Hedonic Equation

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Hedonic Regression

Basic Concepts

the term "hedonic" – pleasure (+) and pain (-)

consumers demand *characteristics*

consumption of an item is consumption of a *bundle of characteristics*

there is an *explicit* market in the item, but no *explicit* (only implicit) markets in characteristics

Examples: pocket calculators, houses

Hedonic Regression Example hedonic_example.xls

- Source of data: http://www.sfgate.com/homes/
- Variables included in the analysis
  - House price (asking price) ← Dependent (LHS) variable
  - Number of bedrooms
  - Number* of bathrooms
  - Square feet of floor area
  - Year built

  ← Independent (RHS) variables

* “half” or “partial” bath entered as one-half

Expectations of Sign and Significance of Variables in Hedonic Equation

House prices (dependent or LHS variable) is expected to be:

- *Positively* related to the number of bedrooms
  - but WATCH OUT! Remember we are holding "other factors" (like floor area) constant. So if consumers prefer floor plans that break up space into smaller subspaces, rather than preferring larger open areas, the number of bedrooms will be positively related to house price. Basically, this expectation is reasonable if people have large families and each person in the family wants his or her "private space"
- *Positively* related to the number of bathrooms
  - but WATCH OUT! In this and similar situations there may not be much variation in the variable, which makes the coefficient estimates less efficient
- *Positively* related to square feet of floor area
  - The *mother of all housing hedonic variables* – bigger houses cost more
- *Positively* related to Year built
  - Usual expectation is that the greater is the year built (the younger is the structure – other factors held constant), the greater the house price. But WATCH OUT! Year Built may be a *proxy variable* for "vintage" or character of the neighborhood

How Good are the Data?

- Because it comes from real estate listings, the prices are *asking prices* not *transaction prices*
- Not all listings included square feet. This may introduce a subtle bias in the sample, if the listings not including square feet differ systematically from those including square feet.
  - Different stories of bias can be told
- No indication of how long any particular house has been on the market and whether the asking price has changed

How Good are the Data?

Compare Pogodzinski and Sass, "The Theory and Estimation of Endogenous Zoning,"*Regional Science and Urban Economics* 24 (1994), pp. 601-630

- Over 900 observations (all from sales finalized in the same month)
- Uses transaction prices from County Assesor's Office
- About 30 variables available

Results of Hedonic Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.806996608
R Square	0.651243526
Adjusted R Square	0.604742663
Standard Error	160594.9623
Observations	35

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1.4448E+12	3.61199E+11	14.00498	1.47909E-06
Residual	30	7.73722E+11	25790741931		
Total	34	2.21852E+12			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1025306.359	3415528.436	0.300189672	0.766103	-5950133.265	8000745.983	-5950133.265	8000745.983
BR	-140367.2396	52875.16346	-2.65469136	0.01258	-248352.7292	-32381.75	-248352.7292	-32381.75
Baths	-124462.2121	78679.58495	-1.581886993	0.124162	-285147.3607	36222.93661	-285147.3607	36222.93661
SqFt	579.6968902	94.36028383	6.14344157	9.34E-07	386.9874823	772.4062982	386.9874823	772.4062982
YearBlt	-278.0236029	1767.730945	-0.157277104	0.87608	-3888.21181	3332.164604	-3888.21181	3332.164604

Interpreting the Coefficient Estimates

- Number of bedrooms is negative, statistically significant, and large
  - Interpretation: each additional bedroom reduces the value of the house by about $140,000
- Number of bathrooms is negative, not statistically significant, and large
  - Interpretation: each additional bathroom reduces the value of the house by about $124,000, but we have little confidence that this effect is statistically valid
- Square feet of floor area is positive, statistically significant, and large
  - Interpretation: Each additional square foot of floor area increases the value of the house by almost $580

Transforming Variables

Suppose the functional form of a relationship between x and y is assumed to be:

$y=Ax^{\alpha}$

which is a non-linear equation.

However, by taking the natural logarithm of both sides of the equation gives

$\ln(y)=\ln(A) + \alpha\ln(x)$

This expression that is linear in the logarithms of the transformed variables

Transforming Variables

Why transform variables?

If we use the functional form $y=Ax^{\alpha}$ the parameter **α** represents an *elasticity* – the elasticity of y with respect to x.

Elasticity is a measure of how sensitive one variable is to changes in another variable – *expressed in terms of percentages*

α is the percent change in y for a 1% change in x

Elasticity

What's so good about elasticity?
It is *scale-free*: it does not depend on the units in which x and y are measured.
Some common elasticities
own-price elasticity of demand
cross price elasticity of demand
income elasticity of demand
Some uncommon elasticities
elasticity of house price with respect to floorarea

Hedonic Regression Transformed

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.810861938
R Square	0.657497082
Adjusted R Square	0.611830026
Standard Error	0.203254043
Observations	35

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	2.379190364	0.594798	14.39762	1.13734E-06
Residual	30	1.239366174	0.041312		
Total	34	3.618556538			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	8.348886062	4.247494425	1.965603	0.058661	-0.325654781	17.02342691	-0.325654781	17.02342691
BR	-0.174128232	0.067882291	-2.56515	0.015555	-0.312762364	-0.0354941	-0.312762364	-0.0354941
Baths	-0.107654554	0.096282022	-1.11812	0.272391	-0.304288675	0.088979568	-0.304288675	0.088979568
ln(SqFt)	1.265403463	0.20173043	6.272745	6.52E-07	0.853414964	1.677391963	0.853414964	1.677391963
YearBlt	-0.001748343	0.002234204	-0.78253	0.440034	-0.006311195	0.00281451	-0.006311195	0.00281451

Sometimes debatable about which variables *should* be transformed.

Teaser question: should you make a logrithmic transformation of a dummy variable?

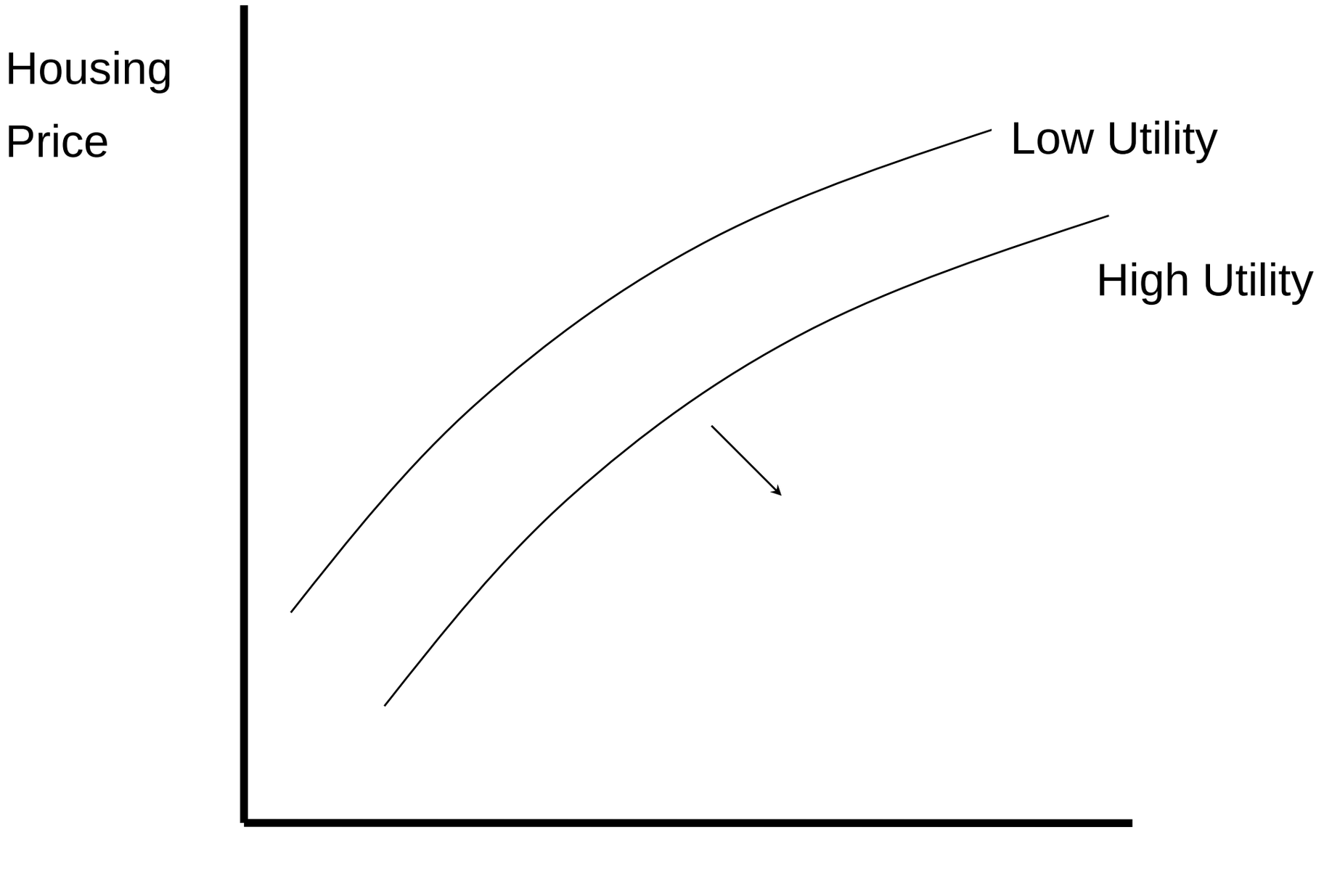
Hedonic Regression

END THIS SLIDESHOW

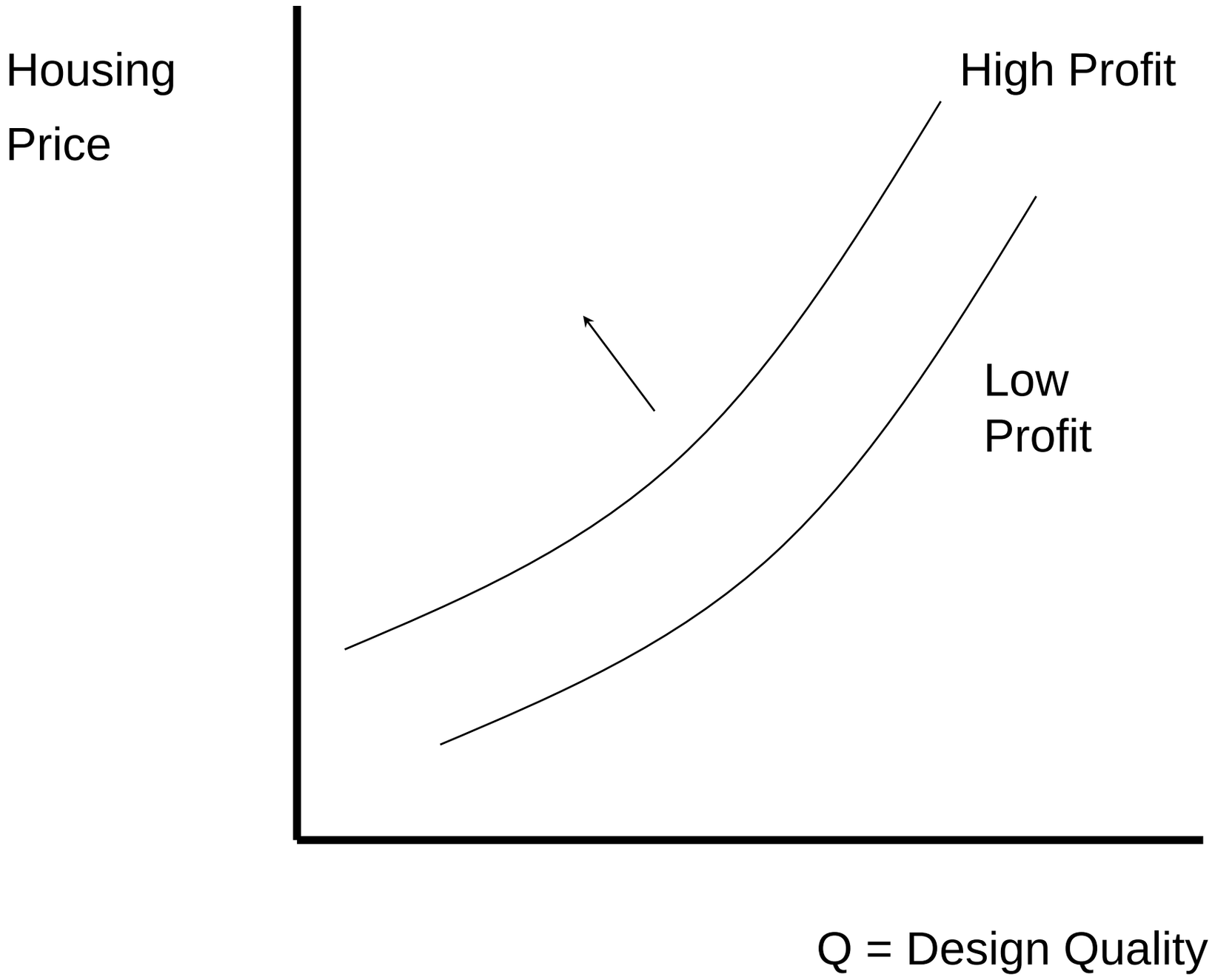
Chapter 10
The Hedonic Housing Model

- Implicit price of multi-faceted good
  - Housing, wages, cars
  - Price is a function of multiple characteristics:
    - $P_H(h_1, h_2, \ldots, h_n)$
  - Marginal Price is simply the partial derivative:
    - $P_j = \partial P_H(h_1, h_2, \ldots, h_n)/ \partial h_j$
- Consumers get utility from numeraire good and various housing characteristics
  - Utility function: $U(G,H(h_1, h_2, \ldots, h_n))$
  - Budget constraint: $W = G + P_H(h_1, h_2, \ldots, h_n)$
- Producers vary mix of housing characteristics

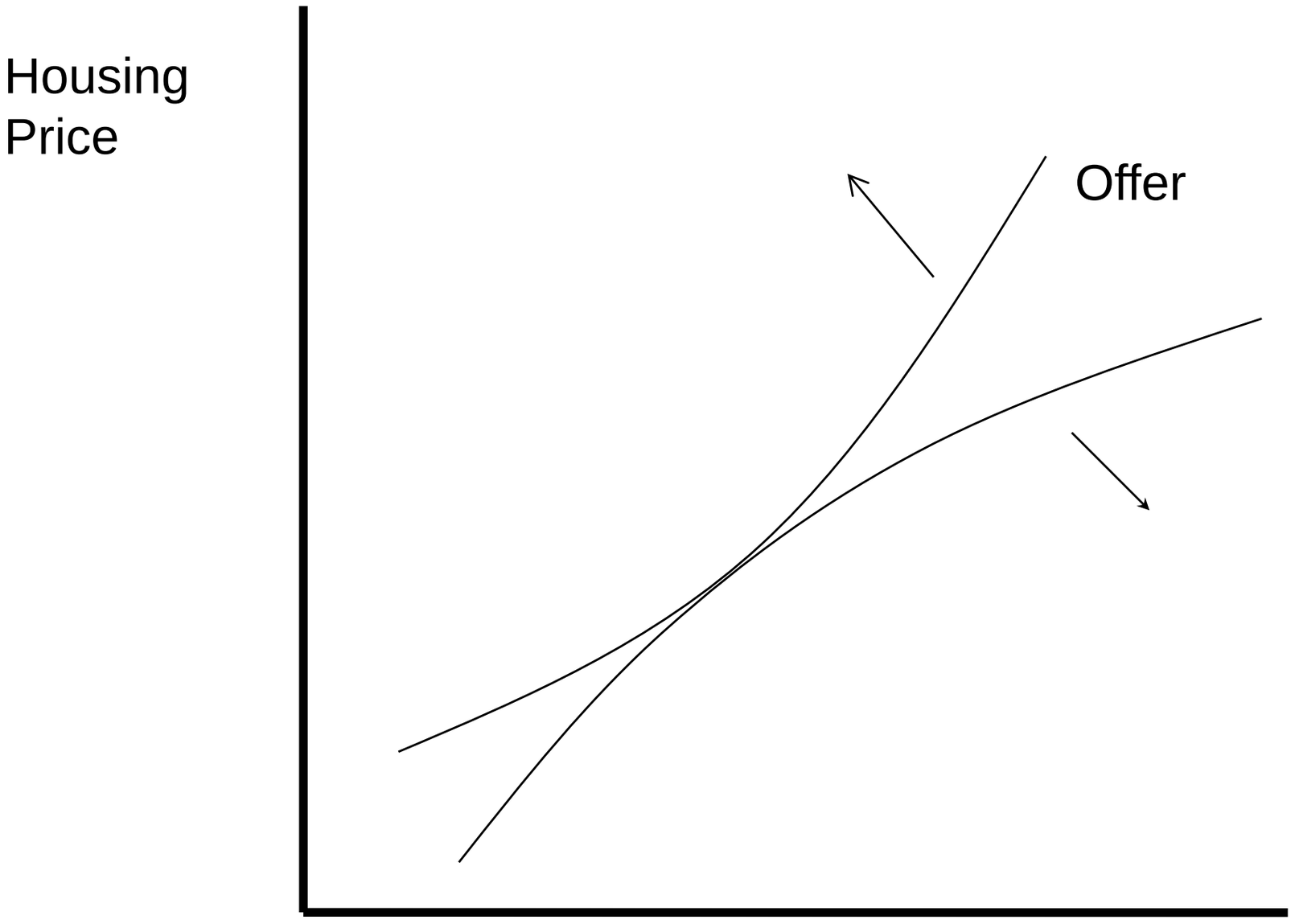
Household Bid Curves



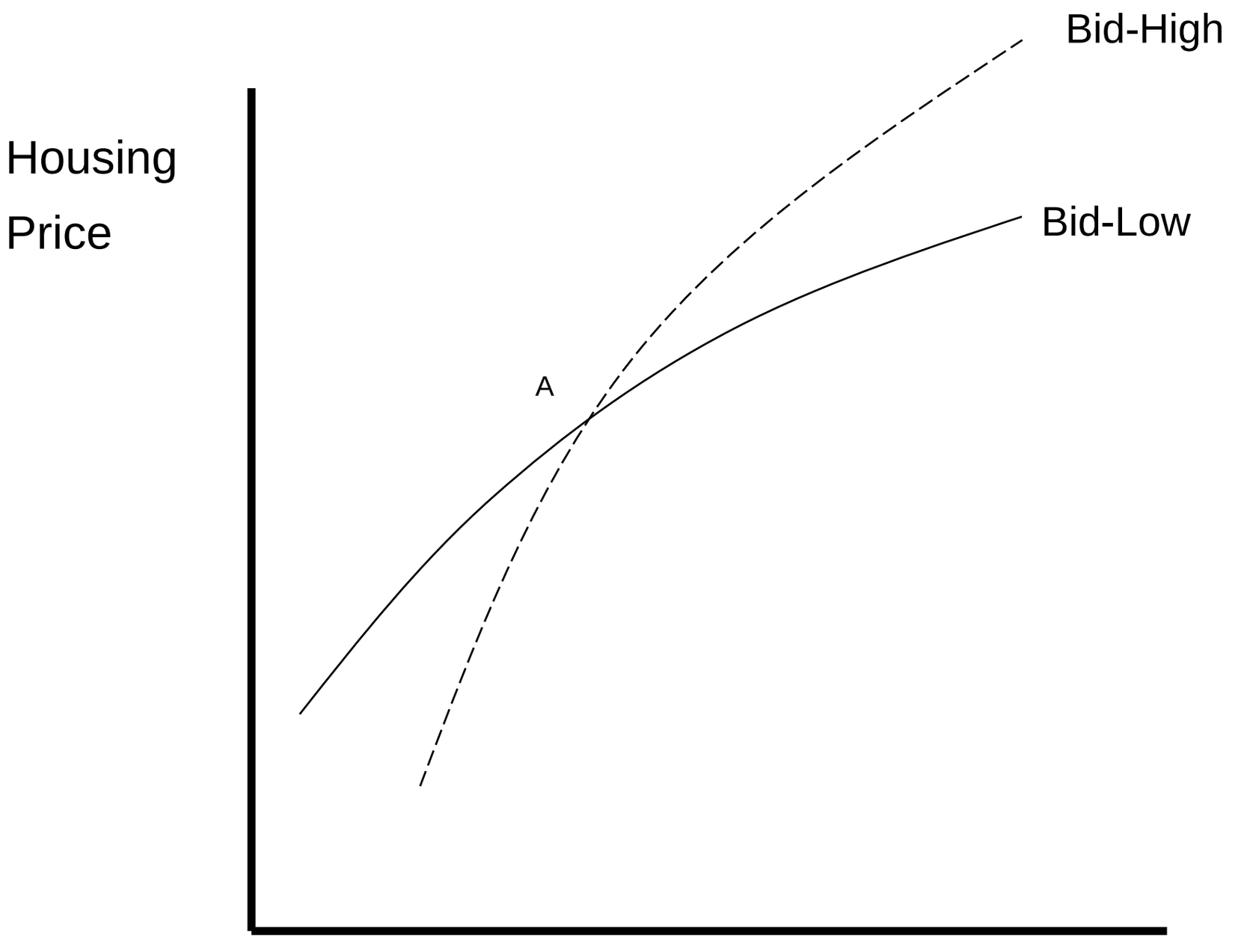
Producer Offer Curves



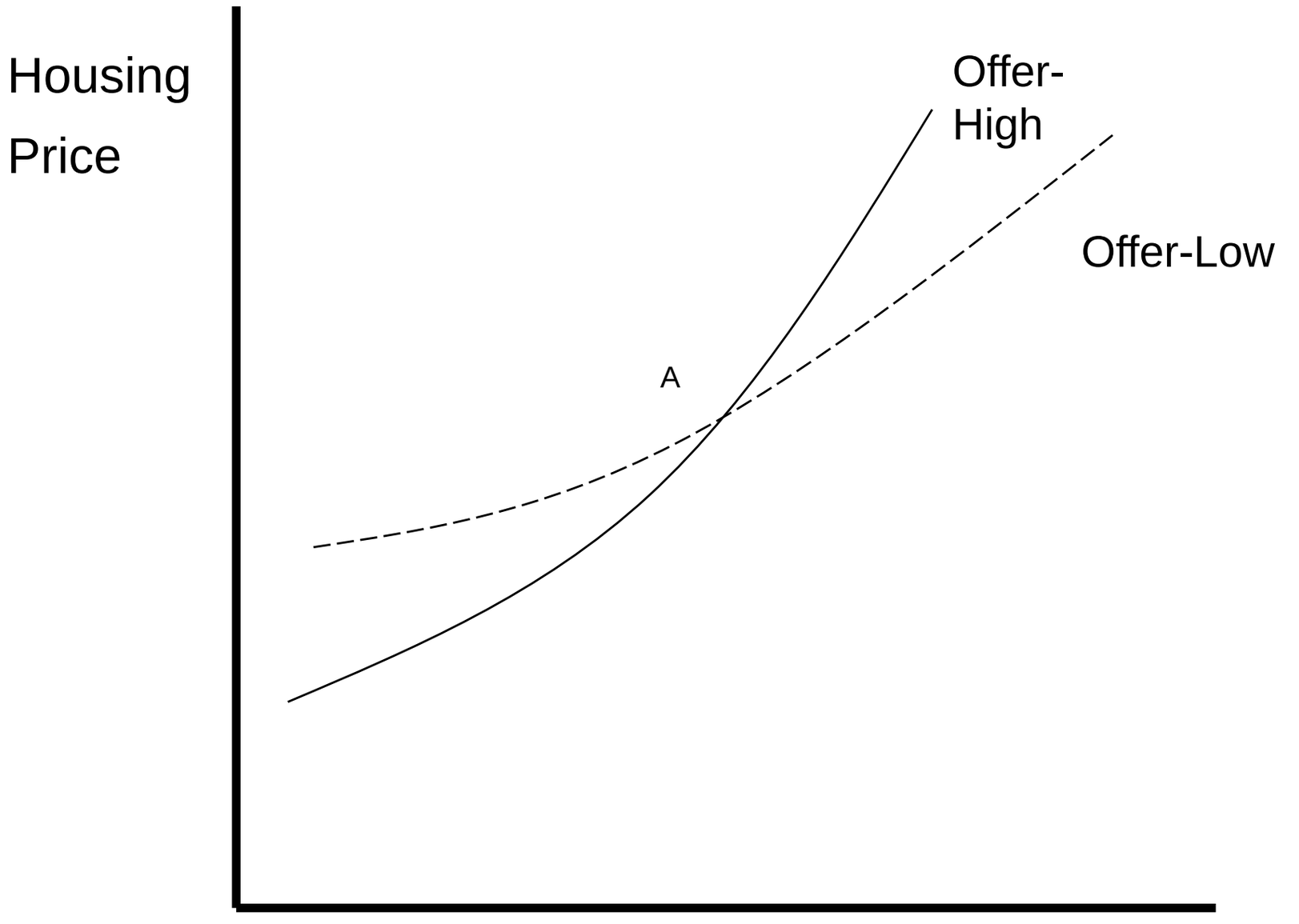
Hedonic Equilibrium



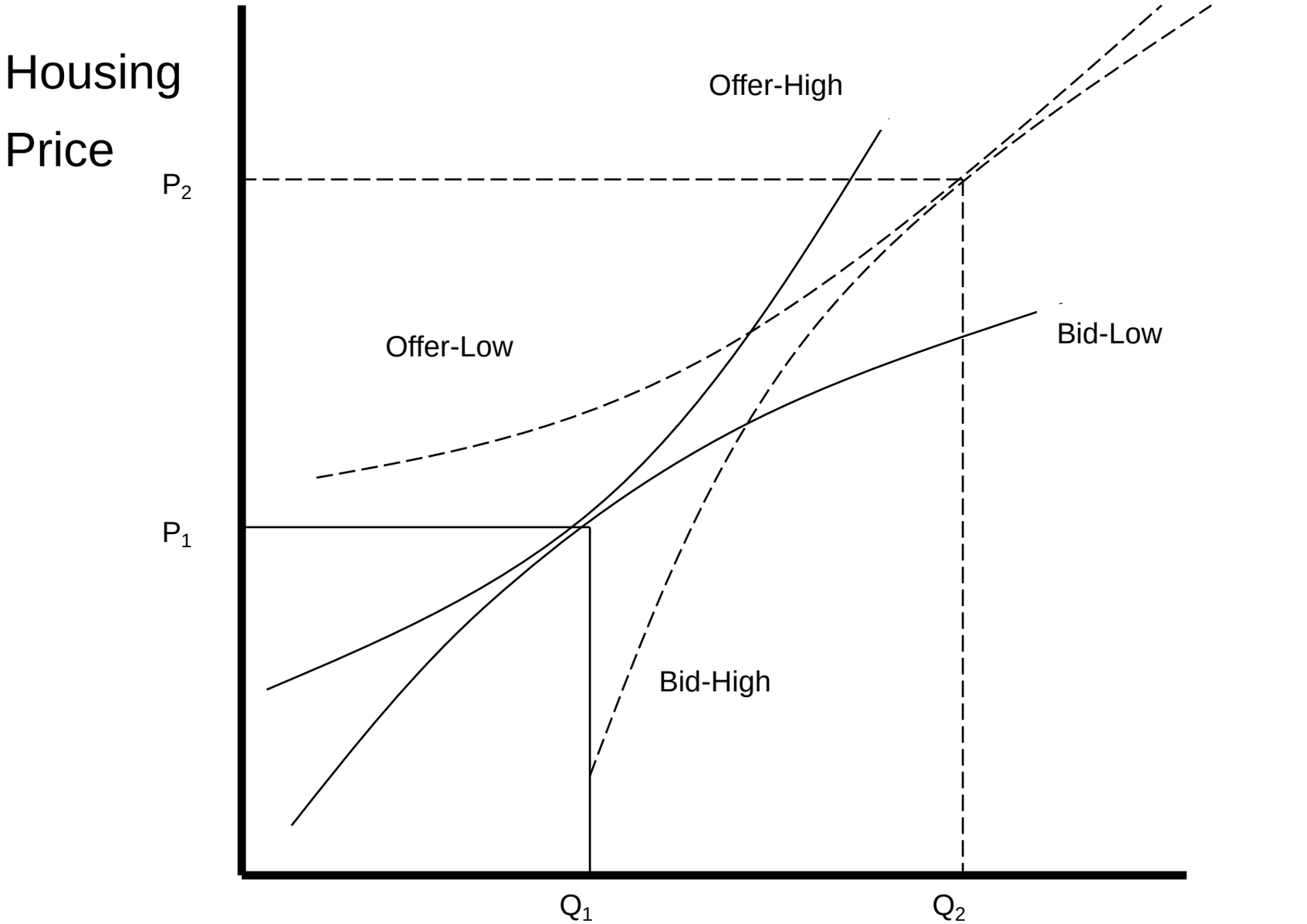
Heterogeneous Consumers: High versus Low Demand



Heterogeneous Producers: High versus Low Cost

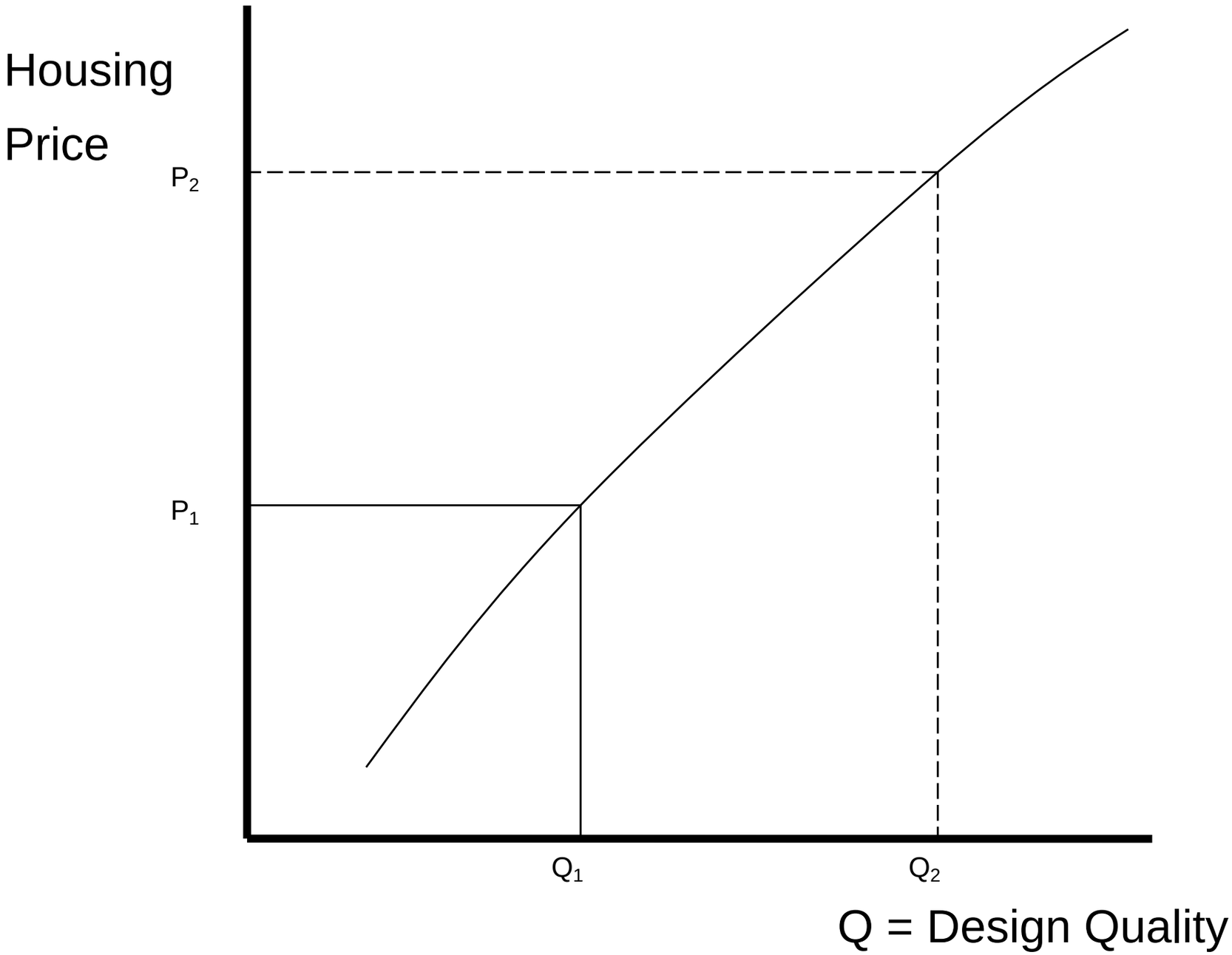


Hedonic Equilibrium



Q = Design Quality

Hedonic Price Function – Set of Tangencies for Multiple Consumers & Producers



Implications of the Model

- $P = P_H(h_1, h_2, \ldots, h_n)$ "Hedonic Price Function"
- $P_j = \partial P_H(h_1, h_2, \ldots, h_n)/ \partial h_j$ Marginal price of good of good j
- Marginal Price = Marginal willingness to pay by consumer
- Marginal Price = Marginal cost to producer
- Matching of high-demand consumers to low-cost firms