

LECTURE NOTES

Price Dispersion in Search Markets

Alexander Dentler

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Abstract

The law of one price predicts that identical goods sell at a single price. Empirical evidence—from 1950s car dealers to modern financial markets—shows otherwise. These notes present the [Burdett and Judd \[1983\]](#) model in which firms trade off per-unit profit against sales volume, generating an equilibrium distribution of prices. The key ingredient is heterogeneity in customer information: as long as some buyers observe only one quote, price dispersion persists.

1 Price dispersion

Learning targets. After studying these notes, you should be able to:

1. Explain why the law of one price fails in practice and cite empirical evidence.
2. Set up the Burdett–Judd model of equilibrium price dispersion.
3. Characterize monopoly, competitive, and dispersed price firm equilibria.
4. Derive the lowest equilibrium price and explain the volume-versus-profit trade-off.

1.1 Outlook

The *law of one price* states that in a Walrasian market, identical goods sell for the same price. This section presents evidence that identical goods are, in practice, available at different prices. We then show how economists reconcile this phenomenon with utility-maximizing households and profit-maximizing firms, once again employing search theory.

1.2 Empirical evidence of price dispersion

Stigler (1961) states that price “**dispersion is ubiquitous for homogeneous goods.**” He documents two examples. A particular **Chevrolet** model cost, on average, US\$ 2,436 at 27 dealers in Chicago in 1959, with a **standard deviation of US\$ 42**. He also compares quoted prices for a delivery of **anthracite coal** in Washington, D.C. in April 1953. The average from 14 dealers was US\$ 16.90, with a standard deviation of US\$ 1.15.

How can car and coal dealers charge different prices for the same good? Perhaps the goods are not perfectly homogeneous, or transportation costs drive a wedge between local markets. Surely, as information improves and transportation costs fall, the law of one price should hold.

Pratt, Wise and Zeckhauser (1979) investigate prices for 39 goods in the Boston area, calling 4–22 sellers. For 18 products, the **highest price exceeded twice the lowest price**. For 4 products, the highest was five times the lowest.

Perhaps households are poor at playing markets, or local markets are segmented. Consider, then, financial markets—where participants are sophisticated and informed. The federal funds market is an inter-bank market for uncollateralized overnight loans, settled bilaterally. The Federal Reserve Bank of New York publishes the percentiles of observed rates.

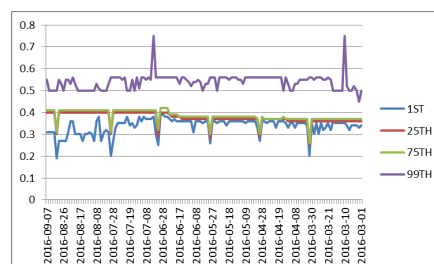


Figure 1: Distribution of the federal funds rate. Data from the Federal Reserve Bank of New York.

Even among the most sophisticated participants, price dispersion persists.

1.3 Reconciling theory and evidence

What went wrong for the Walrasian model? The centralized exchange it models is a strong approximation of how trade actually works. In practice, buyers do not purchase water, cars, or houses from a centralized market. Obtaining goods involves costs: walking to a store, browsing a website, requesting a quote. Even small search costs prevent buyers from finding the lowest price among all opportunities. Information about goods and their prices is costly.

We reconcile this clash between theory and evidence by focusing on costly price information. In practice, buyers must ask for prices. Walking to a store or visiting a webpage

costs time.

Burdett and Judd (1983, *Econometrica*) propose a model in which firms choose prices and reveal them only when contacted. Customers obtain a number of price quotes from different firms and buy from the cheapest. Firms choose prices first, and do not adjust them afterward. Customers do not reveal quotes from other firms. As a result, each firm faces a probability that its price is the lowest a customer has seen, and firms **trade off per-unit profit against volume** when setting prices. A **non-degenerate distribution of quoted prices** arises as long as a positive fraction of customers obtains **only one quote**. These captive customers purchase from the only firm they contacted, even if the price is not the global minimum. If every customer saw at least two prices, the highest-priced firm would always be outbid.

1.4 Environment

1.4.1 Firms

A large number of firms sell a homogeneous good produced at constant marginal cost r . Each firm chooses a price p to quote when contacted. Contacts occur simultaneously, so firms learn nothing from the process. Firms have perfect knowledge of **equilibrium objects**, including the **distribution of posted prices** $F(\cdot)$, where $F(p)$ is the fraction of firms quoting a price below p . No firm posts a price below r —doing so would mean a loss:

$$F(r - \epsilon) = 0 \quad \forall \epsilon > 0$$

1.4.2 Customers

A large number of customers want to buy the good. There are μ customers per firm. The maximum a customer is willing to pay is p^* , the **reservation price**, interpretable as a monopolistic price or an outside option. We assume $p^* \geq r$ throughout; otherwise the market would not exist. No firm charges above p^* , so

$$F(p^*) = 1$$

A fraction q_1 of customers observes only one price, and $q_2 = (1 - q_1)$ observe two prices. For now, this information structure is exogenous.

Customers know the distribution F but **do not know which firm charges which price**. A customer **can only buy from a firm that quoted a price to her**.

1.4.3 Actions

All firms and all customers are identical ex ante. To generate a non-degenerate price distribution, ex-ante identical agents must take different actions. The key is to generate

indifference, so we **do not impose symmetry between similar types in equilibrium** as we so often do.

A **customer** makes two decisions. First, she decides **whether to obtain quotes** ($\varpi = 1$) at cost c , not knowing how many quotes she will receive: with probability q_k she gets k quotes drawn from F . Second, she buys from the firm that quoted the lowest price.

A **firm** chooses what price to quote, and quotes the same price to all customers.

We begin by analyzing the firm's problem, taking the customer's search decision as given.

1.5 Firm equilibria

1.5.1 The firm's problem

A firm faces a fundamental trade-off. Setting a high price earns more per sale but risks losing customers who received a lower quote elsewhere. Setting a low price attracts more buyers but sacrifices margin. The profit function captures this tension:

$$\Pi(p) = \begin{cases} (p - r)\mu(q_1 + q_2(1 - F(p))) & \text{if } p \leq p^* \\ 0 & \text{if } p > p^* \end{cases}$$

The term $p - r$ is the profit per unit. Of all customers, q_1 observe only the firm's price and buy as long as $p \leq p^*$. The remaining q_2 observe two prices and buy only if p is below the competitor's quote, which occurs with probability $1 - F(p)$. (In equilibrium, every firm independently draws its price from the same distribution F , so $1 - F(p)$ is the probability of undercutting a given competitor.)¹

1.5.2 Definition

Definition 1 (Firm equilibrium). Given $\{q_1, q_2, p^*\}$, a **firm equilibrium** is a pair (F, Π) where F is a distribution function and Π is the common profit level such that

1. $\Pi = \Pi(p)$ for all p in the support of F , and
2. $\Pi \geq \Pi(p)$ for all p .

The first condition requires that all firms earn the same profit: any firm earning less would deviate. The second ensures that no firm can increase profit by choosing a price outside the support of F . Three equilibrium types arise, depending on q_1 .

¹More generally, if fraction q_k of customers obtains k quotes, $\Pi(p) = (p - r)\mu \sum_{k=1}^{\infty} q_k(1 - F(p))^{k-1}$ for $p \leq p^*$.

1.5.3 Monopoly price firm equilibrium

Lemma 1 (Monopoly price firm equilibrium). *Given $\{q_1, q_2, p^*\}$ where $q_1 = 1$, the unique firm equilibrium is*

1. $\Pi = \mu(p^* - r)$, and
2. $F(p) = \begin{cases} 0 & \text{if } p < p^* \\ 1 & \text{if } p \geq p^* \end{cases}$

If all customers observe only one price, all firms charge the monopoly price p^* . The distribution F is degenerate at p^* . No firm wants to deviate: customers are willing to pay p^* and have no alternatives, so charging less reduces profit while charging more loses the customer.

1.5.4 Competitive price firm equilibrium

Lemma 2 (Competitive price firm equilibrium). *Given $\{q_1, q_2, p^*\}$ where $q_1 = 0$, the unique firm equilibrium is*

1. $\Pi = 0$, and
2. $F(p) = \begin{cases} 0 & \text{if } p < r \\ 1 & \text{if } p \geq r \end{cases}$

If all customers observe two prices, all firms charge the competitive price r . The distribution F is degenerate at r , and firms earn zero profit.

1.5.5 Dispersed price firm equilibrium

The two cases above yield degenerate distributions. The interesting case follows.

Lemma 3 (Dispersed price firm equilibrium). *Given $\{q_1, q_2, p^*\}$ where $0 < q_1 < 1$ and $p^* > r$, the unique firm equilibrium satisfies*

1. $\Pi = \mu(p^* - r)q_1$,
2. there exists \underline{p} with $r < \underline{p} < p^*$ such that $\Pi = \mu(\underline{p} - r) > 0$, and
3. $f(p) \begin{cases} > 0 & \forall \underline{p} \leq p \leq p^* \\ = 0 & \text{otherwise} \end{cases}$

If $p^* = r$, all firms charge the competitive price and $\Pi = 0$.

When some customers observe only one price ($0 < q_1 < 1$), the distribution is **non-degenerate** with support $[\underline{p}, p^*]$. Firms charging p^* earn profit only from captive (q_1) customers. No firm charges r , because $\Pi = \mu(p^* - r)q_1 > 0$ while $\Pi(r) = 0$. The support therefore starts at some $\underline{p} > r$. Firms charging \underline{p} attract all customers. Firms in the interior $\underline{p} < p < p^*$ **trade off volume against profit**. [Burdett and Judd \[1983\]](#) show that $f(p) > 0$ for all $\underline{p} \leq p \leq p^*$, which we will do below.

A firm charging \underline{p} is indifferent to switching to p^* : she would lose customers with two quotes ($1 - q_1$) and the associated profit $(\underline{p} - r)$, but retain captive customers q_1 and increase per-unit profit by $(p^* - \underline{p})$. Indifference implies

$$(\underline{p} - r)(1 - q_1) = q_1(p^* - \underline{p})$$

Rearranging:

$$\underline{p} = p^*q_1 + (1 - q_1)r$$

Three conclusions follow:

1. A larger fraction of captive customers (q_1) raises the lowest price.
2. An increase in marginal cost r is not fully passed through—only the fraction $(1 - q_1)$ matters.
3. An increase in the reservation price p^* is also not fully passed through—only the fraction q_1 matters.

1.5.6 The equilibrium price distribution

We can derive $F(p)$ explicitly from the equal-profit condition. Every price in the support must yield the same profit $\Pi = \mu(p^* - r)q_1$:

$$(p - r)\mu(q_1 + (1 - q_1)(1 - F(p))) = \mu(p^* - r)q_1$$

Solving for $F(p)$:

$$F(p) = 1 - \frac{q_1}{1 - q_1} \cdot \frac{p^* - p}{p - r}, \quad p \in [\underline{p}, p^*]$$

Numerical example. Set $p^* = 10$, $r = 2$, $q_1 = 0.3$, and $\mu = 100$. Then $\underline{p} = 10 \times 0.3 + 0.7 \times 2 = 4.4$ and $\Pi = 100 \times 8 \times 0.3 = 240$. [Figure 2](#) plots the equilibrium CDF.

When q_1 increases from 0.3 to 0.6 (so more people only get to see 1 price), the lowest price rises from 4.4 to 6.8, and the entire distribution shifts rightward. More captive customers reduce competitive pressure, allowing firms to charge higher prices. The average

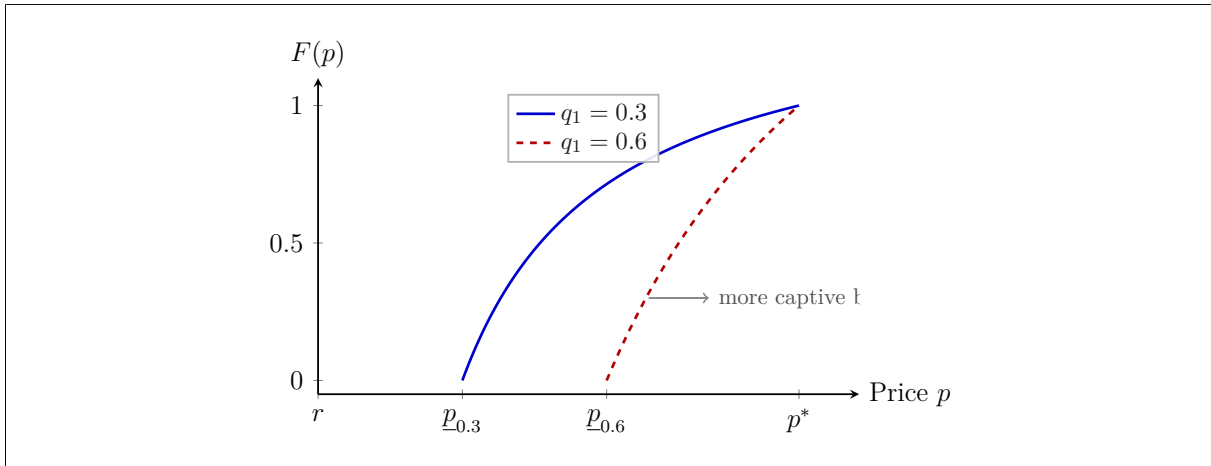


Figure 2: Equilibrium price CDF with $p^* = 10$, $r = 2$. A higher fraction of captive customers (q_1) shifts the distribution to the right: more firms charge higher prices.

quoted price when $q_1 = 0.3$ is $\mathbb{E}[p] \approx 6.13$, well above the competitive price $r = 2$ but below the monopoly price $p^* = 10$.

We can now confirm that the density is positive on the support, as the dispersed equilibrium lemma asserts. Differentiating $F(p)$ yields

$$f(p) = \frac{q_1}{1 - q_1} \cdot \frac{p^* - r}{(p - r)^2} > 0 \quad \text{for all } p \in [p, p^*]$$

since $q_1 \in (0, 1)$, $p^* > r$, and $p \geq \underline{p} > r$.

1.6 Search decision

1.6.1 Endogenizing search intensity

So far the fractions q_1 and q_2 were exogenous. We now endogenize the search decision: a customer decides whether to obtain quotes ($\varpi = 1$) at cost c , or not ($\varpi = 0$). With probability q_k she observes k prices.

1.6.2 The smallest observed price

The **expected smallest price when observing one price** is

$$\int_0^\infty p dF(p)$$

The **expected smallest price when observing two prices** is

$$2 \int_0^\infty p(1 - F(p)) dF(p)$$

The factor 2 arises because either draw can be the minimum: the density of the smallest of two independent draws from F is $2(1 - F(p))f(p)$.²

The **expected smallest price** when the customer does not know whether she will see one or two quotes is

$$q_1 \int_0^\infty p dF(p) + 2(1 - q_1) \int_0^\infty p(1 - F(p)) dF(p)$$

The **expected utility** from the search decision is

$$U(\varpi) = \begin{cases} -c - q_1 \int_0^\infty p dF(p) - 2(1 - q_1) \int_0^\infty p(1 - F(p)) dF(p) & \text{if } \varpi = 1 \\ -p^* & \text{if } \varpi = 0 \end{cases}$$

1.7 Market equilibria

Definition 2 (Market equilibrium). The triple $\{F, \Pi, \varpi\}$ is a market equilibrium with customer search if, for fixed $\{q_1, q_2\}$,

1. the pair (F, Π) is a firm equilibrium given ϖ , and
2. ϖ maximizes expected utility given F .

Three cases arise:

$q_1 = 1$: All customers see one price. Firms charge p^* , but customers gain nothing from searching and still pay cost c . This **equilibrium does not exist**.

$q_1 = 0$: All customers see two prices. Firms charge the competitive price r . Customers search **only if** $c \leq p^* - r$. Nobody wants to deviate. This **equilibrium exists**.

$0 < q_1 < 1$: Customers search ($\varpi = 1$) if the expected price reduction exceeds the search cost c :

$$p^* - q_1 \int_r^{p^*} p dF(p) - 2(1 - q_1) \int_r^{p^*} p(1 - F(p)) dF(p) \geq c$$

Customers participate when p^* is high and c is low.

1.8 Conclusion

Ex-post heterogeneity in customer information is the driving force behind equilibrium price dispersion. It is neither the only possible source nor always sufficient, but it is a persistent one—even in the age of the internet [Baye et al., 2004]. Firms trade off per-unit

²The expected smallest out of n prices is $n \int_0^\infty p(1 - F(p))^{n-1} dF(p)$, since the minimum of n iid draws has density $n(1 - F(p))^{n-1} f(p)$.

profit against volume, a logic familiar from pricing strategy but here rooted in the quality of customer information rather than product differentiation or scale economies. Related models include Varian [1980], where informed and uninformed consumers generate sales, and Stahl [1989], who studies sequential consumer search.

Key takeaways.

- If all customers see one price ($q_1 = 1$), firms charge the monopoly price. If all see two ($q_1 = 0$), firms charge marginal cost.
- For $0 < q_1 < 1$, the equilibrium price distribution is non-degenerate with support $[\underline{p}, p^*]$.
- Firms are indifferent across all prices in the support: higher prices yield more per-unit profit but lower volume.
- The lowest price $\underline{p} = p^*q_1 + (1 - q_1)r$ increases in the fraction of captive customers.
- A-priori knowledge of the price distribution does not eliminate dispersion—it is sustained in equilibrium.

1.9 Exercises

Two extended problem sets accompany these notes: one on pooling customers across types with heterogeneous costs, and one on endogenous search intensity with $c(\theta) = -\log(\theta)$.

1. Verify that $F(\underline{p}) = 0$ and $F(p^*) = 1$ using $F(p) = 1 - \frac{q_1}{1-q_1} \cdot \frac{p^*-p}{p-r}$.
2. Using the numerical example ($p^* = 10$, $r = 2$, $q_1 = 0.3$, $\mu = 100$), compute $\Pi(p)$ for $p = 6$ and verify that it equals the equilibrium profit $\Pi = 240$.
3. What happens to the price distribution as $q_1 \rightarrow 0$? As $q_1 \rightarrow 1$? Relate your answer to the monopoly and competitive equilibria.

References

- Michael R. Baye, John Morgan, and Patrick Scholten. Price dispersion in the small and in the large: Evidence from an internet price comparison site. *Journal of Industrial Economics*, 52(4):463–496, 2004.
- Kenneth Burdett and Kenneth L Judd. Equilibrium price dispersion. *Econometrica: Journal of the Econometric Society*, pages 955–969, 1983.

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- John W Pratt, David A Wise, and Richard Zeckhauser. Price differences in almost competitive markets. *Quarterly Journal of Economics*, 93(2):189–211, 1979.
- Dale O. Stahl. Oligopolistic pricing with sequential consumer search. *American Economic Review*, 79(4):700–712, 1989.
- George J Stigler. The economics of information. *The Journal of Political Economy*, pages 213–225, 1961.
- Hal R. Varian. A model of sales. *American Economic Review*, 70(4):651–659, 1980.