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CESIFO WORKING PAPER NO. 3803
CATEGORY 1: PUBLIC FINANCE
APRIL 2012

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Abstract

Combining a spatial equilibrium model with a matching unemployment model, this paper analyzes the regional quality of life when wages, rents, and unemployment risk compensate for local amenities and disamenities. In particular, the paper shows for quasi-linear utility that the effects of any amenity on wages and unemployment rates are of opposite sign. Additionally, the wage rate and the labor market tightness increase and the unemployment ratio decreases in reaction to an increase in the level of an amenity if the amenity is marginally more beneficial to producers than to consumers per unit of land. Based on the model, quality of life of average mobile workers in West German counties is estimated.

JEL-Code: R120, R130, R140, H730, J610, J640.

Keywords: quality of life, unemployment, job search, matching, mobility.

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This version: April 2012

1 Introduction

Though the total population growth has been declining in many OECD countries, the demographic burden is not uniformly distributed among or within countries. While population declined in some regions, e.g., East Germany, southern Italy, western Spain, northern Sweden, during the same period, other regions experienced enormous increases in population, e.g., the western U.S., eastern Spain, southern Germany, northern Italy, and southern Sweden. The population of these countries is geographically mobile; more so 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. Taking into account price differences, households and firms move to locations where they expect to face better living and working conditions.

Employing a neoclassical model with perfect competition and perfect geographical household and firm mobility, the value households attach to local amenities can be calculated from the wages and prices of non-tradeable goods, especially land prices (see Rosen, 1979; Roback, 1982; Blomquist, Berger, and Hoehn, 1988; Blomquist, 2006). The quality of life of a certain location is measured by the amount of labor income minus expenditures for the non-tradeable 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 capture more consistently the 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 fixed effects rather than a long list of local amenities. Others 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 capture unemployment in empirical models, unemployment must be considered as a local disamenity.

Either unemployment is a right-hand side variable in price regressions or it is indirectly taken into account by location-specific fixed effects. However, unemployment cannot be considered as exogenous, because it is the result of individual decisions, institutions, and market forces. Furthermore, wages, land prices, and employment are simultaneously determined. Taking into account imperfect labor markets, unemployment risk must be added to local wages and local prices as 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 household's willingness 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 to 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 rate. Referring to the present discounted value of the expected income stream of perfectly mobile unemployed workers, we calculate a quality-of-life measure. Quality of life is determined as the land rent that mobile unemployed workers 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 the results with results from the standard approach, in which unemployment is considered as an exogenous disamenity. We also use these data to test several predictions from the underlying model.

The paper makes several important contributions: First, by adding a spatial dimension to a search-matching model, it develops a general equilibrium model with unemployment and geographic mobility that can be used to determine regional quality of life. As such, it 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 as an exogenous parameter. Second, we analyze for quasi-linear utility the relationship between regional amenities and the negative slope of the wage curve (see, e.g., Blanchflower and Oswald, 1994), that is, that 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. As opposed to Buettner and Ebertz (2009), our quality-of-life measure for West German counties is not based only on land rents.

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

2 Theoretical model

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

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

Individuals rationally choose regions under conditions of perfect foresight and perfect mobility to maximize lifetime utility. Each individual supplies in any period one unit of labor and demands one unit of land, the latter being used as a proxy for housing. Instantaneous utility is additive separable and the indirect utility function is

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

where y denotes the income net of 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

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

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 face only 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 and V is the number of vacancies. Defining labor market tightness as $\theta = V/U$, the worker arrival rate, i.e., the probability that a firm posting a vacancy finds a worker, can be written 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 worker finds a job, is $\theta q(\theta)$. To simplify the formal analysis, the on-the-job search is excluded from the analysis. This assumption implies that workers always migrate into unemployment and never into employment. Finally, workers face the risk of being fired with time-invariant (exogenous) probability, λ.

As absentee landlords and entrepreneurs are assumed, neither profits nor land rents are considered as a source of financing worker consumption. Furthermore, we assume that landlords could be taxed lump sum to balance the government budget which allows the fixing of unemployment benefits. An alternative interpretation would be that the federal government sets tax rates and unemployment benefits and balances its budget not at the regional, but at the national, level.

2.1 Present discounted values of utility and profit

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

[2] Partial derivatives are indicated by subscripts.

unemployed workers are

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

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 $\tau(0)=0$, $0\leq\tau<w$, and $0\leq\tau'<1$.[3] With probability $1-\lambda$, she will 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 faced by an unemployed worker in any other region is denoted by $\bar{J}_U$. When she loses her job, she may only choose between the last two options. An unemployed worker receives unemployment benefit, 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 of the present values of utility of unemployment inside and outside 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 gained from employment. Whenever production takes place in period $t+1$, the present value of employment cannot fall short of the present value of unemployment, that is, $J_N(t+1)\geq\max[J_U(t+1),\bar{J}_U(t+1)]$. Similarly, migration is not a dominant strategy of the unemployed if $J_U(t+1)\geq\bar{J}_U(t+1)$. The absence of mobility costs implies, in equilibrium, $J_U(t+1)=\bar{J}_U(t+1)$.

By the same procedure, the Bellman equations of active and non-active firms can be written as

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

where $J_F(t)$ and $J_V(t)$ are the present discounted values of profits of active and non-active firms. The present discounted value of profits of an active firm is determined by the

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

immediate cash flow $f(l(t), A) - w(t) - R(t)l(t)$ and the lagged present values of profits of active and non-active firms, weighted by the probabilities of occurrence λ and $1 - \lambda$. A non-active firm's present value of profits 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 only host active firms if $J_F(t+1) \geq J_V(t+1)$. Free entry and exit will push the present values of profits faced by 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 and $J_U(t)$ and $J_V(t)$:

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

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 steady states where production actually takes place.

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 workers, and the amount of land used by each firm are time-invariant.*

Applying this definition, steady state equilibrium conditions are

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

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

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

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

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

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

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

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

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

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

Setting the number of laid-off employees equal to the number of hired unemployed, 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), while 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, (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. As the wage falls short of 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) follows that

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

where $u = U/(U + N)$ is the unemployment ratio. Labor market tightness and unemployment move in opposite directions as the level of the amenity 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.

Due 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 a condensed form as

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

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

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 workers, 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.

From Equations (18) and (19), the following statement on existence immediately follows.

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

2.3 Quality of life

Equations (7) and (8) can be solved for 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 value of utility flows of a currently (un-)employed worker is a weighted average of instantaneous utility of unemployed and employed workers where the weights determined by the separation rate and the job-arrival rate. Totally differentiating J_U, yields the marginal willingness to pay for the amenity of unemployed workers.[4] Using the mobility equilibrium condition $J_U = \bar{J}_U$ and the relationship between labor market tightness and unemployment described by Equation (17), the marginal willingness to pay for the amenity of an unemployed worker can be written as:

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

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. The weight of wages is less than $1 - \tau'$, and the change in unemployment affects the willingness to pay via the job-arrival rate θq. Due to the assumption of fixed housing for both employed and unemployed workers, the weight of rents is the same.

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 worker if workers are risk averse, i.e., if $v_y^N < v_y^U$. Income matters less for the employed than for the unemployed because their present value of expected income is higher.

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

[4] The willingness to pay is defined as the maximum amount of resources the individual is willing to forgo *independent of the employment status in every period from now on* 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. The definition for firms is analogous.

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 than it is for perfect labor markets.
(iii) Risk averse unemployed workers 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

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

Solving Equations (10) and (11), leads to

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

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

Totally differentiating J_V and taking $J_V = 0$ and $(f_l - R)dl/dA = 0$ into account, yields 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 to pay of an inactive firm, since 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, i.e., $v = y + \phi(A)$. Totally differentiating conditions (7) through (16), the effect of changes in the level of the amenity can be determined. The comparative static exercise yields in particular

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

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

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

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 are of opposite signs.
(ii) If the amenity is productive and utility-enhancing, an increase in the level of the amenity raises land rents.
(iii) If the amenity is marginally more beneficial to producers than to consumers per unit of land, i.e., if $f_A/l > \phi'$, wage rate and labor market tightness increase and the unemployment ratio decreases in reaction to an increase of the level of the amenity.

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

Figure 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;

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

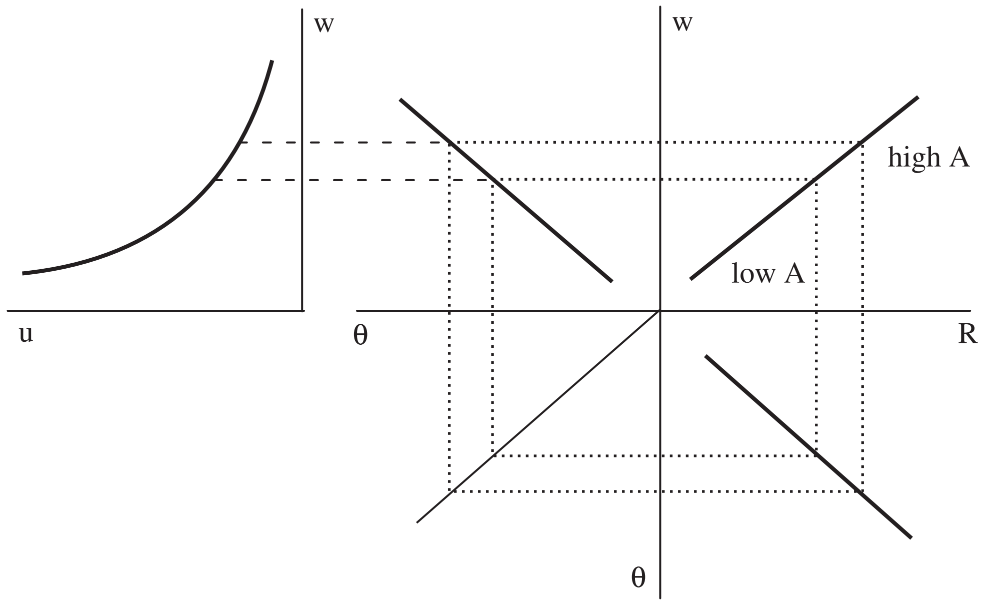

Figure 1: Amenity level, wages, rents, and labor market tightness if $v = y + \phi(A)$ and $f_A/l > \phi' > 0$

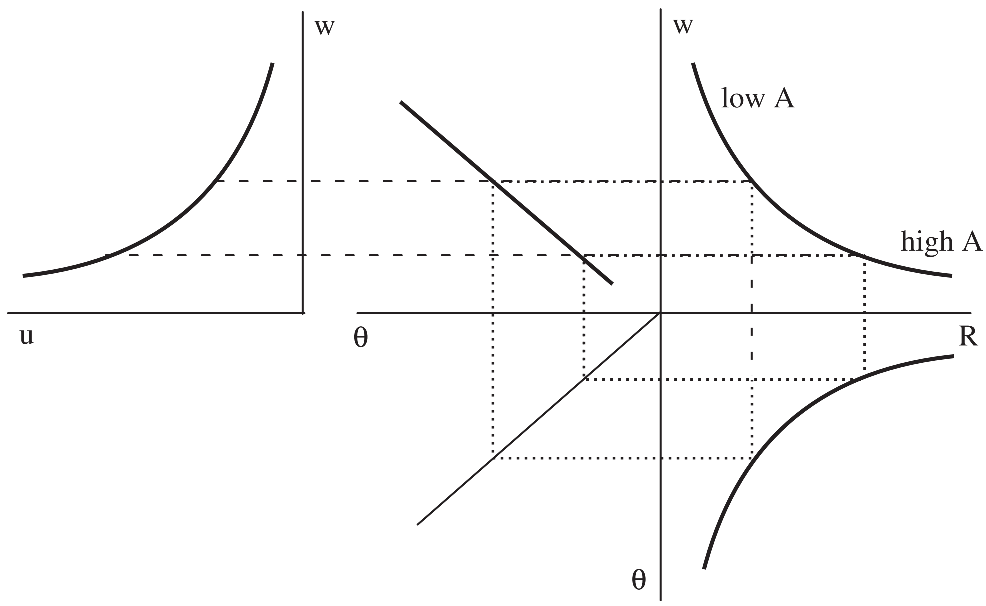

Figure 2: Amenity level, wages, rents, and labor market tightness if $v = y + \phi(A)$ and $0 < f_A/l < \phi'$

Nijkamp and Poot, 2005; Blanchflower and Oswald, 2005). The reason is that, on the one hand, both wages and labor market tightness affect the value of inactive firms negatively and the present value of unemployed workers positively. On the other hand, the steady state condition (15) implies that the unemployment ratio and the indicator of labor market tightness are negatively correlated. While the land rent compensates for the aggregate effect of an amenity, changes in wages and unemployment are driven by the difference between effects of the amenity on firms and workers. Since

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

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

If workers were risk adverse, i.e., if $\psi'' < 0$, 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), the effect of a variation in the amenity supply on land use by firms and labor market tightness can be analyzed. 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), determining J_U, has a negative slope, and Equation (19), referring to J_N, has a positive slope in the $\theta - l$-space (see Figure 3).

Differentiating these equations with respect to A indicates that the downward-sloping J_U-curve shifts downwards if and only if $f_{lA} - \phi' < 0$, while the upward-sloping J_N-curve shifts downwards 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 impact on labor market tightness (see Figure 3).[6]

While 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

[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.

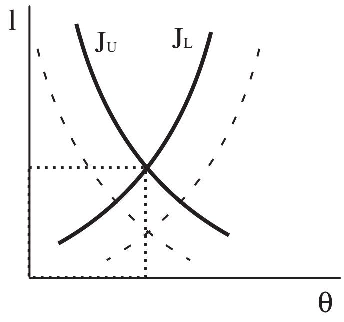

Figure 3: Amenity level, land use by firms, and labor market tightness if $v = y + \phi(A)$, $f_A > 0$, $\phi_A > 0$, and $f_{lA} < 0$

firms – being better off than their inactive counterparts – are practically immobile and, therefore, are affected by changes in amenity levels. Inserting for dR/dA, dw/dA, and $d\theta/dA$, total differentials can be calculated as:

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

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

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

For quasi-linear utility, the marginal willingness to pay for an amenity of both unemployed and employed individuals 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 – derived from Equations (22) and (23) – can be easily used for empirical estimations of the quality of life.

For quasi-linear utility, it is also possible to compare the standard approach relying on land rents and wages only with the approach proposed in this paper more rigorously.

Using comparative static results, 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 to pay of unemployed workers and inactive firms reads as

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

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

Because the coefficient of a change in wages for unemployed workers is between $-(1-\tau')$ and 0, the standard approach overestimates (underestimates) the willingness to pay of mobile workers if the amenity reduces (increases) the wage, provided that unemployment is altogether neglected in the hedonic estimations.

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

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

This 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 too strong and the amenity is mainly utility enhancing, 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., $\tau' = 0$, this condition can be written as

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

Taken altogether, workers and firms are willing to forego land rents and profits.

3 Empirical study

Data on 326 West German counties (mainly) for 2007/2008 will be used for the empirical exercise. Data are provided by the Federal Statistical Office, the Federal Employment

Agency, the Federal Institute for Research on Building, Urban Affairs and Spatial Development, the German Weather Service, and two variables are taken 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 laying the foundation for the calculation of the workers' quality of life in West German counties based on Equations (36) and (24). That is, in the empirical analysis, we assume quasi-linear utility.

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}, $i = R, w, u, \theta$, 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, the quality-of-life formula is adjusted by multiplying the coefficient with the average value of the imputed rent, and the wage, respectively, and by dividing it with the average value of the respective amenity.[7]

The proxies for the (dis-)amenities taken into consideration 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. As county data rather than

[7]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 $r = 0.05/12$.

individual wage data are used and wage varies 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.

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

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

Table 3 shows the results for OLS regressions for Equations (41) through (44). The results are most convincing for sunshine, minimum temperature, and peripherality. Sunshine has a statistically significant positive effect on land prices, wages, and labor market tightness but a negative effect on unemployment. Minimum temperature and peripherality show opposite effects, all significant with the exception of the effect of peripherality on labor market tightness. According to Equations (29) through (31), and Equation (17), for sunshine, $f_A/l > \phi'$ and $f_A > 0$ holds, for minimum temperature and peripherality, $f_A/l < \phi'$ and $f_A < 0$. Most likely, sunshine is a positive consumption and production amenity, while minimum temperature and peripherality are disamenities for both consumers and produc-

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, * p<0.1

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

ers. Rurality is similar to peripherality, but less significant. All other amenities show less consistent coefficients; i.e., mean effects are either insignificant or violate the predictions of the model. Omitted variables, measurement error and also misspecified spatial units may explain these ambiguous findings. The skill composition has the expected effect on wages. As labor market regions usually comprise more than one county, it is not surprising that R^2s and statistical significance are higher for the imputed rent than for labor market variables.

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 to pay of workers

Table 4 shows the willingness to pay for local amenities by (perfectly mobile) workers derived from regressions (41) through (43). Leisure, tempmin30, sun30, but also totalemission are amenities; waterareapc, forestareapc, crime, peripherality and rural are disamenities. Presumably, waterareapc, forestareapc, and totalemission are proxies for other local amenities not included in the analysis, e.g., travel distances and urban life style[8]

Quality of life, shown by figure 4, peaks especially in the metropolitan areas of Munich, Stuttgart, Rhein-Main, Rhein-Ruhr, and Nuremberg, while 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 valuable for workers.[9] On average, cities

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

[9]It should be stressed that absolute numbers, as well as ranks, are sensitive to changes in the weighting factor of rents, assumptions on lot size, and the set of included amenities. However, in particular the top rank of the Munich area is independent of varying parameter settings.

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, * p<0.1

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

enjoying county status are higher ranked than counties. Interestingly enough, the quality-of-life index is statically significantly positively correlated with netimmigration ($\rho = 0.48$).

To assess the overall impact of explicitly modeling unemployment, we compare our regressions with a standard regression of wage and imputed rents where 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

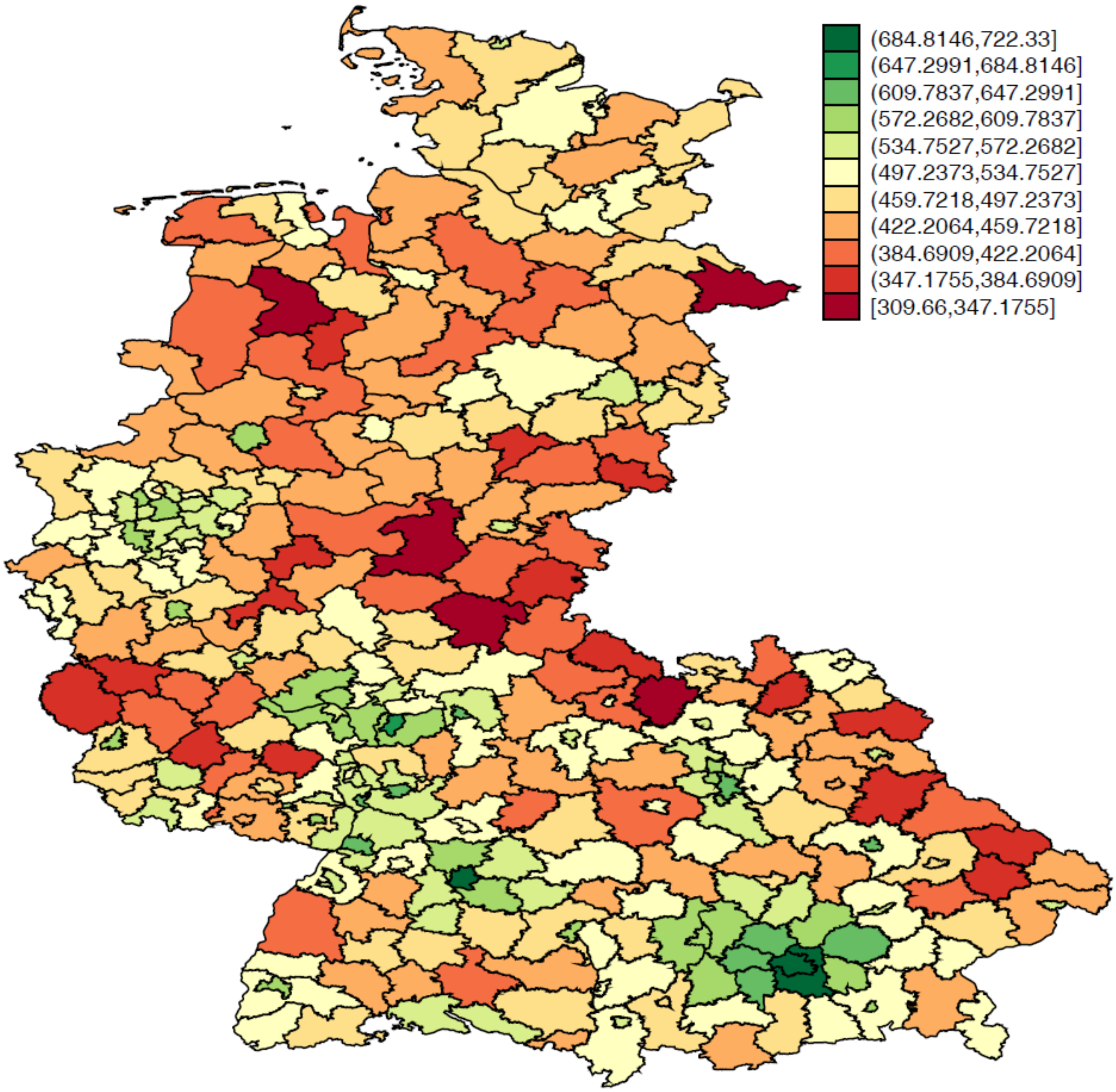

Figure 4: Quality of life in West Germany's counties 2007

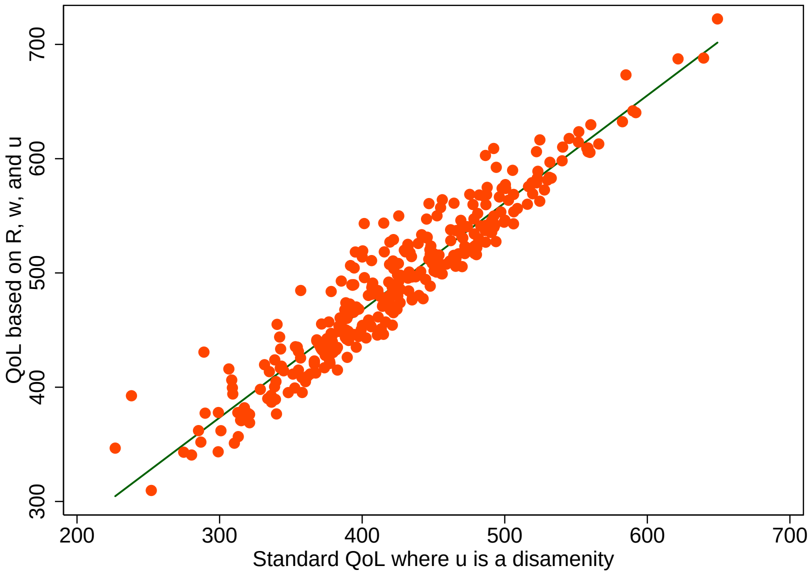

Figure 5: 3-variable approach vs. standard 2-variable approach

indicators.[10] A linear regression of our index on the standard index that disregards unemployment and is on average higher reveals an even stronger correlation with a regression coefficient of 0.9640.

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 non-linearly, we obtain a significant negative ratio $\beta_{\theta i}/\beta_{ui}$ for minimum temperature and sunshine.[11] The 95%-confidence intervals of these ratios substantially overlap and, according to a

[10]The Spearman rank correlation coefficients of Buettner and Ebertz (2009) quality-of-life index 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). Inclusion of net rents, differences in right-hand-side variables, and some differences in statistical methods may contribute to the somewhat low correlation of their approach and imputed rents based on the standard approach in our paper.

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

Wald test, equality of the ratios could not be rejected ($Prob > \chi^2 = 0.1680$ ($\chi^2(1) = 1.90$)).[12] However, in contrast to 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 data are not really reliable.[13] 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. While for some amenities this relationship is confirmed, for others the slope of the wage curve is positive or insignificantly negative.[14] Even more important, 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, compared to unemployment wages vary across counties much less than predicted by the model. Either collective bargaining and other omitted variables in the wage regression or risk aversion could explain this obvious deviation from the model's prediction. Hence, the implicit prices of amenities given in table 4 and the quality-of-life index shown in Figure 4 are only rough calculations and should be considered with some caution.

4 Concluding remarks

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

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

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

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

However, the theoretical model has left out several important issues. Neither on-the-job search nor migration costs were considered. Agglomeration externalities and inter-regional spillovers were also disregarded. Furthermore, while the model assumed migration into unemployment, migration of unemployed workers into employment 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, while the theoretical model assumed congruent labor and housing markets, counties are actually bad proxies for those markets, because housing markets are often smaller and labor markets are larger. However, all of these theoretical and empirical issues are left for future research.

Acknowledgement I thank Benjamin Wirth for excellent research assistance. This paper was presented at the CESifo area conference on public sector economics 2012 and at research seminars at University Osnabrück and Halle Institute for Economic Research. The comments of the participants, in particular Jean-Marie Lozachmeur, are appreciated with thanks.

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 of laborgrossincome and labornetincome with respect to laborgrossincome (2007)
- uempratio: share of unemployed in the workforce (2008)
- tightness: ratio of number of vacancies and number of unemployed (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, sharehighskilled
- Provided by the Federal Institute for Research on Building, Urban Affairs and Spatial Development on request: netrent
- Provided by the Federal Employment Agency: number of vacancies
- Provided by the Federal Statistical Office: totalemission, number of unemployed
- Provided by the German Weather Service via webverdis: tempmin30, sun30
- Data taken from the online survey "Perspektive Deutschland" conducted in Germany in 2004 by McKinsey & Company, involving a huge number of participants (data and details are available via GESIS on www.gesis.org): leisure, crime

References

Albouy, D. (2009): "The Unequal Geographic Burden of Federal Taxation," *Journal of Political Economy*, 117, 635–667.

Bauer, T., and S. Bender (2004): "Technological Change, Organizational Change, and Job Turnover," *Labour Economics*, 11, 265–291.

Bayer, P., N. Keohane, and C. Timmins (2009): "Migration and Hedonic Valuation: The Case of Air Quality," *Journal of Environmental Economics and Management*, 58, 1–14.

Bellmann, L., H.-D. Gerner, and R. Upward (2011): "Job and Worker Turnover in German Establishments," *IZA Discussion Paper*, 6081.

Blanchflower, D., and A. Oswald (1994): *The Wage Curve*. MIT Press.

——— (2005): "The Wage Curve Reloaded," *NBER Working Paper*, 11338.

Blomquist, G. (2006): "Measuring Quality of Life," in *A Companion to Urban Economics*, ed. by R. Arnott, and D. McMillen, pp. 480–501. Wiley-Backwell.

Blomquist, G., M. Berger, and J. Hoehn (1988): "New Estimates of Quality of Life in Urban Areas," *American Economic Review*, 78, 89–107.

Buettner, T., and A. Ebertz (2009): "Quality of Life in the Regions: Results for German Counties," *Annals of Regional Science*, 43, 89–112.

Card, D. (1995): "The Wage Curve: A Review," *Journal of Economic Literature*, 33, 785–799.

Chen, Y., and S. Rosenthal (2008): "Local Amenities and Life-Cycle Migration: Do People move for jobs or fun?," *Journal of Urban Economics*, 64, 519–537.

Deller, S. (2009): "Wages, Rent, Unemployment and Amenities," *Journal of Regional Analysis and Policy*, 39, 141–154.

Diamond, P. (1984): *A Search-equilibrium Approach to the Microfoundations of Macroeconomics*. Cambridge: MIT Press.

Douglas, S., and H. Wall (1993): "Voting with Your Feet and the Quality of Life Index: A Simple Non-Parametric Approach Applied to Canada.," *Economics Letters*, 42, 229–236.

——— (2000): "Measuring Relative Quality of Life from a Cross-Migration Regression, with an Application to Canada," *Research in Labor Economics*, 19, 191–214.

Gabriel, S., and S. Rosenthal (2004): "Quality of the Business Environment Versus Quality of Life: Do Firms and Households Like the Same Cities?," *Review of Economics and Statistics*, 86, 438–444.

Greenwood, M., G. Hunt, D. Rickman, and G. Treyz (1991): "Migration, Regional Equilibrium, and the Estimation of Compensating Differentials," *American Economic Review*, 81, 382–390.

Gyourko, J., and J. Tracy (1991): "The Structure of Local Public Finance and the Quality of Life," *Journal of Political Economy*, 99, 774–806.

Hobijn, B., and A. Sahin (2009): "Job-finding and Separation Rates in the OECD," *Economics Letters*, 104, 107–111.

Lee, C. (2008): "Migration and the Wage and Unemployment Gaps Between Urban and Non-urban Sectors: A Dynamic General Equilibrium Reinterpretation of the Harris-Todaro Equilibrium," *Labour Economics*, 15, 1416–1434.

Mortensen, D., and C. Pissarides (1994): "Job Creation and Job Destruction in the Theory of Unemployment," *Review of Economic Studies*, 61, 397–415.

Nakajima, K., and T. Tabuchi (2011): "Estimating Interregional Utility Differentials," *Journal of Regional Science*, 51, 31–46.

Nijkamp, P., and J. Poot (2005): "The Last Word on the Wage Curve?," *Journal of Economic Surveys*, 19, 421–450.

Petrongolo, B., and C. Pissarides (2001): "Looking into the Black Box: A Survey of the Matching Function," *Journal of Economic Literature*, 39, 390–431.

Pissarides, C. (2000): *Equilibrium Unemployment Theory.* MIT Press.

Roback, J. (1982): "Wages, Rents, and the Quality of Life," *Journal of Political Economy*, 90, 1257–1278.

Rogerson, R., and R. Shimer (2011): "Search in Macroeconomic Models of the Labor Market," in *Handbook of Labor Economics, Volume 4a*, ed. by O. Ashenfelter, and D. Card, pp. 619–700. Elsevier.

Rosen, S. (1979): "Wages-based Indexes of Urban Quality of Life," in *Current Issues in Urban Economics, Baltimore*, ed. by P. Mieszkowski, and M. Straszheim. John Hopkins University Press, Baltimore.

Suedekum, J. (2005): "Increasing Returns and Spatial Unemployment Disparities," *Papers in Regional Science*, 84, 159–181.

Wall, H. (2001): "Voting with Your Feet in the United Kingdom: Using Cross-Migration Rates to Estimate Relative Living Standards," *Papers in Regional Science*, 80, 1–23.

Winters, J. (2010): "Differences in Quality of Life Estimates Using Rents and Home Values," *MPRA*, 24270.

Zenou, Y. (2009): *Urban Labor Economics.* Cambridge University Press.