WHAT HAS BEEN CAPITALIZED INTO PROPERTY VALUES:

HUMAN CAPITAL, SOCIAL CAPITAL, OR CULTURAL CAPITAL?

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Abstract

Urban amenities can be capitalized into land values or property values. However, little attention has been paid to the capitalization of social amenities. This paper classifies three types of social-interaction-based social amenities: human capital, social capital, and cultural capital at residential neighborhood levels. We use the restricted version of the 1990 Massachusetts census data and estimate hedonic housing models with social amenities. The findings are as follows: (1) Human capital has significant positive effects on property values. This tests the Lucas conjecture. (2) Different types of social capital have different effects on property values: an increase in the percentage of new residents has significant positive effects on property values, probably due to the strength of weak ties. However, an increase in the percentage of single-parent households has negative effects on property values. An increase in the home ownership rate has positive effects at large geographic levels. (3) Cultural capital's effects vary from high to low geographic levels, the effects of English proficiency and racial homogeneity are positive at and beyond the tract level, but insignificant at the block level. This may imply that cultural capital is more important in social interactions at large geographic scale.

Keywords: Urban amenities, capitalization, property values, human capital, social capital, cultural capital, hedonic model, social interaction

JEL Classifications: A14, C21, D62, H41, R31

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1 Introduction

Urban amenities are location-specific goods attached to urban land (Diamond and Tolley [12]). To utilize amenities, people have to move to the location where amenities are attached. Therefore, the use of urban amenities is closely related to the use of urban land.

Two types of urban amenities have been applied to partly explain the spatial variations of land rents or property values, also known as the capitalization of urban amenities.[1] The first type is natural (physical) amenities. Such amenities include transportation accessibility (Alonso [1]), climate (Roback [45]), the quality of views (Pollard [38]), pollution (Ridker and Henning [43]), noise (Li and Brown [30], Vaughan and Huckins [53]), sports facilities (Do and Grudnitski [14]), and open spaces and parks (Weicher and Zerbst [54], Irwin [27]). The second type of urban amenities is related to local social environment or milieu, including school quality (Haurin [24], Brasington [6], Chiodo et al. [9]), crime (Roback [45]), and racial concentration or segregation (Laurenti [29], Smith [47]).[2]

The observed second type of urban amenities is actually the consequences of social interactions among urban populations. Wherever people concentrate, they form a social environment within which different types of social interactions take place. Information spillovers, peer effects, and neighborhood effects play a very important role in shaping pupils' school achievement (Zimmer and Toma [55]) , criminal behavior (Glaeser et al. [16]), and labor market outcomes in cities (O'Regan and Quigley [37]). In this paper, we are particularly interested in how social interactions at neighborhood levels affect housing values. We define social amenities as the location-specific en-

[1] The spatial variations of property values include not only the inter-city and intra-city variation of property values in the static context (cross-sectional variation), but also the spatial-intertemporal variation of property value appreciation.

[2] Roback's [45] empirical testing shows that local unemployment, population density, and population growth are amenities and, therefore, are capitalized into residential site value; but, crime and climate are not significant.

vironment of social interactions, where urban residents interact with each other, and directly study the impact of local social amenities on property values. Here, "local" refers to residential neighborhoods at microgeographic levels, such as census tracts, blockgroups, and blocks.

Social amenities could be either consumption amenities or production amenities, or both. For example, the concentration of well-educated residents can promote local information diffusion and learning, but it can also create a safer and more pleasant living environment. Unlike natural amenities that may charge user fees, impact fees, taxes, or tolls, social amenities are generally not priced. Therefore, studying unpriced externalities from social amenities may have important policy implications on public education, urban labor markets, and housing markets.

Following the pioneer work by Becker [3], Coleman [10], and Bourdieu [5], we classify social amenities into three categories: human capital, social capital, and cultural capital. By using the 1990 Massachusetts census data, we estimate hedonic housing models with social amenities. We find that: (1) Human capital has significant positive effects on property values, which tests the Lucas conjecture.[3] (2) Different types of social capital have different effects on property values. An increase in the percentage of new residents has significant positive effects on property values, probably due to the strength of weak ties. However, an increase in the percentage of single-parent households has negative effects on property values. An increase in the home ownership rate has positive effects at large geographic levels, which is consistent with the argument that homeowners have strong incentives to invest in social capital (DiPasquale and Glaeser [13]). (3) The effects of cultural capital vary from large to small geographical scales: English proficiency and racial homogeneity have positive effects at and beyond the tract level, but have insignificant effects at the block level. This is probably because English

[3] Lucas [33] constructed a human-capital-externalities-based city model and concluded that human capital externalities can be capitalized into land values.

proficiency is more important for communication in larger geographic areas and people care more about the homogeneity of their communities but less with regard to their direct neighbors.

The rest of the paper is organized as follows: section 2 introduces the concept of three types of social amenities, section 3 constructs a theoretical model to derive the capitalization of social amenities. Section 4 presents the econometric model and the measurement of social amenities, and section 5 introduces the dataset. Section 6 describes how property values are imputed for rental housing units, and section 7 presents the estimate results. Section 8 discusses further research issues and concludes.

2 Human capital, social capital, and cultural capital as social amenities

Urban social amenities are referred to as the local social milieu or the local environment of social interactions in cities, which include human capital, social capital, and cultural capital. This section explains briefly what each type of social amenities means and how they can be measured by a set of variables. However, the details on the construction of variables will be left to section 4.

2.1 Human capital

Human capital is the knowledge and skills embodied in individuals. Though each individual worker can reap the benefit of his (or her) human capital accumulation, extensive studies (Moretti [36]) show that social interactions between skilled workers can generate a significant amount of learning externalities or knowledge spillovers. Those uncompensated learning externalities are considered the driving force of long-run economic growth (Romer [44], Lucas [32]) and the reason why cities exist (Henderson [25]). Fu [15] tested four types of human capital externalities through which workers learn from each other through social interactions in the workplace: quality of human

capital, Marshallian labor market externalities, Jacobs labor market externalities, and the thickness of the local labor market. One of the purposes of this paper is to test further the effects of local human capital externalities on residential property values.

There are at least three important mechanisms of human capital affecting property values.

The first is that in order to achieve spatial equilibrium, land and housing rents must adjust correspondingly to the increase in individual earnings resulting from human capital externalities. A general equilibrium model by Roback [45] shows that human capital quality differences can be reflected in both wages and the rent gradient. A human-capital-externalities-based city model by Lucas [33] implies that human capital externalities can be capitalized into land values. These theories have been supported by empirical studies. Rauch [41], the first to examine the effect of human capital quality on housing rents, treated the Metropolitan Statistical Areas average level of formal education and working experience as a local public good, and found that the semi-elasticity of housing rents to average education is about 0.1˜0.2, depending on the model specifications. Shapiro [46] found that metropolitan areas richer in high human capital residents tend to experience faster growth in housing values: between 1940 and 1990, a 10% increase in the share of college educated residents corresponded to a 0.7% increase in the growth of house values. Glaeser et al. [21] also found that at the metropolitan level, education levels have a positive effect on future housing price growth (maybe due to a productivity effect). At the city level, low levels of human capital predict urban decline and falling housing prices (maybe because of the localized social interactions).

The second mechanism of human capital affecting property values is that the social benefit of education reduces the probability of engaging in socially costly activities, such as committing a crime (Lochner [31]). This will make residential neighborhoods safer.

The third reason is that skilled neighbors, themselves, are attractive consumption amenities (Glaeser et al. [20]).

Existing empirical studies (Rauch [41], Shapiro [46]) considered only one of the multiple dimensions of human capital externalities, the quality of human capital stock, at macrogeographic levels. However, other aspects, such as the density and diversity of human capital, may also be very important. Testing how human capital externalities affect property values at macrogeographic levels fails to control for the impact of local natural amenities (such as city-level amenities) and the spatial difference of housing production efficiency. We estimate hedonic housing models at microgeographic levels with location fixed effects to avoid those problems.

2.2 Social capital

Social capital refers to the relations between people that can be used to reach other resources or facilitate certain actions of actors (Coleman [10]).[4] Coleman found that social capital within family and beyond family in a neighborhood affects the creation of human capital. The social capital within a family is the relation between children and parents. Evidence shows that children from single-parent families have less desirable educational and personality outcomes than children from married-couple families because single-parent families have structural deficiency and tend to change residence more often (Coleman [10], McLanahan and Sandefur [34]). The social interactions between parents in a community (intergenerational closure), such as the social interactions among churchgoers, also have positive effects on children's school performance.

Social capital, specifically, the strength, diversity, and content of network ties, also has important effects on labor market outcomes (Montgomery [35])

[4] Coleman listed three types of social capital: trust and reciprocity, information channel, norms and effective sanctions in a community. Glaeser et al. [18] constructed an individual-based social capital investment model, and also provided some evidence on what affects individuals' investment in social capital.

and business innovations (Ruef [42], Huysman and Wulf [26]). Friendship and familial relationships are examples of strong ties in terms of the time and emotions invested in a relationship (Granovetter [22]). People in a strong tie network are familiar with and trust each other, but they have relatively homogenous information and may impose pressures for social conformity. Therefore, strong ties are less important in spreading information or resources. In contrast, people in a weak tie network can provide new and disparate information and impose less conformity, which promotes innovation.[5] Social capital created by tight community networks is useful to parents, teachers, and police authorities and has an impact on children's school performance, juvenile delinquency and its prevention, job search and occupational attainment, and ethnic immigration and business. Putnam [40] argued that social capital at the community level is a strong predictor of educational performance, crime rate, and other measures of neighborhood quality of life.

Not all social capital is productive (Portes [39]). The strength of strong ties in poor urban communities in inner cities may deprive their residents of sources of useful information about employment opportunities elsewhere and ways to attain them (Stack [48]).

We have not found empirical studies on the impact of social capital on property values. DiPasquale and Glaeser [13] argued that home ownership can promote residents' investment in social capital, both through the direct incentive effect and the longer tenure. Here, we tentatively use the percentage of different types of households in a neighborhood to measure the stock of social capital at the community level, including home ownership rate. Explanations are detailed in section 3.

[5] Burt [8] emphasized that weak ties can be sources of new knowledge and resources. Studies of business networks (Uzzi [51, 52]) show that economic action often benefits from initial increase in relational ties, but suffers when actors are highly embedded.

2.3 Cultural capital

Cultural capital refers to the values, norms, customs, and cultural traditions that serve to identify and bind together a given group of people.[6] It is expressed in people's behavior, through shared language, working attitudes, and belief systems. Much cultural capital is not taught, but rather, it is formed through interactions with people from the same culture. Race, language spoken, and religion are the main indicators of cultural capital. Studies on residential segregation and labor market race discrimination show that cultural capital has important effects on housing and labor markets. The so-called cultural capital hypothesis in the labor market argues that it is the deterioration in individual responsibility and family morals and values that are principally responsible for continued inequality in urban America over the last two decades (Darby [11]).[7] The Harvard students' experiments done by Glaeser et al. [17] show that trustworthiness declines among peers from different races or nationalities. The bounded solidarity in a homogenous racial community, identification with one's own group, sect, or community can be a powerful motivational force. This may imply that heterogeneity in terms of cultural background may decrease trustworthiness in social groups.

The interest in and debates on racial segregation and property values have been going on for almost a century (Laurenti [29], pp. 5-6). The representative study would be Kain and Quigley [28]. Our perspective is different in the sense that we try to identify the relationship between social interactions derived from cultural capital and property values.

In this paper, two variables are used to measure cultural capital: the percentage of residents who spoke English well and the neighborhood diversity in terms of races.

[6] This definition is based on Throsby [49].

[7] However, using data from the Multi-City Survey of Urban Inequality, Bienenstock and Stoloff [4] found that the negative effects of cultural capital are not significant after controlling for human capital.

3 The social amenity component of land values

Consumption amenities can be directly capitalized into property values since the only way to consume them is to live in the same location. Productive amenities, such as human capital externalities, have positive effects on labor market outcomes. This will result in migration. Migration to higher wage locations leads to high housing rents in order to restore spatial equilibrium where utility levels are equalized across locations. This section constructs a simple monocentric city model incorporating both consumption and production amenities. The model is adapted from the local public goods model of Roback [45], and Rauch [41], as well as the urban amenities' model of Diamond and Tolley [12], and the monocentric city model by Brueckner [7].

In a monocentric city with a central business district (CBD) as the center, identical residents commute to the CBD to work and bid for residential locations with local amenities to maximize individual utility. Consider the following individual problem:

$$\underset{L,A,Z,x}{Max}\, U[L(x), A(x), Z(x)], \tag{1}$$

$$s.t.\ Z(x) + T(x) + R[x, A(x)]L(x) + \tau(x) = B(x)Y, \tag{2}$$

where x is the location of x miles away from the CBD. A representative resident chooses lot size $L(x)$, consumption amenities $A(x)$, and composite consumption goods $Z(x)$ to maximize his or her utility. Note that $A(x)$ denotes consumption amenities other than locational accessibility, since accessibility has been incorporated into the consumption of lot size. Amenities may be priced, such as accessibility, whose price is the transport cost $T(x)$; or financed by location-based taxation $\tau(x)$, such as city-wide public goods; or unpriced, such as social amenities. Y is individual earnings. $B(x)$ is production amenities at location x, such as learning externalities from communication with well-educated neighbors, which could affect individual productivity and thus individual earnings. Here, production amenities

are treated as a productivity shift. $R[x, A(x)]$ is the land rents per unit area at location x. Note that land rents directly depend on both distance itself (locational accessibility) and consumption amenities, but not production amenities. Equation (2) is the budget constraint at location x for a representative resident.

The first order conditions are as follows:

$$\frac{\partial U}{\partial L} = \lambda R, \tag{3}$$

$$\frac{\partial U}{\partial A} = \lambda \frac{\partial R}{\partial A} L, \tag{4}$$

$$\frac{\partial U}{\partial Z} = \lambda. \tag{5}$$

In equilibrium, a resident must be indifferent between any locations, which implies

$$U'(x) = 0. \tag{6}$$

Also at each location, the budget constraint must be binding, which means

$$Z'(x) + T'(x) + R'(x)L + RL'(x) + \tau'(x) = B'(x)Y. \tag{7}$$

Combining (3)-(7), we obtain the generalized Muth condition

$$R'(x) = \frac{-T'(x) - \tau'(x) + B'(x)Y}{L(x)} + \frac{\partial R}{\partial A} A'(x). \tag{8}$$

(8) shows that the land rents gradient, or the spatial variation of equilibrium land rents per unit area consists of four components per unit area: the savings of transportation costs $\frac{T'(x)}{L(x)}$, the taxation difference $\frac{\tau'(x)}{L(x)}$, the difference of benefit from production amenities $\frac{B'(x)Y}{L(x)}$, and the difference of the marginal value of consumption amenities $R_A A'(x)$. In summary, amenities, including accessibility, taxation, other natural amenities, and unpriced social amenities, are all capitalized into land rents.

Since land values can be inferred from housing values after controlling for housing characteristics and neighborhood attributes, we will employ an hedonic housing model with urban amenities to test (8).

The above model only shows the capitalization of urban amenities within a city or metropolitan area. The model can be extended easily to an inter-city or inter-metropolitan case with city or metropolitan specific amenities, by introducing a Tiebout sorting mechanism (Tiebout [50]).[8]

4 Hedonic housing model with social amenities

To control for the difference in natural amenities and housing production efficiency at macrogeographic levels, we estimate hedonic housing models with social amenities at microgeographic levels. The first benchmark model is specified at the census tract level:

$$\log P_{nj} = \alpha + \lambda_c + \beta' X_n + \gamma' X_j + \epsilon_{nj}, \tag{9}$$

where P_{nj} is the reported or imputed housing value of housing unit n at census tract j; α is a constant; λ_c is a county fixed effect, representing natural amenities that serve at least at the county level; β and γ are the coefficient vectors to be estimated; ϵ_{nj} is the disturbance term, probably spatially correlated; X_n is the characteristics vector of housing unit n, variables include the number of bedrooms and other rooms, building age, and a set of dummies for housing type (dummies for mobile, detached, attached, number of apartments is 2, 3-4, 5-9, 10-19, 20-49, and greater than 50, if lot size is greater than 10 acres, and if there is a business or medical office on it); X_j is the attributes vector of social amenities at census tract j, including indices measuring human capital externalities, social capital stock, and cultural capital.

Continuing the work of Fu [15], we construct the following variables to

[8] For the discussion of inter-city models of urban amenities, see Bartik and Smith [2].

proxy for different dimensions of local human capital externalities at the tract level:

Average education: Percentage of residents with college or higher degree at a tract, proxy for the quality of local human capital stock.

Occupation diversity: Occupation diversity index, proxy for the broadness of human capital in terms of occupations at a tract. It equals one minus the Hirchman-Herfindahl index for occupations at a tract. Let S_{oj} denote the ratio of residents of occupation o at tract j to the total residents at tract j, then

$$Occupation\ diversity = 1 - \sum_{o} S_{oj}^2.$$

Industry diversity: Industry diversity index, proxy for the broadness of human capital in terms of industries where residents worked at a location. It is constructed as the same way as *Occupation diversity*.

Concentration: Concentration index. It equals the percentage of Boston metropolitan area residents who concentrated at tract j, and directly measures the thickness or density of local social interactions. However, this index may also reflect the effect of local demand for housing.

We tentatively use the following variables to measure social capital at the tract level:

$Parent - kids\ households$: Percentage of households with a married-couple and their children under 18 years old at a tract.

$Single - parent\ households$: Percentage of households that are single-headed parent with children at a tract.

$Five - year\ households$: Percentage of residents at a tract who lived in the same house for at least five years.

$Home\ ownership\ rate$: Percentage of households who are homeowners at a tract.

To check the robustness of the estimate, we also use other related variables such as percentage of households that moved into a house within one

year, within two years, and percentage of single residents and unemployed residents at a tract.

We construct two variables to measure cultural capital:

English proficiency: Percentage of residents at a tract who spoke English well.

Race diversity: Diversity index in terms of races. It equals one minus the Hirchman-Herfindahl index of races. Let S_{rj} denote the ratio of residents belonging to race r at tract j to the total number of residents at tract j, then

$$Race\ diversity = 1 - \sum_r S_{rj}^2.$$

We also try the percentage of residents who spoke more than one language at a tract to approximate the racial diversity.

If residents commute to the CBD or subcenters to work, then commuting costs will be capitalized into residential land rents. Therefore, we also include a variable "*Average commuting time*", which is the average commuting time to the workplace (tract) from a residential tract. It is measured by minutes.

The county fixed effects control for natural amenities with service areas at or beyond a county, such as climate, parks, and museums. They also control for the difference of housing production efficiency. However, they fail to capture natural amenities at the tract level and other tract-specific attributes, such as local schools, churches, and highway intersections. To take into account the localization of natural amenities at (or beyond) tract level, we create the second benchmark model by constructing social interaction variables at the blockgroup level and replacing county fixed effects with tract fixed effects. For example, *Aveage education* now is the percentage of residents with a college degree or higher at a blockgroup. By the same token, we also estimate a model at the block level with blockgroup fixed effects.

We use the Huber/White estimate of variance clustered by locations to

produce consistent standard errors. The estimate results are reported in section 7.

5 Data

We use the restricted version of the 1990 Massachusetts census data. The data set contains information on surveyed individuals' personal characteristics, family structure, geographical information of residence and workplaces, and housing characteristics. The sample used in this paper is constructed as follows: select workers whose ages are between 16 and 65, living in the Boston metropolitan area, exclude workers whose working industry is agriculture, mining, military, and not classified, exclude those who have disabilities that prevented them from working. The classification of industries and occupations are listed in Table A1 and A2 in the appendix. The sample includes 142,026 housing units, 622 census tracts, 2,573 blockgroups, and 29,801 blocks. The average number of housing units in a block, blockgroup, and tract are about 5, 57, and 233, respectively.

6 Imputed housing values for rental housing units

The census data contain reported housing values by owners and reported rents by tenants. The first step of our estimation is to impute housing values for rental housing units. We specify the following model to impute property values for rental housing units:

$$\log P_i = \alpha_0 + \alpha_1 Owner + \delta X_i + \epsilon_i, \tag{10}$$

where P_i is the reported property values or rents of housing unit i, $Owner$ is a dummy variable (1 for owner-occupied units and 0 for rental units), X_i is the vector of housing characteristics for unit i, δ is the coefficient vector of housing characteristics to be estimated.[9]

[9] I thank Patrick Bayer for pointing out this methodology of imputing housing values for rental units.

The results are presented in Table 1.

TABLE 1
Estimate the Coefficient of Tenure

Dependent variable: log (price or rents)		
Variable	Coefficient	t Statistic
Constant	5.6577	362.5
Owner	5.6934	1300.6
Number of bedrooms	0.1444	80.9
Number of other rooms	0.1233	70.7
Building age	-0.0012	-13.63
Dummy for mobile	-0.8649	-33.83
Dummy for detach	{-0.0278}	-1.86
Dummy for attach	{-0.0293}	-1.78
Dummy for 2 apt.	0.0519	3.44
Dummy for 2-4 apt.	0.0333	2.2
Dummy for 5-9 apt.	{-0.0110}	-0.7
Dummy for 10-19 apt.	0.0600	3.78
Dummy for 20-49 apt.	0.1408	8.78
Dummy for >50 apt.	{-0.0001}	-0.01
Dummy for lot size >10 acres	0.1595	11.9
Dummy for office use	0.1421	10.5
Number of observations:132,859; Adjusted $R^2 = 0.969$		

{ }indicates insignificance at the 5% level.

After obtaining the estimated coefficient for home ownership, we impute property values for rental housing units by using the following formula:

$$\text{Imputed Property Value} = \text{Reported Rent} \times e^{5.6934}.^{10}$$

For housing units with missing reported rents or values, we use the predicted values by applying the estimated coefficients in Table 1.

[10] The implies a capitalization rate, which is the ratio of annual housing rent to housing price, of 4%. This seems too low. However, the mean of imputed values of rental housing units is very clos to the mean of reported housing values.

7 Results

Table 2 presents the estimated results with county fixed effects. The tract, blockgroup, and block level models construct social amenities at the tract, blockgroup, and block level, respectively. Overall, the coefficients of housing characteristics are very stable, and many are also similar to those in Table 1. This implies that housing characteristics are relatively orthogonal to the neighborhood attributes.

TABLE 2
Benchmark Model With County Fixed Effects

	Tract		Blockgroup		Block	
Variable	Coefficient	t	Coefficient	t	Coefficient	t
Number of bedrooms	0.1402	14.54	0.1404	14.66	0.1406	9.71
Number of other rooms	0.0977	18.76	0.0943	16.23	0.0957	10.00
Building age	-0.0020	-3.95	-0.0017	-3.55	-0.0012	-1.96
Dummy mobile	-0.7633	-7.26	-0.7563	-7.08	-0.7668	-7.45
Dummy for detach	{-0.0176}	-0.70	{-0.0041}	-0.15	{0.0188}	0.50
Dummy for attach	{-0.0005}	0.02	{0.0003}	0.02	{-0.0077}	-0.35
Dummy for 2 apt.	0.1143	4.87	0.1182	4.86	0.1119	3.90
Dummy for 3-4 apt.	0.1286	2.75	0.1257	2.70	0.1134	2.34
Dummy for 5-9 apt.	{-0.0104}	-0.36	{-0.0001}	-0.00	{0.0123}	0.30
Dummy for 10-19 apt.	0.0425	4.23	0.0518	4.94	0.0538	4.02
Dummy for 20-49 apt.	0.0842	3.28	0.0775	2.50	0.0863	2.86
Dummy for >50 apt.	-0.0755	-2.86	-0.0943	-3.73	-0.0708	-2.72
Dummy for lot size>10	0.1463	9.41	0.1396	8.27	0.1588	8.61
Dummy for office use	0.1150	12.32	0.1163	10.91	0.1128	8.83
Average commuting time	-0.0120	-4.44	-0.0073	-3.35	-0.0014	-3.21
Average education (%)	1.0143	28.74	0.9114	25.77	0.4967	13.05
Concentration (%)	{24.6037}	1.27	46.3307	2.23	326.8253	3.23
Occupation diversity (%)	{-0.9930}	-1.71	-0.6905	-3.03	0.0680	2.97
Industry diversity (%)	0.5909	8.30	0.3513	9.88	{-0.0245}	-0.83
Five-year household (%)	-0.2386	-3.11	-0.1962	-2.77	-0.1206	-2.48
Parent-kids households (%)	-0.1360	-2.12	-0.0924	-4.81	-0.0550	-2.82
Single-parent households (%)	-0.6888	-5.22	-0.6679	-14.85	-0.3149	-3.3
Home ownership rate (%)	0.1936	3.18	{0.0973}	1.7	{0.0378}	0.81
English proficiency (%)	0.5614	10.36	0.2509	7.04	0.0540	3.64
Race diversity (%)	-0.0872	-2.25	{-0.0321}	-0.94	-0.0487	-3.80
Adjusted R^2	0.3158		0.3216		0.2957	

{ } indicates insignificance at the 5% level.

For the tract level model, let us first look at the human capital variables. The elasticity of property value to the quality of local human capital stock (*Average education*) is 1.01. The effect of concentration of employed residents is not significant but is large (elasticity is 24.6). The elasticity of industry diversity is about 0.59. These results are consistent with the

findings in Fu [15]. The effect of occupation diversity is negative, this is surprising, but not significant.

For social capital variables, the proportion of old households has a negative effect on property value: a 1% increase in the residents who lived in the same house more than five years at a tract is associated with a 0.24% decrease in property values. In Table 3 column C, we replace this index with the percentage of households who moved in within one, two to five, and more than 10 years at a tract. The coefficient of the percentage of households that moved in within one year is positive and significant, the other two coefficients are negative and significant. This further confirms the effects of tenure. This could be explained by the strength of weak ties. Though old residents have built more social connections with neighbors, the redundant information from social interactions is not very useful. New movers brought new information and social networks to the neighborhood, and made the neighborhood more dynamic and interesting.[11]

The effect of the percentage of single-parent households is negative, and this is not surprising. What is surprising is that the coefficient of the percentage of married-couple-with-kids household is negative. Since such families have more within-family social capital, and parents most likely socialize with each other if their children attend the same local school, we expect this social capital variable to have a positive effect on property values. This needs further investigation.

Home ownership promotes household's investment in social capital (DiPasquale and Glaeser [13]). The elasticity of housing value to home ownership rate is 0.19. Combining with the analysis of the effects of residence length, we can tentatively infer the trade-off of promoting home ownership: on the one hand, home ownership per se can promote investment in so-

[11] Moving to a new community tends to destroy established bonds with old community, thus depriving family and children of existing network ties. But, parental support and higher expectation for children can compensate for the loss of community among migrants (Hagan et al. [23]).

cial capital; on the other hand, long tenure tends to block the flow of new information and the formation of new social capital.

For cultural capital variables, the coefficient of the percentage of residents who spoke English well is positive. This is straightforward since good English facilitates social interactions and civic engagement. The effect of racial diversity is negative; this means that people prefer to live in a community with others of the same cultural background. This is observed in Boston, for example: Brookline is a Jewish neighborhood, South Boston is an Irish cluster, the North End is predominantly Italian, and the South End has a large Puerto Rican community. However, if housing markets are segregated by race discrimination, then the discriminated race will have to pay higher housing price or rents. Therefore, we can only tentatively conclude that, in general, the homogeneity of race is an amenity.

Table 3 further presents different specifications of the benchmark model at the tract level. The results show that our model specification in Table 2 is pretty robust.

TABLE 3
Different Model Specifications at the Tract Level

	A	B	C	D
Variable	Coefficient	Coefficient	Coefficient	Coefficient
Average education	1.0601	1.0044	0.9722	1.0018
	34.43	23.89	40.68	25.97
Concentration	{31.7206}	{28.4631}	{21.8769}	{23.1097}
	1.56	1.62	1.08	1.25
Occupation diversity	{-0.8330}	{-0.9124}	{-1.0688}	-1.2429
	-1.30	-1.56	-1.78	-3.53
Industry diversity	0.6015	0.4607	0.6658	0.6437
	8.44	4.42	10.57	10.22
Five-year household(%)	{-0.1041}		-0.2318	-0.2076
	-1.83		-2.76	-2.77
Move in within 1 year		0.1875		
		2.16		
Move in within 2-5 year		-0.3233		
		-4.21		
Move in 10 years ago		-0.2059		
		-2.03		
Unemployment (%)			-1.1439	
			-3.36	
Parent-kids households	{0.0059}	{-0.1228}	-0.1629	-0.1287
	0.09	-1.4	-2.73	-2.22
Single-parent households	-0.7494	-0.7415	-0.5494	-0.7386
	-6.49	-5.74	-3.17	-7.55
Ownership rate		0.1790	0.1867	0.1817
		2.09	3.37	3.67
English proficiency	0.5023	0.5741	0.5459	1.2733
	8.18	9.30	10.25	3.83
Race diversity	-0.0999	{-0.0969}	-0.0671	
	-2.43	-2.86	-2.37	
Multi-language				-0.6428
				-2.75
Adjusted R^2	0.3150	0.3161	0.3167	0.3161

{ } indicates insignificance at the 5% level.
The numbers below the coefficients are t test statistics.

If economic activities and social interactions are distributed evenly, then the coefficients from tract, blockgroup, and block level variables should be the same. However, Table 2 shows that coefficients become smaller when moved down to lower geographic levels. This probably is due to measurement errors, but it also may hint that there exists a certain spatial pattern of social interactions.

County fixed effects control for amenities whose service areas are at least at the county level, such as climate, major highway, and national parks. However, they fail to control amenities of lower service areas, such as local schools, churches, shopping malls, secondary highways. To better estimate the effects of social amenities, we construct all social amenity indices at the blockgroup level, and estimate the model with tract fixed effects. Results are presented in Table 4 where the coefficients of housing characteristics are suppressed.

TABLE 4
Benchmark Model at the Blockgroup Level

	County fixed effects		Tract fixed effects	
	Coefficient	t	Coefficient	t
Average commuting time	-0.0073	-3.35	{-0.0005}	-0.35
Average education	0.9114	25.77	0.4733	10.56
Concentration	46.3307	2.23	56.2082	3.62
Occupation diversity	-0.6905	-3.03	{-0.3253}	-1.86
Industry diversity	0.3513	9.88	{0.0595}	0.48
Five-year households	-0.1962	-2.77	-0.2096	-5.73
Parent-kids households	-0.0924	-4.81	{-0.0501}	-1.19
Single-parent households	-0.6679	-14.85	-0.5419	-6.68
Home ownership rate	{-0.973}	-1.70	{0.0371}	0.99
English proficiency	0.2509	7.04	{0.0371}	0.46
Race diversity	{-0.0321}	-0.94	{-0.0135}	-0.35
Adjusted R^2	0.3216		0.3576	

{ } indicates insignificance at the 5% level.

In Table 4, the tract fixed effects model, the coefficient of average commuting time is not significant, though it is still negative. This is not sur-

prising since tract fixed effects control for local transport accessibility very well. For human capital variables, the diversity indices are not significant, probably because human capital externalities through diversity take place mainly at the workplace and on large geographic scale instead of small residential places. For social capital variables, the effects of percentage of married-couple-with-kids households and home ownership rates become insignificant. This is a bit puzzling. One interpretation could be that the social interactions and civic engagement among parents and homeowners are beyond blockgroup level.

The effects of cultural capital in terms of English proficiency and race diversity become insignificant. Residents probably spoke their native languages more frequently at home and nearby social occasions, so English proficiency becomes not so important as in large geographic area communication. Also, people may care more about the homogeneity of their community, but may be less concerned about where their direct neighbors came from.

By the same token, we also estimate the model at the block level with blockgroup fixed effects. Results are presented in Table 5. The results are very similar with the blockgroup level model with tract fixed effects. Since only a few amenities serve within a blockgroup scope, we believe the blockgroup level model with tract fixed effects is the most appropriate specification.

TABLE 5
Benchmark Model at the Block Level

	County fixed effects		Tract fixed effects		Blockgroup fixed effects	
Variable	Coefficient	t	Coefficient	t	Coefficient	t
Average commuting time	-0.0014	-3.21	{0.0005}	1.67	{0.0004}	1.75
Average education	0.4967	13.05	0.2110	15.10	0.1616	13.52
Concentration	326.8253	3.23	366.4435	6.20	345.8265	5.22
Occupation diversity	0.0680	2.97	0.0552	2.52	0.0428	2.26
Industry diversity	{-0.0245}	-0.83	{-0.0072}	-0.37	{-0.0014}	0.08
Five-year households	-0.1206	-2.48	-0.1154	-11.05	-0.0992	-10.74
Parent-kids households	-0.0550	-2.82	{-0.0134}	-1.55	{-0.0011}	-0.15
Single-parent households	-0.3149	-3.30	-0.1831	-8.36	-0.1354	-7.44
Home ownership rate	{0.0378}	0.81	{0.0066}	0.43	{-0.0051}	-0.41
English proficiency	0.0540	3.64	{0.0105}	0.50	{0.0193}	1.12
Race diversity	-0.0487	-3.80	{-0.0245}	-1.20	{-0.0174}	-0.94
Adjusted R^2	0.2956		0.3634		0.3938	

{ } indicates insignificance at the 5% level.

To identify which geographic level of social interactions is most important, we also estimate a county fixed effects model by including social interaction indices at the block, blockgroup, and tract level. The results are reported in Table 6.

TABLE 6
Benchmark Model at the Block, Blockgroup, and Tract Level

	A		B		C	
Variable	Coefficient	t	Coefficient	t	Coefficient	t
Average education-t	0.4885	8.26	0.5153	8.68	0.7922	13.91
Average education-bg	0.3627	13.6	0.5265	13.45		
Average education-b	0.1873	10.6			0.2350	9.89
Concentration-t	{21.2346}	1.20	{19.8428}	1.10	{22.5367}	1.29
Concentration-bg	{-2.0809}	-0.2	30.201	2.22		
Concentration-b	257.0416	3.55			254.6850	3.80
Occupation diversity-t	{-0.6000}	-1.14	{-0.6927}	-1.40	-1.0760	-2.06
Occupation diversity-bg	-0.5309	-2.95	-0.3732	-2.39		
Occupation diversity-b	0.0575	2.44			0.0523	2.61
Industry diversity-t	0.6256	5.19	0.5928	3.70	0.6213	10.34
Industry diversity-bg	{0.0418}	0.45	{0.0905}	0.73		
Industry diversity-b	{-0.0043}	-0.19			0.0015	0.08
Five-year households-t	{0.0449}	0.99	{-0.0118}	-0.19	{-0.0513}	-1.01
Five-year households-bg	-0.1054	-5.8	-0.2039	-6.94		
Five-year households-b	-0.1049	-5.7			-0.1206	-5.14
Parent-kids households-t	{0.0261}	0.37	{-0.0766}	-1.20	-0.1718	-3.12
Parent-kids households-bg	-0.0620	-2.59	-0.0518	-2.50		
Parent-kids households-b	{-0.0053}	-0.65			-0.0148	-1.64
Single-parent households-t	{-0.0861}	-0.69	{-0.1059}	-0.70	-0.4735	-3.11
Single-parent households-bg	-0.4422	-6.13	-0.5644	-7.02		
Single-parent households-b	-0.1271	-3.94			-0.1828	-4.52
Home ownership rate-t	0.1585	6.2	0.1514	4.55	0.1892	3.92
Home ownership rate-bg	{0.0386}	1.00	{0.0214}	0.44		
Home ownership rate-b	{-0.0107}	-0.36			-0.1206	-5.14
English proficiency-t	0.5745	4.07	0.5077	4.01	0.5832	9.03
English proficiency-bg	{0.0024}	0.02	{0.0399}	0.46		
English proficiency-b	0.0209	2.64			{0.0153}	1.07
Race diversity-t	-0.0932	-2.48	-0.0922	-2.05	-0.0752	-2.22
Race diversity-bg	{0.0151}	0.41	{0.0139}	0.55		
Race diversity-b	{-0.0090}	-0.64			-0.0196	-1.54
Adjusted R^2	0.3367		0.3266		0.3320	

{ } indicates insignificance at the 5% level. "-t","-bg", and "-b" indicate variables are constructed at the tract, blockgroup, and block level, respectively.

A few points worth noting in Table 6 Column A. For human capital variables, the quality of local human capital stock is always positive and significant; the thickness of human capital is significant at the block level; the effect of industry diversity is significant at the tract level. All these results are consistent with Fu [15] where social interactions take place in the workplace. However, the effect of occupation diversity is only significant at the block level; this is somewhat surprising. The effects of most social capital are significant at the blockgroup level, but we are not sure if in real life most social connections and networks are within blockgroup scope. The effect of home ownership rate is only significant at the tract level, probably meaning that homeowners engage in larger geographic scale communications. The effects of cultural capital are significant at the tract level, which confirms our early analysis. Column B drops block level variables, column C drops blockgroup level variables; these results are consistent with column A.

All the above models consider only social interactions among local residents. However, workers whose workplace and residential location are different may also interact with local residents in the workplace. Such social interactions between local residents and commuting-in workers may also play an important role. To explore this effect, for each residential location, we count workers living there and workers working but not living there, then construct social amenity indices based on this resident-worker sample. We expect the effects of social interactions will be stronger. The results, presented in Table A-3 in the appendix, indeed show that (the absolute values of) most coefficients of social amenities become larger.

8 Discussion and conclusion

This paper classifies three types of social amenities: human capital, social capital, and cultural capital at microgeographic levels. We used the 1990 Massachusetts census data and estimate the effects of social amenities on residential property values. We found that human capital externalities have

strong positive effects on property values. Different types of social capital have different effects on property values; the home ownership rate has a positive effect at large geographic levels, while the percentage of households with short tenure has a positive effect on property values, probably due to the strength of weak ties. The percentage of single-parent households has negative effect on property values. Cultural capital's effects vary from high to low geographic levels, positive at and beyond the tract level, but insignificant at the block level.

There are a few issues worth further discussion. First, our indices proxy for social amenities are experimental and incomplete. A better data set is needed to further investigate the impact of local social interactions on property values. Second, not only do social interactions affect property values, but, also, housing has a broad set of social consequences on occupants (Glaeser and Sacerdote [19]). However, this does not cause endogeneity problems in our estimation since we use a cross-section model and neighborhood attributes. The third question is that the classification of human capital, social capital, and cultural capital is not a consensus. Some writers argue that human capital includes both social capital and cultural capital. But if this becomes consensus, it will change only the title of this paper. Fourth, the three types of capital are correlated. Well-educated people have stronger social skills or higher status, which make them access more social capital; social capital affects the creation of human capital, as Coleman [10] argued. However, our huge sample size can partly remedy this problem.

The last, but not least important, issue is sorting effects. Well-educated people may prefer to socialize with well-educated peers, and easily develop trust and trustworthiness; they also have higher income and demand for high quality housing and neighborhood. Households with kids may be willing to trade housing quality for having expensive kids. This issue needs further investigation.

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Appendix:

Table A-1 Industry Code

Industry	1990 census code
Construction	60-99
Manufacturing	100-399
Public utility	400-499
Wholesale trade	500-579
Retail trade	580-699
Finance, real estate, and insurance	700-720
Business and repair services	721-760
Personal services	761-799
Entertainment	800-811
Professional services	812-899
Public administration	900-939

Table A-2 Occupation Code

Occupation	1990 Census code
Managerial, professional specialty	1-42
Engineers, architects, surveyors	43-63
Mathematical, computer scientists	64-68
Natural scientists	69-83
Health diagnosing occupation	84-112
Teachers, librarians, archivists	113-165
Social scientists, urban planners	166-182
Writers, artists, entertainers, athletes	183-202
Technicians	203-242
Sales	243-302
Administrative	303-402
Service	403-472
Mechanics, repairers	503-552
Construction	553-612
Precision production	628-702
Machine operators, tenders	703-802
Transportation, material moving	803-863
Handlers, equipment cleaners, laborers	864-902

Table A-3
Resident-Worker Social Interaction Model

	Tract		Blockgroup		Block	
Variable	Coefficient	t	Coefficient	t	Coefficient	t
Average education	1.1358	35.28	0.4827	9.66	0.1606	13.43
Concentration	{29.0092}	1.26	{36.9908}	2.30	217.2624	4.06
Occupation diversity	-2.0218	-6.05	-0.4821	-2.83	{0.0221}	1.20
Industry diversity	0.6130	6.20	{-0.0927}	-0.99	0.0121	0.71
Five-year households	-0.2929	-2.91	-0.3126	-7.61	-0.1090	-12.23
Parent-kids households	-0.2080	-2.38	{-0.0755}	-1.57	{-0.0075}	-1.05
Single-parent households	-0.8131	-6.27	-0.5839	-5.81	-0.1452	-7.65
Home ownership rate	0.2366	3.00	{0.0547}	1.28	{0.0148}	-1.13
English proficiency	0.7090	10.43	{-0.0483}	-0.51	{0.0152}	0.82
Race diversity	-0.1634	-3.32	{-0.0006}	-0.01	{-0.0050}	-0.26
Adjusted R^2	0.3095		0.3571		0.3924	
Fixed effects	County		Tract		Blockgroup	

{ } indicates insignificance at the 5% level.