# Do Lower Search Costs Reduce Prices and Price Dispersion?

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**Abstract:** This paper presents a search model, for which a decrease in the search cost may lead to lower prices and to a lower price variance, but may also lead to the opposite. This result contrasts with some predictions about the impact of the Internet on prices, but fits well with the empirical literature on e-commerce.

**Key Words:** *Search, Price Levels, Price Dispersion*

**JEL Classification:** *D43, D83, L13*

## 1 Introduction

Recently there was some speculation on whether the Internet would create perfectly competitive markets. "The explosive growth of the Internet promises a new age of perfectly competitive markets. With perfect information about prices and products at their fingertips, consumers can quickly and easily find the best deals. In this brave new world, retailers' profits margins will be competed away, as they are all forced to price at cost" ("Frictions in Cyberspace", *The Economist*, November 20th 1999, p. 112). These forecasts where justified, first, by the presumption that the Internet eliminates search costs, and second, by a putative prediction of search theory that lower search costs reduce prices and price dispersion.

The Internet can reduce the cost of observing prices. According to an estimate, finding a high interest rate certificate of deposit requires 25 minutes using the telephone, 10 minutes using the Internet, and less than a minute using a price-comparison search engine (Butler et al. (1997)).[2] However, does search theory have a simple prediction about the relationship between search costs, price levels, and price dispersion?

I develop a search model related to Benabou (1993), MacMinn (1980), and Reinganum (1979), which exhibits no pathology, and for which a decrease in search costs may lead to lower prices and a lower price variance, but may also lead to the opposite.[3] These results contrast with some predictions of how the Internet

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[2] Ellison & Ellison (2001) report price obfuscation behavior online. Some vendors that post prices at price-comparison sites follow bait-and-switch practices, while others post very low prices, which are more than compensated by unreasonably high shipping and handling charges. Technology can be used either to reduce or to increase consumer search costs.

[3] The variance is a poor measure of dispersion (Rothschild & Stiglitz (1970)), but is the measure used by the empirical e-commerce literature.

would create perfectly competitive markets (Bakos (1997)),[4] but fit well with the seemingly puzzling results of the empirical e-commerce literature.

All empirical studies made so far found evidence of significant price dispersion across sellers online, even for homogenous goods, and even after controlling for vendors' characteristics. Baye et al. (2001) found price dispersion for consumer electronics. Brynjolfsson & Smith (2000), Clay et al. (2001), and Smith (2001), found price dispersion for books. Carlton & Chevalier (2001) found price dispersion for fragrances, DVD players, and side-by-side refrigerators. Clemons et al. (2002) found price dispersion for airline tickets. Lee (2000) found price dispersion for over-the-counter medications. And Pan et al. (2001) found price dispersion for books, DVDs, computers, computer software and consumer electronics.

There is also empirical evidence of significant market power online.[5] Price dispersion for homogeneous goods is itself a sign of market power. But more specifically, Lee (1998) and Lee et al. (1999) found that for cars, prices were higher online that offline. Bailey (1998) reached a similar conclusion for books and software. And Brynjolfsson & Smith (2000) found that for books, established firms with both physical and virtual shops charged on their virtual shops higher prices than newly created purely virtual firms.

In the model I develop, firms have different marginal costs and set prices. Consumers have different search costs and search for prices. Costly search leads consumers to accept prices above the minimum charged in the market. Low search cost consumers hold a lower reservation price than high search cost consumers. Low cost firms charge the lowest prices. Since consumers accept prices above the minimum charged in the market, low cost firms are not constrained by consumer search, charge their monopoly price, and sell to both types of consumers. If the reservation price of low search cost consumers is high, high cost firms charge the reservation price of low search cost consumers, and sell to both types of consumers. If the reservation price of low search cost consumers is low, high cost firms charge the reservation price of high search cost consumers, and sell only to these consumers. There are 2 types of equilibria. At a *Competing* equilibrium high cost firms sell to both types of consumers. At a *Segmentation* equilibrium high cost firms sell only to high search cost consumers.

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[4] Bakos (1997) develops a model of circular product differentiation, where consumers search for prices and product characteristics, and firms set prices. He shows that a decrease in the search cost reduces prices. Based on this prediction he argues that electronic marketplaces will reduce search costs, and thereby increase allocational efficiency, and lower prices. See Harrington (2001) for some qualifications of Bakos' (1997) analysis.

[5] *Market Power* is the ability to raise price above marginal cost.

A decrease in the search costs reduces reservation prices, but can have different impacts on prices. Within each type of equilibrium, a decrease in the reservation prices forces high cost firms to reduce their price. The price variance also decreases. However, if the decrease in search costs induces the model to switch from a *Competing* to a *Segmentation* equilibrium, then not only prices rise, but the price variance also increases.

Samuelson & Zhang (1992) developed a model of a duopoly with horizontal product differentiation and cost asymmetry, where a decrease in search costs increases price levels and price dispersion. A decrease in search costs, first increases the ability of consumers that sample a firm to look for an alternative, which reduces prices. And second increases the number of consumers that sample a firm, which raises prices. In their setting, the second effect dominates the first. My results show that even in the absence of product differentiation, a decrease in search costs may lead to higher prices and a higher price variance, but may also lead to the opposite. Search theory has no simple prediction about the relationship between search costs, price levels, and price dispersion.

In Section 2 I present the model, and in Section 3 I characterize the equilibria. In Section 4 I conduct the analysis of the model, in Section 5 I discuss two generalizations, and in Section 6 I reconcile the model with the empirical evidence. Section 7 concludes. Proofs are in the Appendix.

# 2 The Model

In this section I present the model. The model is simple to make the point as clearly as possible. In Section 5 I discuss 2 generalizations.

## (a) The Setting

Consider a market for a homogeneous search good, that opens for 1 period. The game consists of 2 stages. In stage 1 firms choose prices, and in stage 2 consumers search for prices.

## (b) Consumers

There are a large number of consumers. Formally, there is a continuum of consumers distributed on $[0,1]$. Consumers are risk neutral, and of 2 types, which differ only with respect to their search cost; a proportion $\lambda$ on $(0,1)$ has a *low* search cost, $\sigma_l$ on $(0,+\infty)$; and the other consumers have a *high* search cost, $\sigma_h = \sigma_l + \Delta_\sigma$, with $\Delta_\sigma$ on $(0,+\infty)$. Subscript $j$ refers to consumers, and I index low and high search cost consumers by: $l,h$. A consumer who buys at price $p$ on $[0,+\infty)$ demands $D(p)$, where $D(.)$ is a twice differentiable, bounded function, with a

bounded inverse, and decreasing for $p$ on $\left[0, D^{-1}(0)\right]$. Denote by $S(p) := \int_p^\infty D(x)dx$, the surplus of a consumer who pays $p$.

Consumers do not know the prices charged by individual firms. However, they hold common beliefs about the price distribution. Cumulative distribution function, $F(.)$, gives the consumers' beliefs about the price distribution; the lowest and highest prices on its support are $\underline{p}$ and $\bar{p}$.

Consumers search sequentially with recall. Search is instantaneous. Consumers may observe any number of prices, and pick randomly which firm to sample, from the set of firms whose price they do not know.

A consumer's *strategy* is a stopping rule, $s_j$, that says if search should stop or continue, for every search cost, beliefs, and sequence of observations. A consumer's *payoff* is its expected surplus, net of the search expenditure.

## (c) Firms

There are a large number of firms. Formally, there is a continuum of firms distributed on $[0,1]$. Firms are risk neutral, and of 2 types, which differ only with respect to their constant marginal cost; a proportion $\mu$ on $(0,1)$ has a *low* marginal cost, $c_l$; and the other firms have a *high* marginal cost, $c_h$, where $0 \le c_l < c_h < D^{-1}(0)$. Subscript $t$ refers to firms, and I index low and high cost firms by: $l, h$.

[Figure 1]

Denote by $p_t$ on $[0, +\infty)$, the price of a cost $c_t$ firm, and denote by $\pi(p_t; c_t) := (p_t - c_t)D(p_t)$, the per consumer profit of a cost $c_t$ firm. Let $\hat{p}_t := argmax_p \, \pi(p; c_t)$; I will refer to $\hat{p}_t$ as the *monopoly price* of a cost $c_t$ firm. I assume that $\pi(.)$ is strictly quasi-concave in $p$. I also assume that high cost firms can charge $\hat{p}_l$ without losing money, i.e., $c_h \le \hat{p}_l$, and that the highest price high search cost consumers accept paying, their *reservation price*, is lower than $\hat{p}_h$ (Figure 1). Denote by $\varphi(p_t)$, the expected consumer share of a cost $c_t$ firm, and denote by $\Pi(p_t; c_t) := \pi(p_t; c_t)\varphi(p_t)$, the expected profit of a cost $c_t$ firm.

A firm's *strategy* is a rule that says which price the firm should charge, for every marginal cost. A firm's *payoff* is its expected profit.

**(d) Equilibrium**

An *equilibrium* is: a stopping rule, consumer beliefs, and a pricing rule, $\left\{ s_j^*, F^*, p_t^* \middle| t, j = l, h \right\}$, such that:[6]

**(i)** Given consumer beliefs and search costs, consumers choose a stopping rule to maximize net expected surplus;

**(ii)** Given the stopping rule and marginal costs, firms choose a pricing rule to maximize expected profit;

**(iii)** Beliefs agree with the price distribution induced by the pricing rule and the marginal cost distribution.

# 3 Characterization of Equilibrium

In this section I construct the equilibrium by working backwards. The consumers' equilibrium search behavior consists of holding reservation prices. Low search cost consumers hold a lower reservation price than high search cost consumers. Low cost firms charge their monopoly price and sell to both types of consumers. High cost firms sometimes charge the reservation price of low search cost consumers, and sell to both types of consumers; other times high cost firms charge the reservation price of high search cost consumers, and sell only to this type of consumers.

## 3.1 The Search Game

In this sub-section I characterize the search equilibrium.

If consumers search, their optimal strategy consists of holding a reservation price, $\rho_j$, which equates the expected marginal benefit of search to the search cost (Benabou (1993), MacMinn (1980), or Reinganum (1979)):

$$\int_{\underline{p}}^{\rho_j} \left[ S(p) - S(\rho_j) \right] dF(p) = \sigma_j \tag{1}$$

That is, the optimal strategy for consumers of type $j$ is to terminate search and buy, if and only if offered a price no higher than $\rho_j$.

The next Lemma groups 2 results that will be useful later.

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[6] The equilibrium concept is related to a sequential equilibrium (Kreps & Wilson's (1982)), and requires that the consumers' beliefs about the price distribution satisfy *Sequential Rationality* and the *Independent Prices Conjecture*, which generalize subgame perfection to incomplete information games. The first implies that consumers behave optimally, at every information set, given their beliefs about the firms' strategies. The second implies that consumers do not change their beliefs upon observing the price of any single firm (and thus, any finite set of firms), and that on the equilibrium path, consumers' beliefs agree with the price distribution induced by the firms pricing strategies. See Bagwell & Ramey (1994) and Pereira (2001).

**Lemma 1: (i)** The reservation price of low search cost consumers is strictly lower than the reservation price of high search cost consumers. **(ii)** For all positive search costs, the reservation price of low search cost consumers is strictly higher than the lowest price charged in the market. §

Costly search, $\sigma_j > 0$, gives firms market power, since it leads consumers to accept prices above the minimum charged in the market, $\underline{p} < \rho_l < \rho_h$.

## 3.2 The Pricing Game

In this sub-section I characterize the equilibrium prices.

Denote by $n_j$, the measure of firms that charge a price acceptable to consumers of type $j$. A firm that charges $p$ gets an expected consumer share of:

$$\varphi(p) = \begin{cases} 0 & \Leftarrow \rho_h < p \\ \frac{1-\lambda}{n_h} & \Leftarrow \rho_l < p \leq \rho_h \\ \frac{\lambda}{n_l} + \frac{1-\lambda}{n_h} & \Leftarrow p \leq \rho_l \end{cases}$$

Denote by $p^s = p^s(\lambda, c_h, \rho_h)$, the value of the reservation price of low search cost consumers, $\rho_l$, for which a high cost firm is indifferent between selling to both consumer types at price $p_h = \rho_l$, and selling only to high search cost consumers at price $p_h = \rho_h$, i.e., $\pi(p^s(\lambda, c_h, \rho_h); c_h)[\lambda/n_l + (1-\lambda)/n_h] \equiv \pi(\rho_h; c_h)(1-\lambda)/n_h$.

The next Lemma characterizes the equilibrium prices.

**Lemma 2: (i)** Low cost firms charge their monopoly price. **(ii)** If the reservation price of low search cost consumers is no lower than $p^s$, high cost firms charge the reservation price of low search cost consumers; if the reservation price of low search cost consumers is lower than $p^s$, high cost firms charge the reservation price of high search cost consumers. **(iii)** Value $p^s$ is increasing in the reservation price of high search cost consumers and the high cost level, and is decreasing in the proportion of low search cost consumers. §

Low cost firms charge the lowest price. Since reservation prices are strictly higher than the lowest price charged in the market, $\underline{p} < \rho_j$, they are never constrained by consumer search and charge their monopoly price, $\hat{p}_l$.

High cost firms also benefit from the market power generated by costly search, by charging a higher price than low cost firms, $p_l^* < p_h^*$.

High cost firms trade-off 2 effects. If a high cost firm charges the reservation price of low search cost consumers, $\rho_l$, instead of the reservation price of high search cost consumers, $\rho_h$, first, it sells to $\lambda / n_l$ additional low search cost consumers, earning an additional $\pi(\rho_l; c_h)\lambda / n_l$, the *volume of sales* effect; second, it loses $-\left[\pi(\rho_h; c_h) - \pi(\rho_l; c_h)\right]$ per high search cost consumer, and a total of $-\left[\pi(\rho_h; c_h) - \pi(\rho_l; c_h)\right](1-\lambda)/n_h$, the *per consumer profit* effect.

If the reservation price of low search cost consumers is high, $p^s(\lambda) \le \rho_l$, or alternatively, if the proportion of low search cost consumers is large, $\lambda > \hat{\lambda}(\rho_l) := (p^s)^{-1}(\rho_l)$,[7] the *volume of sales* effect dominates the *per consumer profit* effect, and high cost firms want to sell to both types of consumers. So they charge the reservation price of low search cost consumers, $\rho_l$. If the reservation price of low search cost consumers is low, $\rho_l < p^s(\lambda)$, the *per consumer profit* effect dominates the *volume of sales* effect, and high cost firms want to sell only to high search cost consumers. So they charge the reservation price of high search cost consumers, $\rho_h$.

[Figure 2]

There are 2 types of equilibria (Figure 2). In both, low cost firms charge their monopoly price, $\widehat{p}_l$. At a *Competing* equilibrium, high cost firms charge the reservation price of low search cost consumers, $\rho_l$, and compete with low cost firms for both types of consumers. At a *Segmentation* equilibrium, high cost firms charge the reservation price of high search cost consumers, $\rho_h$, and sell only to these consumers; low search cost consumers buy from low cost firms.

The higher is the proportion of low search cost consumers, $\lambda$, and the lower are the high cost level, $c_h$, and the reservation price of high search cost consumers, $\rho_h$, the more willing are high cost firms to lower their price to sell to low search cost consumers. From Lemma 2: $n_h = 1$ and:

$$n_l = \begin{cases} 1 & \Leftarrow \ p^s \le \rho_l \\ \mu & \Leftarrow \ \rho_l < p^s \end{cases}$$

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[7] I am omitting the reservation price of high search cost consumers and the high cost level in $p^s$.

## 3.3 The Equilibrium Reservation Price Mappings

In this sub-section I develop the equilibrium reservation price mappings.

Using Lemma 2, (1) becomes:

$$\mu\left[S(\widehat{p}_l) - S(\rho_j)\right] - \sigma_j = 0 \tag{2}$$

which defines implicitly, $\rho_j = R^j(\sigma_j, \mu)$.[8] Let $\sigma_l^c(\mu, \rho_h, \lambda)$ be defined by $R^l(\sigma_l^c(\mu, \rho_h, \lambda), \mu) - p^s(\lambda, c_h, \rho_h) \equiv 0$.

By implicit differentiation, $R^j(.)$ is increasing in $\sigma_l$. If the search cost rises, the expected marginal benefit of search must increase for consumers to remain in equilibrium, which requires the reservation prices to rise.

# 4 Analysis

In this section I conduct the analysis of the model. I show that a decrease in the search cost may lead to lower prices and a smaller price variance, but may also lead to the opposite.

The next Proposition analysis the impact of a decrease in the search cost, $\sigma_l$, on the price levels, and price the variance.

**Proposition 1: (i)** Within each type of equilibrium, a decrease in the search cost shifts the price distribution in the first-order stochastic dominated sense, and reduces the price variance. **(ii)** If a decrease in the search cost leads the model to switch from a *Competing* to a *Segmentation* equilibrium, then it shifts the price distribution in the first-order stochastic dominating sense, and increases the price variance §

[Figure 3]

A decrease in the search cost, $\sigma_l$, leads both types of consumers to hold lower reservation prices (Figure 3). Within each type of equilibrium, this forces high cost firms to reduce their price; at a *Competing* equilibrium because $R^l(\sigma_l, \mu)$ falls; and at a *Segmentation* equilibrium because $R^h(\sigma_l + \Delta, \mu)$ falls. The price variance also decreases. However, if the search cost falls below $\sigma_l^c$ and the model switches from a *Competing* to a *Segmentation* equilibrium, i.e., if high cost firms charge the reservation price of high search cost consumers, $p_h = \rho_h$, instead of the reservation price of low search cost consumers, $p_h = \rho_l$, then, not only prices rise, but the price variance also increases.

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[8] Straightforward implicit differentiation shows that the left-hand side of (2) is monotonic in $\rho_j$.

In Reinganum (1979), consumers are homogeneous with respect to the search cost. Thus, high cost firms do not face the trade-off between the *volume of sales* and the *per consumer profit* effects. In MacMinn (1980), consumers are heterogeneous with respect to the search cost, but each type of consumers has zero mass.

To sum up, a decrease in the search cost may lead to lower prices and a lower price variance, but may also lead to the opposite. Search theory has no simple prediction about the relationship between search costs, price levels, and price dispersion.

# 5 Two Generalizations

In this section I discuss 2 generalizations of the model.

A fall in the search cost leads to higher prices and to a larger price variance only when the model jumps between types of equilibria. Almost everywhere, lower search costs do reduce prices and the price variance. However, it is straightforward to generalize the model to a continuum of production cost types (Benabou (1993), MacMinn (1980), and Reinganum (1979)). And then, it is easy to construct examples for which lower search costs increase prices and the price variance for "large" sets of parameter values, by controlling the values of $\partial R^l/\partial \sigma_l$ and $\widehat{p}_h - p^s$, where $\widehat{p}_h$ and $p^s$ should be defined in terms of the model with a continuum of cost types.

It is also straightforward to extend the model to any finite number of types of consumers, $n$, in which case there will be $n$ types of equilibria. Within each type of equilibria a decrease in the search cost will lead to lower prices and to a smaller price variance. However, a decrease in the search cost that leads the model to switch between types of equilibria will lead to higher prices, and to a larger price variance.

# 6 Discussion

In this section I relate the patterns identified by the empirical literature with the model's predictions.

The Internet reduces search costs. This presumably should lead to prices being lower online than offline. And while some studies found evidence of lower prices online, e.g., Brynjolfsson & Smith (2000), other studies found evidence of the opposite, e.g., Bailey (1998). The model I developed accommodates both possibilities. Within each type of equilibrium, a decrease in search costs leads to lower prices. However, if the decrease in search costs induces the model to switch from a *Competing* to a *Segmentation* equilibrium, then prices rise. The varying degrees across products of price dispersion online, and the varying degrees across products of the relative price dispersion between online and offline markets, allows a similar interpretation.

From the perspective of the evolution of the industry, if the development of the Internet causes a search cost reduction, that induces the market to switch from a *Competing* to a *Segmentation* equilibrium, then the first impact is for the price level and price dispersion to increase. Over time, further search cost reductions, induced perhaps by an expansion in the use of price-comparison search engines, should lead the market to move along a *Segmentation* equilibrium, generating decreases in the price level and the price dispersion. Brown & Goolsbee (2002) found that the increase in Internet use reduced the price of term life insurance by 8–15%, but only after price-comparison search engines were introduced, and for insurance types covered by the search engines.

# 7 Conclusion

This paper develops a search model related to Benabou (1993), MacMinn (1980) and Reinganum (1979), for which a decrease in the search cost may lead to lower prices and a lower price variance, but may also lead to the opposite. These results contrast with some predictions of how the Internet would create perfectly competitive markets, but fit well with the seemingly puzzling results of the empirical e-commerce literature. The paper intends to be a reminder that search theory has no simple prediction about the relationship between search costs, price levels, and price dispersion.

# Appendix

**Lemma 1: (i)** Implicit differentiation of (1) shows that $\rho_j$ is strictly increasing in $\sigma_j$. The result then follows from $\sigma_l < \sigma_h$. **(ii)** Obvious from the inspection of (1). §

**Lemma 2: (i)** I proceed in 3 steps. In *step* 1 I show that $\underline{p} = p_l^* \le p_h^* = \bar{p}$. Suppose that $p_h^* < p_l^*$. By definition: $\Pi(p_h^*;c_l) \le \Pi(p_l^*;c_l)$ and $\Pi(p_l^*;c_h) \le \Pi(p_h^*;c_h)$; adding gives $(c_h - c_l)\big[D(p_l^*)\varphi(p_l^*) - D(p_h^*)\varphi(p_h^*)\big] \ge 0$, which is false, since $\varphi(.)$ is non-increasing and $D(.)$ is strictly decreasing. Thus $p_l^* \le p_h^*$. In *step* 2 I show that $p_l^* < \rho_l$. Follows from step 1 and Lemma 1: (ii). In *step* 3 I show that $p_l^* = \hat{p}_l$. Given step *2* and the definition of $\varphi(.)$, from the $c_l$ firms' perspective, $\varphi(p_l)$ is given. Thus, only $\pi(.)$ matters to determine $p_l^*$. Suppose $p_l^* \ne \hat{p}_l$. Consider first $p_l^* < \hat{p}_l$. There is a $\varepsilon > 0$ sufficiently small such that $p_l^* + \varepsilon < \rho_l$. Thus, if a $c_l$ firm deviates and charges $p_l^* + \varepsilon$, it loses no customers, and by strict quasi-concavity of $\pi(.)$ rises. Thus, $\hat{p}_l \le p_l^*$. Now consider $\hat{p}_l < p_l^*$. If a $c_l$ firm deviates and charges $p_l = \hat{p}_l$, by definition $\hat{p}_l$ profit rises. Thus, $p_l^* \le \hat{p}_l$, and therefore, $p_l^* = \hat{p}_l$. **(ii)** I proceed in 3 steps. In *step* 1 I show that $p_h = \rho_l$ or $p_h = \rho_h$. Suppose $p_h < \rho_l$. If a $c_h$ firm charges $p_h = \rho_l$, it loses no clients, and by strict quasi-concavity, $\pi(.)$ rises. Suppose $p_h > \rho_h$. A $c_h$ firm charges makes no sales, whereas if $p_h = \rho_h$, it has a positive profit. Suppose $p_h \in (\rho_l, \rho_h)$. If a $c_h$ firm charges $p_h = \rho_h$, it loses no clients, and by strict quasi-concavity, $\pi(.)$ rises. In *step* 2 I establish the existence of $p^s(.)$. For $(\rho_l, \rho_h, \lambda) \in [c_h, \hat{p}_h] \times [\hat{p}_l, \hat{p}_h] \times (0,1)$, $\Psi(\rho_l; \rho_h, \lambda) := \pi(p^s(\rho_h, \lambda); c_h)\big[\lambda/n_l + (1-\lambda)/n_h\big] - \pi(\rho_h; c_h)(1-\lambda)/n_h$ and $\Psi(p^s(\rho_h, \lambda); \rho_h, \lambda) \equiv 0$. Since, $\forall(\rho_h, \lambda)$, $\Psi(c_h; \rho_h, \lambda) < 0 < \Psi(\hat{p}_h; \rho_h, \lambda)$, and $\Psi(.)$ is monotonic in $\rho_l$, the intermediate value theorem implies that

$\forall (\rho_h, \lambda) \in [\bar{p}_l, +\infty) \times (0,1)$, $\exists^1 p^s \in [\bar{p}_l, c_h)$. In *step* 3 I establish $p_h^*$. Follows from *step* 1 and the definition of $p^s$.
**(iii)** Follows from straightforward implicit differentiation. §

**Proposition 1 (i)** The part about on first-order stochastic dominance follows from the Lemma 2 and $\partial R^j/\partial \sigma_l > 0$. Regarding price variance: $Var(p) = \mu p_l^2 + (1-\lambda)p_h^2 - [\lambda p_l + (1-\lambda)p_h]^2$, and $\partial Var(p)/\partial p_h = 2\mu(1-\mu)(p_h - p_l) > 0$. **(ii)** As in **(i)**. §

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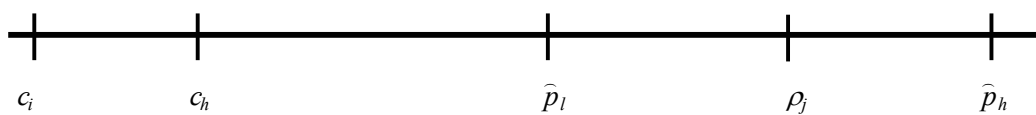
**Figure 1: Cost Levels**

$$c_i \qquad c_h \qquad \widehat{p}_l \qquad \rho_j \qquad \widehat{p}_h$$

**Figure 2: Price Equilibria**

*Segmentation*        *Competing*

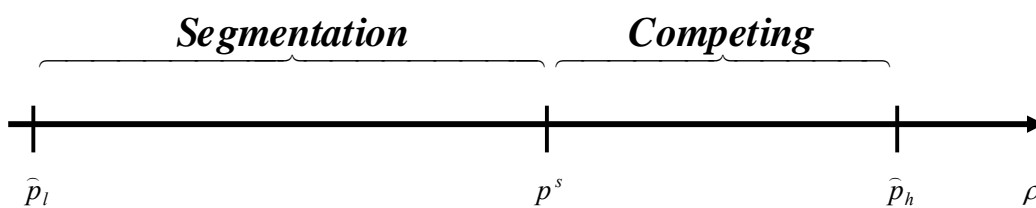$$\widehat{p}_l \qquad\qquad\qquad p^s \qquad\qquad \widehat{p}_h \qquad \rho_l$$

**Figure 3 : The Price Distribution and the Search Costs**