ISSN 1503-299X

WORKING PAPER SERIES

No. 17/2006

USING SURVEY DATA TO STUDY CAPITALIZATION OF LOCAL PUBLIC SERVICES

Fredrik Carlsen
Bjørg Langset
Jørn Rattsø
Lasse Stambøl

Department of Economics

Norwegian University of Science and Technology
N-7491 Trondheim, Norway
www.svt.ntnu.no/iso/wp/wp.htm

This version: May, 18 2006

Using survey data to study capitalization of local public services

Fredrik Carlsen [a,*], Bjørg Langset [b], Jørn Rattsø [a], Lasse Stambøl [b]

[a] Department of Economics, Norwegian University of Science and Technology, 7491 Trondheim, Norway

[b] Research Department, Statistics Norway, Postboks 8131 Dep, 0022 Oslo, Norway

Abstract
We use surveys in which respondents evaluate local amenities in Norway to compute proxy variables for the quality of local public services as well as other local amenities relevant to location decisions. Average satisfaction reported by the respondents is computed for each amenity and each municipality, adjusted for sample variation in personal characteristics and included as explanatory variables in a cross-section study of house prices. We find that house prices are increasing in satisfaction with health care, cultural activities and public transportation, suggesting that the quality of local public services indeed affects the attractiveness of a residential site. When the analysis is repeated with input measures of service levels instead of satisfaction variables, we find no effects of local public services on house prices, indicating that traditional Tiebout studies based on input measures may have underestimated the importance of local public services for location decisions.

Keywords: Capitalization; Local public services; Survey data

JEL classification: R23

[*]Corresponding author. Tel.: +47-73-591931; E-mail: fredrik.carlsen@svt.ntnu.no

1. Introduction

A large number of studies have examined the impact of local fiscal conditions on residential location decisions.[1] The empirical literature on Tiebout mobility includes studies of how local public services and taxes are capitalized into house prices and wages, and studies of the relation between local public services/taxes and migration flows or individual exit and/or entry decisions.

A major methodological challenge of this literature is to characterize how attractive the local bundle of government services is to households. Most studies use input measures, such as local government spending per capita, hospital beds per capita or education spending or teachers per pupil, as proxy variables for service levels. However, since the quality of local public services cannot be observed by the researcher, these studies are in effect testing two hypotheses jointly: that migration is sensitive to the level and/or mix of local public services and that inputs are appropriate proxies for service levels. Insignificant results may therefore reflect poor proxies rather than a rejection of the hypothesis that local fiscal conditions affect residential location choices.

In this paper, we present a new method of measuring the quality of local public services. The last years have brought a large number of studies by economists based on surveys in which respondents express how satisfied they are with various aspects of life, including their job, their health, their marriage, housing conditions, the environment and the financial situation.[2] Our contribution is to use survey data about satisfaction with local amenities to compute proxy variables for the quality of local public services as well as other local amenities relevant to location decisions, such as recreation opportunities and street safety.

For each of ten local amenities and each of the Norwegian municipalities included in our study, we compute average satisfaction reported by respondents residing in the municipality. The raw averages are adjusted for sample variation between municipalities in personal characteristics that may affect a respondent's propensity to form favourable judgements and included as explanatory variables in a cross-section study of house prices. Our results suggest that the quality of local public services affect the attractiveness of a residential site. We find

[1] See Charney (1993) for a review of the early literature. Carlsen (2005) summarizes the main results from more recent contributions.

[2] Van Praag and Ferrer-i-Carbonell (2004) discuss the methodological foundations of satisfaction analyses and present contributions by economists.

that house prices are increasing in satisfaction with health care, cultural activities, public transportation and safety.

To compare our approach with Tiebout studies based on input measures, we have computed input measures for the local public services at the municipal level and repeated the analysis with the input measures instead of the satisfaction variables. We find that none of the input measures are statistically significant determinants of house prices. This result suggests that traditional Tiebout studies based on input measures may have underestimated the importance of local fiscal conditions for residential location decisions.

The rest of the paper is organized as follows. The next section presents a brief review of the literature, which also serves to motivate our use of survey data. A brief presentation of the local sector in Norway is included in Section 3. Section 4 describes our empirical strategy in more detail. The data set is presented in Section 5. Results are presented in Section 6, and Section 7 reports several robustness checks. In Section 8, we repeat the main analysis using input measures instead of satisfaction variables. Section 9 contains concluding remarks.

2. Literature review and motivation of paper

The first generation of Tiebout studies employed input measures to characterize service levels.[3] A basic assumption underlying these studies is that input measures are good proxies for the quality of local public services as perceived by households. However, the quality of local public services is a function of inputs, need, environmental factors affecting the production process (e.g. peer group effects) and (depending on how inputs are measured) factor prices. Unless the researcher can observe and control for the other determinants of quality, input may be a poor proxy for quality. As pointed out by Charney (1993), bivariate correlations between input and quality may actually be *negative*: low health spending may indicate that the population is relatively healthy, few police officers may indicate a safe area, and low spending on fire control may reflect that buildings satisfy fire safety standards.

The assumption that input is a good proxy for quality is particularly controversial within the

[3] Blomquist, Berger and Hoehn (1988), Gyourko and Tracy (1989) and Gabriel, Mattey and Wascher (2003) consider how house prices and wages depend on local public inputs. Fox, Herzog and Schlottman (1989) and Nechyba and Strauss (1998) examine the effects of inputs on individual location decisions. Nelson and Wyznan (1989), Clark and Hunter (1992), Day (1992) and Andersson and Carlsen (1997) study the relation between inputs and interregional migration flows.

educational sector where a large literature has studied the relation between school inputs and student outcomes (Hanushek, 2003; Krueger, 2003). The second generation of Tiebout studies examines how school performance affects housing values, using gross or value-added adjusted test score outcomes as proxy variables for school quality.[4]

Whereas test scores are likely to be superior to inputs as measures of school quality, none of these contributions have developed better quality measures for other local public services. The second generation of Tiebout studies therefore do not add to our knowledge about the relation between household location decisions and other local public services than schools. Hence, this literature does not add to our understanding of how and whether local authorities can attract households by adjusting the composition of local public services.

In this paper, we use survey data to characterize the quality of local public services and other local amenities. We take advantage of a large nation wide survey conducted by TNS Gallup in which respondents evaluate a range of local amenities, including most local public services, safety, recreation opportunities and living conditions for children and youth. For each amenity and municipality, we compute average satisfaction reported by the respondents residing in the municipality. Our proxy variable for the quality of an amenity is average reported satisfaction adjusted for sample variation in personal attributes of respondents (age, gender and education level).

An advantage of using survey data to compute proxies for local amenities is that surveys provide direct information about assessments made by agents involved in the markets for housing and labour. Housing demand and labour supply depend on the entry and exit decisions of households which in turn depend on their assessments of living conditions and job opportunities in the their resident communities and potential destination communities.

Another advantage of survey data is that the researcher does not have to collect data on the determinants of quality. When making assessments, respondents consider whether the quantity and quality of inputs are sufficient given needs and the production process.

Our procedure for computing amenity variables rests on the assumption that interpersonal

[4] Black (1999), Gibbons and Machin (2003), Figlio and Lucas (2004), Kane, Steiger and Riegg (2005)

comparisons of subjective measures of well-being, such as reported satisfaction with life of domains of life, are meaningful. This assumption is controversial among economists. However, during the last years economists have used subjective measures of well-being to examine a wide range of issues, including the monetary valuation of unemployment, bad health, terrorism, direct democracy, becoming widowed or divorced and becoming a crime victim[5], the weights of inflation and unemployment in society's welfare function[6], the effects of job attributes including safety and racial harassment on job turnover[7], the impact of local labour market conditions on wage formation and interregional migration[8] and the impact of school dissatisfaction on risky behaviour of adolescents[9]. These and other contributions have shown that responses to questions about well-being are not random numbers but correlated with objective events and actions. The present paper adds to this literature by showing that house prices depend on subjective assessments of local amenities.

3. The local sector in Norway

Local government plays an important role in providing public services in Norway. About two-third of all government employees work in the local sector, of which the majority are employed by the municipalities. The TNS Gallup survey data set includes questions about most main services provided by the municipalities: day care, primary education, cultural services, primary health care, care for the elderly and public transportation. The only exception is infrastructure (water supply, garbage collection and sewage). The main revenue sources of the municipalities are state grants, income and wealth taxes and infrastructure fees. Since income and wealth tax rates do not vary between municipalities, infrastructure fees represent the only important revenue source for which municipalities have discretion.

4. Empirical strategy

House prices in a municipality depend on local amenities, including local public services, and the labour market opportunities within commuting distance. Local labour market conditions in turn depend on labour supply and therefore on the factors which affect household location decisions, including house prices and amenities. Following the seminal contribution by

---

[5] Winkelmann and Winkelmann (1998), Frey and Stutzer (2000), Clark and Oswald (2002), Frey, Luechinger and Stutzer (2004), Powdthavee (2005)

[6] Di Tella, MacCulloch and Oswald (2001)

[7] Clark (2001), Shields and Wheatley Price (2002), Kristensen and Westergård-Nielsen (2004)

[8] Carlsen and Johansen (2004,2005)

[9] Lévy-Garboua, Lohéac and Fayolle (2006)

Roback (1982), most empirical studies of capitalization handle the two-ways causality between amenities and job opportunities by estimating two equations explaining house prices and wages as functions of amenities. The value of an amenity is imputed from the estimated coefficients of the amenity in both equations.

The Roback approach rests on the assumption that the wage rate is a sufficient indicator for the labour market prospects of the residents in a community. However, there are several other job and community attributes which may affect households' evaluations of the local job market, including non-financial job attributes, future career opportunities, the risk of job loss and the prospects of getting a new job in case of unemployment. If one of more of these attributes affect workers' reservation wages and are correlated with the quality of local amenities, the Roback approach may produce biased estimates of amenity values.

In this paper, we use an alternative empirical strategy which takes into account that local labour market opportunities may depend on unobservable job and community attributes. Our methodological innovation is to identify the value of amenities from variation in house prices between municipalities where residents face roughly similar job prospects. The following simple model serves to illustrate our approach. We consider a travel-to-work area consisting of a centre and surrounding municipalities. All jobs are located at the centre, and all households live in the municipalities. Consider a representative household whose utility function $U(w_i,a_i)$ is separable in disposable income and a local amenity:

$$U(w_i,a_i) = u(\hat{w} - \delta t_i - r_i) + v(a_i), \;\; u' > 0, \;\; v' > 0,$$

where $\hat{w}$ is the wage rate offered by firms at the centre (suitably adjusted for non-financial job attributes and the risk of unemployment), t_i is commuting time from municipality i to the centre, δ is the cost per unit time of commuting, r_i is the cost of housing in municipality i, and a_i is the amenity level in municipality i. When households are free to move, utility is equalized across municipalities:

$$u(\hat{w} - \delta t_i - r_i) + v(a_i) \;\; = \;\; \text{constant}.$$

It follows from this equilibrium condition that, within the travel-to-work area, the cost of housing is increasing in the amenity level and decreasing in commuting time: $\partial r_i / \partial t_i < 0$,

$\partial r_i / \partial a_i > 0$. The value of local amenities can be identified by examining how the cost of housing varies between municipalities within travel-to-work areas as a function of commuting time to the centre and amenity levels. We implement the model by estimating a house price equation with amenity variables, fixed effects for each travel-to-work area and controls for commuting time and house characteristics as explanatory variables.

A potential problem of our approach is that some municipalities may have commuting to more than one travel-to-work area or to several municipalities within a travel-to-work area. For these municipalities, travel-to-work fixed effects and commuting time to the centre are insufficient controls for the job prospects of the municipality's residents. We expect this problem to be most important for municipalities situated at the border between travel-to-work areas. Our remedy is to include in the sample only municipalities for which commuting is towards the centre of the travel-to-work area.

5. Data description

Travel-to-work areas. To construct travel-to-work areas, we use data collected by Statistics Norway about commuting between each pair of municipalities in the year 2000. We first identify potential centre municipalities. These are municipalities that have more inhabitants than their neighbours and receive a positive net inflow of commuters. We then add municipalities that satisfy two criteria: i) at least five percent of the work force commutes to the centre municipality or to municipalities closer to the centre than the municipality itself, and ii) less than three percent of the work force commutes to municipalities outside the travel-to-work area or to municipalities located further away from the centre. This procedure produces 50 travel-to-work areas, denoted regions, with 205 out of Norway's 435 municipalities. The other 230 municipalities either have few commuters or belong to regions with more than one commuting centre.

The capital, Oslo, is not included in our sample as the municipalities of the Oslo region do not meet our two criteria due to the existence of several travel-to-work centers within the region. The sample includes the labour market regions of the three largest cities outside Oslo: Bergen, Trondheim and Stavanger.

From the Norwegian national transport model, developed by the Institute of Transport Economics, we have obtained data for 1997/98 about average travel time by car and/or ferry

from the municipality centre to the centre of the region's centre municipality (Hamre, Grue and Rekdal, 2001). We do not know the travel time from the different parts of the centre municipality to its centre or from outside the centre of other municipalities. In the following, we assume that the commuting time of all inhabitants of a municipality is equal to the travel time from the municipality centre to the centre of the centre municipality. The travel time is assumed to be 20 minutes or less for all inhabitants in the centre municipality.[10]

House transactions. The house transaction data base of Statistics Norway contains information about every house transaction in Norway with the exception of transactions administered by the housing co-operatives. To raise the number of observations in small municipalities, we pool data for three years, 1996-1998. During this period, 44,232 transactions were registered in the 205 municipalities considered in this study. Information about one or more house characteristics is missing for 2,869 transactions. We have omitted 94 transactions for which the house size is reported to be below five square meters, leaving a total sample of 41,269 observations. The data base contains information about house type (villa, flat, etc), house size, age, whether the house has a carport and the number of bathrooms and water closets. The data base does not identify the location of the house within the municipality, but there is information about travel distance in kilometers to the municipality centre.

Local amenities. Amenity variables at the municipal level are computed from three waves (1996-1998) of a survey conducted by TNS Gallup. Each year, a random sample of 25,000-50,000 persons received a questionnaire with questions about their resident municipality. Respondents were asked to rank various local amenities on a scale from 1 (very dissatisfied) to 6 (very satisfied). About 50 % returned the questionnaire. Pooling data from three waves produces 29,612 respondents residing in the 205 municipalities considered in our study. 1,618 respondents did not provide information about personal characteristics, leaving a total sample of 28,094.

- Table 1 about here -

Table 1 presents the ten questions we use to compute amenity variables. Six of the questions

[10] Travel time $\leq$ 20 minutes is our reference category in the empirical analysis.

cover the main services provided by Norwegian municipalities except infrastructure. The other four questions are about outdoor recreation, shopping opportunities, safety and living conditions for children and youth. The response rate varies between 96.6 % (recreation) and 56.4 % (primary education). Respondents are most satisfied with recreation opportunities and safety, and least satisfied with care for the elderly and public transportation.

A natural amenity variable would be the average satisfaction reported by the respondents in the municipality. However, we find that the propensity to report a high level of satisfaction is systematically related to personal characteristics. For instance, young and highly educated people are generally less satisfied than elderly people with little education. To control for variation between municipalities in the composition of respondents, we compute the municipal amenity variables from OLS regressions explaining reported satisfaction as a function of personal characteristics (dummy variables for age, gender and education level) and dummy variables for each municipality. The coefficients of the municipal dummy variables can be interpreted as municipal averages adjusted for sample variation in personal characteristics.[11]

Since we do not have information about the quality of infrastructure, and infrastructure is mainly financed by user fees, the impact of infrastructure fees on house prices is ambiguous in our empirical framework. In preliminary analyses, we have included annual infrastructure fees paid by the owner of a standardized apartment as explanatory variable together with the amenity variables. We did not find any effect of fees on house prices. Fees are therefore excluded from our baseline specification.

6. Results

The following regression is estimated for our sample of house transactions:

$$\text{Price}_{jirt} = \alpha_r + \alpha_t + \mathbf{House\ characteristics}_{\mathbf{jirt}}\,\boldsymbol{\alpha_1} + \mathbf{Travel\ time}_{\mathbf{jr}}\,\boldsymbol{\alpha_2} + \mathbf{Amenity}_{\mathbf{ir}}\,\boldsymbol{\alpha_3} + \mathbf{Municipality\ size}_{\mathbf{ir}}\,\boldsymbol{\alpha_4} + \varepsilon_{jirt}$$

where Price_{jir} is the sale price of house j in municipality i, region r and year t, α_r are regional effects, α_t are year effects, $\mathbf{House\ characteristics}_{\mathbf{jirt}}$ is a vector of house characteristics,

[11] Di Tella, MacCulloch and Oswald (2001) use this technique to compute a measure of life satisfaction in a particular country and year from individual survey data.

Travel time$_{jr}$ is a set of dummy variables describing the travel time from the centre of municipality j to the centre of region r and **Amenity$_{ir}$** is the vector of amenity variables. **Municipality size$_{ir}$** is a vector of dummy variables for population size included to control for unobserved amenities related to the size of the municipality as well as interregional variation in job opportunities not handled by the commuting time variables. ε_{jirt} is the error term. We have also estimated a log-linear version of the equation, but the reported specification performs best in terms of adjusted R^2.

- Table 2 about here -

The two first columns of table 2 present summary statistics for the explanatory variables. The two last columns present the estimated coefficients and standard errors corrected for clustering of residuals at the municipal level.

Amenity variables. Two of the amenity variables have negative and insignificant coefficients. Eight coefficients are positive of which two are significant at the 5 % level and two are significant at the 1 % level. Three local public services have significant positive effects on house prices: cultural services, health care and public transportation. Satisfaction with safety also has a positive and significant effect on house prices. The quantitative effects of the three local public services are of the same magnitude: an increase of one standard deviation raises the price of a house by 25,000 – 30,000 NOK (~ 3,300 $). The quantitative effect of satisfaction with safety is somewhat stronger. For each of the three local public services, the difference between the municipalities in our sample with the highest and the lowest levels of satisfaction corresponds to approximately 150.000 NOK. By comparison, an increase in the commuting time from 20 minutes or less to 45-60 minutes lowers house prices by the roughly the same amount.

Other covariates. The estimated effects of the other covariates are consistent with expectations. The sale price is decreasing in travel time from the municipality centre to the regional centre, decreasing in the distance from the house to the municipality centre and increasing in the population size of the municipality (up to 100,000 inhabitants).
The sale price is an increasing function of house size, the number of bathrooms and water closets and decreasing in the age of the house.

7. Sensitivity analysis

Table 3 presents coefficients and standard errors of the amenity variables for six alternative specifications. The covariates are the same as in table 2; the results for other covariates than the amenity variables are not reported in order to save space.[12]

- Table 3 about here -

Number of respondents. The first issue we consider is the number of respondents in each municipality. Average reported satisfaction is likely to be a less noisy measure of amenity levels in municipalities with many respondents than in municipalities with few respondents. In column (1), we have omitted municipalities with less than 20 respondents. Column (2) presents results for municipalities with 40 or more respondents.

Comparison with table 3 shows that the results change very little. The coefficients of the four significant amenity variables increase somewhat, but so do the standard errors and the levels of significance are not affected. None of the other amenity variables becomes significant.

Omitting the largest cities. Bergen, Trondheim and Stavanger together comprise almost one third of our sample of house transactions. To check how our conclusions are affected by the largest municipalities, we have estimated the house price equation without these three municipalities (column 3). Again, the results are very robust. The estimated coefficients of the four significant amenity variables do not change much and remain significant.

Personality traits. We next consider two potential sources of simultaneity bias, personality traits and cognitive dissonance. It is well known from research by psychologists that subjective assessments depend on personality traits of the respondents, such as extroversion, neuroticism and self-esteem (Diener et al, 1999). A person who is disposed towards making favourable judgments of amenities may also have a tendency to make favourable judgments of properties. Variation in personality traits between municipalities within a region may therefore cause spurious correlations between the amenity variables and house prices.

To control for variation in personality traits between respondents, we use a question in the

[12] Complete results are available upon requests.

questionnaire about local weather conditions. As weather conditions are approximately the same for all inhabitants in a region, variation within regions in reported satisfaction with the weather provides information about the respondents' general propensity to make favourable judgments.

We estimate an OLS regression explaining reported satisfaction with the local weather as a function of dummy variables for regions. Our proxy for a respondent's personality traits is the residual from this regression. A new set of amenity variables is computed from regressions explaining reported satisfaction with the amenities as a function of the weather residual, controls for age, gender and education level and municipal dummy variables. The coefficients of the municipal dummy variables can be interpreted as average satisfaction adjusted for observable personal characteristics and personally traits. The regressions confirm that personality traits indeed matter for evaluations of amenities: the coefficient of the residual is positive (in the range 0.15-0.20) and very significant (t-values ~ 30) for all amenities.

In column (4), the new amenity variables are included as explanatory variables. As is evident from a comparison between table 2 and column (4) of table 3, adjusting the amenity variables for personality traits has virtually no impact on the estimated effects of amenities on house prices.

Cognitive dissonance. The second source of simultaneity bias is cognitive dissonance.[13] Persons like to view themselves as having made correct decisions. Suppose movers attempt to legitimize their location choice by forming positive judgments about the destination municipality and negative judgments about the origin municipality. Then inhabitants of municipalities with a large share of in-migrants ceteris paribus will tend to have positive view of their municipality whereas the opposite will be the case for municipalities with a large share of inhabitants who plan to exit the municipality. Since migration affects the demand for housing, cognitive dissonance may create a spurious correlation between house prices and the respondents' evaluations of their resident municipality.

To explore the practical relevance of this bias, we use information from the survey about when respondents moved to the resident municipality. We would expect cognitive dissonance

[13] The pioneering application of cognitive dissonance in economics is Akerlof and Dickens (1982).

to be most important for recent movers, both because the probability of out-migration depends on the number of years a respondent has lived in the municipality and because incorrect assessments about the resident municipality are likely to be adjusted over time. In column (5) we have included amenity variables computed from the subsample of respondents who reported to have lived in the municipality for five years or longer. Comparison with table 2 shows that the estimated effects of municipal amenities are not much affected.

Municipal labour markets. In the last column, we have included two labour market variables computed at the municipal level, the wage rate and the unemployment rate.[14] The positive effect of wages and the negative effect of unemployment suggest that house prices are affected by labour markets conditions in the municipality in addition to commuting time to the regional centre. However, the estimated effects of the amenity variables are hardly affected by inclusion of municipal wage and unemployment variables.

8. Comparison with input measures

In this section, we compare the performance of our amenity variables with the performance of input measures of the type used in earlier Tiebout studies. For four of the local public services, day care, primary education, health care and care for the elderly, we are able to compute input of person years per user or potential user. We use per capita municipal spending on cultural activities rather than municipal cultural worker person years per capita as input measure for cultural activities because many municipalities subsidize private cultural activities. For public transportation, information about labour input at the municipal level is not available.

- Table 4 about here -

Table 4 presents correlations between our amenity variables and input measures for five local public services. The correlations are positive as could be expected. However, with the exception of day care and care for the elderly, the correlations are not large in absolute values, confirming that input measures are not necessarily good proxies for service quality.

- Table 5 about here -

[14] The wage and unemployment variables are computed from register data provided by Statistics Norway about all employees aged 20-50. Details about our procedure are available upon request.

Table 5 presents regression results for a specification where the five input measures have been substituted for the corresponding amenity variables whereas the other five amenity variables have been retained. The results are quite striking: none of the input measures are statistically significant whereas satisfaction with public transportation and safety remain significant. Hence, analyses based on amenity variables and input measures produce opposite conclusions about the relation between service levels and demand for housing.

9. Conclusion

Our results suggest that the municipal council can make their municipality more attractive to households by giving priority to cultural activities, health care and public transportation at the expense of other municipal services. We find small and insignificant effects of day care, schools and care for the elderly on house prices. We find much stronger effects on house prices of amenity variables than of traditional input measures on house prices. In fact, none of the input measures have significant effects on house prices.

Given the low mobility of the elderly, the insignificant result for care for the elderly is not surprising. The result for schools is more surprising and inconsistent both with most international studies of housing values and school performance. A possible explanation is that the quality of schools is more difficult to observe for the general public than the quality of other municipal services. If respondents have limited information about the quality of schools in their municipality, average reported satisfaction with schools is a poor proxy for school performance.

References

Akerlof, G., Dickens, W., 1982. The economic consequences of cognitive dissonance. American Economic Review 72, 307-319.

Andersson, K., Carlsen, F., 1997. Local public services and migration, evidence from Norwegian municipalities. Review of Regional Studies 27, 124-142.

Black, S., 1999. Do better schools matter? Parental valuation of elementary education. Quarterly Journal of Economics 114, 577-599.

Blomquist, G., Berger, M., Hoehn, J., 1988. New estimates of quality of life in urban areas. American Economic Review 78, 89-107.

Carlsen, F., 2005. Migration plans, local fiscal variables, and local economic conditions. Finanzarchiv 61, 154-177.

Carlsen, F., Johansen, K., 2004. Subjective measures of employment opportunities and interregional migration. Labour 18, 563-589.

Carlsen, F., Johansen, K., 2005. Regional wages and subjective assessments of employment opportunities. Journal of Socio-Economics 34, 377-400.

Charney, A., 1993. Migration and the public sector: a survey. Regional Studies 27, 313-326.

Clark, A., 2001. What really matters in a job? Hedonic measurement using quit data. Labour Economics 8, 223-242.

Clark, A., Oswald, A., 2002. A simple statistical method for measuring how life events affect happiness. International Journal of Epidemiology 31, 1139-1144.

Clark, D., Hunter, W., 1992. The impact of economic opportunity, amenities and fiscal factors on age-specific migration rates. Journal of Regional Science 32, 349-365.

Day, K., 1992. Interprovincial migration and local public goods. Canadian Journal of Economics 25, 123–144.

Diener, E., Eunkook, M., Lucas, R., Smith, H. 1999.Subjective well-being: three decades of progress. Psychological Bulletin 125, 276-302.

Di Tella, R., MacCulloch, R., Oswald, A., 2001. Preferences over inflation and unemployment, evidence from surveys of happiness. American Economic Review 91, 335-341.

Figlio, D., Lucas, M., 2004. What's in a grade? school report cards and the housing market. American Economic Review 94, 591-604.

Fox, W., Herzog, H., Schlottman, A., 1989. Metropolitan fiscal structure and migration. Journal of Regional Science 29, 523-536.

Frey, B., Stutzer, A., 2000. Happiness, economy and institutions. Economic Journal 110, 918-938.

Frey, B., Luechinger, S., Stutzer, A., 2004, Valuing public goods. The life satisfaction approach. CESifo Working paper 1158.

Gabriel, S., Mattey, S., Wascher, W., 2003. Compensating differentials and evolution in the quality-of-life among U.S. states. Regional Science and Urban Economics 33, 619-649.

Gibbons, S., Machin, S., 2003. Valuing english primary schools. Journal of Urban Economics 53, 197-219.

Gyourko, J., Tracy, J., 1989. The importance of local fiscal conditions in analyzing local labor markets. Journal of Political Economy 97, 1208-1231.

Hamre, T., Grue, B., Rekdal, J., 2001. Tilrettelegging av data for estimering av nye langdistansemodeller i Den nasjonale transportmodellen (in Norwegian). Report 523/2001. Oslo: Institute of Transport Economics.

Hanushek, E., 2003. The failure of input-based schooling policies. Economic Journal 113, F64-F98.

Kane, T., Staiger, D., Riegg, S., 2005. School quality, neighbourhoods and housing prices: the impact of school desegregation. NBER Working Paper 11347.

Kristensen, N., Westergård-Nielsen, N., 2004. Does low satisfaction lead to job mobility? IZA Discussion paper 1026.

Krueger, A., 2003. Economic considerations and class size. Economic Journal 113, F34-F63.

Lévy-Garboua, L., Lohéac, Y., Fayolle, B., 2006. Preference formation, school dissatisfaction and risky behaviour of adolescents. Journal of Economic Psychology 27, 165-183.

Nechyba, T., Strauss, R., 1998. Community choice and local public services: a discrete choice approach. Regional Science and Urban Economics 28, 51-73.

Nelson, M., Wyzan, M., 1989. Public policy, local labor demand, and migration in Sweden, 1979–84. Journal of Regional Science 29, 247–264.

Powdthavee, N., 2005. Unhappiness and crime: evidence from South Africa. Economica 72, 531-547.

Roback, J., 1982. Wages, rents, and quality of life. Journal of Political Economy 90, 1257-1278.

Shields, M., Wheatley Price, S., 2000. Racial harassment, job satisfaction and intentions to quit: evidence from the British nursing profession. Economica 69, 293-326.

Van Praag, B., Ferrer-i-Carbonell, A., 2004. Happiness Quantified. Oxford University Press, Oxford, UK.

Winkelmann, L., Winkelmann, R., 1998. Why are the unemployed so unhappy? Evidence from panel data. Economica 65, 1-15.

Table 1
Description of amenity variables

Variable	Question	Mean (St. dev)	Respondents
	How satisfied/dissatisfied are you with:		
Municipal services:			
Day care	the supply of day care services	3.96 (1.33)	19,967
Schools	primary education	4.36 (1.10)	15,844
Culture	the supply of cultural services in the municipality	4.04 (1.16)	24,812
Health care	the supply of primary physician services in the municipality	3.78 (1.41)	26,200
Care for the elderly	the supply of care for the elderly in the municipality	3.46 (1.36)	23,269
Transport	public transportation services within the municipality	3.58 (1.52)	25,718
Other amenities:			
Recreation	the opportunities for outdoor recreation in the municipality and the surroundings	5.49 (0.86)	27,148
Shopping	the variety of shops and goods	4.81 (1.29)	26,862
Safety	safety in your living area	5.26 (1.00)	27,017
Children	living conditions for children and youth	4.43 (1.09)	24,734

Table 2
Regression analysis. Dependent variable: house price in 10^5 NOK
(Mean = 8.78, St.dev = 4.17)

	Mean	St.dev	Coefficient	St.error
Local amenities:				
Day care	4.44	0.59	0.011	0.200
Schools	4.44	0.38	-0.287	0.240
Culture	3.80	0.42	0.527*	0.214
Health care	3.77	0.73	0.420**	0.123
Care for the elderly	3.92	0.64	0.203	0.169
Transport	3.03	0.59	0.407*	0.158
Recreation	5.58	0.22	0.340	0.433
Shopping	4.08	0.78	0.098	0.148
Safety	5.52	0.23	1.428**	0.505
Children	4.72	0.34	-0.445	0.346
Travel time to regional centre:				
< 20 minutes			Reference category	
20 – 30 minutes	0.088		-0.905**	0.226
30 – 45 minutes	0.058		-0.953**	0.196
45 – 60 minutes	0.026		-1.483**	0.262
60 – 90 minutes	0.021		-2.023**	0.280
90 – 120 minutes	0.013		-2.051**	0.404
> 120 minutes	0.006		-3.503**	0.000
Distance to municipality centre:				
< 3 kilometers			Reference category	
3 – 8 kilometers	0.142		-0.558**	0.087
> 8 kilometers	0.051		-1.488**	0.129

Table 2 continued

House characteristics:				
Age of house	33.1	33.2	-0.027**	0.006
(Age of house)^2/100	22.0	54.7	0.010**	0.002
Size of house (sqm)	149.6	70.5	0.034**	0.003
(Size of house) ^{2}/1000	27.4	33.3	-0.033**	0.004
Carport	0.568		0.478**	0.123
0-1 bathroom		Reference category		
2 bathrooms	0.327		0.825**	0.289
> 2 bathrooms	0.027		1.406**	0.262
0-1 water closet		Reference category		
2 water closets	0.438		1.260**	0.287
> 2 water closets	0.106		2.257**	0.173
Municipality population:				
< 1,000		Reference category		
1 - 5,000	0.060		2.409**	0.766
5 - 10,000	0.089		2.314**	0.608
10 - 50,000	0.434		2.857**	0.435
50 - 100,000	0.112		3.687**	0.773
100 - 150,000	0.201		4.617**	0.785
> 150,000	0.104		3.745**	0.766

** Statistically significant at 0.01. * Statistically significant at 0.05. Fixed effects for region, year and house type (villa, terrace house, flat, etc) are included. Number of house transactions: 41,269. R^2 = 0.5519. Standard errors are adjusted for clustering at the municipal level. Mean and standard deviation of local amenities are at the municipal level (205 data points).

Table 3
Robustness analysis. Coefficients and standard errors of amenity variables

	(1)		(2)		(3)	
Day care	0.055	0.205	-0.021	0.277	-0.109	0.177
Schools	-0.329	0.257	-0.216	0.390	-0.247	0.218
Culture	0.547*	0.219	0.680*	0.274	0.556**	0.200
Health care	0.435**	0.126	0.473**	0.178	0.313*	0.122
Care for the elderly	0.225	0.174	0.240	0.195	0.296	0.153
Transport	0.429**	0.165	0.501*	0.212	0.462**	0.139
Recreation	0.417	0.461	0.116	0.563	0.115	0.425
Shopping	0.064	0.157	0.117	0.167	0.100	0.139
Safety	1.495**	0.526	2.722**	0.614	1.116*	0.493
Children	-0.502	0.353	-0.976*	0.474	-0.283	0.368

	(4)		(5)		(6)	
Day care	-0.023	0.206	0.067	0.203	0.042	0.186
Schools	-0.297	0.248	-0.231	0.245	-0.230	0.245
Culture	0.513*	0.213	0.463*	0.207	0.462*	0.217
Health care	0.459**	0.124	0.395**	0.127	0.366**	0.122
Care for the elderly	0.191	0.172	0.204	0.168	0.106	0.173
Transport	0.362*	0.152	0.385*	0.151	0.433**	0.155
Recreation	0.352	0.428	0.377	0.427	0.270	0.402
Shopping	0.036	0.148	0.145	0.149	0.142	0.131
Safety	1.504**	0.528	1.633**	0.517	1.373*	0.552
Children	-0.520	0.341	-0.608	0.341	-0.589	0.338
Wage rate					4.811*	2.093
Unemployment rate					-0.154	0.084

** Statistically significant at 0.01. * Statistically significant at 0.05. Other covariates as in table 3. Standard errors are adjusted for clustering at the municipal level.

(1) Only municipalities with at least 20 respondents
(2) Only municipalities with at least 40 respondents
(3) Without the three largest cities
(4) Amenity variables adjusted for personal traits
(5) Amenity variables computed for non-movers
(6) Wage rate and unemployment rate of municipality included as covariates
The wage rate is scaled by the wage rate of the capital, Oslo.
Unemployment rate is in percentage points

Table 4
Correlations between amenity variables and input measures

	Amenity variables:				
	Day care	Schools	Culture	Health care	Care for the elderly
Input measures:					
Manyears in day care/ population aged 0-6	0.494**				
Teacher manyears/ pupils		0.144*			
Spending on culture/ population			0.133		
Physician manyears/ population				0.229**	
Manyears in care for the elderly/ population aged 67+					0.400**

All variables are the municipal level (205 data points). ** Statistically significant at 0.01. *Statistically significant at 0.05.

Table 5
Regression analysis with input measures for five local public services

	Mean	St.dev	Coefficient	St.error
Input measures:				
Manyears in day care/ population aged 0-6	0.102	0.028	5.412	4.761
Teacher manyears/pupils	0.122	0.029	-4.207	5.456
Spending on culture/ population (in 10^3 NOK)	0.154	0.063	2.642	2.223
Physician manyears/ population*10^{-3}	0.920	0.335	-0.713	0.529
Manyears in care for the elderly/population aged 67+	0.166	0.064	0.080	1.328
Amenity variables:				
Transport	3.03	0.59	0.372*	0.164
Recreation	5.58	0.22	0.272	0.407
Shopping	4.08	0.78	0.240	0.169
Safety	5.52	0.23	1.380**	0.527
Children	4.72	0.34	0.124	0.373

** Statistically significant at 0.01. *Statistically significant at 0.05. Distance variables, house characteristics and fixed effects for municipal size, region, year and house type as in table 3. Number of observations: 41,169. $R^2 = 0.5508$. Standard errors are adjusted for clustering at the municipal level.