present discounted values of the profits of active and non-active firms, respectively. The present discounted value of the profits of an active firm is determined by sum of the immediate cash flow $f(l(t),A) - w(t) - R(t)l(t)$ and the lagged present values of the profits of active and non-active firms weighted by the probabilities of occurrence λ and $1-\lambda$. The present value of the profits of a non-active firm is the sum of the immediate vacancy costs and the prospective values of being active or non-active weighted by the respective probabilities $q(\theta(t+1))$ and $1-q(\theta(t+1))$. The region will host active firms only if $J_F(t+1) \geq J_V(t+1)$. Free entry and exit dirves the present values of the profits of inactive firms down to zero: that is, $J_V(t+1) = 0$.

In each period, any active firm shares the total surplus with its workers through generalized Nash bargaining taking as given the wages in other firms as well as $J_U(t)$ and $J_V(t)$:

$$w(t) = \arg\max\left\{[J_N(t) - J_U(t)]^{\gamma}[J_F(t) - J_V(t)]^{1-\gamma}\right\}\,, \qquad (6)$$

where γ is the exogenously given bargaining power of workers, with $0 < \gamma < 1$.

2.2 Steady-state equilibrium

The following analysis neglects transitional dynamics and focuses only on the steady states in wehich production actually occurs.

Definition 1 *A steady-state equilibrium with production is a triple (w, R, θ), i.e., wage, land rent, and labor market tightness, such that workers and firms maximize the present values of utility and profits, the land market clears, and the number of employed and unemployed individuals, and the amount of land used by each firm are time-invariant.*

Applying this definition, we find the following steady-state equilibrium conditions:

$$rJ_U - [v(b - R, A) + \theta q(\theta)(J_N - J_U)] = 0, \tag{7}$$

$$rJ_N - [v(w - \tau(w) - R, A) + \lambda(J_U - J_N)] = 0, \tag{8}$$

$$J_U = \bar{J}_U, \tag{9}$$

$$rJ_V - [-c + q(\theta)(J_F - J_V)] = 0, \tag{10}$$

$$rJ_F - [f(l, A) - w - Rl + \lambda(J_V - J_F)] = 0, \tag{11}$$

$$J_V = 0, \tag{12}$$

$$f_l(l, A) - R = 0, \tag{13}$$

$$\gamma J_F - (1 - \gamma)(J_N - J_U) = 0, \tag{14}$$

$$\lambda N - \theta q(\theta) U = 0, \tag{15}$$

$$lN + N + U - L = 0. \tag{16}$$

Setting the number of laid-off employees equal to the number of hired unemployed individuals, the labor market flow equilibrium condition (15) ensures a stable employed population N in the region. Equation (16) is the land market equilibrium condition. The outcome of generalized Nash wage bargaining is characterized by Equation (14), whereas the land demand of firms is determined by Equation (13). Equations (7) and (8) are the Bellman equations for unemployed and employed workers, and Equations (10) and (11) are the Bellman equations for inactive and active firms. Furthermore, perfect mobility implies Equation (9), and free entry and exit lead to Equation (12).

The steady-state equilibrium conditions, which are Equations (7) through (16), determine the equilibrium values of the endogenous variables $J_U, J_N, J_V, J_F, \theta, N, U, l, w,$ and R. When the wage is less than the marginal product of labor, active workers and firms are better off than their inactive counterparts: $w = f - Rl - (r + \lambda)c/q < f - f_l l =$ marginal product of labor, $J_F = c/q > J_V = 0$, and $J_N = J_U + (w - \tau(w) - b)/(\lambda N/U + r + \lambda) > J_U$.

From the steady-state condition (15), the following equation is obtained:

$$\frac{du}{d\theta} = -\frac{(1 + \eta)u^2 q}{\lambda}, \quad \text{implying} \quad \text{sign}\left(\frac{du}{dA}\right) = -\,\text{sign}\left(\frac{d\theta}{dA}\right), \tag{17}$$

where $u = U/(U + N)$ is the unemployment ratio. Labor market tightness and unemployment move in opposite directions as the amenity level changes. To stabilize employment, an increase in the unemployment ratio must be neutralized by a reduction in the job-arrival rate and, hence, by a looser labor market.

Because of to the non-linearity of the production function, the matching function, and the wage tax, most equilibrium values cannot be determined analytically. However, the steady state can be described in the following condensed form:

$$\psi[b - f_l(l, A)] + \phi(A) - r\bar{J}_U + \frac{c\gamma\theta}{1-\gamma} = 0, \tag{18}$$

$$\psi[w - \tau(w) - f_l(l, A)] + \phi(A) - r\bar{J}_U - \frac{c\gamma(r+\lambda)}{q(\theta)(1-\gamma)} = 0, \tag{19}$$

where

$$J_U = \bar{J}_U, \quad J_N = \bar{J}_U + \frac{c\gamma}{q(\theta)(1-\gamma)}, \quad U = \frac{\lambda L}{(1+l)\theta q(\theta) + \lambda}, \quad N = \frac{\theta q(\theta) L}{(1+l)\theta q(\theta) + \lambda},$$
$$R = f_l(l, A), \quad w = f(l, A) - f_l(l, A)l - \frac{c(r+\lambda)}{q(\theta)}.$$

Equation (18) is derived from the Bellman equation for unemployed individuals, Equation (7). Equation (19) is derived from the Bellman equation for employed workers, Equation (8). These two equations determine land use by firms, l, and labor market tightness, θ.

The following statement on existence immediately follows from Equations (18) and (19).

Proposition 1 *If the production function satisfies the Inada conditions* $\lim_{l\to 0} f_l(l, A) = \infty$, $\lim_{l\to\infty} f_l(l, A) = 0$, $\lim_{l\to 0}[f(l, A) - f_l(l, A)l] = 0$, *and* $\lim_{l\to\infty}[f(l, A) - f_l(l, A)l] = \infty$, *for any finite amenity level, A, then there exists a reference present value level, $\bar{J}_U$, a level of vacancy costs, c, and a level of unemployment benefits, b, such that levels of land use, l, and labor market tightness, θ, exist to satisfy Equations (18) and (19) but still allow for a positive wage level. Hence, a steady-state equilibrium with production exists.*

2.3 Quality of life

Equations (7) and (8) can be solved for the present discounted values of utility flows, J_U and J_N:

$$J_U = \frac{(r+\lambda)v(b-R,A)+\theta q(\theta)v(w-\tau(w)-R,A)}{r[r+\lambda+\theta q(\theta)]}, \tag{20}$$

$$J_N = \frac{[r+\theta q(\theta)]v(w-\tau(w)-R,A)+\lambda v(b-R,A)}{r[r+\lambda+\theta q(\theta)]}. \tag{21}$$

The present discounted value of utility flows of a currently (un-)employed worker, J_U, is a weighted average of the instantaneous utility of unemployed and employed workers; the weights are determined by the separation rate, the job-arrival rate, and the interest rate. Because $w-\tau(w)>b$, an employed worker achieves higher utility than an unemployed individual. Totally differentiation of J_U yields the marginal willingness to pay for the amenity of unemployed individuals.[4] Using the mobility equilibrium condition $J_U=\bar{J}_U$ and the relationship between labor market tightness and unemployment that is described by Equation (17), we can write the marginal willingness to pay for the amenity of an unemployed individual as follows:

$$\begin{aligned} -\left.\frac{dy}{dA}\right|_U &= \phi' \frac{\theta q + r + \lambda}{\theta q v_y^N + (r+\lambda)v_y^U} \\ &= -\Bigg\{ \underbrace{-1}_{(drJ_U/dR)/(drJ_U/dy)} \frac{dR}{dA} + \underbrace{(1-\tau')\left[\frac{\theta q v_y^N}{\theta q v_y^N + (r+\lambda)v_y^U}\right]}_{(drJ_U/dw)/(drJ_U/dy)} \frac{dw}{dA} \\ &\quad + \underbrace{\left[\frac{(v^N - v^U)(r+\lambda)}{(\theta q + r + \lambda)\left[\theta q v_y^N + (r+\lambda)v_y^U\right]}\right]}_{(drJ_U/d\theta q)/(drJ_U/dy)} \underbrace{\left(-\frac{\lambda}{u^2}\right)}_{d\theta q/du} \frac{du}{dA} \Bigg\}. \end{aligned} \tag{22}$$

The willingness to pay for an amenity differs from the willingness to pay under perfect competition, i.e., from $dR/dA-(1-\tau')dw/dA$, in the standard Roback (1982) framework. On the one hand, the weight of wages is less than $1-\tau'$; on the other hand, the change

[4] The willingness to pay is defined as the maximum amount of resources that an individual is willing to forgo *in the current period and in every subsequent period independent of the employment status* to be able to consume an infinitesimal additional unit of the amenity in every period. The willingness to pay may depend on the current employment status of an individual. The definition for firms is analogous.

in unemployment affects the willingness to pay via the job-arrival rate θq. Because of the assumption of fixed housing for both employed and unemployed individuals, the weight of rents is unchanged. The weight of net-wage changes is the ratio of the expected utility of one additional income unit in the state of employment and the expected utility of one additional income unit in both states, dy/dw. Changes in the unemployment rate are weighted by the impact on the job arrival rate, $d\theta q/du$, and the ratio of the expected utility increase induced by an increase in the job arrival rate and the expected utility of one additional income unit in both states, $dy/d\theta q$.

The marginal willingness to pay for the amenity of an employed worker,

$$- \left.\frac{dy}{dA}\right|_N = \left[\frac{\theta q v_y^N + (r+\lambda) v_y^U}{(r+\theta q) v_y^N + \lambda v_y^U}\right] \left(- \left.\frac{dy}{dA}\right|_U \right), \tag{23}$$

is larger – in absolute terms – than the marginal willingness to pay of an unemployed individual if indiviudals are risk averse, i.e., if $v_y^N < v_y^U$. Income is less important for the employed than for the unemployed because the present value of expected income of the former is higher.

The following proposition compares the willingness to pay across models and states of nature.

Proposition 2 *(i) The change in land rents has the same weight in the formula for the willingness to pay for an amenity with and without search frictions.*
(ii) The weight of the change in the wage rate is smaller for an imperfect labor market than for a perfect labor market. (iii) Risk averse unemployed indiviudals are willing to pay less for amenities than employed workers (in absolute terms).

For more than one amenity, a regional quality-of-life index for mobile (unemployed) individuals can also be determined. Quality of life in region j is given by the following:

$$QOL_j = - \sum_i A_{ij} \left.\frac{dy}{dA_i}\right|_U . \tag{24}$$

Solving Equations (10) and (11), we can express the present discounted values of profit flows for a firm as follows:

$$J_V = \frac{q(\theta)[f(l,A) - lR - w] - (r+\lambda)c}{r[q(\theta)+r+\lambda]}, \tag{25}$$

$$J_F = \frac{[q(\theta)+r][f(l,A) - lR - w] - \lambda c}{r[q(\theta)+r+\lambda]}. \tag{26}$$

A firm's value of profit flows is a weighted average of instantaneous profits of an active firm and vacancy costs in which the weights are determined by the separation rate, the job-filling probability, and the interest rate. An active firm has greater value than an inactive firm. Taking the total differential of J_V and considering $J_V = 0$ and $(f_l - R)dl/dA = 0$, we obtain the marginal willingness to pay for the amenity of an inactive firm:

$$\begin{aligned} -\left.\frac{dy}{dA}\right|_V &= \frac{qf_A}{r+q+\lambda} \\ &= \frac{q}{r+q+\lambda}\left(l\frac{dR}{dA} + \frac{dw}{dA}\right) + \left[\frac{(r+\lambda)(f - lR - w + c)\lambda\eta}{(r+q+\lambda)^2 u^2 \theta(1+\eta)}\right]\frac{du}{dA}. \end{aligned} \tag{27}$$

Similar to consumers, firms deviate from firms acting on perfect labor markets in their willingness to pay for amenities by a term that captures changes in unemployment. The marginal willingness to pay for the amenity of an active firm,

$$-\left.\frac{dy}{dA}\right|_F = \left(\frac{r+q}{q}\right)\left(-\left.\frac{dy}{dA}\right|_V\right), \tag{28}$$

is larger – in absolute terms – than the marginal willingness of an inactive firm to pay, because only active firms are directly affected by the amenity.

2.4 Quasi-linear utility

Throughout this subsection, it will be assumed that utility is quasi-linear: $v = y + \phi(A)$. Taking the total differential of conditions (7) through (16), we can determine the effect of changes in the amenity level. Specifically, the comparative static exercise yields the following:

$$\frac{dR}{dA} = \frac{(1-\tau')q^2 f_A \gamma + \phi'\left\{q^2\gamma - [1-(1-\gamma)\tau']q'(r+\lambda)\right\}}{\Delta}, \tag{29}$$

$$\frac{dw}{dA} = \frac{(f_A - l\phi')\gamma[q^2 - q'(r+\lambda)]}{\Delta}, \tag{30}$$

$$\frac{d\theta}{dA} = \frac{(1-\tau')(f_A - l\phi')\gamma q(r+\theta q+\lambda)}{[w-\tau-b]\Delta}, \tag{31}$$

where

$$\Delta = [1 + (1 - \tau')l]q^2\gamma - q'[1 - (1 - \gamma)\tau'](r + \lambda) > 0.$$

The following proposition summarizes the main comparative static effects.

Proposition 3 *Suppose that utility is quasi-linear.*
(i) The effects of any amenity on wages and unemployment rates have opposite signs.
(ii) If the amenity is productive and utility-enhancing, then an increase in the amenity level causes an increase in land rents.
(iii) If the amenity is marginally more beneficial to producers than to consumers per unit of land, i.e., if $f_A/l > \phi'$, then wage rate and labor market tightness increase, and the unemployment ratio decreases in response to an increase of the amenity level.

If the amenity does not directly affect consumers, then a productive amenity increases land rents, wages, and labor market tightness. Similarly, if the amenity has no direct effect on production, then a utility-enhancing amenity increases land rents but reduces wages and labor market tightness. Whereas a positive amenity unambiguously increases the value of land, the overall-effect of amenities on labor market indicators depends on the relative strength of the positive effects. Wages increase and unemployment decreases if an increase in the amenity level benefits firms more than workers. Analogous statements are possible for disamenities.

Figures 1 and 2 show how utility and productivity-enhancing amenities simultaneously affect rents, wages, and labor market tightness.[5] In any case, the wage curve in an unemployment-wage diagram would be downward-sloping as empirically confirmed by Blanchflower and Oswald (1994) (see also, among others, Card, 1995; Suedekum, 2005; Nijkamp and Poot, 2005; Blanchflower and Oswald, 2005). The reason is that both wages and labor market tightness negatively affect the value of inactive firms and positively affect the present value of unemployed individuals. Moreover, the steady state condition (15) implies that the unemployment ratio and the indicator of labor market tightness are negatively correlated. Whereas the land rent compensates for the aggregate effect of an

[5] Without any explicit analytical underpinning, Deller (2009) derived Figure 2.

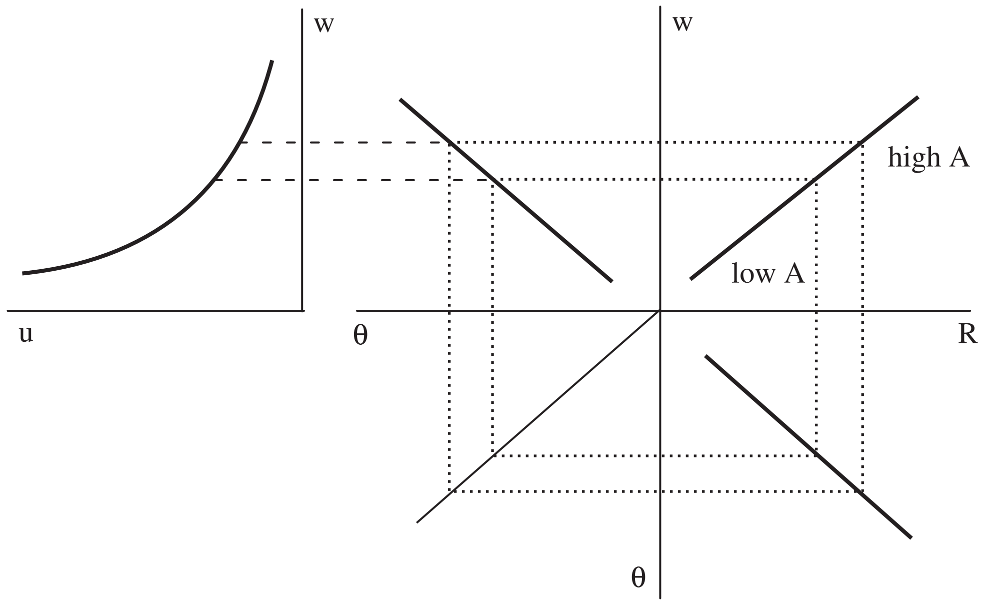

Figure 1: Amenity level, wages, rents, and labor market tightness if $v = y + \phi(A)$ and $f_A/l > \phi' > 0$

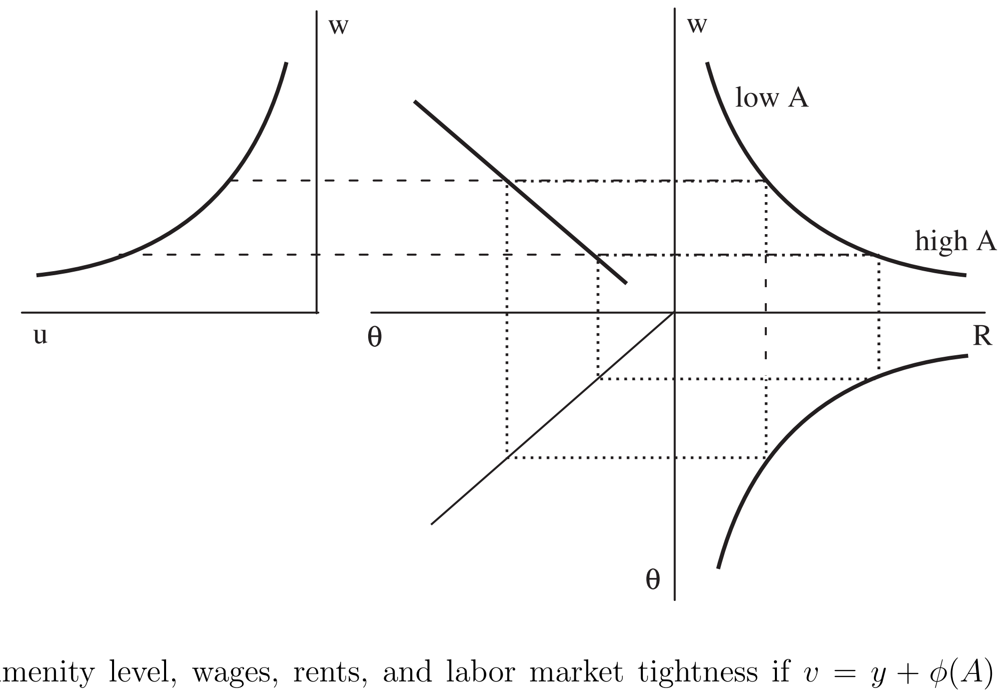

Figure 2: Amenity level, wages, rents, and labor market tightness if $v = y + \phi(A)$ and $0 < f_A/l < \phi'$

amenity, changes in wages and unemployment are driven by the difference between the effects of the amenity on firms and workers. Furthermore, because

$$\frac{(1-\tau')\frac{dw}{dA}-\frac{dR}{dA}}{\frac{du}{dA}} = \frac{(w-\tau-b)\lambda}{(1+\eta)(ru+\lambda)uq^2}\left[q'(r+\lambda)+\frac{\phi'\Delta}{(1-\tau')(f_A/l-\phi')l}\right], \tag{32}$$

even the after-tax real-wage curve is downward-sloping if $\phi' > f_A/l$, i.e., if active firms require higher compensation than consumers.

If workers were risk adverse, i.e., if $\psi'' < 0$, then the effects of amenities on wages, rents, and labor market tightness could not be signed. Risk aversion may even imply an upward-sloping wage curve.

Using the reduced form of the steady state given by Equations (18) and (19), we can analyze the effect of a variation in the amenity supply on land use by firms and labor market tightness. Because

$$\left.\frac{dl}{d\theta}\right|_{J_N} = \frac{\frac{(r+\lambda)c[1-(1-\gamma)\tau']}{1-\gamma}\frac{q'}{q^2}}{f_{ll}[1+l(1-\tau')]} > 0 \text{ and } \left.\frac{dl}{d\theta}\right|_{J_U} = \frac{c\gamma\theta}{f_{ll}(1-\gamma)} < 0, \tag{33}$$

Equation (18), which is related to J_U, has a negative slope, and Equation (19), which refers to J_N, has a positive slope in the $\theta - l$-space (see Figure 3).

Differentiation of these equations with respect to A indicates that the downward-sloping J_U curve shifts downward if and only if $f_{lA} - \phi' < 0$, whereas the upward-sloping J_N curve shifts downward if and only if $-(1-\tau')f_A - \phi' + [1 + l(1-\tau')]f_{lA} < 0$. Hence, if land and the amenity are substitutes, i.e., if $f_{lA} < 0$, then an increase in the supply of a utility-enhancing and productivity-enhancing amenity reduces land use in production, but has an ambiguous effect on labor market tightness (see Figure 3).[6]

Whereas any change in the amenity level in a small open region with free entry and exit cannot alter the well-being of unemployed workers and inactive firms, employees and active firms – who are better off than their inactive counterparts – are practically immobile and are thus affected by changes in amenity levels. Inserting for dR/dA, dw/dA, and $d\theta/dA$,

[6]Further analysis of the total differential shows that the sign of $f_A - l\phi'$ is, indeed, crucial for the effect on labor market tightness, as previously stated.

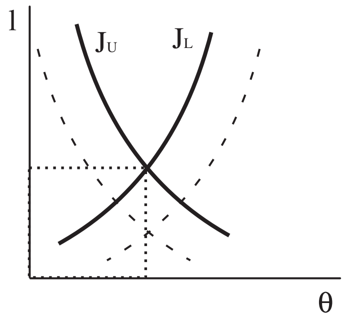

Figure 3: Amenity level, land use by firms, and labor market tightness if $v = y + \phi(A)$, $f_A > 0$, $\phi_A > 0$, and $f_{lA} < 0$

we can calculate total differentials as follows:

$$\frac{dJ_N}{dA} = (1-\tau')\gamma \frac{(\phi' - f_A/l)lq'}{\Delta}, \tag{34}$$

$$\frac{dJ_F}{dA} = (1-\tau')(1-\gamma) \frac{(\phi' - f_A/l)lq'}{\Delta}. \tag{35}$$

Employed workers benefit more than marginal workers from an increase in the amenity level if and only if $f_A/l > \phi'$. The same statement applies to active firms relative to inactive firms. The intuition is simply that the benefits of consumption amenities are independent of employment and activity status, but productive benefits are particularly valuable for firms that actually produce.

For quasi-linear utility, the marginal willingness of both unemployed and employed individuals to pay for an amenity depends only on observable variables:

$$-\left.\frac{dy}{dA}\right|_U = -\left.\frac{dy}{dA}\right|_N = \phi' = \frac{dR}{dA} - (1-\tau')\left(\frac{\lambda N/U}{\lambda N/U + r + \lambda}\right)\frac{dw}{dA} + \left\{\frac{(w-\tau-b)(r+\lambda)\lambda}{(\lambda N/U + r + \lambda)^2 u^2}\right\}\frac{du}{dA}. \tag{36}$$

This formula, which is derived from Equations (22) and (23), can easily be used in the empirical estimations of the quality of life.[7]

For quasi-linear utility, it is also possible to conduct a more rigorous comparison of the standard approach that relies only on land rents and wages with the approach that is

[7] If the amenity were a publicly provided private good financed by a uniform head tax that is levied on all citizens in the region under consideration, then Equation (36) would measure the willingness to pay for the publicly provided good in excess of marginal costs: $\phi'-$ marginal costs.

proposed in this paper. Using comparative statics, namely,

$$\frac{du}{dw} = -\frac{(1-\tau')(1+\eta)\,(\lambda+ru)\,u}{(w-\tau-b)\left(1-\eta\,\frac{r+\lambda}{\lambda}\,\frac{U}{N}\right)\lambda}\,, \tag{37}$$

to express du/dA in terms of dw/dA, the marginal willingness of workers and inactive firms to pay is expressed as follows:

$$-\left.\frac{dy}{dA}\right|_U = -\left.\frac{dy}{dA}\right|_N = \frac{dR}{dA} - \left(\frac{1-\tau'}{1-\eta\,\frac{r+\lambda}{\lambda}\,\frac{U}{N}}\right)\frac{dw}{dA}\,, \tag{38}$$

$$-\left.\frac{dy}{dA}\right|_V = \frac{q}{r+q+\lambda}\left[l\frac{dR}{dA} + \left(\frac{1-\eta\,\frac{1-(1-\gamma)\tau'}{\gamma}\,\frac{(r+\lambda)}{\lambda}\,\frac{U}{N}}{1-\eta\,\frac{r+\lambda}{\lambda}\,\frac{U}{N}}\right)\frac{dw}{dA}\right]. \tag{39}$$

Because the coefficient of a change in wages for a worker in Equation (38) lies in the interval $(-(1-\tau'), 0)$, the proposition below immediately follows.

Proposition 4 *Suppose that utility is quasi-linear. The standard procedure to calculate the marginal willingness to pay for an amenity, provided that it entirely disregards unemployment overestimates (underestimates) the willingness of mobile workers to pay if the amenity reduces (increases) the wage, i.e. if* $f_A/l < \phi'$ $(f_A/l > \phi')$.

Hence, if, on average, local amenities are more beneficial to consumers than to producers the unemployment adjusted measure would indicate lower quality of life than the non-adjusted measure.

Furthermore, the aggregate marginal willingness to pay for an increase in the amenity level can be written as follows:

$$\begin{aligned}(N+U)\phi' + N\,\frac{(r+q)f_A}{r+q+\lambda} + V\,\frac{qf_A}{r+q+\lambda} &= (N+U)\phi' + Nf_A \\ = L\,\frac{dR}{dA} + \frac{Nq(\phi'-f_A/l)l\{(1-\tau'/u)\gamma\lambda + [1-(1-\gamma)\tau']\eta(r+\lambda)\}}{\theta\Delta}&\,.\end{aligned} \tag{40}$$

This expression differs from the respective value under perfect labor markets, i.e., from $L\,dR/dA$ (see Roback, 1982). If the bargaining power of workers is not excessively strong and the amenity primarily enhances utility, i.e., if $\phi' > f_A/l$, the change in aggregate land rents would overestimate the total willingness to pay. If jobs were chosen efficiently, i.e., if $\gamma = -\eta$ (see Pissarides, 2000), and wage taxation were lump sum conditional on employment, i.e., $\tau' = 0$, then this condition could be written as follows:

$$(N+U)\phi' + N f_A = L\,\frac{dR}{dA} + Nr\,\left(\frac{dJ_N}{dA} + \frac{dJ_F}{dA}\right).$$

In summary, workers and firms are willing to forego land rents and profits.

3 Empirical application

To complement the theoretical comparison of the unemployment-adjusted quality-of-life measure that is proposed in this paper with the standard quality-of-life measure, we will calculate the quality-of-life indices for regions in West Germany. Data on 326 West German counties (mainly) for 2007/2008 will be used for the empirical exercise.[8] Data were provided by the Federal Statistical Office, the Federal Employment Agency, the Federal Institute for Research on Building, Urban Affairs and Spatial Development, and the German Weather Service. In addition, two variables were obtained from the online survey "Perspektive Deutschland". Detailed descriptions are provided in the appendix. Data aggregated at the county level are used since comprehensive individual land market data with full information on house characteristics are not available for Germany.

The estimated effects on the average monthly imputed rent, R, the average monthly gross wage, w, and the unemployment rate, u, of various amenities, A_i, are used to calculate the marginal willingness to pay for these amenities by workers; thus, the quality of life of workers in West German counties can be calculated based on Equations (36) and (24). That is, in the empirical analysis, we assume quasi-linear utility.

[8] East Germany has been excluded from the analysis because mobility between the two parts of Germany is clearly imperfect. Unfortunately, this exclusion substantially reduces the variance in wages and unemployment rates. Furthermore, this choice may also reduce the calculated quality of live in districts that are close to the former border between the Federal Republic of Germany and the German Democratic Republic.

Using certain controls, X_i, the basic estimation equations are

$$R_j = \beta_{R0} + \sum_i \beta_{Ri} A_{ij} + \epsilon_{Rj}, \tag{41}$$

$$w_j = \beta_{w0} + \sum_i \beta_{wi} A_{ij} + \sum_i \alpha_{w^i} X_{ij} + \epsilon_{wj}, \tag{42}$$

$$u_j = \beta_{u0} + \sum_i \beta_{ui} A_{ij} + \epsilon_{uj}, \tag{43}$$

$$\theta_j = \beta_{\theta 0} + \sum_i \beta_{\theta i} A_{ij} + \epsilon_{\theta j}, \tag{44}$$

where ϵ_{ij}, $i = R, w, u$, and θ, are error terms. The coefficients β_{Ri}, β_{wi}, and β_{ui} will be inserted into Equation (36) to determine the willingness to pay for every amenity A_i. In the regressions, the logs of imputed rents, gross wages, and some amenities, are used. To adjust for these logs, we adjust the quality-of-life formula by multiplying the coefficient by the average value of the imputed rent and the wage, respectively, and by dividing the obtained value by the average value of the respective amenity.[9]

The proxies for the (dis-)amenities that were considered include peripherality, water area per inhabitant, afforested area per inhabitant, self reported satisfaction with leisure facilities, perception of crime, aggregated emissions, 30-year average daily minimum temperature, and 30-year average annual duration of sunshine. Because county data rather than individual wage data are used and because wages vary with skills, the wage equation controls for the share of workers with only a primary education and the share of workers with a tertiary education.[10]

Variable	Mean	Std. Dev.	Min.	Max.	N
logimputedrent	5.808	0.356	5.124	7.271	321
loglaborincome	7.914	0.108	7.679	8.324	326
uempratio	0.068	0.029	0.019	0.183	326
tightness	0.143	0.089	0.021	0.794	326

Table 1: Summary statistics

[9]Following Hobijn and Sahin (2009), we set $\lambda = 0.0106$. Their estimation is between the findings of Bauer and Bender (2004) (0.0155) and Bellmann, Gerner, and Upward (2011) (0.0088). Following Buettner and Ebertz (2009), we set $r = 0.05/12$.

[10]The inclusion of these controls in regressions (43) and (44) changes the results only marginally.

Variables	logimputedrent	loglaborincome	uempratio
loglaborincome	0.517		
	(0.000)		
uempratio	-0.088	0.047	
	(0.117)	(0.393)	
tightness	0.406	0.408	-0.358
	(0.000)	(0.000)	(0.000)

Table 2: Cross correlations

Tables 1 and 2 show the summary statistics and cross-correlations of the main variables in the model. High-cost regions are also high-wage regions with tight labor markets. This positive relationship resembles single amenity effects shown in figure 1; however, the slope of the wage curve is insignificant.

Table 3 shows the results for the OLS regressions for Equations (41) through (44). The results are the most convincing for sunshine, minimum temperature, and peripherality. Sunshine has a positive and statistically significant effect on land prices, wages, and labor market tightness but exerts a negative effect on unemployment. Minimum temperature and peripherality show opposite effects, all of which are significant with the exception of the effect of peripherality on labor market tightness. According to Equations (29) through (31) and Equation (17), $f_A/l > \phi'$ and $f_A > 0$ holds for sunshine, and $f_A/l < \phi'$ and $f_A < 0$ for minimum temperature and peripherality. Sunshine is likely viewed as a positive consumption and production amenity, whereas minimum temperature and peripherality are disamenities for both consumers and producers. Rurality is similar to peripherality, but less significant. All other amenities show less consistent coefficients; that is, their mean effects either are insignificant or violate the predictions of the model. Omitted variables, measurement error or misspecified spatial units may explain these ambiguous findings. Skill composition has the expected effect on wages. As labor market regions typically comprise more than one county, it is not surprising that the R^2 values and statistical significance are higher for the imputed rent than for the labor market variables.

Table 4 shows the willingness of (perfectly mobile) workers to pay for local amenities, as derived from regressions (41) through (43). Leisure, tempmin30, sun30, and totalemission

dependent variable	logimputedrent	loglaborincome	uempratio	tightness
tempmin30	-0.0517**	-0.0196***	0.00576***	-0.0306***
	(-2.455)	(-3.178)	(3.499)	(-4.195)
sun30	0.106***	0.0213***	-0.0146***	0.0436***
	(5.893)	(3.186)	(-8.551)	(6.260)
totalemission	0.00160**	-0.000202	-0.00000429	-0.000262
	(2.267)	(-0.886)	(-0.0811)	(-0.973)
logwaterareapc	-0.00211	-0.00129	-0.00371**	-0.00518
	(-0.143)	(-0.296)	(-2.337)	(-0.831)
logforestareapc	-0.0536***	-0.00787*	-0.00960***	-0.0126***
	(-5.136)	(-1.754)	(-8.169)	(-3.038)
leisure	1.460***	-0.101	0.0334	0.00343
	(6.179)	(-1.306)	(1.482)	(0.0413)
crime	-0.499**	0.227***	0.0324	-0.00471
	(-2.295)	(3.323)	(1.617)	(-0.0708)
logperipherality	-1.556***	-0.339***	0.0859***	-0.0846
	(-10.24)	(-5.409)	(5.685)	(-1.247)
rural	-0.0850***	-0.0170	0.00651**	-0.00267
	(-3.406)	(-1.645)	(2.395)	(-0.211)
logsharelowskilled		-0.394***		
		(-7.380)		
logsharehighskilled		0.100***		
		(6.364)		
constant	12.10***	10.83***	-0.160	0.210
	(11.65)	(22.22)	(-1.619)	(0.529)
observations	321	326	326	326
R^2	0.734	0.639	0.621	0.294

Robust t statistics in parentheses; *** p<0.01, ** p<0.05, and * p<0.1

Table 3: Regression of imputed rents, wages, unemployment rate, and tightness

Amenity	MWTP in €
tempmin30	5.103
sun30	7.318
totalemission	0.777
waterareapc	-0.016
forestareapc	-0.010
leisure	644.740
crime	-393.202
peripherality	-0.641
rural	-9.060

Table 4: Marginal willingness of workers to pay

are amenities; in contrast, waterareapc, forestareapc, crime, peripherality and rural are disamenities. Presumably, waterareapc, forestareapc, and totalemission are proxies for other local amenities that are not included in the analysis, e.g., travel distances and urban life-styles[11]

As shown in figure 4, the quality of life is especially high in the metropolitan areas of Munich, Stuttgart, Rhein-Main, Rhein-Ruhr, and Nuremberg, whereas most counties in the central regions, such as northeastern Hesse, northeastern Bavaria, part of Rhineland-Palatinate, and large parts of Lower Saxony, appear to be less amenable for workers.[12] On average, cities that enjoy county status are more highly ranked than counties. Interestingly, there is a statically significant positive correlation between the quality-of-life index and netimmigration ($\rho = 0.48$).

To assess the overall effect of explicitly modeling unemployment, we compare our regressions with a standard regression of wage and imputed rents in which the unemployment ratio is a given disamenity (see Table 5). On average, the quality-of-life indices that result from the standard approach are slightly lower; the coefficient in a linear regression of our index on the standard index is 0.9397. Figure 5 shows the close relationship of both indicators.[13] Finally, a linear regression of our index on the standard index that entirely disregards unemployment and that tends to yield higher results reveals an even stronger correlation with a regression coefficient of 0.9640. Because the direction of the deviation of the standard approach from this paper's approach depends on the sign of the effect of the amenity on wages and because some of the amenities that are included in the analysis increase wages whereas other amenities reduce wages, on balance, both approaches lead to similar results. Because the constant in the regression is positive but small, proposition 4

[11]The variable totalemission is particularly high in metropolitan areas.

[12]It should be emphasized that absolute numbers and ranks are sensitive to changes in the weighting factor of rents, assumptions regarding lot size, and the set of included amenities. However, in particular, the top ranking of the Munich area is independent of varying parameter settings.

[13]The Spearman rank correlation coefficients of the quality-of-life index of Buettner and Ebertz (2009) and our measures are as follows: 0.4971 for the full model, 0.6377 for the standard approach, and 0.6611 for imputed rents based on the standard approach (all significant at the 1% level). The inclusion of net rents, differences in right-hand variables, and differences in statistical methods may contribute to the rather low correlation of their approach and the imputed rents based on the standard approach in our paper.

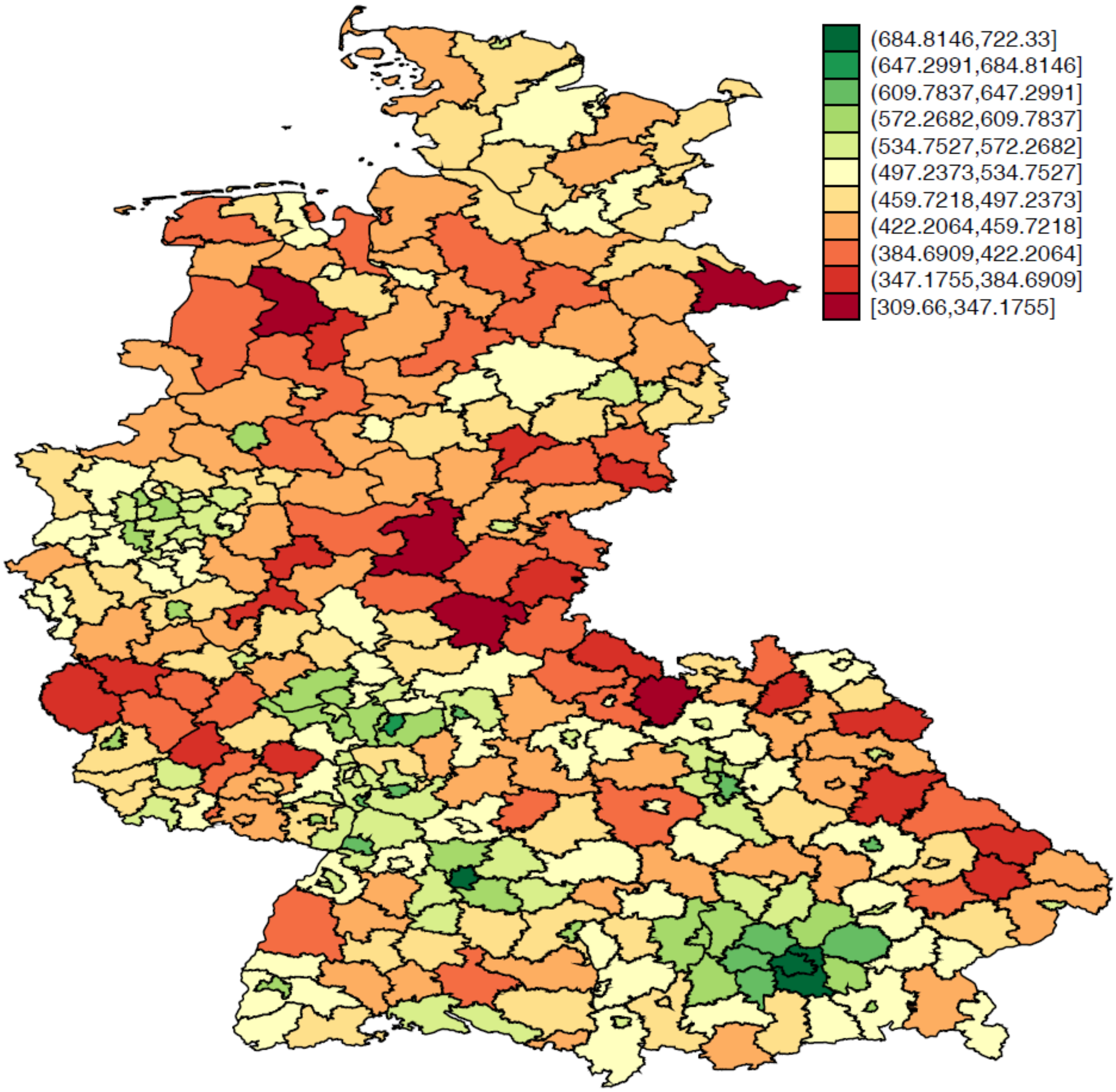

Figure 4: Quality of life in West German counties in 2007

dependent variable	logimputedrent	loglaborincome
uempratio	-2.568***	-0.0734
	(-5.319)	(-0.401)
tempmin30	-0.0365*	-0.0193***
	(-1.664)	(-3.089)
sun30	0.0677***	0.0202***
	(3.796)	(2.769)
totalemission	0.00160**	-0.000202
	(2.282)	(-0.886)
logwaterareapc	-0.0115	-0.00160
	(-0.769)	(-0.356)
logforestareapc	-0.0779***	-0.00856*
	(-7.163)	(-1.731)
leisure	1.549***	-0.0989
	(7.082)	(-1.265)
crime	-0.422**	0.229***
	(-1.996)	(3.339)
logperipherality	-1.333***	-0.332***
	(-8.448)	(-4.971)
rural	-0.0694***	-0.0164
	(-2.798)	(-1.572)
logsharelowskilled		-0.392***
		(-7.220)
logsharehighskilled		0.101***
		(6.359)
constant	11.67***	10.80***
	(11.37)	(21.72)
observations	321	326
R^2	0.751	0.639

Robust t statistics in parentheses; *** p<0.01, ** p<0.05, and * p<0.1

Table 5: Regression of imputed rents and wages with unemployment as a disamenity

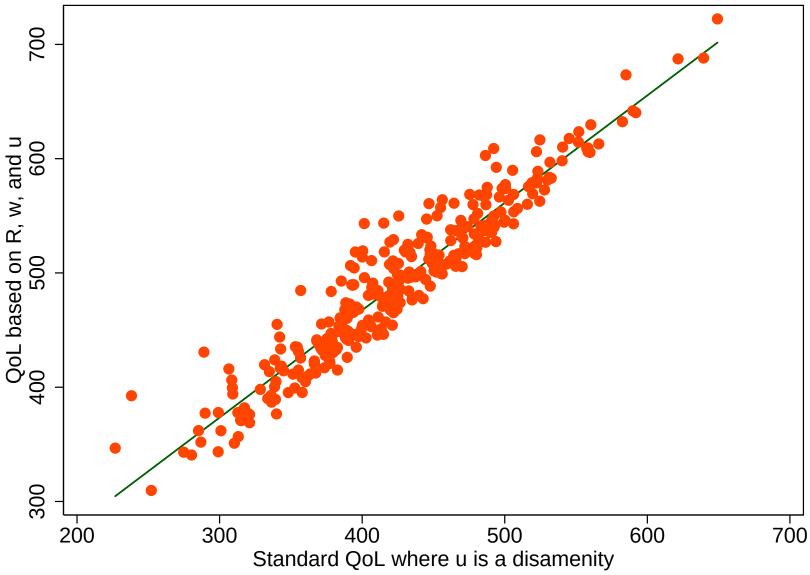

Figure 5: 3-variable approach vs. standard 2-variable approach

indicates that, on average, local amenities are slightly more beneficial to producers than to consumers.

The data can be used to test the reliability of the model. Independent on the functional form of the utility function, the model predicts that each amenity has opposite effects on labor market tightness and unemployment and that the ratio of coefficients is constant across amenities. Indeed, combining coefficient ratios in estimations of θ and u in a non-linear manner, we obtain a negative and statistically significant ratio $\beta_{\theta i}/\beta_{ui}$ for minimum temperature and sunshine.[14] The 95% confidence intervals of these ratios substantially overlap, and according to a Wald test, the equality of the ratios could not be rejected ($Prob > \chi^2 = 0.1680$ ($\chi^2(1) = 1.90$)).[15] However, in contrast with the prediction of the model, for several amenities the coefficients in the regressions of labor market tightness and unemployment have the same sign. One reason could be that vacancy

[14] Because the sample covers only 326 observations, the test statistics that rely on approximations that are appropriate in large samples should be considered with caution.

[15] Consistent with the lower degree of significance for peripherality, the same analysis of the coefficient ratios of peripherality and sunshine leads to less consistent results.

data are not actually reliable.[16] Furthermore, for quasi-linear utility, the model implies that each amenity has opposite effects on wages and unemployment and that the ratio of coefficients is also constant across amenities. Although this relationship is confirmed for some amenities, the slope of the wage curve is positive or insignificantly negative for other amenities.[17] More importantly, according to Equation (37), the model predicts that $(dw/w)/(du/u) \approx -1.4$ if $\eta = -0.6$ (see Rogerson and Shimer, 2011). In West Germany, unemployment wages exhibit significantly less variance across counties compared with the predictions of the model. Either collective bargaining and other omitted variables in the wage regression or risk aversion could explain this discrepancy. Hence, the implicit prices of amenities that are given in table 4 and the quality-of-life index that is shown in Figure 4 are only rough calculations and should be considered with some caution. However, a comparison of the unemployment-adjusted quality-of-life index based on Equation (36) with the unemployment-adjusted quality-of-life index based on Equation (38), in which du/dw is obtained from the model rather than from the empirical correlation, shows impressive similarities. In a linear regression of the first index on the second index the respective coefficient is 0.9746.

4 Concluding remarks

Combining a spatial equilibrium model with a matching unemployment model, this paper analyzed regional quality of life when wages, rents, and unemployment risk compensate for local amenities and disamenities. In particular, for quasi-linear utility, the paper shows that the effects of any amenity on wages and unemployment rates are of opposite signs; wage rates and labor market tightness increase and the unemployment ratio decreases in response to an increase in the level of an amenity that is marginally more beneficial to producers than to consumers per unit of land. Based on the model, the quality of life of

[16] Accordingly, the R^2 value is much lower in the tightness regression than in the unemployment regression.

[17] β_{wi}/β_{ui} is negative and statistically significant for minimum temperature and sunshine, and based on the considerably overlapping 95% confidence intervals, the equality of these ratios could not be rejected ($Prob > \chi^2 = 0.1889$ ($\chi^2(1) = 1.73$)).

workers in West German counties was calculated.

However, the theoretical model has omitted several important issues. Neither on-the-job searches nor migration costs were considered. Agglomeration externalities and inter-regional spillovers were also disregarded. Furthermore, although the model assumed that immigrants are initially unemployed, migration of unemployed individuals after successful job search is much more common. Regarding the empirical application, it would clearly be worthwhile to use micro data. For Germany, rich micro data sets exist for labor markets, but not for housing markets. Finally, the theoretical model assumed congruent labor and housing markets, but counties are actually poor proxies for these markets because housing markets are often smaller and labor markets are larger. However, all of these theoretical and empirical issues can be investigated in future research.

Acknowledgement I would like to thank Benjamin Wirth for his excellent research assistance. This paper was presented at the CESifo area conference on public sector economics in 2012, at the annual meeting of the public finance committee of the Verein für Socialpolitik in 2012, and at research seminars at the University of Osnabrück and the Halle Institute for Economic Research. The comments of the participants, especially Jean-Marie Lozachmeur and Peter Egger, are appreciated with gratitude.

Appendix: Variables and Sources

Variables

- netrent: net rent per m^2 (2008)
- buildinglandprice: average price for building land per m^2 2007-2008
- imputedrent: weighted average of netrent times average dwelling size and buildinglandprice times nominal interest rate (0.05) times average lot size (752.68 m^2) divided by the average number of housing units per structure (1.479); the homeownership ratio (0.45) is used as a weighting factor; average lot size and housing units per structure are taken from Buettner and Ebertz (2009)
- laborgrossincome: gross wage per employee including social security contributions in Euro (2007).
- labornetincome: net wage per employee calculated from laborgrossincome using the income tax code (applicable to a single tax payer) and social contribution rates (2007)
- marginaltaxrate: derivative of the difference between laborgrossincome and labornetincome with respect to laborgrossincome (2007)
- uempratio: share of unemployed in the workforce (2008)
- tightness: ratio of the number of vacancies and the number of unemployed people (2007).
- peripherality: aggregate air/road travel time to 41 European agglomerations in minutes (2007)
- waterareapc: water area per inhabitant in m^2 (2008)
- forestareapc: afforested area per inhabitant in m^2 (2008)
- rural: dummy for a rural county relying on the classification of counties by the Federal Institute for Research on Building, Urban Affairs and Spatial Development

- leisure: weighted average and recoded self-reported satisfaction with leisure facilities (2004) (for details, see Buettner and Ebertz, 2009)
- crime: weighted average and recoded perception of crime (for details, see Buettner and Ebertz, 2009)
- sharelowskilled: share of workers with only primary education among regularly employed workers (2008)
- sharehighskilled: share of workers with tertiary education among regularly employed workers (2008)
- totalemission: aggregate CH_4, NO_X and SO_2 emissions of the mining and manufacturing sector in tons per km^2 (2005) (for details, see Buettner and Ebertz, 2009)
- tempmin30: 30-year average of daily minimum temperature 1971-2001
- sun30: 30-year average annual duration of sunshine in 100 h 1977-2007

Sources

- Provided by Federal Institute for Research on Building, Urban Affairs and Spatial Development via INKAR 2010: buildinglandprice, laborgrossincome, waterareapc, forestareapc, peripherality, rural, uempratio sharelowskilled, and sharehighskilled
- Provided by the Federal Institute for Research on Building, Urban Affairs and Spatial Development upon request: netrent
- Provided by the Federal Employment Agency: number of vacancies
- Provided by the Federal Statistical Office: totalemission and the number of unemployed people
- Provided by the German Weather Service via webverdis: tempmin30 and sun30
- Data obtained from the online survey "Perspektive Deutschland" that was conducted in Germany in 2004 by McKinsey & Company involving a large number of participants (data and details are available via GESIS at www.gesis.org): leisure and crime

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