Quality of Life in the Regions
Results for German Counties

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Abstract

In order to assess differences in living conditions across German regions we apply the hedonic approach of Rosen (1979) and Roback (1982) to land-price and wage differences across Germany's counties. Employing a recent survey of more than half a million Germans on a wide range of social and political issues we confirm that differences in amenities give rise to substantial differences in land prices. With regard to wages, however, we find only little effects of amenities. Relying on the land-price effects we assess the quality of life in each of the German counties and provide a comprehensive ranking.

JEL Code: R22, R32.
Keywords: Land prices; regional income differentials; hedonic regression; quality of life; compensating wage differentials.

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1 Introduction

Differences in living conditions, land prices, and in the quality of life always capture a lot of attention by citizens and local governments in Germany as well as in other countries of the world. However, there has been little research on this issue in Germany as compared to the US, for example. This could well be due to a lower degree of household mobility. The neglect of those issues is, however, disturbing since the German systems of local public finance and fiscal federalism place a lot of emphasis on attempts to equalize living conditions across regions. Moreover, since sub-national governments consume a rather large fraction of the public sector's budget in Germany, there is much need of an evaluation of sub-national government policies and their impact on the quality of life.

Several attempts have been made to assess and compare regional growth and labor market situations and many more possibly relevant indicators of living conditions (*e.g.*, Prognos, 2004). However, an objective assessment of living conditions faces not only substantial problems in collecting information, it also would have to make rather arbitrary assumptions about how different regional characteristics can be aggregated in order to obtain a comprehensive assessment. Given the substantial difficulties involved we suggest to adopt a market-based, hedonic, approach where problems of both, gathering information as well as aggregating regional characteristics, are solved using the revealed willingness to pay. The hedonic approach, pioneered by Rosen (1979) and Roback (1982), utilizes differences in land prices and wages across regions to infer the marginal willingness to pay for regional attributes including quantity and quality of public services. Based on corresponding estimates we follow Blomquist, Berger, and Hoehn (1988) and generate an index of the quality of life across German regions.

To the best of our knowledge no attempt has been made so far to apply this concept to German regions. This might be due to the lack of information about regional characteristics, in particular with regard to hard-to-measure public services and amenities such as safety, education, or the facilities for leisure activities. For this study we utilize a large, almost untapped, data source,

the "Perspektive Deutschland" study 2004/2005,[1] a recent survey among more than half a million households on a wide range of social and political issues, and combine this with county-level data from a variety of other sources.

Our results show that, indeed, differences in amenities and disamenities do capitalize into land prices and can be used to predict a substantial part of observed land-price differences across regions, supporting the hedonic approach. With regard to wages, however, we find only little effects of amenities. Nevertheless, relying on the land-market effects of amenities a quality of life indicator is computed which ranks cities and counties. The results indicate that among the West German regions the southern regions rank highest. The regions in the East show less pronounced differences in the quality of life which to some extent reflects consistent labor market difficulties.

The paper proceeds as follows. The following section derives the underlying theoretical model. Section 3 briefly describes the data. Section 4 discusses the investigation approach. Section 5 presents the results from hedonic land-price and income regressions. Section 6 is concerned with the implicit prices and the quality of life index. Section 7 provides a short summary.

2 Theoretical Background

This section briefly reviews the basic approach to the estimation of quality of life developed by Rosen (1979) and Roback (1982). For an excellent overview see Blomquist (2006). Consider a spatial equilibrium model with several jurisdictions. Each provides specific quantities of (dis-) amenities. Land is scarce such that mobile households and firms compete for locations with high levels of amenities (low levels of disamenities). Spatial equilibrium requires household utility and production costs to be equal across jurisdictions such that there is no further arbitrage opportunity by moving. Therefore, housing costs and wages have to adjust according to the respective amenity levels at each location.

[1] This study was initiated and conducted by McKinsey corporation. For an overview of the project see Fassbender and Kluge (2006).

Let us assume that households have identical preferences and offer one unit of labor, each. They earn the regional wage rate w_j and consume housing h_j and a tradable good, which serves as a numeraire. For simplicity, we further assume that the price of one unit of housing is equal to the land rent r_j. Utility maximization yields an indirect utility function with the usual properties. It characterizes the combinations of private consumption and amenities for which households are indifferent between locations

$$u^* = V\left(\underbrace{w_j - r_j}_{x_j}, A_j\right), \tag{1}$$

where private consumption x_j is determined by the household budget constraint, $x_j = w_j - r_j$, and A_j denotes the vector of (dis-)amenities $a_{j,i}$ at location j. (Dis-)amenities increase (decrease) household utility according to

$$\frac{\partial V\left(w_j - r_j, A_j\right)}{\partial a_{j,i}} > (<)\, 0.$$

Firms produce the numeraire using local labor and land. Profit maximization requires that the unit cost are equal to the price of the numeraire such that

$$1 = c\left(w_j, r_j, A_j\right), \tag{2}$$

where c is the unit cost function. A regional attribute $a_{j,i}$ also can be a production (dis-)amenity, depending on its effect on the unit cost:

$$\frac{\partial c\left(w_j, r_j, A_j\right)}{\partial a_{j,i}} < (>)\, 0.$$

Spatial equilibrium is characterized by a combination of wages and rents which solves both equations simultaneously. This is illustrated graphically in Figure 1. For a given level of amenities A_1 in region 1, all combinations of wages and housing prices that leave the household indifferent with regard to other regions are located on the lower upward sloping line. Unit costs for the same set of attributes A_1 are depicted by the lower downward sloping line. The intersection at point a determines the equilibrium levels of housing price r_1 and wage rate w_1. The second set of curves refers to region 2 which is more attractive for households in the sense that it has more amenities

and less disamenities. Formally, this case is characterized by the requirement that

$$a_{2,i} > a_{1,i} \text{ if } \frac{\partial V\left(w_j - r_j, A_j\right)}{\partial a_{j,i}} > 0, \qquad \text{and } \textit{vice versa}.$$

As a consequence, the iso-utility curve shifts up. The consequence for wages depends on whether the amenities have also effects on productivity. If there are no effects the equilibrium would be at intersection point b. In this case, land rents would be higher but wages would be reduced to maintain cost-competitiveness. The positive impact on land prices is often referred to as (cross-sectional) capitalization of amenities into the land price. Note, however, that capitalization is only partial, as wages adjust.

However, it may well be the case that amenities have productivity effects. Consider the case of positive productivity effects of amenities and negative productivity effects of disamenities, such that

$$a_{2,i} > a_{1,i} \qquad \text{if } \frac{\partial c\left(w_j, r_j, A_j\right)}{\partial a_{j,i}} < 0, \qquad \text{and } \textit{vice versa}.$$

Then, region 2 would be able to pay a higher land rent at the going wage rate, in other words, the iso-cost curve shifts up – the higher cost–competitiveness would show up in higher land-rents. Thus, due to the productivity effects the land-rent would be further increased. The impact on the wage rate now becomes ambiguous and we might even have a higher wage rate in equilibrium as depicted by intersection point c.

Wage and land-price effects can be used to obtain an implicit price for each amenity f_i. To see this, differentiate equation (1) and make use of the mobility assumption to obtain:

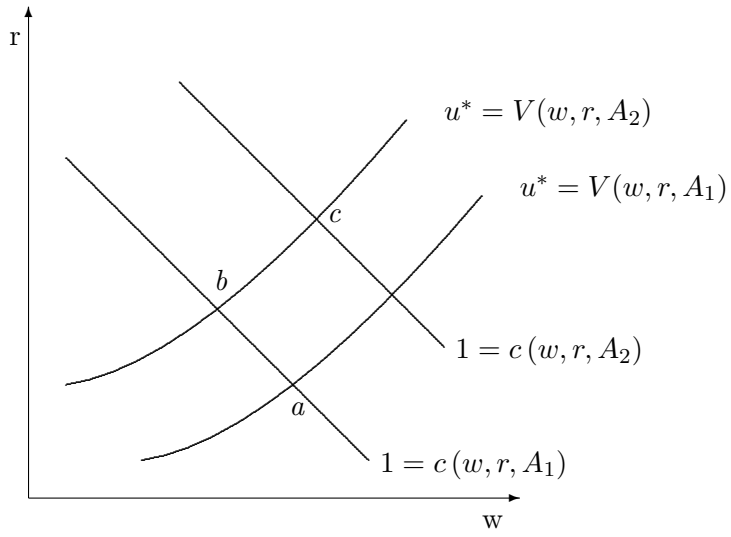
$$\frac{\partial V}{\partial x_j} dw_j - \frac{\partial V}{\partial x_j} dr_j + \frac{\partial V}{\partial a_{j,i}} da_{j,i} = 0.$$

Rearranging yields the implicit price of amenity i

$$f_i \equiv \frac{\partial V}{\partial a_{j,i}} / \frac{\partial V}{\partial x_j} = \frac{dr_j}{da_{j,i}} - \frac{dw_j}{da_{j,i}}. \tag{3}$$

This expression indicates that the marginal assessment of an amenity can be obtained from the price responses of the rental price of land and the wage rate.

Figure 1: Land Rent and Wage Rate in Spatial Equilibrium



Given information about price responses to each of the amenities we can construct a weighted average representing the quality of life index. The index is calculated in a straightforward manner by summing over all amenities using the implicit prices as weights:

$$QOL_j = \sum_i f_i a_{ij}. \tag{4}$$

Based on the theory, QOL_j is an estimate of the willingness to pay for the bundle of amenities and disamenities in region j.

3 Investigation Approach

To obtain empirical estimates of capitalization into land prices and income effects of each amenity, we estimate hedonic land-price and income regressions.

In a first step, we regress the natural logarithm of average regional land prices on our set of regional

(dis-)amenities:

$$\ln r_j = \beta_0 + \beta_1 z_j + \beta_2 A_j + \varepsilon_j, \tag{5}$$

where z_j is a vector of land-market characteristics and A_j is the set of (dis-)amenities in region j. However, note that there are no a-priori restrictions imposed on the parameters. In other words, we do not postulate that a region characteristic is perceived as an amenity or as a disamenity for households and/or firms. z_j captures control variables related to variations in the location rent as suggested by standard models of the urban land market (see DiPasquale and Wheaton, 1996). This includes population density as the main determinant of the location rent within metropolitan and urban areas and population growth as an indicator of the expected change in the location rent.

In a second step, we model the log of monthly net household income reported by full-time employed respondents as a function of individual characteristics like gender, education, job, etc., the number of adult household members as well as of our set of regional (dis-)amenities. The regression equation models the income of household k in region j:

$$\ln w_{k,j} = \alpha_0 + \alpha_1 x_k + \alpha_2 A_j + \alpha_3 z_j + \varepsilon_k, \tag{6}$$

where x_k is a vector of individual characteristics. Since data on household income is reported in income classes we use the means of these classes to construct the left-hand variable. Estimation is done using weighted least squares to take account of the sampling weights of the various types of respondents in the survey dataset. As micro data at the household level are combined with aggregate data at the regional level, inference is based on heteroscedasticity and group-correlation consistent standard errors. While the theoretical model relies on the strong assumption of perfect mobility, we experiment with different groups of households to identify possible effects of differences in household mobility.

In a third step, the coefficients (α_2, β_2) obtained are converted into implicit prices for the amenities. For this purpose, with regard to the land-price regression we need to convert the prices per sqm into monthly spending by households. To do so, we multiply the marginal land-price effect of each amenity by a factor h, which represents an estimate of the monthly housing cost associated with a

land price of € 1 per squared meter.[2] The implicit price of amenity i follows from equation (3).

As the coefficients obtained from the hedonic regressions (5) and (6) are subject to considerable variation in their statistical significance we calculate standard errors for the implicit prices. For this purpose, we employ a Monte-Carlo simulation approach. Technically, we randomly draw 1000 observations of each amenity coefficient from a multivariate normal distribution with an underlying variance-covariance structure equivalent to that of the respective estimation. We then apply the calculations as described above and finally get a mean value for each implicit price and its corresponding standard deviation.

4 Data and Descriptive Statistics

While the above approach has been applied several times to US data, to the best of our knowledge no attempt has been made so far to apply the quality of life concept to German regions. This study is concerned with the county-level in Germany which comprises 116 unincorporated cities, sometimes referred to as urban counties, and 323 counties. The latter are larger administrative units incorporating, on average, 38 municipalities.

Table 1 presents summary statistics for land prices, household income, amenities, and control variables. The data is obtained from a variety of sources. Data on land prices comes from the German federal and regional statistical offices and refers to transactions of land available for construction. Land prices are calculated as average prices per sqm sold in 2001 - 2003 in each county.[3]

Data on household income as well as on several amenities is based on the "Perspektive Deutschland"

[2]We use a figure of $h = .53$, which is obtained as follows: we first obtain an estimate of the average lot size used for a housing unit: for this purpose we multiply the average lot size (752.8 sqm) with 0.25 which is an estimate of the share of land typically consumed by the structure following Viejo Garcia (2003). In a second step we divide this figure by an average number of housing units per structure (1.479) taken from the Statistical Yearbook (2006). In the last step we transform each Euro of land value per sqm into monthly cost by fixing the rate of interest at 0.05 and dividing by 12.

[3]Most data points are three-year averages. However, some data is missing for privacy reasons and we use 2004 land prices to obtain three- or at least two-year averages where possible.

study 2004, a large survey among more than half a million Germans. It reports opinions and valuations of German residents concerning a variety of aspects of life in Germany and the German regions, respectively. Along with this information, the data set contains information on household income, age, education, local neighborhood, job, etc. Representativeness is ensured by sampling weights drawn from a parallel field-survey with more than 10,000 participants. The regression analysis of the wage equation as well as the aggregation of survey responses at regional level both take account of these sampling weights to correct for participation bias.

Information on monthly household income is reported in eleven income intervals (see Appendix) net of taxes and including transfers. In order to reduce possible problems with the differences in hours worked we focus on full-time employed individuals in our analysis. We use the means of each income class as dependent variable in our hedonic income estimation. However, the highest interval is top-coded, *i.e.* it has no explicit upper bound. We therefore follow Cowell (2000) and assume that the distribution of household income is Paretian over the highest two intervals. Fitting the distribution to our data gives an estimate of the Paretian shape parameter $a > 1$, which allows us to obtain an estimate of the mean of the highest income class.[4]

To capture the residents' living conditions we use data from the same survey and compute indicators of the assessment of the region in terms of security and crime, education, cultural and leisure facilities, the local market for labor, as well as accessibility and traffic conditions. In the survey, these variables show the value 1 if the participant considers the aspect in question as being one of the four most urgent problems to be dealt with in her/his residential region. For our purposes, the individual assessments are aggregated at the county level. To facilitate interpretation we recode the variables, such that our regressors take values between zero and one, where a higher value indicates a better situation or less need for improvement (except for crime, where a higher value indicates a worse situation). Formally, we aggregate over individual assessments of amenity i in region j by

$$\frac{1}{\sum_{k=1}^{n_j} \mathsf{w}_{k,j}} \sum_{k=1}^{n_j} \mathsf{w}_{k,j} \left(\text{"Urgent problem"}_{k,j,i} = 0 \right),$$

[4]We obtain a shape parameter of the Pareto distribution of the highest two intervals of $a = 5.04$, resulting in a mean of the highest income class of $\widehat{w} = 7484.62$. For the sample of mobile households we have $a = 5.03$ and $\widehat{w} = 7487.85$. See Cowell (2000), p.156f, for more details.

where i refers to the variables leisure facilities, accessibility, education, and local labor market, and $\mathsf{w}_{k,j}$ is the respondent's sampling weight. "urgent problem"$_{k,j,i} = 0$ indicates that respondent k from region j considers i not to be an urgent problem.[5] An additional labor market indicator is designed specifically to capture the existence of job alternatives within the region. This indicator captures the individuals' expectations of whether an adequate job would be found in the region in case of job loss. The individual response takes the value unity if the answer is yes and zero otherwise. Individual assessments are aggregated simply as the weighted sum

$$\frac{1}{\sum_{k=1}^{n_j} \mathsf{w}_{k,j}} \sum_{k=1}^{n_j} \mathsf{w}_{k,j} \left(\text{"Altern. job opportunities exist"}_{k,j} = 1 \right),$$

where "Altern. job opportunities exist"$_{k,j} = 1$ indicates that respondent k from region j expects to find an alternative job opportunity.

Further amenity data relates to climate and environment. The data on sunshine comes from the Federal Meteorological Office ("Deutscher Wetterdienst"). It reports the average annual duration of sunshine in 2004 in 100 hours measured at one observatory in each county. Data on industry emissions stems from federal and states' statistical offices and utilizes information about the average emission of CH4, NOx and SO2 particles in 27 industry branches on a per-worker basis. For each county, we calculate total emission in tons per sqkm using local employment in these industries. Further variables capture the area covered by forests or water as a fraction of total county area. Another variable reports the number of overnight stays and is used to capture regions specialized in tourism. Some further variables capture possible advantages from living in or close to metropolitan areas which might relate not only to productivity advantages of agglomerations but also to consumption advantages.[6] Metropolitan area is a binary variable reflecting the classification of the Federal Bureau of Regional Planning ("Bundesamt für Bauwesen und Raumordnung"). An indicator of the peripherality is taken from the same source and reports the average travel time to the next three agglomeration centers in minutes. Finally, as an indicator of social problems, a local poverty variable is added capturing the number of welfare recipients per resident.

[5] To obtain an indicator for crime we simply sum whether the respondent *is* considering crime as an urgent problem.

[6] For a discussion see Rosenthal and Strange (2004) and Dalmazzo and de Blasio (2007).

Moreover, we use a couple of control variables. In the land price regressions, population density and population growth are used to capture differences in the location rent and are obtained from the states' statistical offices. The analysis of cross-sectional income differences includes several individual characteristics following the standard Mincer-type wage regression at the individual level. This includes indicators of nationality, family status, gender, age, and education. A further variable captures the size of the household of the respondent. In order to make sure that the specific situation in eastern Germany does not affect the results we include a binary variable for counties in the eastern part of the country capturing the former German Democratic Republic and Berlin. Since unincorporated cities and counties are different administrative units we also include a binary variable which is unity for rural counties (as opposed to urban counties). Furthermore, an interaction term is added capturing the city/county difference in the eastern part of the country.

5 Regression Results

Table 2 reports the results of hedonic regressions of land prices and household income on the set of amenities. The results for the land-price regressions are reported in Column (1). Except for education and the dummies for metropolitan area and rural county, all amenities show a significant impact on the log of the land price. The signs are as expected: the price for land is higher in regions with more sunshine, more appeal to tourists, or good traffic connections, whereas high levels of industry emissions or perceived crime tend to reduce the price. Strong effects are also exerted from the local labor market conditions and the existence of alternative job opportunities within the region - the positive coefficients of the respective variables are highly significant. The overall predictive power of the regression is quite good: about 90 % of observed differences in the land price across German counties can be predicted from the local amenities and further controls.

The results from the income regression are provided in Column (2). Note that the estimates are obtained from a weighted-least squares approach where individual observations are weighted with the sampling probability. The Mincer-type variables show highly significant coefficients with the expected sign for all of the individual characteristics. However, the amenity variables prove mostly insignificant. Only the labor-market situation shows a significant positive effect. While this is at

Table 1: Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max
	Survey data "Perspektive Deutschland"			
Leisure facilities	.784	.071	.523	.957
Crime	.185	.076	.032	.480
Accessibility	.720	.126	.275	.973
Education	.694	.067	.481	.883
Local labor market	.272	.158	.006	.724
Altern. job opport.	.097	.049	.002	.254
Household income	2456	5.91	250	7485
HH income (mobile sample)	2491	7.69	250	7488
	County characteristics			
Sunshine	16.2	1.19	10.5	18.9
Industry emissions	6.06	9.97	.061	80.2
Share of forest	27.4	15.2	.800	64.8
Share of water	2.48	3.07	.200	28.8
Tourism	4.48	6.50	.200	76.9
Met.area	.352	.478	0	1
Peripherality	104	38.3	24	258
Poverty	29.3	16.2	3.50	118.5
East	.256	.437	0	1
Rural	.733	.443	0	1
Rural-east	.194	.396	0	1
Population growth	.535	6.05	-25	19.4
Density	5.08	6.55	.398	40.2
Land price	119	111	15.0	979

See text for description. Statistics for 438 counties. Figures on individual household income are weighted and refer to 211216 weighted observations in the full sample and 127828 weighted observations in the sample of mobile households, respectively.

Table 2: Regression Results

Variable	log Landprice (€ /sqm) (1)		log Household Inc. (net) (2)	
Region Characteristics				
Leisure facilities	1.55***	(.279)	.103	(.057)
Crime	-.815**	(.266)	-.054	(.045)
Accessibility	.664***	(.155)	-.044	(.036)
Education	.034	(.250)	.008	(.061)
Local labor market	1.03***	(.209)	.201***	(.038)
Altern. job opport.	2.09***	(.542)	.090	(.108)
Sunshine	.038**	(.012)	.004	(.003)
log Ind. emissions	-.086**	(.030)	-.001	(.006)
Share of forest	.006***	(.001)	.000	(.000)
Share of water	.020***	(.005)	.000	(.001)
Tourism	.010***	(.002)	-.001	(.001)
Met.area	.049	(.032)	.028***	(.007)
Peripherality	-.001*	(.001)	-.000	(.000)
Poverty	-.004*	(.001)	.000	(.000)
East	-.456***	(.075)	-.103***	(.020)
Rural	-.058	(.065)	.011	(.014)
Ruraleast	.189*	(.076)	-.022	(.018)
Region Controls				
Populationgrowth	.018***	(.003)	.002	(.001)
log Density	.561***	(.058)	-.000	(.010)
Individual Characteristics				
German			.065***	(.015)
Married			.232***	(.005)
Female			-.073***	(.005)
Year of birth			.050***	(.007)
Year of birth sqrd			-.002**	(.001)
Education			.080***	(.007)
Education sqrd.			-.002***	(.000)
No. of household members			.074***	(.003)
R^2	.898		.334	

Results for the land price are obtained from least squares estimation with 435 observations; heteroskedasticity robust standard errors in parentheses. The income regression results are obtained using weighted-least squares with weights for individual sampling probabilities. Sum of weighted observations: 211190. Robust standard errors clustered at region level in parentheses. * denotes significance at the 10% level (** at 5%, *** at 1% level).

odds with the existence of compensating wage differentials it should not be overemphasized since respondents may take the regional wage level into account when assessing the local labor market conditions. Moreover, the second labor market indicator which is more precisely asking for job opportunities is not significant. A significant positive effect is obtained only for the indicator for metropolitan areas which possibly points at some agglomeration effects.[7]

Note that the dummy for eastern German counties remains significantly negative in both regressions. This indicates that the differentials in land prices and income between western and eastern Germany cannot be fully explained by amenity differences or by differences in the labor-market situation. This might point to some omitted amenities favoring West Germany's regions. However, an alternative explanation might relate to transition problems in the East.

Since the data on land prices used in this study reflect actual transactions of land ready for construction, it makes sense to argue that, as it reflects location decisions, it may well be representing decisions where mobility is important. This is different with the income data which simply report the earnings of the current population. Hence, lack of household mobility might be much more important in the income regressions. The second column of Table 3 reports results obtained using a sub-sample of households that have explicitly expressed a higher willingness to move in the survey.[8] For ease of comparison, the first column repeats the above results. As can easily be seen, most of the amenities still prove insignificant. Only leisure facilities and sunshine now exert positive effects on the wage level. However, also the positive coefficient of the local labor market indicator is confirmed.

[7]The size of the coefficient points at an urban income premium of about 3 %. Lehmer and Moeller (2007) find a wage premium of 8 %. However, note that our study is concerned with household income and includes taxes and transfers.

[8]More precisely, the sub-sample consists of people who responded positively to the survey question "Could you basically imagine to move to a region that is located at a distance of more than 100 km from your current residence?"

Table 3: Income Regression: Further Results

Variable	log Household Inc. (net) complete sample (1)		log Household Inc. (net) sample of mobile Households (2)	
Region Characteristics				
Leisure facilities	.103	(.057)	.190**	(.073)
Crime	-.054	(.045)	-.022	(.053)
Accessibility	-.044	(.036)	-.060	(.040)
Education	.008	(.061)	.040	(.069)
Local labor market	.201***	(.038)	.160***	(.046)
Altern. job opport.	.090	(.108)	.077	(.127)
Sunshine	.004	(.003)	.006*	(.003)
log Ind. emissions	-.001	(.006)	.005	(.007)
Share of forest	.000	(.000)	.000	(.000)
Share of water	.000	(.001)	.000	(.001)
Tourism	-.001	(.001)	.000	(.001)
Met.area	.028***	(.007)	.035***	(.009)
Peripheral	-.000	(.000)	-.000	(.000)
Poverty	.000	(.000)	.000	(.000)
East	-.103***	(.020)	-.084***	(.019)
Rural	.011	(.014)	.012	(.015)
Ruraleast	-.022	(.018)	-.032	(.019)
Region Controls				
Populationgrowth	.002	(.001)	.002*	(.001)
log Density	-.000	(.010)	-.009	(.012)
Individual Characteristics				
German	.065***	(.015)	.067***	(.015)
Married	.232***	(.005)	.236***	(.006)
Female	-.073***	(.005)	-.081***	(.006)
Year of birth	.050***	(.007)	.047***	(.010)
Year of birth sqrd	-.002**	(.001)	-.001	(.001)
Education	.080***	(.007)	.078***	(.009)
Education sqrd.	-.002***	(.000)	-.002***	(.000)
No. of household members	.074***	(.003)	.082***	(.003)
R^2	.334		.350	

Weighted least squares estimates with weights for individual sampling probabilities. Robust, clustered standard errors in parentheses. * denotes significance at the 10% level (** at 5%, *** at 1% level). Complete sample: sum of weighted observations: 211190. Sample of mobile HH: sum of weighted observations: 127820.

6 Implicit Prices and Quality of Life Index

As discussed above, in order to obtain the implicit price of an amenity the standard approach does not only consider the land-price effect but also the income effect of the amenity. For most amenities, however, the above results confirm only land-price effects. Apart from the labor market variable, significant income effects have only been found for metropolitan regions, sunshine, and leisure facilities. An attempt to incorporate those income effects, however, faces problems. To see this, consider, for instance, the sunshine variable. Sunshine exerts a positive impact on the land price. Let us ignore for a moment the income effect of sunshine. Evaluating the point estimate of the semi-elasticity at the mean land-price we obtain an implicit price of € 2.40 per 100 hours of sunshine. However, at least in the income regression for the mobile households we obtain a positive income effect. This suggests that the implicit price of sunshine might be overestimated. To see this assume that the income effect would amount to the same value, *i.e.* € 2.40. Then, the land price effect of sunshine would simply reflect the income effect, in other words, the direct utility impact of sunshine would be zero in this case. However, evaluating the point estimate of the semi-elasticity of sunshine in the income regression at the mean income level we find that the income effect of 100 hours of sunshine is € 14.95. As a consequence, if we base the calculation of the implicit price on the difference of land-price and income effects, we would assign a negative price to sunshine: an increase of the hours of sunshine would exert a depressing effect on utility. Applying the same procedure to leisure facilities would similarly suggest that better leisure facilities would deteriorate the quality of life. The relative strength of land-price and income effects depends crucially on the factor by which price effects on land are translated into monthly housing cost. Therefore, the unconvincing results may just be a result of a too low translation factor. However, it is also disturbing that the income regression does not point at any compensating income differentials. One might speculate whether this results from specific institutions in the labor market. Another, more simple explanation is that the income data available to our study is somewhat flawed as it includes also taxes and transfers.

Facing those difficulties we compute implicit prices solely on basis of the land-price regression. In terms of equation (3) this implies to set $\frac{dw_j}{da_{j,i}} = 0$. Table 4 reports the resulting implicit prices for the amenities. The values in parentheses give the standard deviations of the prices obtained in our

Monte-Carlo simulation to account for differences in statistical significance.

The figures report the price per month. For example, the results suggest that households are willing to pay around € 2.40 per month to enjoy one hundred additional hours of sunshine per year. To illustrate the magnitude the last column of Table 4 reports the difference in the quality of life between the top 10 regions in the respective category and the mean. Accordingly, compared with a region with average hours of sunshine the quality of life is higher by about € 5.89 per month. In other words, households would be willing to pay about € 5.89 per month in order to enjoy the longer sunshine per year which is experienced in the ten regions with most hours of sunshine relative to the mean. Thus, combining implicit prices with the observed variation in amenities this column allows us to see what is mainly driving the quality of life differences. Generally, we can see that on the one hand quality of life differences are driven by geographical disposition, leisure facilities, and touristic amenities. On the other hand, the labor market conditions are quite important.

Another important difference in the quality of life relates to the situation in the eastern or western part of the country. However, the dummy for the eastern part of the country may simply reflect the incapability to adequately capture all possible regional amenities.

Table 5 summarizes the results for the quality of life index for each of the four groups of regions. Accordingly, the differences in the quality of life are most significant among counties in West Germany. The differences in East Germany are much less pronounced. Within the group of West German cities (urban counties) the maximal difference in the quality of life amounts to € 154.

Table 6 in the Appendix reports the quality of life index for each county. The table also shows the complete ranking of the counties in eastern and western Germany according to the index. Figures 2 and 3 report the results graphically. For West Germany Figure 2 shows that the southern part of the country exhibits the highest figures for the quality of life, whereas the northern regions tend to show much lower figures. For East Germany the quality of life differences are less spatially concentrated. This could possibly reflect the fact that labor market conditions are equally difficult in most regions in the East and, hence, geographical conditions might dominate.

Table 4: Implicit Prices (monthly figures in €)

Variable	Price	(Std.err)	Top vs. Average
Leisure facilities	97.9	(18.1)	14.8
Accessibility	41.7	(9.67)	9.28
Education	2.16	(15.3)	.325
Crime	-52.1	(16.5)	6.93
Local labor market	64.8	(13.2)	24.9
Altern. job opport.	131.4	(35.1)	17.0
Sunshine	2.40	(.782)	5.89
Ind. emissions	-.903	(.319)	5.33
Share of forest	.347	(.063)	12.1
Share of water	1.27	(.337)	19.6
Tourism	.610	(.139)	19.2
Met.Area	3.10	(2.02)	2.01
Peripherality	-.074	(.037)	5.16
Poverty	-.234	(.091)	5.48
East	-28.7	(4.69)	21.4
Rural	-3.39	(4.10)	.905
Ruraleast	11.8	(4.67)	9.52

Table 5: Descriptive Statistics on the Quality of Life (monthly figures in €)

Sub-sample	Mean	Std.Dev.	Min	Max
Rural counties (West)	170	22.7	120	245
Urban counties (West)	159	24.7	76	230
Rural counties (East)	126	12.5	98	175
Urban counties (East)	124	18.1	90	158

Calculations are based on the implicit prices according to the land-price effects. The list of amenities considered includes Tourism, Met.area, Peripheral, Rural, East, Ruraleast, Poverty, Share of water, Share of forest, Leisure facilities, Accessibility, Education, Crime, Industry emissions, Local labor market, Alternative job opportunities, and Sunshine.

7 Summary

In order to derive a comprehensive set of indicators of the quality of life in the German regions, we adopt a market-based, hedonic, approach where the problem of aggregation of various dimensions of the quality of life is solved using the revealed willingness to pay. Following Rosen (1979) and Roback (1982), we utilize differences in land prices and incomes across regions to infer the marginal willingness to pay for regional attributes including quantity and quality of public services.

Based on estimates of the cross-sectional capitalization of amenities into land prices and incomes we follow Blomquist, Berger, and Hoehn (1988) and generate an index of the quality of life across German regions. For this study, we utilize a large, almost untapped, data source, the "Perspektive Deutschland" study 2004/2005, a recent survey among more than half a million households on a wide range of social and political issues, and combine this with county-level data from a variety of other sources.

Our results show that, indeed, differences in amenities and disamenities do capitalize into land prices, supporting the hedonic approach to land prices. In fact, the land-price regression allows us to predict about 90 % of the observed land-price differences across German counties. However, with regard to incomes we fail to detect effects of most amenities. This finding proves to be robust even when focusing on households with higher mobility. However, it is remarkable that the income regressions do not point at any compensating income differentials. One might speculate whether this results from specific institutions in the labor market. Yet, a more simple explanation is that the income data available to our study fails to detect compensating wage effects as it reports household income and includes taxes and transfer income. Given this data limitation, it is left for future research to further discuss the existence of compensating wage differentials across regions in Germany.

Relying on land price capitalization we obtain implicit prices for each of the amenities. Taking into account the observed differences we find that quality of life differences are mainly driven by two sets of amenities. The first refers to geographical conditions, leisure facilities, and touristic amenities. The second set relates to local labor market conditions. Interestingly, the results confirm

a strong effect on the quality of life not only for labor market conditions in general but also for the expectation to find an alternative employment opportunity in the same region.

Finally, we derive a quality of life index for all German counties and cities. Accordingly, among the regions in West Germany the southern counties, particularly those in the Munich area, as well as in Baden-Wuerttemberg show the highest quality of life. For East Germany the quality of life differences are less concentrated spatially.

Appendix: Datasources and Definitions

Survey data on urgent problems are taken from the "Perspektive Deutschland" study 2004 and are based on answers to the question "which is the issue to be improved most urgently in your region?" The original variable takes the value unity if the aspect in question is considered one of the four most urgent problems in the region. We calculate the average assessment of each aspect in each county. We recode the variables, such that our regressors take values between 0 and 1, where a higher value indicates a better situation or less need for improvement (except for crime, where a higher value indicates a worse situation). The interpretation of the derived variables is:

Leisure facilities : local cultural and leisure facilities are considered as satisfactory.

Crime : crime is considered to be one of the four most urgent problems in the region.

Accessibility : local traffic system/connection to other regions is considered as satisfactory.

Education : local schooling/education facilities are considered as satisfactory.

Local labor market : local market for labor is considered as satisfactory.

Data on **alternative job opportunities** is also taken from the "Perspektive Deutschland" study 2004 and is based on answers to the question "in the case of loosing your job: will you be able to find an equally good job in your region within reasonable time?" The original variable takes the value unity if the answer is yes and zero otherwise. We calculate the average of all answers within each county.

Household income : net household income in € per month, grouped in eleven income classes as follows. Taken from the Perspektive Deutschland study 2004.

1	0 € - 500 €
2	500 € - 899 €
3	900 € - 1,299 €
4	1,300 € - 1,499 €
5	1,500 € - 1,999 €
6	2,000 € - 2,599 €
7	2,600 € - 3,199 €
8	3,200 € - 4,499 €
9	4,500 € - 5,499 €
10	5,500 € - 5,999 €
11	more than 6,000 €

Sunshine : average yearly duration of sunshine in 100 Hrs., measured at, at least, one meteorological office in each county. For counties with missing information the value of the closest neighboring county is used. Taken from "Deutscher Wetterdienst" (2004).

Emissions : aggregate emission of CH4, NOx and SO2 particles of 27 industry branches in tons per sqkm. Calculations based on average emissions per worker of each industry branch and regional occupation figures of the sectors. Data taken from the states' statistical offices (2004).

Share of forest : forest area as a share of the total surface area in percent. Taken from the states' statistical offices (2000).

Share of water : water area as a share of the total surface area in percent. Taken from the states' statistical offices (2000).

Tourism : number of overnight stays per inhabitant. Taken from the Federal Statistical Office and States' statistical offices (2003).

Metropolitan area : dummy variable that takes the value unity if a region belongs to a metropolitan area according to the classification of the "Bundesamt für Bauwesen und Raumordnung". Taken from the "Perspektive Deutschland" study 2004.

Peripherality : average travel time in minutes to the next three agglomeration centers by public transport. Source: "Bundesamt für Bauwesen und Raumordnung."

Poverty : number of welfare recipients ("Sozialhilfeempfänger") per 1,000 inhabitants. Taken from the Federal Statistical Office and States' statistical offices (2003).

East : dummy variable that takes the value unity if a region is situated in eastern Germany.

Rural : dummy variable that takes the value unity if a region is a rural county.

Ruraleast : dummy variable that takes the value unity if a region is a rural county situated in eastern Germany.

Population growth : population growth in percent. Taken from the Federal Statistical Office and States' statistical offices (2003).

Density : population density in 100 persons per sqkm. Taken from the states' statistical offices (2004).

Land price : three-year average price in € per sqm land sold. Mostly calculated with data from 2001-2003, data on 2004 or two-year averages are used where information is missing. Taken from the states' statistical offices.

Table 6: Ranking of Counties and Quality of Life
(monthly figures in €)

Pos.	County/City	QOL	Pos.	County/City	QOL
	West German counties		45	Main-Kinzig	191
1	Starnberg	245	46	Göppingen	190
2	München	239	47	Lörrach	190
3	Miesbach	232	48	Traunstein	189
4	Bad Tölz	232	49	Konstanz	188
5	Freising	229	50	Emmendingen	188
6	Garmisch-P.	225	51	Germersheim	188
7	Fürstenfeldbruck	216	52	Mainz-Bingen	188
8	Ebersberg	216	53	Groß-Gerau	187
9	Oberallgäu	215	54	Augsburg	187
10	Bad Dürkheim	213	55	Fürth	187
11	Landsberg a.L.	212	56	Offenbach	187
12	Hochtaunus	210	57	Alb-Donau	186
13	Karlsruhe	209	58	Rottweil	186
14	Esslingen	208	59	Pfaffenhofen	186
15	Rems-Murr	207	60	Südl. Weinstraße	185
16	Breisgau	207	61	Miltenberg	185
17	Weilheim	207	62	Ortenau	185
18	Böblingen	205	63	Heilbronn	184
19	Erlangen	204	64	Neuburg-Sch.	184
20	Aschaffenburg	203	65	Enzkreis	184
21	Rastatt	202	66	Rhein-Sieg	184
22	Erding	202	67	Hohenlohe	184
23	Ludwigsburg	202	68	Wetterau	183
24	Rhein-Neckar	202	69	Forchheim	183
25	Dachau	201	70	Bamberg	182
26	Rosenheim	201	71	Schwarzwald	182
27	Berchtesgadener L.	200	72	Ravensburg	182
28	Main-Taunus	198	73	Landshut	181
29	Freudenstadt	197	74	Regensburg	181
30	Aichach-Friedberg	197	75	Rheinisch-Berg.	181
31	Rheingau-Taunus	196	76	Lindau	180
32	Bodenseekreis	194	77	Passau	180
33	Nürnberger L.	194	78	Main-Spessart	179
34	Ostallgäu	194	79	Würzburg	179
35	Tübingen	194	80	Bergstraße	179
36	Roth	194	81	Kelheim	178
37	Tuttlingen	194	82	Ostalbkreis	176
38	Biberach	194	83	Kitzingen	176
39	Darmstadt	193	84	St. Wendel	176
40	Calw	193	85	Waldshut	176
41	Unterallgäu	193	86	Straubing	176
42	Eichstätt	193	87	Neuss	175
43	Neu-Ulm	192	88	Reutlingen	175
44	Rhein-Pfalz	191	89	Olpe	175

Continued on next page

Pos.	County/City	QOL	Pos.	County/City	QOL
West German counties, cont.			138	Mühldorf a.Inn	164
90	Stormarn	174	139	Mayen-Koblenz	164
91	Neumarkt i.d.OPf.	174	140	Main-Tauber	164
92	Ahrweiler	173	141	Neckar-Odenw.	163
93	Bernkastel	173	142	Limburg-Weilburg	163
94	Ostholstein	173	143	Helmstedt	162
95	Weißenburg	172	144	Lichtenfels	162
96	Nordfriesland	172	145	Neunkirchen	162
97	Regen	172	146	Euskirchen	161
98	Pinneberg	171	147	Westerwald	161
99	Donau-Ries	171	148	Bad Kreuznach	161
100	Schw. Hall	170	149	Amberg-Sulzbach	161
101	Dillingen a.d.D.	170	150	Goslar	161
102	Hannover	169	151	Kleve	160
103	Harburg	169	152	Oberbergisch.	160
104	Günzburg	169	153	Hochsauauerland	160
105	Ennepe	169	154	Sigmaringen	160
106	Ansbach	169	155	Heidenheim	160
107	Neustadt a.d.A.	168	156	Segeberg	159
108	Zollernalbkreis	168	157	Südwestpfalz	159
109	Erftkreis	168	158	Steinfurt	159
110	Mettmann	168	159	Rendsburg	159
111	Saarpfalz	168	160	Fulda	158
112	Herzogtum Lauenburg	168	161	Neuwied	158
113	Kaiserslautern	167	162	Cham	157
114	Lüneburg	167	163	Schaumburg	157
115	Gießen	167	164	Peine	157
116	Alzey-Worms	167	165	Herford	157
117	Siegen-Wittg.	167	166	Wolfenbüttel	157
118	Merzig-Wadern	167	167	Diepholz	157
119	Freyung-Grafenau	167	168	Oldenburg	157
120	Altötting	167	169	Osnabrück	157
121	Rhein-Hunsrück	167	170	Märkischer K.	157
122	Coesfeld	167	171	Lippe	156
123	Düren	166	172	Marburg-Biedenkopf	156
124	Gifhorn	166	173	Daun	156
125	Rottal-Inn	166	174	Plön	155
126	Rhein-Lahn	166	175	Soest	155
127	Viersen	166	176	Odenwald	154
128	Dingolfing	166	177	Göttingen	154
129	Lahn-Dill	165	178	Vechta	154
130	Cochem-Zell	165	179	Recklinghausen	154
131	Trier-Saarburg	165	180	Hof	153
132	Bayreuth	165	181	Schwandorf	153
133	Wesel	165	182	Borken	153
134	Aachen	164	183	Höxter	153
135	Uelzen	164	184	Minden-Lübbecke	153
136	Paderborn	164	185	Deggendorf	153
137	Gütersloh	164	186	Soltau	152

Continued on next page

Pos.	County/City	QOL	Pos.	County/City	QOL
West German counties, cont.			212	Neustadt a.d.W.	144
187	Bad Kissingen	152	213	Osterholz	142
188	Waldeck-Frankenberg	152	214	Steinburg	142
189	Verden	152	215	Hersfeld-Rotenburg	142
190	Hildesheim	152	216	Donnersberg	141
191	Bentheim	151	217	Dithmarschen	141
192	Stade	151	218	Haßberge	140
193	Emsland	151	219	Kronach	139
194	Saarlouis	150	220	Wunsiedel i.F.	138
195	Hameln-Pyrmont	150	221	Tirschenreuth	138
196	Rotenburg	150	222	Northeim	138
197	Schwalm-Eder	150	223	Altenkirchen	137
198	Unna	149	224	Osterode	137
199	Schweinfurt	149	225	Cuxhaven	137
200	Warendorf	149	226	Kusel	136
201	Heinsberg	148	227	Aurich	136
202	Kassel	148	228	Cloppenburg	135
203	Wittmund	148	229	Birkenfeld	134
204	Ammerland	146	230	Coburg	133
205	Schleswig-Flensburg	146	231	Wesermarsch	133
206	Bitburg-Prüm	146	232	Nienburg	132
207	Friesland	146	233	Rhön-Grabfeld	130
208	Werra-Meißner	145	234	Vogelsberg	128
209	Kulmbach	144	235	Lüchow	126
210	Leer	144	236	Holzminden	120
211	Celle	144			
West German cities			23	Ulm	175
1	Baden-Baden	230	24	Mainz	174
2	Karlsruhe	217	25	Landshut	172
3	Heidelberg	213	26	Mülheim	170
4	Bonn	205	27	Fürth	170
5	Freiburg im Breisgau	198	28	Memmingen	170
6	Darmstadt	198	29	Erlangen	169
7	Wiesbaden	194	30	Kaiserslautern	169
8	Neustadt	191	31	Oberhausen	167
9	Landau	190	32	Schwabach	166
10	Rosenheim	188	33	Saarbrücken	166
11	Münster	188	34	Passau	165
12	München	187	35	Trier	164
13	Aschaffenburg	184	36	Koblenz	163
14	Speyer	184	37	Essen	163
15	Kempten	183	38	Wolfsburg	163
16	Stuttgart	183	39	Bielefeld	162
17	Pforzheim	178	40	Ansbach	162
18	Düsseldorf	177	41	Augsburg	160
19	Köln	176	42	Aachen	160
20	Hamburg	176	43	Heilbronn	160
21	Frankfurt a.M.	176	44	Hagen	159
22	Würzburg	175	45	Osnabrück	159

Continued on next page

Pos.	County/City	QOL	Pos.	County/City	QOL
	West German cities, cont.		68	Bochum	145
46	Worms	158	69	Weiden	145
47	Hamm	158	70	Wuppertal	144
48	Braunschweig	157	71	Kiel, Landeshauptstadt	142
49	Mannheim	156	72	Remscheid	142
50	Lübeck	156	73	Flensburg	139
51	Offenbach	153	74	Bremen	138
52	Leverkusen	153	75	Delmenhorst	137
53	Solingen	152	76	Bremerhaven	137
54	Bottrop	151	77	Gelsenkirchen	134
55	Duisburg	151	78	Herne	134
56	Oldenburg	150	79	Hof	133
57	Dortmund	150	80	Kassel	131
58	Frankenthal	150	81	Emden	130
59	Bamberg	150	82	Neumünster	128
60	Krefeld	150	83	Wilhelmshaven	127
61	Kaufbeuren	150	84	Salzgitter	126
62	Nürnberg	148	85	Amberg	125
63	Straubing	148	86	Bayreuth	121
64	Ingolstadt	147	87	Coburg	118
65	Regensburg	147	88	Ludwigshafen	114
66	Zweibrücken	147	89	Pirmasens	114
67	Mönchengladbach	146	90	Schweinfurt	76
	East German counties		26	Saale-Holzland	132
1	Rügen	175	27	Bördekreis	131
2	Potsdam	159	28	Greiz	130
3	Wernigerode	150	29	Bautzen	130
4	Dahme-Spreewald	148	30	Riesa	129
5	Müritz	148	31	Sangerhausen	129
6	Sächsische Schweiz	148	32	Wartburg	128
7	Bad Doberan	145	33	Saalfeld	128
8	Barnim	143	34	Güstrow	128
9	Ostvorpommern	141	35	Kamenz	127
10	Meißen	139	36	Stollberg	127
11	Oberhavel	139	37	Jerichower L.	126
12	Parchim	139	38	Freiberg	126
13	Mecklenburg-Strelitz	138	39	Schmalkalden	125
14	Ohrekreis	138	40	Weimarer L.	125
15	Delitzsch	136	41	Wittenberg	125
16	Teltow-Fläming	136	42	Weißeritz	124
17	Oder-Spree	135	43	Sonneberg	124
18	Gotha	135	44	Bitterfeld	124
19	Leipziger L.	135	45	Märkisch-Oderl.	124
20	Havelland	134	46	Saalkreis	124
21	Chemnitzer L.	134	47	Vogtland	124
22	Ilm-Kreis	133	48	Oberspreewald	124
23	Uckermark	132	49	Ostprignitz	124
24	Uecker-Randow	132	50	Anhalt-Zerbst	124
25	Nordvorpommern	132	51	N.W.Mecklenburg	124

Continued on next page

Pos.	County/City	QOL	Pos.	County/City	QOL
East German counties, cont.			69	Sömmerda	117
52	Spree-Neiße	122	70	Quedlinburg	117
53	Döbeln	122	71	N. Oberlausitz	117
54	Nordhausen	122	72	Mansfelder L.	116
55	Burgenland	121	73	Merseburg	115
56	Altenburger L.	121	74	Mittweida	115
57	Muldental	121	75	Saale-Orla	114
58	Torgau-Oschatz	120	76	Eichsfeld	112
59	Schönebeck	120	77	Aschersleben	111
60	Ludwigslust	119	78	Altmark	110
61	Prignitz	119	79	Bernburg	109
62	Hildburghausen	119	80	Kyffhäuser	109
63	Mittl. Erzgebirg	119	81	Stendal	108
64	Aue-Schwarzenberg	119	82	Demmin	107
65	Köthen	118	83	Löbau-Zittau	107
66	Elbe-Elster	118	84	Unstrut-Hainich	103
67	Weißenfels	117	85	Halberstadt	98
68	Annaberg	117			
East German cities			14	Leipzig	126
1	Potsdam	158	15	Suhl	126
2	Brandenburg	158	16	Magdeburg	122
3	Frankfurt a.d.O.	156	17	Cottbus	121
4	Weimar	140	18	Chemnitz	116
5	Dresden	138	19	Halle	115
6	Schwerin	138	20	Gera	113
7	Jena	136	21	Stralsund	113
8	Rostock	131	22	Plauen	112
9	Berlin	131	23	Greifswald	110
10	Eisenach	131	24	Wismar	99
11	Neubrandenburg	127	25	Hoyerswerda	97
12	Erfurt	127	26	Görlitz	92
13	Dessau	126	27	Zwickau	90

Ranking of counties in Germany, sorted by QOL using implicit prices on land markets considering Tourism, Met.area, Peripheral, Rural, East, Ruraleast, Poverty, Share of water, Share of forest, Leisure, Accessibility, Education, Crime, Industry emissions, Local labor market, Alternative job opportunities, and Sunshine.

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Figure 2: Quality of Life in West Germany

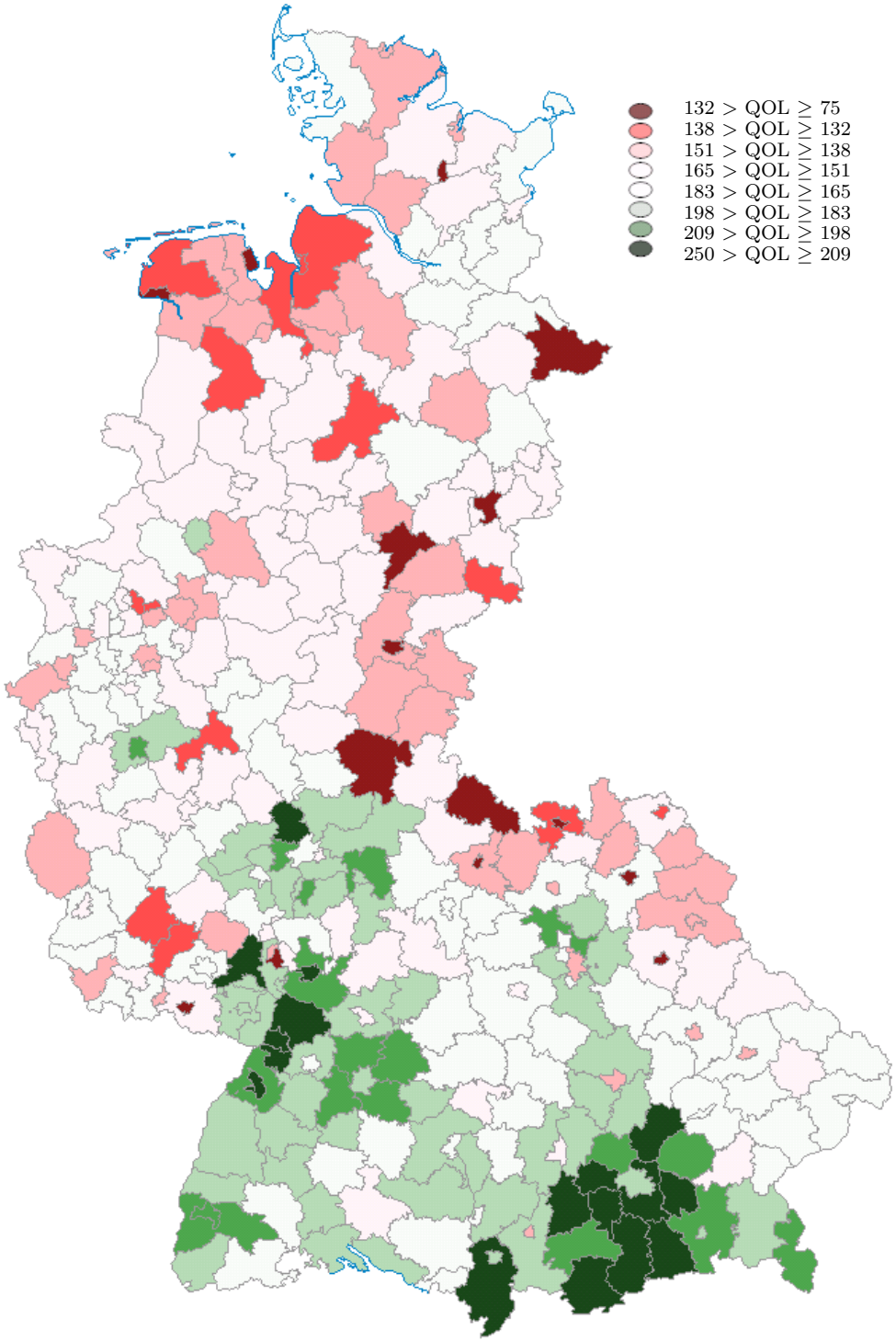
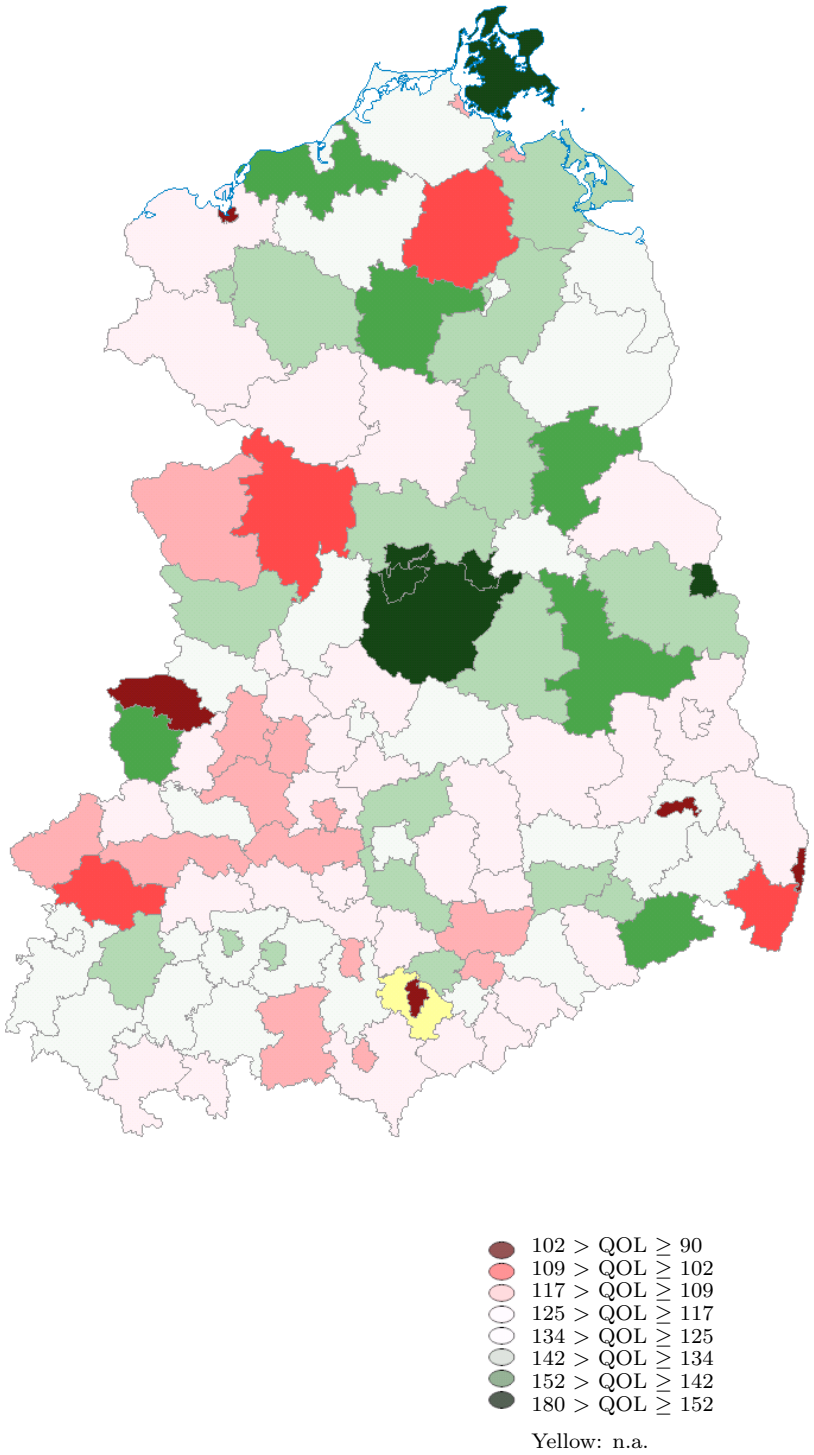


Figure 3: Quality of Life in East Germany



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