Implicit Price

Foundations • The Valuation Engineer

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Formal definition. The implicit price of a characteristic is the partial derivative of the hedonic price function with respect to that characteristic, evaluated at a point in the characteristics space; it represents the marginal market price of an incremental unit of the characteristic, holding all other characteristics fixed.

Intuitive framing. The hedonic price function $p(\mathbf{z})$ assigns a price to each bundle. Most practical questions in appraisal, however, are not about the price of a complete bundle but about the price of a specific *component* of a bundle. How much is the view worth? How much does an extra hundred square feet add? How much does the difference between "good" and "excellent" condition contribute?

The implicit price answers these questions. The term originates with Rosen (1974), who showed that observed prices of differentiated products together with their characteristics "define a set of implicit or 'hedonic' prices"; Lancaster (1966) supplied the underlying view of goods as bundles of characteristics. For each characteristic z_i, the implicit price is the rate at which $p(\mathbf{z})$ changes as z_i varies while all other characteristics are held fixed:

$$\pi_i(\mathbf{z}) \;=\; \frac{\partial p(\mathbf{z})}{\partial z_i}.$$

The implicit price has units of dollars per unit of the characteristic — dollars per square foot of GLA, dollars per square foot of lot, dollars per unit step of condition. For a binary characteristic like view, the implicit price is the full premium paid for moving from no-view (0) to view (1).

The word "implicit" captures the central fact: these prices are *not* posted. No one offers to sell "one square foot of GLA" for $575. The price is implicit in the equilibrium bundle prices that *are* posted, and the hedonic apparatus exists to extract it.

Implicit prices are the appraisal-relevant output of the hedonic framework. The adjustment in a sales comparison grid is, in principle, an estimate of an implicit price multiplied by a characteristic difference. Every adjustment is a wager about the value of π_i at the relevant point in characteristics space.

Where appraisers encounter it. The sales-comparison adjustment grid is a table of implicit-price applications, even when appraisers do not name them that way. A grid entry that adjusts a comp by "+$10,000 for 200 sf less GLA than subject" is asserting that the implicit price of GLA, at the relevant location in characteristics space, is $50 per square foot. A grid entry that adjusts "$100,000 for inferior view" is asserting an implicit price of $100,000 for the binary view characteristic. The entire defensibility of the sales comparison approach rests on whether these implicit prices can be supported from the market. In practice, however, appraisers estimate adjustments directly — from matched pairs, from experience, or from peer practice — without ever computing the underlying value contributions; the traditional grid records only the adjustments themselves. The implicit-price reading is an interpretation of what those adjustments assert, not a description of how they are derived.

This naming also clarifies why paired-sales analysis is the foundational technique for adjustment derivation. Two comps that differ in exactly one characteristic give a direct estimate of that characteristic's implicit price: the price difference divided by the characteristic difference. The reliability of paired-sales analysis depends on whether the two comps are truly close enough in characteristics space that the implicit price recovered from them generalizes to the subject.

Three properties of implicit prices that matter for practice:

They are local. The implicit price of GLA at the 1,650-sf point is not necessarily the same as at the 2,500-sf point. The hedonic price function is generally nonlinear, so its partial derivatives vary with location in characteristics space. An adjustment derived from a 1,500-sf paired-sales analysis does not necessarily apply to a 3,000-sf subject.

They are conditional. The implicit price of view in a beachfront submarket is not the same as in an inland submarket. The partial derivative is taken holding other characteristics fixed, but the value of that derivative depends on *where* the other characteristics are held fixed.

They are market-dependent. Implicit prices are equilibrium prices, so they reflect the preferences of the buyer pool at the time of the transactions. A market shift can change implicit prices even if the characteristics themselves are unchanged. Time adjustments are implicitly admissions that yesterday's implicit prices may not be today's.

Why it matters for defensibility. The implicit-price framing exposes adjustment defensibility questions that the informal grid can obscure:

Where in characteristics space are you? An implicit price is defensible only if estimated near the subject's location in characteristics space. A view premium derived from inland comps and applied to a beachfront subject is extrapolating across a region of the characteristics space where the function's behavior is unknown.

What is the local geometry? If two characteristics interact — for instance, if view is worth more on a larger lot — then treating them as additive separately is a misspecification. The implicit price of view depends on lot size, and an adjustment that ignores the interaction underestimates the function's actual structure.

How was the implicit price recovered? A paired-sales analysis, a regression coefficient, an industry rule-of-thumb, and a "professional judgment" all point to the same quantity — the implicit price — but with very different epistemic standing. The appraiser's defensibility depends on saying which source produced the implicit price used in each adjustment.

Worked appraisal example. For the Pacifica running example with the additive specification adopted in the previous entry, the implicit prices are simply the coefficients of the linear function:

$$\pi_{\text{GLA}} = \beta_{\text{GLA}}, \quad \pi_{\text{lot}} = \beta_{\text{lot}}, \quad \pi_{\text{view}} = \beta_{\text{view}}, \quad \pi_{\text{cond}} = \beta_{\text{cond}}.$$

With the estimated coefficients from entry 003:

Characteristic	Implicit price	Units
GLA	\$575	per sf
Lot	\$22.70	per sf
View	\$86,179	per yes/no
Condition	\$49,824	per step

These implicit prices imply a paired-sales analysis. Returning to the Comp A vs. Comp B difference from entry 001:

- Comp A has view ($\Delta z_{\text{view}} = +1$); contribution +\$86,179.

- Comp A has a 1,800-sf larger lot ($\Delta z_{\text{lot}} = +1{,}800$); contribution $1{,}800 \times \$22.70 = +\$40{,}860$.
- All other characteristics identical.
- Predicted price difference: $\$86{,}179 + \$40{,}860 = \$127{,}039$.

The observed price difference was \$145,000. The implicit-price decomposition accounts for about \$127,000 of it; the remaining \$18,000 reflects sampling variability in the small dataset (and, more generally, the kinds of unobserved factors that the latent variable entry will take up).

Two operational points are worth noting. First, the linearity assumption is doing real work: under a nonlinear $p(\mathbf{z})$, the same physical lot difference might be worth more on a small lot than on a large one, and the additive decomposition above would be biased. Second, the implicit price of \$22.70 per square foot of lot is the marginal value of an incremental square foot, not the total value of the lot. The total contribution of a 9,000-sf lot to the bundle price is $9{,}000 \times \$22.70 = \$204{,}300$, but adding one more square foot raises the bundle price by only \$22.70.

This distinction — marginal vs. total — is the source of considerable confusion in everyday appraisal language and is one of the most important conceptual gains from naming the implicit price explicitly.

References.

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

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Cross-references: heterogeneous good; *characteristics space*; *hedonic price function*; *hedonic regression.*

Addendum: Prolog Formalization

The following machine-readable companion (`004-implicit-price.pl`) formalizes this entry in the journal's Prolog knowledge base. It is also published as a browsable galley alongside this article.

```
%% 004-implicit-price.pl
%%
%% Prolog companion to Foundations Vol. 1, Issue 1, Article 004
%%   Title:    Implicit Price
%%   Author:   Bert Craytor
%%   Concept:  implicit_price
%%   Version:  0.1.0-draft

% ====================================================================
% DICTIONARY IMPORT
% ====================================================================
```

```
:- use_module('../../../../tools/dictionary/dictionary').
:- dictionary_release('dictionary-2026.1').

% --- From the dictionary (loaded via :- use_module above) -----------
% term(implicit_price, "Implicit Price", economic_theory,
%      "The implicit price of a characteristic is the partial
%       derivative of the hedonic price function with respect to that
%       characteristic, evaluated at a point in the characteristics
%       space; it represents the marginal market price of an
%       incremental unit of the characteristic, holding all other
%       characteristics fixed.", published, 'dictionary-2026.1').
%
% term(hedonic_price_function, ...).
% term(paired_sales_analysis, ...).
% term(adjustment, ...).
%
% formalized_by(implicit_price, rosen_1974).
% depends_on(implicit_price, hedonic_price_function).
% --------------------------------------------------------------------

:- use_terms([ implicit_price, hedonic_price_function, characteristics_space,
               heterogeneous_good, hedonic_regression,
               sales_comparison_approach, paired_sales_analysis, adjustment,
               comp_selection ]).
:- use_relations([related/2, depends_on/2, formalized_by/2]).

% Provenance: the term originates with Rosen (1974).
formalized_by(implicit_price, rosen_1974).

% ====================================================================
% ARTICLE SUBJECT
% ====================================================================

article_concept(implicit_price).
article_issue(volume(1), number(1), year(2026)).
article_id('foundations.2026.004').

% ====================================================================
% LOCAL VOCABULARY
% ====================================================================

local_term(partial_derivative).
local_term(marginal).
local_term(total).
local_term(locality).
local_term(conditionality).
local_term(market_dependence).

% ====================================================================
% IMPLICIT PRICE AS PARTIAL DERIVATIVE
% ====================================================================
%
% π_i(z) = ∂p(z)/∂z_i

implicit_price_definition(
    "Implicit price of characteristic i at point z = partial derivative of p with respect to z_i,
   ↪ evaluated at z.").
```

```
unit_of_implicit_price(continuous, "dollars per unit of the characteristic").
unit_of_implicit_price(binary,     "the full premium between the two states").

% ======================================================================
% THREE PROPERTIES OF IMPLICIT PRICES (per the article)
% ======================================================================

property_of_implicit_prices(local,
    "The implicit price of GLA at 1,650 sf is not necessarily the same as at 2,500 sf. p is
   ↪generally nonlinear; partial derivatives vary with location.").
property_of_implicit_prices(conditional,
    "Implicit price depends on where the OTHER characteristics are held fixed. View premium on a
   ↪beachfront submarket differs from inland.").
property_of_implicit_prices(market_dependent,
    "Implicit prices are equilibrium prices reflecting the current buyer pool. Market shifts change
   ↪ implicit prices even when characteristics do not.").

% ======================================================================
% IMPLICIT-PRICE / ADJUSTMENT EQUIVALENCE
% ======================================================================
%
% Every adjustment in a sales-comparison grid can be READ as asserting an
% implicit price applied to a characteristic difference. This is an
% interpretation of what the adjustment asserts, not a description of how
% traditional adjustments are derived in practice.

adjustment_as_implicit_price_application(
    "Interpretation: adjustment magnitude = (implicit price of attribute at relevant point) * (
   ↪characteristic difference between comp and subject) --- what the adjustment asserts, not how
   ↪it is derived.").

adjustment_derivation_in_practice(
    "Traditional adjustments are estimated directly --- from matched pairs, experience, or peer
   ↪practice --- without computing the underlying value contributions; the traditional grid
   ↪records only the adjustments themselves.").

% ======================================================================
% LINEAR-FORM IMPLICIT PRICES (from entry 003's adopted specification)
% ======================================================================
%
% Under the additive linear specification, implicit prices ARE the
% regression coefficients. The article reproduces them:

:- consult('../../kb/pacifica_comps').

% Implicit price per characteristic, as inherited from the additive
% form of p adopted in entry 003.
implicit_price_of(gla_sqft,  575.00,   "per square foot").
implicit_price_of(lot_sqft,   22.70,   "per square foot").
implicit_price_of(view,    86179.03,   "per yes/no").
implicit_price_of(cond,    49824.33,   "per step on the ordinal scale").

% ======================================================================
% PAIRED-SALES DECOMPOSITION: COMP A vs COMP B
% ======================================================================
%
% Returns to the article-001 paired comparison and decomposes it using
% implicit prices.
%
```

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% Comp A and Comp B share GLA, bedrooms, baths, condition.
% They differ in: view (+1) and lot_sqft (+1800).
% Predicted differential = 86179 + 40860 = 127039.
% Observed differential  = 145000.
% Unexplained            = 17961  (~$18,000).

paired_sales_decomposition(comp_a, comp_b,
    [ contribution(view,     86179),
      contribution(lot_sqft,  40860) ],
    127039,
    145000,
    17961).

% Derived from the data + coefficients (for the linter to type-check
% against the dataset rather than the hand-computed values).
contribution_for_pair(A, B, Attr, Contribution) :-
    coord(A, Attr, VA),
    coord(B, Attr, VB),
    Diff is VA - VB,
    Diff =\= 0,
    implicit_price_of(Attr, Pi, _),
    Contribution is Diff * Pi.

% Tiny coord helper for symbolic view/cond values.
coord(P, A, N) :-
    attribute_value(P, A, V),
    ( number(V) -> N = V
    ; A == view, V == yes -> N = 1
    ; A == view, V == no  -> N = 0
    ; V = N
    ).

% ======================================================================
% MARGINAL vs TOTAL CONTRIBUTION
% ======================================================================
%
% The article emphasizes the distinction. The implicit price of lot is
% $22.70 per square foot (marginal); the TOTAL contribution of Comp A's
% 9,000-sf lot is 9,000 * 22.70 = $204,300.

distinction(marginal_vs_total,
    "Implicit price is MARGINAL ($22.70 per additional sqft of lot). Total contribution of a 9,000-
   ↪sf lot is 9,000 * $22.70 = $204,300. Confusing them is a common source of error in everyday
   ↪appraisal language.").

%! total_contribution(?Property, ?Attribute, -Total) is det.
%
% Total dollar contribution of a characteristic to a property's bundle
% price under the linear specification.

total_contribution(P, A, Total) :-
    coord(P, A, V),
    implicit_price_of(A, Pi, _),
    Total is V * Pi.

% ======================================================================
% DEFENSIBILITY QUESTIONS RAISED
% ======================================================================
```

```
defensibility_question(location_in_space,
    "An implicit price is defensible only when estimated near the subject's location in
   ↪characteristics space; a view premium from inland comps applied to a beachfront subject
   ↪extrapolates into unknown territory.").
defensibility_question(local_geometry,
    "If view interacts with lot size, treating them as additively separable misspecifies the
   ↪function. The implicit price of view depends on lot.").
defensibility_question(epistemic_provenance,
    "Paired-sales analysis, regression coefficient, industry rule, and professional judgment all
   ↪point to the same quantity but have different epistemic standing. Defensibility requires
   ↪declaring the source.").

% ======================================================================
% CROSS-REFERENCES
% ======================================================================

cross_reference(heterogeneous_good).
cross_reference(characteristics_space).
cross_reference(hedonic_price_function).
cross_reference(hedonic_regression).
```