HEDONIC PRICES AND EQUILIBRIUM SORTING IN HOUSING MARKETS: A CLASSROOM SIMULATION

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We introduce a classroom simulation to teach core concepts in hedonic price analysis. Students maximize utility by deciding where to live. Locations differ in two dimensions: school quality and environmental quality. Endogenous housing prices in each location equilibrate the market. The simulation demonstrates the power of hedonic analysis, as well as its limitations and assumptions. It is fun, engaging, and accessible for both undergraduate and graduate students. We provide materials for implementation in an online appendix.

Keywords: hedonic theory, implicit prices, classroom simulation

JEL codes: A2, H41, Q51, R31

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I. INTRODUCTION

Should we tighten our city's air-quality standards? Increase the parks budget? Reduce public school class sizes? To answer these questions, we need to know how much people value clean air, nice parks, and good public schools. But these goods are not directly traded in markets. We could directly ask people how much they value these goods and charge them accordingly. But what if they misreport their true values? Theory tells us that it is typically not possible to design a mechanism that induces people to truthfully report willingness to pay while also raising enough revenue to pay for the optimal level of a public good (Myerson and Satterthwaite 1983). What can we do? To resolve this conundrum, economists have developed a range of indirect valuation methods based on analyzing people's real-world choices. Hedonic price analysis is one common approach.

Hedonic price analysis seeks to explain the equilibrium price of a differentiated product — say a home, car, or computer — as a function of its individual attributes. This equilibrium relationship is known as the hedonic price function. In the case of a home, the relevant attributes may include local public goods, such as air quality, proximity to a park, or the performance of neighborhood schools. As Rosen (1974) shows, the slope of the hedonic price function with respect to a particular attribute — the "implicit price" of the attribute — equals the marginal willingness to pay for changes in the attribute. Thus, hedonic price analysis allows us to recover the value of local public goods and other residential amenities indirectly from actual behavior in the housing market. However, the assumptions underlying hedonic price theory and empirical practice are strong and not immediately intuitive.

This paper introduces a classroom simulation to teach core concepts in hedonic price analysis and residential sorting. In the simulation, students maximize utility by deciding where to live. Locations differ according to their level of two local amenities. Here, environmental quality is our main variable of interest, while school quality serves as a potential confounding variable. Endogenous housing prices in each location adjust until no student wishes to change locations, i.e. the market reaches equilibrium. Over several rounds, the simulation shows the power of hedonic price analysis under the assumptions of a housing market in equilibrium, local amenities that vary independently of other home attributes, and fully informed, rational, and mobile consumers with identical preferences. It also shows the limitations of hedonic analysis when these conditions are relaxed. Instructors may add complexity with each round, while econometric analysis and in-depth discussion of the simulation provide many enrichment opportunities. Thus, the simulation can add value to both undergraduate and graduate courses in public, urban, and environmental economics.

We have used this simulation since 2012 in a unique environmental economics course at Michigan State University. This course is taught in the Department of Agricultural, Food, and Resource Economics but is open to all graduate students at the university, drawing graduate students from economics, forestry, fish & wildlife, and public policy, as well as the occasional high-achieving undergraduate. Thus, in any given year, we are teaching students in their second or third year of an economics doctoral program, as well students with very limited backgrounds in economics, and everything in-between. In our experience, students at all levels enjoy and learn from the simulation, which is accessible to beginners yet remains stimulating for more advanced students. Even students that have already seen Rosen's (1974) theory gain a deeper understanding by seeing the theory play out before their eyes — indeed, we have seen economics PhD students nodding their heads and saying, "Cool, very cool" or "Ahhh, I get it!" during the simulation.

The rest of the paper proceeds as follows. Section II provides a short and readable overview of the simulation, in which we describe key points from each round. Section III describes our supporting materials for implementation. These materials include instruction slides for the simulation (SimulationInstructions.pptx), student handouts that contain key parameter values (StudentHandouts.docx), data and figures illustrating the equilibrium outcomes and analyzing these data econometrically (EquilibriumResults.xls), and lecture slides (HedonicTheoryAnalysis.pptx). We provide these materials in an online appendix.

II. OVERVIEW OF THE SIMULATION

To summarize, we divide a large classroom table — or designate several smaller tables — to represent six neighborhoods and label them A–F. Each neighborhood has different levels of environmental quality and school quality. We typically group students into six teams of 2–3 students. We then give each team its own set of color-coded cards. Each team gets a different color. Each card represents an individual household, and each color represents a different household type. Each team maximizes utility for its households by locating them in their preferred neighborhoods. Each color set includes 5–25 cards, depending on color, for a total of 75 cards in the simulation. We have chosen these and all other simulation parameters carefully to make calculations easy, to ensure whole-number equilibrium outcomes, and to highlight a wide range of conceptual issues in a single simulation. We provide all of these parameters in the online appendix (StudentHandouts.docx).[3]

We divide the simulation into several rounds to highlight core concepts. The entire simulation and discussion runs about 60 minutes. We present the formal theory and empirical methods in a follow-up lecture. Each round features a different set of parameter values and

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3 Our experience is in a small class of about 15 students. For larger classes, the instructor may wish to divide cards for the more common household types (i.e., larger color groups) among multiple teams and mark each team's cards to differentiate them from each other. Alternatively, instructors may wish to run multiple simulations in parallel, perhaps with the help of a teaching assistant.

different equilibrium outcomes. At the beginning of every round, we assign to each team's color-coded households constant marginal willingness to pay (MWTP) values for environmental quality and school quality. The utility a household derives from a given location equals the household's total willingness to pay (WTP) for that location's amenities less that location's home price. Thus, household type *i* that chooses neighborhood *j* earns the following utility:

$$u_{ij} = \alpha_i EnvironmentalQuality_j + \beta_i SchoolQuality_j - Price_j, \tag{1}$$

where α_i and β_i are type *i*'s constant MWTP values for environmental quality and school quality. Thus, households have indifference curves that are linear with slopes α_i and β_i in home price versus amenity space. In early rounds, every household is identical, and the colors serve only to identify each team's cards. In later rounds, where we allow heterogeneous preferences, the colors correspond to household types with different MWTP values.

Each team maximizes utility for its households by placing their color-coded cards in the locations that yield the highest WTP for amenities net of home price. As more households enter a particular location, the home price in that location increases. As home prices adjust, students continue to re-optimize, until no household can earn higher utility by moving. At this point, the housing market is in equilibrium. To streamline the equilibrium-finding process, we designate one location (A) as an "outside option" that can accommodate any number of households at zero utility (i.e., we fix this location's price and set its amenity values to zero). In all other locations (B–F), we set the housing price to equal the total number of households choosing to reside in that location. Thus, it is easy for students to determine the home prices in each location and which locations offer the highest utility.

A. Homogeneous Households

In the first three rounds, every household has identical MWTP values of $\alpha = \$3$ for environmental quality and $\beta = \$1$ for school quality.

Round #1: Basics

In this round, we focus on how a price equilibrium arises via the interaction of buyers and sellers and how the slope of the hedonic price function reflects the marginal willingness to pay for more environmental quality — and the marginal cost of providing it. Locations differ only in the dimension of environmental quality, ranging in whole numbers from 0–6 in neighborhoods A–F. Meanwhile, we set school quality in each location to zero. We ask teams to start with their cards in neighborhood A (zero utility) and we instruct them to move their cards whenever they could gain higher utility by locating elsewhere. Neighborhoods B–F initially have home prices of zero yet offer strictly positive amenity values. Thus, each household has an incentive to move. Teams begin sorting their households into neighborhoods B–F and prices in these locations increase accordingly. Prices continue to adjust, and students continue to re-optimize, until the market reaches equilibrium. To speed the sorting process, we often ask students: "How many households could locate in each neighborhood and still earn positive utility?" Usually, students quickly realize that the total number is less than 75 households. Thus, neighborhood A must contain at least some households, such that all households earn zero utility in equilibrium and are indifferent between locations. Moreover, equilibrium prices in neighborhoods B–F must equal total WTP for amenities in those locations. If students continue to have trouble, and time is short, it is sometimes necessary to directly guide them to the final equilibrium. At the end of the sorting process, we always ask: "Now, could any individual household gain higher utility by moving?" Thus, we emphasize the definition of a price equilibrium and confirm that we have reached it.

Figure 1 illustrates the equilibrium outcome for Round #1, using pattern-coded cards in place of the simulation's color-coded cards. Since all households are identical, the different pattern-coded cards serve only to identify student teams, and there is no meaningful sorting of household types across locations. Note that environmental quality increases by one unit moving from neighborhood A to B to C, and so on. Meanwhile, equilibrium home prices increase by $3 moving from neighborhood A to B to C, and so on. This relationship implies a linear hedonic price function with slope of $3 per unit of environmental quality. Figure 2 illustrates this function. Thus, the slope of the hedonic price function — the implicit price of improved environmental quality — equals the common MWTP of $3.

Round #2: Perfectly Correlated Variables

This round shows how hedonic price analysis can fail empirically in the presence of strong collinearity among observed attributes. To make this point, we set school quality to vary in whole numbers from 0–5 across neighborhoods A–F, i.e. equal to environmental quality in each location.[4] The sorting process can start with all households in location A or from the Round #1 equilibrium outcome. Either way, the same equilibrium logic holds: some households will end up in location A, such that all households earn zero utility in equilibrium and are indifferent between locations.

See Table 1 for the Round #2 results. Equilibrium prices increase by $4 for every unit increase in environmental quality, which correlates one-for-one with school quality. We ask students what can be learned from this equilibrium, given that environmental quality and school quality are perfectly correlated. Students are usually quick to recognize that ignoring the role of school quality would lead them to overestimate MWTP for environmental quality as $4 instead of the actual $3. Meanwhile, there is no way to separately determine MWTP for the two amenities from the equilibrium data.

4 More generally, the same problems would manifest if these two variables were perfectly linearly correlated.

Round #3: Disequilibrium, Linear regression, and Panel Identification

In this round, we increase environmental quality by two units in location C and decrease it by two units in location E, while holding school quality constant. Thus, we break the perfect collinearity of Round #2, while mimicking changes in environmental quality that might occur over time in an actual housing market. We begin the sorting process starting from the Round #2 equilibrium. After students have begun to re-sort themselves in response to the amenity changes, but before the new equilibrium is reached, we often ask students to pause the sorting process. We then prompt a discussion about the need for the housing market to be in equilibrium to infer MWTP from implicit prices. We then restart the sorting process and proceed as in previous rounds until the market reaches equilibrium. See Table 1 for the Round #3 results.

The cross-sectional variation in home prices and amenities now allows students to identify implicit prices for both amenities. We demonstrate this possibility by running an OLS regression of equilibrium home prices on environmental quality and school quality — in-class, for dramatic effect — yielding coefficient estimates of exactly $3 and $1. We then run an OLS regression of home prices on environmental quality, omitting school quality as if it were unobserved in the data. The OLS coefficient on environmental quality increases to $3.77. Thus, we demonstrate that hedonic price analysis will deliver biased estimates in the presence of omitted home attributes that correlate with the attribute of interest.

Finally, we show how to construct a simple difference-in-difference estimator for MWTP by comparing equilibrium results for Rounds #2 and #3. See Table 1. In the three right-most columns, we calculate price and amenity changes for Round #3 relative to Round #2. Note that school quality is unchanged. Meanwhile, locations C and E experience changes in environmental quality of +2 and –2 that correspond to price changes of +$6 and –$6. The correlation between these price and amenity changes suggests an implicit price of $3 per unit of environmental quality. Thus, we again recover the common MWTP value of $3. Note that we need not observe school quality to apply this estimator; we need only assume that school quality is unchanged. Thus, this exercise illustrates the logic and appeal of panel-data empirical strategies based on comparing changes in home prices and amenity values over time (Chay and Greenstone 2005).

B. Heterogeneous Households

In the final two rounds, we introduce preference heterogeneity to generate a nonlinear hedonic price function and to show that only marginal buyers' preferences are reflected in this function. There are six household types. These six types have heterogeneous MWTP for environmental quality ranging in whole numbers from α = $1 to $6. Meanwhile, households have identical MWTP for school quality of β = $1. Households with the highest MWTP for environmental quality will tend to sort into the cleanest neighborhoods, as they outbid the households with lower MWTP. Students can see this sorting reflected clearly in the color-coded cards, as we illustrate below.

Rounds #4a and #4b: Binary Distribution of Environmental Quality

Bayer, Ferreira, and McMillan (2007) show how heterogeneity manifests in a residential sorting equilibrium. Following their graphical analysis for a binary home attribute, we initially offer just one level of environmental quality beyond the outside option. Thus, in equilibrium, the hedonic price function only reflects the MWTP of one "marginal" consumer type, while the preferences of the remaining "infra-marginal" types are not directly reflected anywhere in the hedonic price function. If the attribute is in short supply (e.g., a view of the Golden Gate bridge), then MWTP for the marginal type will tend to exceed the population average MWTP. Meanwhile, if the attribute is widely available (e.g., an attached garage), then the population average MWTP will tend to exceed the MWTP for the marginal type.

To illustrate these points, we begin in Round #4a by offering 3 units of environmental quality in location B. We begin with all households residing in location A (zero utility). We ask students to think about who will be willing to pay most to live in neighborhood B. We then start the sorting process, asking students to move into this location in order of decreasing MWTP until the market reaches equilibrium. In the end, households with MWTP of $6 all reside in location B, and households with MWTP of $4 and lower stay in location A. Households with MTWP of $5 reside in both locations A and B, and the price in location B is $15. Thus, the implicit price of environmental quality is $\$15/3=\$5$, which equals the MWTP of the one marginal household type — those who are indifferent between the two locations.

In Round #4b, we increase the supply of environmental quality by offering 3 units in both locations B and C. In this case, households with MWTP of $5 and $6 all reside in locations B and C, while households with MWTP of $3 and lower all stay in location A. Households with MWTP of $4 reside in A, B, and C. The resulting equilibrium has a price of $12 in both locations B and C. Thus, the implicit price of environmental quality is $\$12/3=\$4$, which now equals the MWTP of a different marginal type. Comparing Rounds #4a and #4b demonstrates the sensitivity of implicit prices to the preferences of marginal home buyers.

Round #5: Rich Distribution of Environmental Quality

In our final round, we offer a range of locations with differing levels of environmental quality. Thus, as in Bayer, Ferreira, and McMillan (2007), different household types are marginal at different levels of environmental quality, leading to a convex hedonic price function that gets increasingly steep at higher levels of environmental quality. The distribution of household types is the same as in Round #4. But environmental quality now ranges in whole numbers from 0–5 across neighborhoods A–F. Students sometimes have difficulty achieving equilibrium in this round. Thus, we begin by asking students where the low, medium, and high MWTP types are likely to end up, start them sorting, and see how far they get. But in the end, we often need to direct students to place their last few cards in the proper locations. At this point, we confirm the equilibrium by asking: "Can anyone earn higher utility by moving?"

Figure 3 illustrates the sorting equilibrium in this case. We use pattern-coded cards to depict color coding. Note that students with the highest MWTP sort into locations with the highest environmental quality. Accordingly, the blank cards, which correspond to the highest MWTP value of $6, all sort into location F. Meanwhile, the checkered, striped, horizontally striped, brick-patterned, vertically striped, and dotted cards have lower MWTP values of $5, $4, $3, $2, and $1. Accordingly, these types sort into the locations with lower environmental quality (A–E). In addition, note that the households with MWTP of $2 are indifferent between locations A, B, and C and reside in all three places. Accordingly, equilibrium home prices increase by $2 from location A to B to C. Similarly, households with MWTP of $3, $4, and $5 are indifferent between locations C and D, D and E, and E and F. Thus, home prices increase by $3, $4, and $5 moving from location C to D, D to E, and E to F.

Figure 4 illustrates the nonlinear hedonic price function corresponding to this sorting equilibrium. Notice that the hedonic price function gets increasingly steep moving left to right, as households with stronger preferences for environmental quality attempt to outbid each other for the cleanest neighborhoods. We use this hedonic price function to connect to Sherwin Rosen's (1974) canonical theory, in which consumers maximize utility by setting their continuous "bid" curves (i.e., indifference curves in price-amenity space) tangent to the hedonic price function, such that their MWTP for environmental quality equals the slope of the hedonic price function. The figure illustrates one such indifference curve and point of tangency — or rather, points of tangency — for the household type with a MWTP of $4.

In this simulation, we know the underlying distribution of consumer types, and we know that the resulting hedonic price function is piecewise linear. In reality, practitioners do not directly observe consumer types and do not know the true functional form. Thus, to infer the distribution of MWTP for a particular amenity, practitioners sometimes approximate the hedonic price function by fitting a flexible, nonlinear function to their home price data. They may then calculate marginal implicit prices at each location and the population-weighted average MWTP (Albouy et al. 2016). Thus, for more advanced students, we use OLS to fit a flexible polynomial function to the home price and environmental quality data. To illustrate, Figure 4 plots the fitted values from a cubic polynomial. We then differentiate this function to find the implicit price at each location. Finally, we calculate the household-weighted average of these implicit prices, yielding an estimate for mean MWTP of $3.21, which is quite close to the true population mean of $3. We provide exact instructions for this analysis in the online appendix (see EquilibriumResults.xlsx).

C. Discussion and Review

We conclude the classroom simulation with a discussion and review of three core concepts: (1) housing prices adjust to balance the supply and demand for housing at each location, leading to the equilibrium hedonic price function; (2) the slope of the hedonic price function reflects the MWTP for residential amenities by marginal consumers; and (3) to empirically identify the gradient of the hedonic price function with respect to a particular amenity, we need to observe said amenity varying independently of other home attributes. To provide further enrichment, we intersperse in-depth discussions of hypothetical extensions to the simulation throughout the activity. For example, we typically ask students to discuss how the shape of the hedonic price function and benefit estimation would differ if individual households had diminishing rather than constant MWTP for local amenities immediately following Round #1 and then again after Round #5.

III. FURTHER GUIDE TO IMPLEMENTATION MATERIALS

The simulation instruction slides (SimulationInstructions.pptx) provide more detailed background, setup, and implementation instructions for the classroom simulation. The slides are intended for use during the simulation itself to lead the transition from one round to the next. They also feature questions after each round to prompt discussions on key concepts. In the notes section below the relevant slides, we provide suggested answers to these questions and cross-references to our lecture slides on hedonic price theory and analysis (see below). We typically ask students to read these instructions before class to minimize the time we spend explaining the simulation during class; instructors may wish to delete the suggested answers prior to sharing with students.

In addition to these slides, the online appendix provides student handouts that contain the total number of households (cards) for each household type (color), household preference parameters for each round, and amenity values for each round and location, all in table format (StudentHandouts.docx). The handouts also provide space for students to calculate their willingness to pay for each location and to record the price for each location, to ensure that they have maximized utility and that the housing market is in equilibrium.

As a resource for instructors, we provide a spreadsheet with data on the equilibrium outcomes and figures illustrating these outcomes for each round (EquilibriumResults.xls). Students sometimes need a nudge to achieve equilibrium. Thus, it is important that the instructor know the equilibrium outcomes in advance. The figures can be used to show the equilibrium hedonic price functions during the simulation or in a follow-up lecture (see below). For students with the requisite statistical background, the data on equilibrium outcomes can be analyzed econometrically. We have found it highly effective to analyze these data during class. Thus, we simulate not only how the housing market works in theory, but also how economists analyze real-world housing market data to infer willingness to pay for residential amenities. To illustrate, we have pasted snapshots of our Stata code and output directly into the data spreadsheet.

In addition to these classroom simulation materials, we provide lecture slides on hedonic price theory and empirical analysis (HedonicTheoryAnalysis.pptx). We typically use the first several slides as a setup to the simulation, which takes up the rest of an 80-minute class. We then return to our lecture slides in a follow-up lecture, delving deeper into the underlying hedonic theory and empirical methods. These slides discuss various techniques for valuing non-market environmental goods, such as clean air and water. They present Rosen's (1974) classic theory of hedonic prices and implicit markets, connecting this theory back to the classroom simulation. Finally, they discuss the challenges and limitations of applying hedonic methods empirically, again connecting these methods back to the simulation.

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DISCLOSURES

The authors have no financial arrangements that might give rise to conflicts of interest with respect to the research reported in this paper.

REFERENCES

Albouy, David, Walter Graf, Ryan Kellogg, and Hendrik Wolff, 2016. “Climate Amenities, Climate Change, and American Quality of Life.” *Journal of the Association of Environmental and Resource Economists* 3 (1), 205–246.

Bayer, Patrick, Fernando Ferreira, and Robert McMillan, 2007. “A Unified Framework for Measuring Preferences for Schools and Neighborhoods.” *Journal of Political Economy* 115 (4), 588–638.

Chay, Kenneth Y. and Michael Greenstone, 2005. “Does Air Quality Matter? Evidence from the Housing Market.” *Journal of Political Economy* 113 (2), 376–424.

Myerson, Roger B. and Mark A Satterthwaite, 1983. “Efficient Mechanisms for Bilateral Trading.” *Journal of Economic Theory* 29 (2), 265–281.

Rosen, Sherwin, 1974. “Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition.” *Journal of Political Economy* 82 (1), 34–55.

Table 1

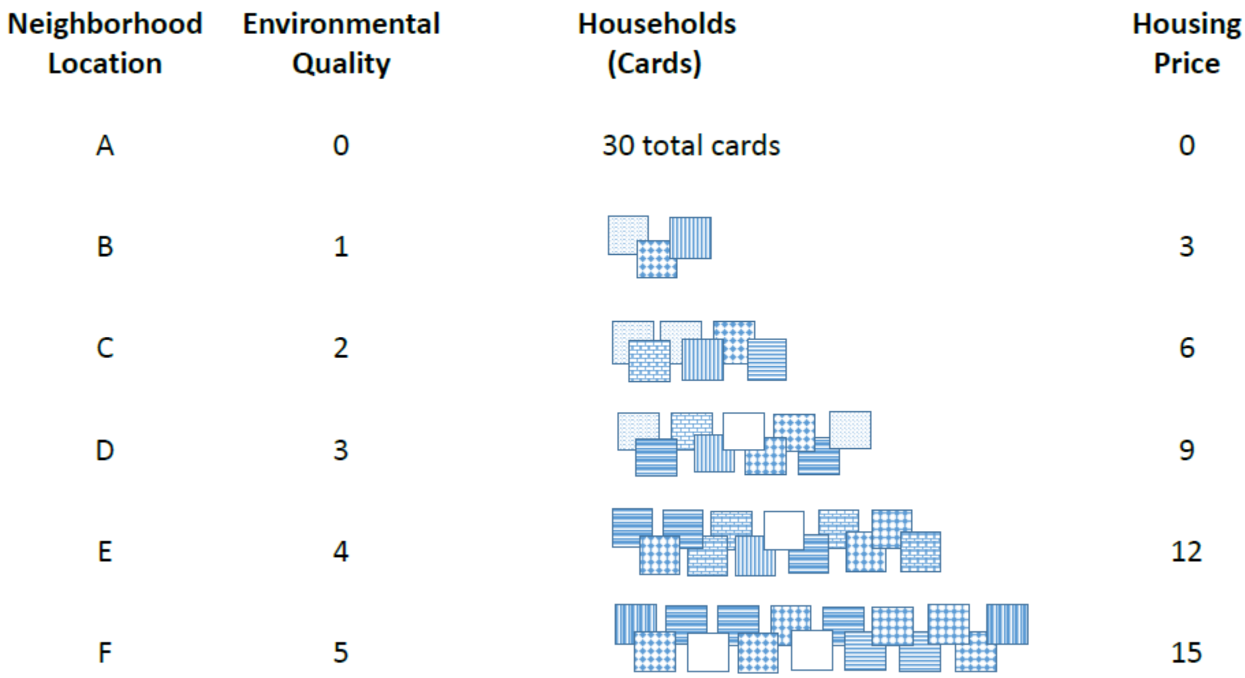
Equilibrium Home Prices in Rounds #2 and #3

	Round #2			Round #3			Round #3 – #2		
Location	EQ	SQ	P	EQ	SQ	P	dEQ	dSQ	dP
A	0	0	0	0	0	0	0	0	0
B	1	1	4	1	1	4	0	0	0
C	2	2	8	4	2	14	2	0	6
D	3	3	12	3	3	12	0	0	0
E	4	4	16	2	4	10	-2	0	-6
F	5	5	18	5	5	18	0	0	0

Note: This table shows amenity values and equilibrium prices in each location for Rounds #2 and #3, along with the changes in these values for Round #3 relative to Round #2. EQ, SQ, and P indicate environmental quality, school quality, and home price, while dEQ, dSQ, and dP indicate the changes in these variables between rounds.

Figure 1

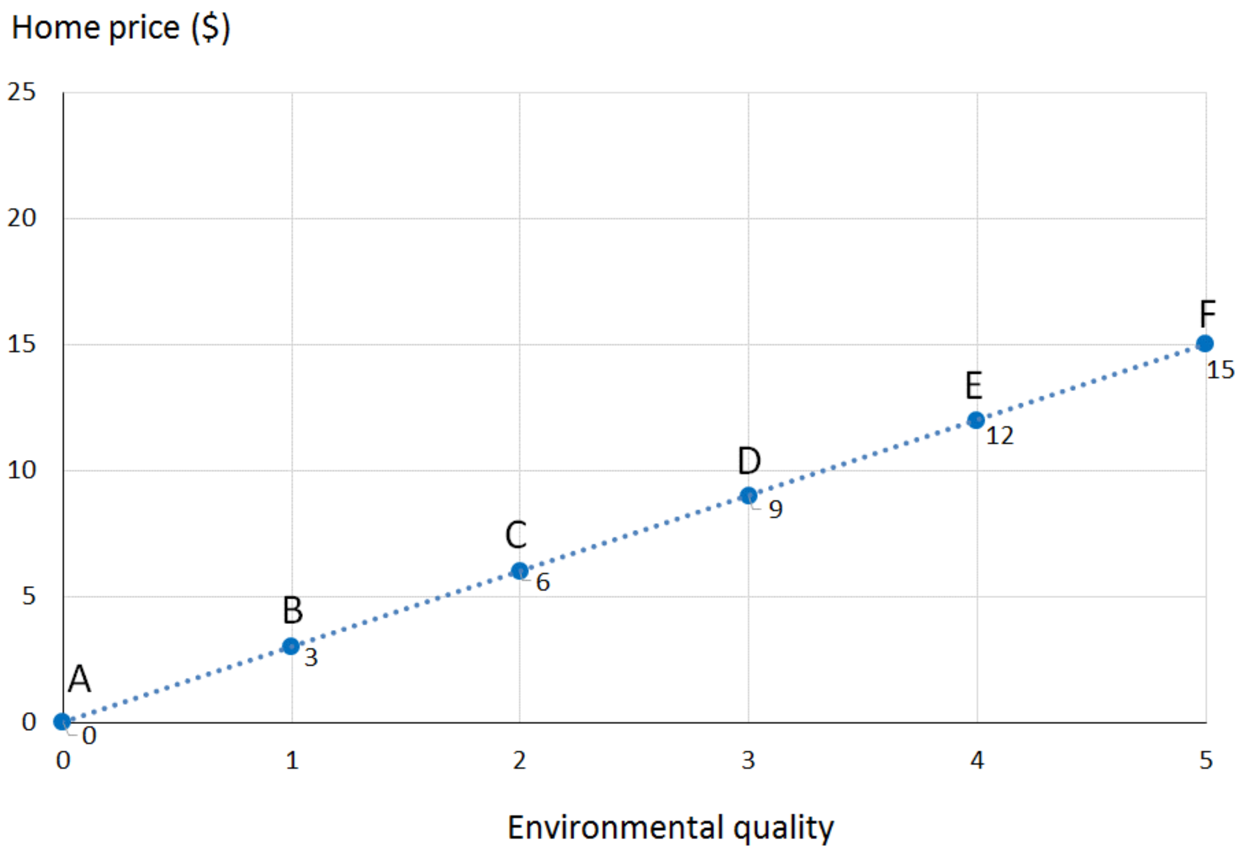
Schematic of Classroom Setup and Sorting Equilibrium for Round #1



Note: This schematic illustrates the classroom setup and equilibrium outcome for Round #1. Locations A–F are labeled on the left, along with their corresponding environmental quality. School quality is zero everywhere. In this schematic all households have homogeneous preferences. Thus, there is no meaningful distinction between the different household types. Different teams are represented as different pattern-coded cards, but there is no obvious sorting of teams across neighborhoods. Home prices are zero in location A, while prices in locations B–F are given by the total number of households residing in those locations. We show only the total number of households located in neighborhood A, so that the cards for these households do not dominate the figure. Note that equilibrium prices increase with environmental quality as one moves top-to-bottom in the schematic.

Figure 2

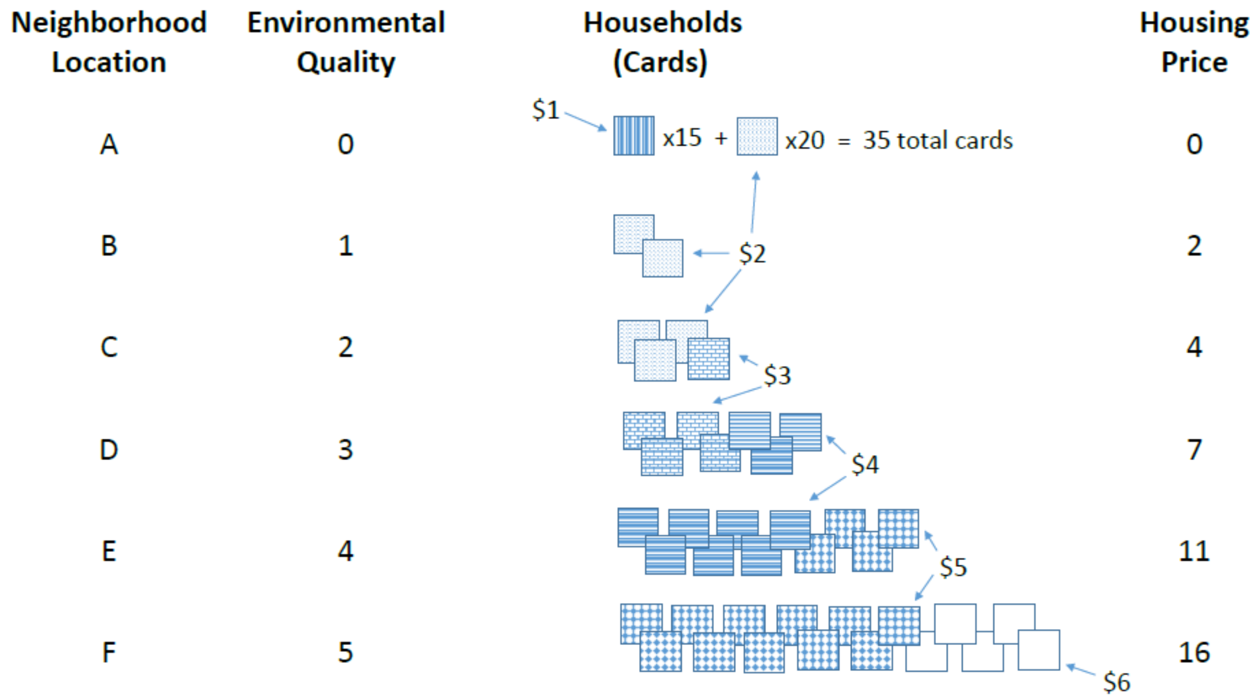
Hedonic Price Function in Round #1



Note: This figure illustrates the equilibrium relationship between home price and environmental quality with homogeneous households in Round#1. We label each neighborhood with its letter (A–F) and equilibrium price. In this round, each household's constant MWTP for environmental quality is $3. See text for details.

Figure 3

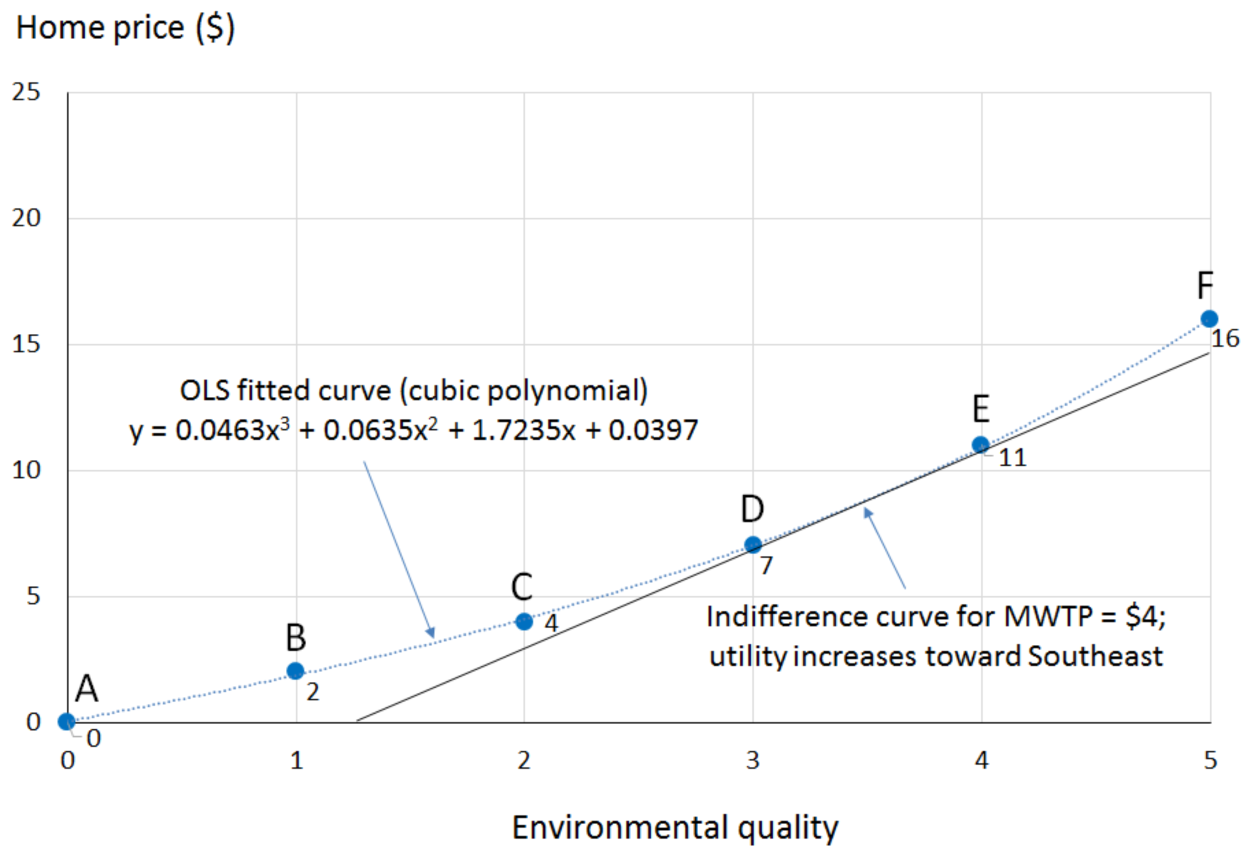
Schematic of Classroom Setup and Sorting Equilibrium for Round #5



Note: This schematic illustrates the classroom setup and equilibrium outcome for Round #5. Locations A–F are labeled on the left, along with their corresponding environmental quality. School quality is zero everywhere. Different household types are represented by different pattern-coded cards (the simulation uses color-coded cards); the dollar-value labels indicate MWTP for these types. Home prices are zero in location A, while prices in locations B–F are given by the total number of households residing in those locations. We show only the total number of households for each type located in neighborhood A, so that the cards for these households do not dominate the figure. Note that equilibrium prices increase with environmental quality as one moves top-to-bottom in the schematic.

Figure 4

Hedonic Price Function in Round #5



Note: This figure illustrates the equilibrium relationship between home price and environmental quality with heterogeneous households in Round #5. We label each neighborhood with its letter (A–F) and equilibrium price. In this round, each household has a constant MWTP for environmental quality, which ranges from $1 to $6 across the simulation's six household types. Thus, the hedonic price function is piecewise linear with an increasing slope. We show the utility-maximizing bid curve for the household type with MWTP = $4. Note that this type is indifferent between locations D and E in equilibrium and that the slope of the hedonic price function between these two locations is precisely $4. In addition to the piecewise linear hedonic price function (with connecting lines omitted), we have plotted the fitted values from an OLS regression of home price on a cubic polynomial in environmental quality (which curves gradually through the points). See text and EquilibriumResults.xlsx for further details.