Third-degree Price Discrimination, Entry and Welfare

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Abstract

This paper investigates the impact of firms’ pricing policies upon entry and welfare under price competition and product differentiation. We consider a model where an incumbent serves two distinct and independent geographical markets and an entrant may enter in one of the markets. Our results show that discriminatory pricing may either be more, less or equally favorable to entry than uniform pricing. The welfare effect of banning price discrimination is also ambiguous. However, the case for banning price discrimination is much weaker than under monopoly. Interestingly, discriminatory pricing may yield higher welfare even when entry occurs only under uniform pricing.

Keywords: Entry, Product Differentiation, Discriminatory Pricing, Uniform Pricing, Third-degree Price Discrimination


1 Introduction

Entry incentives differ according to the pricing policy set in markets. Different pricing policies imply different market equilibria and thus different profit levels for the firms in the market (both entrants and incumbent firms). Therefore, the pricing policy is undoubtedly a determinant of competitors entrance in markets.

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One can find various studies that illustrate the impact of firms’ pricing policies upon entry. Some of them show that discriminatory pricing tends to discourage entry. This is the case of Armstrong and Vickers (1993). They consider a dominant incumbent firm that serves two identical and independent geographical markets where entry can only occur in one of these markets. Both firms sell a homogeneous product and the entrant is price-taker.\footnote{Armstrong and Vickers (1993) first study the case where the entrant firm’s scale of entry is exogenous followed by the case where it is endogenous.} They emphasize that the incumbent sets lower prices in the market where entry is possible when discriminatory pricing is effective. Thus, for intermediate levels of entry costs, there is less entry than under uniform pricing. In this analysis the impact of pricing policies on entry is due to differences in the reaction to competition since market demands are identical. In a research note, Cheung and Wang (1999) extend Armstrong and Vickers (1993) analysis considering non-identical demands. Cheung and Wang show that discriminatory pricing may have a positive or negative effect on entry since the impact on entry due to the difference in market demands may overwhelm the impact due to differences in the reaction to competition. Their analysis assumes that both markets are served by the dominant firm under uniform pricing. Therefore, contrarily to Armstrong and Vickers, they show that allowing discriminatory pricing may encourage more entry.

Other authors have explored, for very different setups, the impact of firms’ pricing policies upon entry. On the one hand, Aguirre \textit{et al.} (1998) explore the strategic choice of pricing policies under a spatial market model. When focusing on symmetric information, they show that discriminatory pricing is more aggressive and entry is more difficult than under uniform pricing. Motta (2004) illustrates that discriminatory pricing always deters entry while uniform pricing may or may not deter entry using a very simple example with Bertrand competition and two identical and independent geographical markets. On the other hand, Katz (1984) shows that allowing discriminatory pricing can increase profits and thus encourage more entry focusing on a long-run monopolistic competition analysis with a mixture of informed and uninformed consumers. Considering a differentiated products duopoly model where firms take simultaneous entry decisions in two symmetric markets and then choose prices, Azar (2003) shows that allowing discriminatory pricing encourages more entry, reduces profits and increases consumer welfare in both markets.

Our aim is to extend Armstrong and Vickers (1993) and Cheung and Wang’s (1999) analysis...
to a framework where price competition and product heterogeneity are present. This setup is more realistic since firms frequently use product differentiation as one of their strategies. Moreover, in many cases, it is not adequate to assume that the entrant is a price-taker. Thus it is important to compare the impact of the two pricing policies upon entry in a differentiated duopoly model.

Considering an incumbent firm that serves two distinct and independent geographical markets with linear demands, an entrant firm may enter one of the markets with a differentiated product. If entry occurs the firms compete in prices. We compare the two pricing policies in terms of entry decision and analyze how this comparison is affected by the difference in market demands and the degree of product substitutability. Our setup has two important differences with respect to Armstrong and Vickers (1993) and Cheung and Wang (1999). On the one hand, they consider a dominant firm model with a price-taker entrant where firms sell homogeneous products whereas we use a duopoly price competition model with differentiated products. On the other hand, they just analyze the case where, under entry, the incumbent firm sells in both markets under uniform pricing whereas we also study the case where the incumbent’s optimal decision when entry occurs is to abandon one of the markets.

It should be noted that the effect of firms using or not third-degree price discrimination under oligopoly has been analyzed recently by many authors, such as Holmes (1989), Corts (1998), Aguirre (2000), Armstrong and Vickers (2001) and Dobson and Waterson (2005). However, our paper provides a much more extensive analysis of the impact of discriminatory prices on entry and of the welfare impact of banning price discrimination. In addition, we explore how these effects vary with the degree of product differentiation and the relative sizes of the competitive and captive markets.

We say that discriminatory pricing is more favorable to entry than uniform pricing when there exist levels of entry costs where entry is profitable under discriminatory pricing but unprofitable under uniform pricing, i.e., when entrant’s post-entry profit is higher under discriminatory pricing than under uniform pricing. Our results show that discriminatory pricing may either be more, less or equally favorable to entry than uniform pricing, depending on whether the competitive market is strong or weak.\footnote{In the price discrimination literature, a market is strong (weak) if a firm wishes to raise (lower) the price in that market with respect to the profit maximizing uniform price. Under duopoly, what determines if a market is \ldots} This result is common to other models of price discrimination
under oligopoly. However, we provide a more complete analysis of the circumstances where discriminatory pricing is more favorable and show that the degree of product substitutability has an impact on determining which of the two pricing policies is more entry deterrent.

The paper provides interesting insights on the desirability of banning price discrimination. When entry cost is high, entry will never occur, thus the welfare impact of price discrimination is exactly as in the monopoly case. When entry cost is low, entry occurs under both pricing policies, and price discrimination is welfare improving in more circumstances. In particular, price discrimination increases welfare when the competitive market is strong and products are not too differentiated. When entry cost is intermediate, entry may occur under discriminatory pricing but not under uniform pricing or the reverse. We show that, if discriminatory pricing is more favorable to entry, then it has higher welfare. Moreover, there are parameter values where uniform pricing is more favorable to entry but banning price discrimination decreases welfare.

This paper is organized as follows. In Section 2 we set up the model. Section 3 analyzes the equilibrium of the price-game under discriminatory and uniform pricing when a competitor enters in one of the markets. In Section 4 we compare the two pricing regimes in terms of their impact on entry. The welfare implications of banning price discrimination are discussed in Section 5. Finally, Section 6 sets the conclusions.

2 The model

Consider an incumbent firm, $I$, operating in two distinct and independent geographical markets. In market $A$ – the competitive market – entrance is possible whereas in market $B$ – the captive market – entrance is not possible. Consider a two stage game where in the first stage a potential entrant, firm $E$, decides whether to enter or not in market $A$, offering a differentiated product. When entry occurs, in the second stage the two firms choose their prices simultaneously.

We assume linear demand in both markets. Since we are interested in exploring the welfare consequences of different pricing policies, using a general demand specification would not take us very far. Moreover, in spite of its simplicity, the linear demand specification still allows us to capture differences across markets and gives us the possibility of representing nicely the results. This type of demand function can be derived from the consumer’s utility maximization
problem with a quadratic utility function. With a single firm operating in market \( i \), demand is given by:

\[
q_i = \frac{a_i}{b_i} - \frac{1}{b_i} p_i, \quad \text{with } i = A, B,
\]

where \( a_i \) and \( b_i \) are positive constants and \( p_i \) and \( q_i \) are the price and quantity demanded in market \( i \). In market \( A \), when entry occurs, demand of firm \( i \) is given by:

\[
q'_i = \frac{a_A (b_A - d_A)}{b_A^2 - d_A^2} - \frac{b_A}{b_A^2 - d_A^2} p'_{iA} + \frac{d_A}{b_A^2 - d_A^2} p'_{jA}, \quad i, j = I, E,
\]

where \( q'_i \) is the quantity demanded of firm \( i \)'s product and \( p'_{iA} \) and \( p'_{jA} \) represent the prices of firm \( i \) and firm \( j \) products, respectively.

Parameter \( d_A \in [0, b_A] \) measures the degree of product substitutability. When \( d_A \to 0 \) products become closer substitutes which implies intense price competition. When \( d_A = 0 \) products are completely differentiated.

We assume the following relationships between market \( B \) and \( A \)'s parameters:

\[
\begin{align*}
b_B &= b_A \\
a_B &= ka_A, \quad k \in ]0, +\infty[. 
\end{align*}
\]

Parameter \( k \) measures the difference in market demands. Under no entry and assuming (1) and (2), when \( k \to 1 \) markets \( A \) and \( B \) are identical. When \( k > 1 \) demand in market \( B \) is larger than demand in market \( A \) and for a given market price, demand in market \( B \) is less elastic than demand in market \( A \). Conversely, when \( k < 1 \) demand in market \( A \) is larger than demand in market \( B \) and for a given market price, demand in market \( A \) is less elastic than demand in market \( B \).

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3 Deriving demands from the consumer's utility maximization problem guarantees consistency between a firm's demand under monopoly and under duopoly. In addition, it allows us to compute in a precise manner the consumer surplus. Following Dixit (1979), we assumed the following representative consumer's utility function in the competitive market:

\[
U(q'_A, q^E) = q'_A + a_A q'_A + a_A q^E - \frac{1}{2} \left[ b_A \left( q'_A \right)^2 + 2 d_A q'_A q^E + b_A \left( q^E \right)^2 \right],
\]

where \( q'_A \) and \( q^E \) are the quantities consumed of the incumbent's and entrant's product, respectively, and \( q'_A \) is the quantity of all other products (with price normalized to 1).
For simplicity we assume that both firms’ production costs are nil. The entrant’s cost of entering market $A$, $f^E$, is non-negative.$^4$

In our notation, the subscript always identifies the market whereas the superscript identifies the firm. The variables associated with uniform pricing have an upper bar, and the letters $m$ and $d$ in the subscript denote monopoly and duopoly, respectively.

3 Discriminatory versus uniform pricing

If entry does not occur the incumbent remains a monopolist. Under discriminatory pricing the monopolist always covers the two markets whereas under uniform pricing one can show that he covers both markets if and only if $\sqrt{2}-1 \leq k \leq \sqrt{2}+1$. For very low (high) $k$ values, demand in market $A$ ($B$) is considerably larger than demand in market $B$ ($A$) and the incumbent prefers to sell in market $A$ ($B$) only. In addition, it is trivial to show that, when both markets are covered under uniform pricing, the monopoly discriminatory price in market $A$ will be higher than the uniform price if and only if market $A$ is larger and less elastic than market $B$ ($k < 1$).

In this section we analyze the Nash equilibrium under discriminatory and uniform pricing when the entrant decides to enter in market $A$.

3.1 Discriminatory pricing

Since the incumbent may set a different price in each market and he continues to be a monopolist in market $B$, the optimal solution in this market is $p_{Bm}^I = \frac{ka}{2}$. However, market $A$ is now a duopoly and we need to find the Nash equilibrium of the price-game:

**Lemma 1** Under discriminatory pricing, the post-entry unique Nash equilibrium in market $A$ is symmetric and it is given by:

$$ p_{Ad}^I = p^E = \frac{a_A(b_A - d_A)}{2b_A - d_A}. $$

The post-entry profits in market $A$ are:

$$ \pi_{Ad}^I = \pi^E = \frac{b_A(b_A - d_A)a_A^2}{(b_A + d_A)(2b_A - d_A)^2}. \quad (3) $$

$^4$We assume that the entrant’s cost of entering in market $B$ is so high that entry in this market would always be unprofitable.
One can show that \( p^I_{Ad} < p^I_{Am} \) and \( \pi^I_{Ad} < \pi^I_{Am} \) as long as \( d_A > 0 \). Conversely \( p^I_{Ad} = p^I_{Am} \) and \( \pi^I_{Ad} = \pi^I_{Am} \) when \( d_A = 0 \). This result is quite obvious: as long as there exists some product substitutability, the incumbent looses with the competition of the entrant. Also notice that the difference between \( p^I_{Ad} \) and \( p^I_{Am} \) increases as products become more substitutable.

### 3.2 Uniform pricing

The Nash equilibrium under uniform pricing depends on whether the incumbent is better off selling in both markets or just in one of the markets. Let \( k_A \) and \( k_B \) be defined as follows:

\[
\begin{align*}
  k_A &= \frac{b_A (8b_A^2 - 5d_A^2) \sqrt{2b_A^2 - d_A^2} - (2b_A^2 - d_A^2) (4b_A^2 - d_A^2)}{2 (2b_A^2 - d_A^2) (b_A + d_A) (2b_A - d_A)} \\
  k_B &= \frac{2 (2b_A + d_A) \left[ 4 (b_A^2 - d_A^2) (2b_A^2 - d_A^2) + (8b_A^2 - 5d_A^2) \sqrt{2b_A^2 - d_A^2} (b_A^2 - d_A^2) \right]}{(b_A + d_A) (32b_A^4 - 32b_A^2d_A^2 + 9d_A^4)}
\end{align*}
\]

The next lemma characterizes the unique Nash equilibrium under uniform pricing when entry occurs.\(^5\)

**Lemma 2** Under uniform pricing, the post-entry equilibrium is as follows:

(i) When \( k < k_A \), the incumbent is better off selling only in market A. The Nash equilibrium prices and post-entry profits are:

\[
\begin{align*}
  p^E_d &= \frac{a_A (b_A - d_A)}{2b_A - d_A} \quad \text{and} \quad \pi^E_d = \frac{b_A (b_A - d_A) a_A^2}{(b_A + d_A) (2b_A - d_A)^2}.
\end{align*}
\]

(ii) When \( k_A \leq k \leq k_B \), the incumbent is better off selling in both markets. The Nash equilibrium prices and profits are given by:

\[
\begin{align*}
  p^E_d &= a_A (b_A - d_A) \frac{[2k (b_A + d_A) + (2b_A + d_A)]}{8b_A^2 - 5d_A^2} \\
  p^E &= a_A (b_A - d_A) \frac{[b_A d_A (k + 1) + 2 (2b_A^2 - d_A^2) + kd_A^2]}{b_A (8b_A^2 - 5d_A^2)} \\
  \pi^E_d &= a_A^2 (b_A - d_A) \frac{[b_A d_A (k + 1) + 2 (2b_A^2 - d_A^2) + kd_A^2]^2}{b_A (b_A + d_A) [8b_A^2 - 5d_A^2]^2} \\
  \pi^E &= a_A^2 (b_A - d_A) \frac{[b_A d_A (k + 1) + 2 (2b_A^2 - d_A^2) + kd_A^2]^2}{b_A (b_A + d_A) [8b_A^2 - 5d_A^2]^2}.
\end{align*}
\]

\(^5\)When \( k = k_A \) and \( k = k_B \) the incumbent is indifferent between covering both markets or covering just one market. In these cases, we assume the incumbent covers the two markets.
(iii) When $k > k_B$, the incumbent is better off selling only in market $B$ and the entrant becomes a monopolist in market $A$. The Nash equilibrium prices and profits are given by:

$$p^I = \frac{ka_A}{2}, \quad p^E = \frac{a_A}{2},$$

$$\pi_d = \frac{k^2 a_A^2}{4b_A} \quad \text{and} \quad \pi = \frac{a_A^2}{4b_A}. $$

Proof: The equilibrium prices are the solution of the system of best response functions of the two firms, taking into account that the incumbent’s best response function depends on $k$ and $d_A$.\[ \square \]

Figure 1 illustrates these results. For the set of parameters in dark grey, the incumbent’s residual demand in market $A$ is considerably larger than demand in market $B$. Thus, the incumbent prefers to sell only in market $A$ even when there is a competitor in this market. On the other hand, when demand in market $B$ is considerably larger than the incumbent’s residual demand in market $A$, the set of parameters in white, the incumbent prefers to sell in market $B$ only. In this case, the entrant becomes a monopolist in market $A$. The incumbent prefers to sell in both markets when demand in market $B$ and incumbent’s residual demand in market $A$ are similar, i.e., $k_A \leq k \leq k_B$ (set of parameters in light grey).

![Figure 1: Uniform pricing under duopoly in market A](image_url)

When the entrant decides to enter market $A$, the incumbent’s decision of serving both or just one of the markets depends on the relative size of demand in market $B$ and the incumbent’s residual demand in market $A$. This comparison depends on the difference in market demands, $k$, but it also depends on the degree of product substitutability, $d_A$. The higher $d_A$ is, the larger
is the reduction in the incumbent’s residual demand in market $A$ when entry occurs. Thus, as $d_A$ increases, demand in market $A$ has to be much bigger ($k$ has to be lower) in order for the incumbent to prefer to sell only in market $A$ under duopoly. Thus the value of $k$ below which the incumbent prefers to sell only in market $A$, $k_A$, is decreasing with $d_A$. For the same reason, $k_B$ is also decreasing with $d_A$. As $d_A$ increases, market $A$ becomes more competitive. Thus, the incumbent prefers to abandon this market for smaller values of $k$.

Notice that as products become virtually homogeneous ($d_A \rightarrow b_A$), competition in market $A$ is so fierce that even when market $A$ is much larger (very low values of $k$) the incumbent prefers to sell in market $B$ only. On the other hand, when products are very differentiated ($d_A \rightarrow 0$), competition in market $A$ is soft and consequently market $B$ has to be much larger than market $A$ for the incumbent to start selling in market $B$ only. When $d_A = 0$ the two products are completely differentiated and the incumbent’s demand is the same as under monopoly. Thus he serves both markets as long as $\sqrt{2} - 1 \leq k \leq \sqrt{2} + 1$.

As expected, when the incumbent sells in market $A$ under duopoly, $k \leq k_B$, the incumbent’s price in market $A$ with competition is lower than under monopoly except when there is complete differentiation, in which case the price is the same. The incumbent’s profit under entry is also lower than under monopoly unless the two products are completely differentiated ($d_A = 0$).

### 3.3 Comparison of pricing policies

When the incumbent serves both markets under monopoly uniform pricing, i.e., when $\sqrt{2} - 1 \leq k \leq \sqrt{2} + 1$, one can show that the price decrease in market $A$ due to competition is higher under discriminatory pricing than under uniform pricing. This happens because uniform pricing makes the incumbent softer. When $E$ enters, the incumbent has an incentive to decrease price to maintain a larger market share in market $A$. However the incentive to decrease price is lower under uniform pricing because it implies a reduction in profits in market $B$. Thus the reaction to competition is higher under discriminatory pricing.\(^6\) This is the effect described by Armstrong and Vickers (1993).

\(^6\)When $k_A \leq k < \sqrt{2} - 1$ and $k < k^E$, the effect is reversed. In this case, market $B$ is not served under monopoly uniform pricing. When entry occurs the incumbent has an incentive to decrease the uniform price and start serving market $B$. Since profits in market $B$ increase as the price decreases, uniform pricing makes the incumbent tougher.
However the previous effect does not mean that the incumbent’s equilibrium price in market A is always lower under discriminatory than under uniform pricing. If demand in market A is much larger than demand in market B, the discriminatory price may be higher than the uniform price even when there is a competitor in market A. This is the effect described by Cheung and Wang (1999). When demand in market A is much larger than demand in market B the effect of the difference in market demands may overwhelm the effect of the difference in the reaction to competition. Thus, the price decrease in market A due to competition is higher under discriminatory pricing than under uniform pricing but the incumbent’s equilibrium price in market A is higher under discriminatory than under uniform pricing.

As described in the next section, the degree of product substitutability affects the value of \( k \) such that the effect of the difference in market demands overwhelms the effect of the difference in the reaction to competition. Thus, we add a third effect to Armstrong and Vickers (1993) and Cheung and Wang’s (1999) analysis.

4 Entry decision

The entrant’s decision to enter market A depends on whether his post-entry profit is smaller or higher than his entry costs. When the entrant’s post-entry profit is higher under discriminatory pricing than under uniform pricing, there is an interval of entry costs values where entry is profitable under discriminatory pricing but unprofitable under uniform pricing. Therefore we consider that discriminatory pricing is more favorable to entry than uniform pricing.

Under discriminatory pricing the incumbent always sells in market A and the entrant’s profit function is given by (3). However, under uniform pricing, the entrant’s profit function depends on whether the incumbent sells in market A only, sells in both markets or sells in market B only:

\[
\pi^E = \frac{b_A(b_A-d_A)a_A^2}{(b_A+d_A)(2b_A-d_A)^2} \quad \text{for } k < k_A
\]

\[
\pi^E = \frac{a_A^2(b_A-d_A)[b_A(d_A(k+1)+2(2b_A^2-d_A^2)+kd_A^2)]^2}{b_A(b_A+d_A)[8b_A^2-5d_A^2]^2} \quad \text{for } k_A \leq k \leq k_B
\]

\[
\pi^E = \frac{a_A^2}{4b_A} \quad \text{for } k > k_B.
\]

The next proposition describes which of the two pricing policies implies higher entrant’s post-entry profit, for different degrees of market demands difference and degrees of product
substitutability.

**Proposition 1** The entrant’s post-entry profit under discriminatory pricing is:

(i) Equal to the entrant’s profit under uniform pricing when \( k < k_A \), or when there is complete differentiation or also when \( k = k^E \), where \( k^E = \frac{2(b_A - d_A)}{2b_A - d_A} \).

(ii) Higher than the entrant’s profit under uniform pricing when \( k_A \leq k < k^E \).

(iii) Lower than the entrant’s profit under uniform pricing when \( k > k^E \) where for \( k > k_B \) the entrant is the only firm in market \( A \).

**Proof:** The result is a direct consequence of comparing the entrant’s profit under discriminatory pricing (3) and under uniform pricing (4).

Figure 2 illustrates this proposition where the area marked with circles stands for (i), the area marked with squares stands for (ii) and the area in white stands for (iii). This proposition shows that discriminatory pricing may be more, less or equally favorable to entry than uniform pricing.

![Figure 2: Entrant’s profits comparison](image)

When the competitive market is much larger than the captive market, \( k < k_A \), under uniform pricing the incumbent is better off serving only the competitive market. Thus equilibrium prices in this market are precisely the same than under discriminatory pricing and the two pricing policies are equally favorable to entry. If there is complete differentiation, the two pricing policies
also have the same effect on entry, because the entrant’s profits do not depend on the incumbent’s price.

When the captive market is much larger than the competitive market, \( k > k_B \), the incumbent abandons the competitive market under uniform pricing, thus uniform pricing is *more favorable* to entry.

When both markets are covered under uniform pricing, \( k_A \leq k \leq k_B \), there exist always some levels of the difference in market demands where discriminatory pricing is *more favorable to entry* than uniform pricing and other levels where the reverse is true. Discriminatory pricing is *more favorable to entry* than uniform pricing for \( k \in [k_A, k^E] \). In this region, the impact on entry due to the difference in market demands overwhelms the impact due to the differences in the reaction to competition.\(^7\) Notice that \( k^E \) is decreasing with \( d_A \) and the interval \([k_A, k^E]\) depends on the degree of product substitutability: when products are highly substitutable the interval is small, when products are highly differentiated the interval is large.

The previous result shows that the degree of product substitutability affects the impact of pricing policies upon entry. The entrant’s profit depends on the incumbent’s price in the competitive market. Discriminatory pricing is *more favorable to entry* if and only if the incumbent’s discriminatory price in the competitive market is higher than the uniform price. When the incumbent serves both markets, the discriminatory price in the competitive market is higher than the uniform price when the incumbent’s residual demand in the competitive market is larger and less elastic than the captive market’s demand (i.e., when the competitive market is strong). The comparison of these demand elasticities depends on the difference in market demands, \( k \), but it also depends on the degree of product substitutability, \( d_A \). When products are highly substitutable, the reduction in the incumbent’s residual demand due to competition is very large. Thus, unless the competitive market is much larger, the incumbent’s residual demand in the competitive market is smaller and more elastic than the captive market’s demand, thus the discriminatory price in the competitive market will be lower. In this case, there exists only a small interval of differences in market demands where discriminatory pricing is *more favorable to entry* than uniform pricing. On the other hand, when products are very differentiated the reaction to competition is smaller, thus the difference in market demands is the most relevant factor in the elasticities comparisons and there exists a larger interval of differences in market demands.

\(^7\) For \( k_A < k < \sqrt{2} - 1 \) and \( k < k^E \) both effects point to discriminatory price being higher than uniform price.
demands where discriminatory pricing is *more favorable to entry* than uniform pricing.

Our results have some similarities and some differences relatively to Cheung and Wang (1999). Like in Cheung and Wang’s analysis, when both markets are covered under uniform pricing we may have cases where entry discriminatory pricing is *more favorable to entry* than uniform pricing and cases where the reverse is true. In addition, the effects of the difference in market demands and of the difference in the reaction to competition are also present. However, if we consider the case of homogenous products entry never occurs under discriminatory pricing while it occurs under uniform pricing. Thus the dominant firm model and duopoly model imply very different result in the homogeneous product case. Moreover, when there is duopolistic competition under entry, the degree of products substitutability is a key factor to take into account in the comparison of the impact of pricing policies upon entry.

5 Welfare analysis

We now compare the two pricing policies in terms of social welfare. In this comparison it is important to consider whether the pricing policy affects or does not affect the entry decision and to analyze the impact of the pricing policy on the equilibrium prices.

When the entry decision is affected, a very important variable is the degree of product substitutability. In our model, entry has two effects: it increases competition and it increases product variety. The competition effect benefits consumers in the competitive market. This effect is stronger when product differentiation is low. On the other hand, the variety effect is higher when product differentiation is high (for example, when $d_A = 0$, entry it is equivalent to creating a whole new market). This effect benefits both consumers and producers. Consumers always gain with entry, but the industry profit may either be lower or higher with entry. When products are almost homogeneous the duopoly profit is smaller than the monopoly profit (competition decreases industry profits). On the contrary, when the entrant product is very differentiated the industry profits are higher under entry.

In the welfare comparison there are four alternative scenarios for consideration, depending on the level of the entrant’s entry costs. When the entry cost is high, entry will not occur.

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8This discussion is also relevant when entry occurs under the two pricing regimes but the incumbent abandons market A under uniform pricing.
under both pricing policies and thus we are comparing the two pricing policies under monopoly. Second, when entry cost is low, entry will occur under both pricing regimes, thus we need to compare social welfare under entry in the competitive market. For intermediate entry costs, entry may occur under one of the pricing regimes but not in the other, which leads to the last two scenarios.\footnote{Notice that these two scenarios only occur for $k \geq k_A, k \neq k^E$ and $d_A > 0$ since the entrant profit is the same under both pricing policies when $k < k_A$ or $d_A = 0$ or $k = k^E$.}

5.1 High Entry Costs

When entry cost is high, $f^E > \max[\pi_A, \pi^E]$, entry does not occur under both pricing policies and thus the welfare analysis is limited to the well known case of monopoly third-degree price discrimination with linear demands.

When $\sqrt{2} - 1 \leq k \leq \sqrt{2} + 1$, the incumbent covers the two markets under both pricing policies. For $k \neq 1$, the incumbent’s profit is higher and the consumer surplus is lower under discriminatory pricing. As total quantity does not rise under discriminatory pricing, social welfare is lower under discriminatory pricing.\footnote{This is a well known result in the literature of third degree price discrimination (see, for example, Schmalensee (1981)).} When $k = 1$, social welfare is the same under both pricing policies since market $A$ and $B$ are identical and thus uniform pricing leads to the same results as discriminatory pricing.

When $k < \sqrt{2} - 1$ or $k > \sqrt{2} + 1$ one of the markets is not covered under uniform pricing and the price charged in the market which is covered is the same under the two pricing policies, thus social welfare is clearly higher under discriminatory pricing.

Figure 3 illustrates the welfare comparison under monopoly. Welfare is higher under uniform pricing in the light grey area and smaller in the white area. Notice that consumers and firm’s interests go in the same direction when one of the markets is not covered, but go in opposite directions when both markets are covered.

5.2 Low Entry Costs

When entry cost is low, $f^E < \min[\pi_A, \pi^E]$, entry occurs under both pricing policies. Consequently, the pricing policy does not affect entry and the welfare comparison is based only on
Figure 3: Welfare comparison when entry costs are high.

the implications of pricing policies on the equilibrium prices. Figure 4 summarizes the welfare comparison in this scenario.

Figure 4: Welfare comparison when entry costs are low.

For $k < k_A$, the two policies imply the same equilibrium prices in market $A$ and consequently social welfare in market $A$ is precisely the same under the two pricing policies. However under uniform pricing market $B$ is not covered by the incumbent. Thus, when $k < k_A$ discriminatory pricing clearly yields higher social welfare.

When $k_A \leq k < k^E$, demand in market $A$ is larger than demand in market $B$ and equilibrium prices are such that $p_A^I > p_d^I > p_B^B$ and $p^E > p^E$. Thus, total profit (incumbent and entrant) is higher under discriminatory pricing but consumer surplus\textsuperscript{11} is lower under discriminatory

\textsuperscript{11}To compute the consumer surplus we derived the expenditure function and calculated the compensating

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pricing, and it is not clear which effect will dominate. One can show that when products are completely differentiated, \( d_A = 0 \), uniform pricing yields higher social welfare (the consumer surplus effect dominates). For low \( d_A \) and \( k \) (close to \( k_A \)), we still get the previous result (set of parameters in light grey in figure 4). However, for higher \( d_A \) discriminatory pricing yields higher social welfare (the profit effect dominates). Notice that when \( k = k^E \), duopoly prices in market \( A \) are equal under both pricing policies and therefore social welfare is identical under the two pricing policies.

When \( k^E < k \leq k_B \) equilibrium prices are such that \( p^d_{A_d} < p^m_{B_d} \) and \( p^E < p^E \). In this case, total profit can either be higher or lower under discriminatory pricing. Price discrimination leads to lower profits in market \( A \) and higher profits in market \( B \), so the total effect depends on the relative importance of market \( B \). For values of \( d_A \) and \( k \) close to \( k^E \), the effect in market \( A \)'s profit is stronger and thus total profit is lower under discriminatory pricing. For the remaining values, total profit is higher under discriminatory pricing. Consumer surplus under discriminatory pricing is higher in market \( A \) and smaller in market \( B \), thus total consumer surplus can also be higher or lower under discriminatory pricing. For values of \( d_A \) and \( k \) close to \( k^E \), the consumer surplus difference in market \( A \) outweights the consumer surplus difference in market \( B \) and thus consumer surplus is higher under discriminatory pricing. For the remaining values, consumer surplus is lower under discriminatory pricing. However, one can show that when \( k^E < k \leq k_B \) discriminatory pricing always yields lower social welfare. For values of \( d_A \) and \( k \) close to \( k^E \), the profit difference (which favours uniform pricing) overwhelms the consumer surplus difference (which favours discriminatory pricing). For values \( d_A \) and \( k \) close to \( k_B \), the consumer surplus difference (which favours uniform pricing) overwhelms the profit difference (which favours discriminatory pricing). For intermediate values of \( d_A \) and \( k \), consumer surplus and total profit are both higher under uniform pricing.

Finally, when \( k > k_B \), consumer surplus is higher under discriminatory pricing. The reason is that under uniform pricing the incumbent abandons market \( A \), thus the entrant is a monopolist in market \( A \), whereas under discriminatory pricing there is competition in market \( A \). This leads to lower prices and higher variety in market \( A \), which unambiguously increases consumer surplus. On the other hand, total profit can be higher or lower under discriminatory pricing,
depending on the comparison of monopoly and duopoly profits in market A. When products are close substitutes, \( d_A \rightarrow b_A \), under duopoly competition is fierce and profits in market A are close to zero, thus total profit is lower under discriminatory pricing. On the contrary, when products are completely differentiated, \( d_A = 0 \), under duopoly there is more variety and total profit is twice the entrant’s monopoly profit under uniform pricing. However, one can show that discriminatory pricing always yields higher social welfare. The result is obvious for low \( d_A \) since consumer surplus and total profit are both higher under discriminatory pricing. But it also holds when products are close substitutes.

It is quite interesting to compare the results in this case with the well known results under monopoly. Under monopoly, uniform pricing is better if and only if both markets are covered under uniform pricing. This result is no longer true here. When the entrant enters in market A, it is still true that price discrimination yields higher consumer surplus and higher social welfare whenever the incumbent does not cover one of the markets\(^{\text{12}}\) \( k < k_A \) or \( k > k_B \). However, price discrimination may also yield higher welfare when both markets are covered by the incumbent. This happens when the competitive market is strong and products are not very differentiated.

Another interesting difference is that here consumers and firms’ interests may be aligned even when the two markets are served by the incumbent. When \( k^E < k \leq k_B \) and for intermediate values of \( d_A \) and \( k \), consumer surplus and total profit are both higher if price discrimination is banned.

5.3 Intermediate Entry Costs

In this subsection we consider the two cases where the pricing policy affects the entry decision. These two cases hold for intermediate entry costs, \( \min \left[ \bar{\pi}^E, \pi^E \right] < f^E < \max \left[ \bar{\pi}^E, \pi^E \right] \), which is only possible for \( k \geq k_A, k \neq k^E \) and \( d_A > 0 \). Figure 5 shows the welfare comparisons in these two cases.

5.3.1 Entry occurs only under discriminatory pricing

Let us first consider the case where entry occurs under discriminatory pricing but not under uniform pricing. When \( k_A \leq k < k^E \), if entry occurred under the two regimes, prices would \(^{\text{12}}\)However there are differences in the profit comparison. With competition profit may be lower under price discrimination.
be higher under discriminatory pricing, thus $\bar{\pi}^E < \pi^E$. Consequently, for entry costs such that $\bar{\pi}^E < \bar{f}^E < \pi^E$, entry does not occur under uniform pricing but it occurs under discriminatory pricing. Therefore, this first case holds when $k_A \leq k < k^E$ and entry cost is such that $\bar{\pi}^E < \bar{f}^E < \pi^E$.

When $k_A \leq k < k^E$, consumer surplus is always higher under discriminatory pricing. When $k < \sqrt{2} - 1$, the reason is that under uniform pricing the incumbent abandons market $B$ and under discriminatory pricing there is competition and higher variety in market $A$. For $k \geq \sqrt{2} - 1$, under uniform pricing the incumbent monopolist covers both markets but consumer surplus is still higher under discriminatory pricing as it leads to lower prices in market $B$ and higher variety in market $A$.

On the other hand, total profit may be either higher or lower under discriminatory pricing. For high and intermediate values of $d_A$ and for $k$ close to $k^E$, total profit is higher under uniform pricing. When products are almost homogeneous, duopolistic profits under discriminatory pricing are close to zero, thus profits in market $A$ are much lower under discriminatory pricing. Since market $A$ is much larger than market $B$ (as $k < k^E$), the previous effect dominates the profit difference in market $B$. For $k$ close to $\sqrt{2} - 1$ and low $d_A$, total profit is higher under discriminatory pricing since entry almost duplicates the industry profits. But as $d_A$ rises, total profit is higher under discriminatory pricing only for values of $\bar{f}^E$ close to $\bar{\pi}^E$.

One can show that discriminatory pricing always leads to higher social welfare when entry occurs under discriminatory pricing but not under uniform pricing. This result is not very surprising since price discrimination leads to increased competition and higher product variety in market $A$, benefiting a lot the consumers. In addition, firms may also be better off when product differentiation is high, as in this case competition is not very intense and entry corresponds to a larger total market demand.

5.3.2 Entry occurs only under uniform pricing

Now we consider the case where entry occur under uniform pricing but not under discriminatory pricing, which happens for $k > k^E$ and $\bar{\pi}^E < \bar{f}^E < \bar{\pi}^E$.

When $k^E < k \leq k_B$ consumer surplus is higher under uniform pricing. Under uniform pricing there is competition and higher variety in market $A$ and lower prices in market $B$, thus consumer surplus is unambiguously higher. On the contrary, total profit is higher under discriminatory
Figure 5: Welfare comparison when entry costs are intermediate.

pricing. In market $B$ profit is higher under discriminatory pricing. In market $A$ uniform pricing yields higher industry profits when product differentiation is high, but lower profits otherwise. However the total profit is always higher under discriminatory pricing. One can show that for intermediate and high values of $d_A$, discriminatory pricing yields higher social welfare since the profit effect dominates. Discriminatory pricing also yields higher social welfare when $k$ is close to $k_B$ and $d_A$ is low, since demand in market $B$ is much larger than demand in market $A$ and thus the consumers loss in market $A$ by not having more competition and variety is smaller than the profit difference. On the other hand, as $d_A$ rises (set of parameters in dark grey in figure 5), discriminatory pricing yields higher social welfare only for values of $f^E$ close to $\pi^E$. Finally, for the set of parameters in light grey in figure 5, uniform pricing yields higher social welfare since the consumers gain a lot by having competition and higher variety in market $A$.

When $k > k_B$ and entry occurs under uniform pricing but not under discriminatory pricing consumer surplus is precisely the same under the two pricing policies. Under discriminatory pricing the incumbent is a monopolist in both markets whereas under uniform pricing the incumbent is a monopolist in market $B$ and the entrant is a monopolist in market $A$. Thus we have a monopoly in both markets, under the two pricing policies. Since entry does not increase the post-entry social welfare in any market and it has a cost, discriminatory pricing yields higher social welfare.\(^{13}\)

\(^{13}\)Notice that if we consider asymmetric firms where the entrant is more efficient than the incumbent, uniform pricing may yield higher social welfare.
The results in this case are the most surprising ones. Although uniform pricing leads to entry whereas discriminatory pricing does not, for most parameters values, discriminatory pricing leads to higher welfare than uniform pricing. This is a very interesting result because it implies that one should be very cautious in concluding that if a policy is more favorable to entry then it is necessarily better. The previous reasoning is based on the assumption that entry is always welfare improving, which may not be true.\footnote{It is well known that when a firm decides to enter there are two effects operating in opposite directions which may lead to a divergence between what happens in equilibrium and what would be socially optimal: the nonappropriability of social surplus (the firm cannot capture the whole surplus associated with the introduction of its product) and the business stealing effect (by introducing a new product the firm reduces the profits of the other firm). The first effect may lead to less entry than what would be optimal whereas the second effect may lead to more entry than optimal.}

6 Conclusion

In this paper, we investigate the impact of pricing policies upon entry and welfare in a framework where there exists price competition and differentiated products. We considered a model where an incumbent serves two distinct and independent geographical markets and an entrant may enter in one of the markets.

We have shown that the impact of pricing policies upon entry is ambiguous. Discriminatory pricing may be more, less or equally favorable to entry than uniform pricing. Unless products are completely homogenous, there are always some levels of the difference in market demands where discriminatory pricing is more favorable to entry than uniform pricing. This happens when the effect of the difference in market demands overwhelms the effect of the difference in the reaction to competition. In addition, we have shown that the degree of product substitutability affects the impact of pricing policies upon entry. The higher is the degree of product substitutability the larger is the reduction in the incumbent’s residual demand with competition, thus when products are highly substitutable there is only a small interval of differences in market demands where discriminatory pricing is more favorable to entry than uniform pricing. On the other hand, when products are highly differentiated that interval is large.

In terms of welfare, our paper presents several interesting results which depend crucially on the level of entry costs. When entry cost is high we obtain the monopoly results, which favour
uniform pricing as long as both markets are served.

When entry cost is low, entry occurs under both pricing policies and the case for banning price discrimination is less strong than under monopoly. Price discrimination improves welfare if the incumbent abandons any of the markets under uniform pricing. Moreover, price discrimination also yields higher welfare when the incumbent covers both markets but the competitive market is much larger than the captive market and products are not very differentiated. In this case, competition is less intense under discriminatory pricing which implies higher profits and this effect dominates the consumers surplus effect (which favours uniform pricing).

When entry cost is intermediate the pricing regime affects the entry decision. Curiously, in this case discriminatory pricing yields higher welfare, for most parameter values. When entry occurs under discriminatory pricing but not under uniform pricing, welfare under discriminatory pricing is always higher. On the other hand, there are circumstances where entry occurs under uniform pricing but not under discriminatory pricing and yet welfare is higher under discriminatory pricing. The reason is that the erosion of profits due to entry overwhelms the consumers benefit with entry and, consequently, entry is not desirable. Thus, banning price discrimination is only justified when uniform pricing induces entry whereas discriminatory pricing does not and entry is welfare improving. The analysis of this case tells us that we should be very cautious in inferring that if a pricing policy leads to more entry then it is necessarily better.

Our results reinforce the idea that any policy recommendation should always be based on a complete evaluation of the market conditions (including the degree of product differentiation). However they also show that the case for banning price discrimination is much weaker than under monopoly.

Interesting extensions could consider settings where products are complements and where firms have asymmetric production costs.

References


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