Adverse Price Effects of Entry in Markets with Few Firms

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1. Introduction

A common intuition in economics holds that a greater number of firms in the marketplace leads to more intense competition among sellers and lower prices for buyers. Adam Smith develops this theme in his vigorous critique of mandatory apprenticeships and other restrictions on entry into cutlery, weaving and other trades in 18th century Britain.\footnote{See Book I, chapter X, part II in The Wealth of Nations. Most economists, including the authors of this essay, share Smith’s antagonism towards mandated entry restrictions, because they usually lead to higher prices, inefficiently low output and more costly production. See Carlton and Perloff (2000, pages 74-76) for a modern analysis of the adverse price, output and cost effects of artificial entry restrictions. Entry restrictions can also lead to inefficient quality provision (Mussa and Rosen, 1978).} Textbook theories of competition affirm the intuition that entry puts downward pressure on price: The standard Cournot model predicts that prices decline monotonically with the number of sellers. The standard Bertrand model carries the stark implication that two equally productive firms, offering a homogeneous product, are enough to drive price down to marginal cost.

But this intuition can easily fail, at least as a theoretical matter. Especially in markets with differentiated products and few firms, the successful entry of another competitor can lead to higher prices and markups. Consider, for example, a market that initially has a single incumbent seller, and suppose that an entrant captures part, but not all, of the market. Entry can then put upward pressure on price through several channels:
• **Market Segmentation**: When the two products are differentiated, entry segments the market in a way that can result in a higher price for the incumbent’s good. Every consumer can end up paying a higher price after entry, if some consumers value the entrant’s product more highly than the incumbent’s product.

• **Retreat from Exclusion**: A weak rival, or a firm that operates in an adjacent market, may fail to attract (significant) sales in the incumbent’s market but still place downward pressure on his price. As the rival improves its (differentiated) product, it becomes profit-maximizing at some point for the incumbent to relinquish part of the market to the rival. Quality-adjusted prices can rise for all consumers in this event.

• **Adverse Design Incentives**: Successful entry creates incentives to modify product designs in ways that strengthen market segmentation and relax price competition, which in turn yields higher prices for the incumbent’s and the entrant’s good.

• **Loss of Deterrence Motive**: Actual, as distinct from potential, entry weakens the entry deterrence motive for low pricing that can arise with network effects on the demand side, scale economies on the supply side or consumer switching costs.

• **Erosion of Demand Complementarities**: When the incumbent operates in two markets, A and B, that have complementary demand, successful entry into market A can lead to higher prices for the incumbent’s product in market B. The loss of market share in A erodes the incumbent’s incentive to price low in the B market in order to stimulate sales in the A market.

Aside from higher prices, entry can also harm consumers in at least two other ways:
• **Misallocation of Goods:** The non-cooperative nature of pricing in the post-entry situation can induce a misallocation of goods that lowers total surplus and harms consumers in the process.

• **Loss of Network Benefits:** By fragmenting the market, entry can erode network benefits or cause consumers to incur additional costs in order to continue enjoying network benefits.

Thus, contrary to the common intuition, entry can cause (quality-adjusted) price increases and other effects that harm some or all consumers.

In this study, we illustrate these potentially harmful effects of entry in simple models and ask whether they have any empirical relevance. We draw on a disparate collection of empirical studies to help assess the potential for adverse effects of entry on consumer welfare. We consider the impact of entry on the average level of prices in the affected market and on incumbent price, in particular. We concentrate on markets that initially have one or few competitors and some scope for product differentiation. The available evidence speaks mainly to price effects that arise from market segmentation, entry deterrence motives and demand complementarities. We also consider the impact of successful entry on the nature of product design changes by established firms, but systematic evidence on this score is sparse.

Our study has several motivations. First, the question of how entry affects prices and consumer welfare is a basic one that has occupied economists’ attention for more than two centuries. The beneficial consumer effects of (easy) entry are well appreciated by economists; the potential for harmful consumer effects is less appreciated.

Second, in the antitrust arena, horizontal merger cases often turn on whether anticipated efficiency gains outweigh the presumptively harmful consequences of fewer competitors in the
relevant market. This presumption is the flip side of the common intuition that more
competitors mean lower prices and other consumer benefits. For example, the U.S. Federal
Trade Commission (FTC) opposed the merger of Office Depot and Staples, because “it was
likely to harm competition and lead to higher prices in ‘the market for the sale of consumable
office supplies sold through office superstores.’”2 Under the FTC market definition, Staples,
Office Depot and Office Max were the only three large-scale operators of office superstores.
The FTC argued that the proposed merger would reduce the number of independent
operators from three to two or two to one in many metropolitan areas, and that this reduction
in the number of competitors would lead to substantially higher prices at office superstores.
Largely on the basis of this argument, the FTC prevailed at a 1997 preliminary injunctio n
hearing in Federal District Court and effectively derailed the merger.

Third, theories of liability and claims for damages in class-action antitrust suits often turn
on the effects of entry that would have occurred but for allegedly anti-competitive actions by
the defendant(s). This issue is central in the large wave of class-action suits recently brought
against Microsoft Corporation on behalf of software consumers.3 These class-action suits
assert, in part, that unlawful actions by Microsoft inhibited entry into the market for PC
operating system software and thereby caused consumers to pay higher prices for Microsoft
Windows and, according to some lawsuits, for other Microsoft software as well. In light of the
hundreds of millions of copies of Windows sold in recent years, this legal theory implies many

2 See Dalkir and Warren-Boulton (1999), page 143. The ensuing remarks about the Staples case also draw
on Dalkir and Warren-Boulton.
3 These suits followed in the wake of a U.S. District Court’s conclusion that Microsoft unlawfully
exercised monopoly power in the market for operating system software that runs Intel-compatible personal
computers. See the U.S. District Court's Findings of Fact (11/5/1999) and Conclusions of Law and Final
Order (4/13/2000) at www.usdoj.gov/atr/cases/ms_index.htm. About 60 class-action complaints were
brought against Microsoft in federal court on antitrust grounds in the weeks and months following the
Court’s Findings and Conclusions. Many additional complaints were filed in state courts. See, for example,
tens of billions of dollars in consumer damages. Our study contributes towards an economic foundation for assessing this legal theory and similar legal theories in other class-action antitrust actions.

The paper proceeds as follows. Section 2 identifies several channels through which actual and potential entry can affect prices, consumer welfare and economic efficiency. We organize the discussion around simple theoretical examples that illustrate how entry can harm consumers through the mechanisms outlined above. Our discussion also highlights the crucial distinction between potential entry and actual entry, which can have sharply different implications for pricing, product design incentives, the enjoyment of network benefits and consumer welfare. Section 3 articulates some considerations that guide our selection of empirical studies. Section 4 considers empirical studies of entry into the market for brand name prescription drugs. Section 5 turns to empirical evidence in a variety of settings that speak to the price and welfare effects of entry into markets with one or few incumbents. Section 6 considers evidence related to the price effects of entry into various software markets. Our review of the empirical evidence leads to some tentative conclusions regarding the potentially harmful effects of entry into markets with few firms, and some cautionary notes for the exercise of antitrust policy, which we gather in Section 7.

2. Price and Other Effects of Entry: Theory

This section explains how entry can lead to higher prices for some or all consumers. The discussion also identifies non-price channels through which entry can harm consumers. We focus on potentially harmful effects, because the beneficial effects of entry are well

*Microsoft’s Memorandum in Support of its Motion to Dismiss or, in the Alternative, for Summary*
understood by economists. We do not dwell on the potential for entry to reduce social welfare by diverting production away from firms with lower costs or by causing the socially inefficient duplication of fixed costs. These points are well developed in the existing literature. Nor do we devote attention to the issue of brand proliferation by the incumbent(s).

A Simple Example of an Entry-Induced Price Increase

Consider a local monopolist that produces at constant marginal cost, \( c \), and faces a willingness-to-pay schedule,

\[ p(q) = a + bq^{\frac{1}{e}}, \]

where \( b > 0 \), \( e < -1 \), and \( c > a > 0 \). For present purposes, we interpret this schedule as follows:

The first component, \( a \), reflects the willingness to pay for the good itself, e.g., music CDs. The second component, \( bq^{\frac{1}{e}} \), reflects the willingness to pay for bundled attributes that are unique to the local monopolist. The value of these bundled attributes differs among consumers depending on their location, travel time, affinity for the proprietor and his customers, etc.

These cost and demand conditions yield the monopolist’s profit-maximizing price and quantity outcomes,

\[ p^* = \frac{a + \varepsilon c}{\varepsilon + 1} \quad \text{and} \quad q^* = \left[ \frac{\varepsilon(c - a)}{b(\varepsilon + 1)} \right]^{\frac{\varepsilon}{e}}. \]

The formula for the profit-maximizing price implies \( dp^*/da = 1/(\varepsilon + 1) < 0 \), so that an additive shift in the willingness-to-pay schedule causes the profit-maximizing price to move in the opposite direction. Thus, a per-unit excise tax levied on consumers raises the net price, \( p^* \).


\( ^4 \) See, for example, Tirole (1988) and Carlton and Perloff (2000).

\( ^5 \) See Nachbar et al. (1998) for a recent analysis and references to the related literature.
Equivalently, a per-unit excise tax levied on the firm causes the gross-of-tax price to rise by more than the tax itself.

Now consider the price impact of entry, e.g., the advent of Internet CD sales. Suppose that entry reduces the additive component, $a$, but does not affect willingness to pay for the unique bundled attributes offered by the local monopolist. Then $p^*$ rises, and those consumers who continue to purchase from the local monopolist are worse off.

To understand this result, consider the price elasticity of demand facing the local monopolist, which is given by $\eta = (a + \varepsilon c)/(c - a) < 0$ when evaluated at the profit-maximizing outcome. Hence, $\frac{d\eta}{da} < 0$, so that an additive downward shift in the willingness-pay-schedule makes demand less sensitive to price. In other words, the entrant captures the more price-sensitive customers, who are not so attracted by the monopolist’s unique attributes. The customers who stick with the incumbent are less price sensitive.

In many settings, we might expect entry to lower both components ($a$ and $\varepsilon$) of the willingness-to-pay schedule. The price impact of entry then depends on the reduction in $a$ relative to the increase in the magnitude of $\varepsilon$. In general, price can rise or fall in response to entry.

A Richer Model of Entry, Segmentation and Exclusion

In the preceding example, the incumbent’s price increase is intimately connected to the market segmentation induced by entry. It will be useful to explore this segmentation effect more fully. To that end, we introduce a simple specification for the demand structure and product space that admits a rich treatment of market segmentation and related effects.

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Consider a market with two types of consumers and two possible locations in product space. The incumbent occupies one location. The other location may or may not be occupied by an entrant or rival. We assume that the incumbent cannot preempt entry by occupying both locations.\footnote{This assumption fits many (not all) applications. For example, Microsoft Windows is the leading operating system and software applications platform for Intel-compatible personal computers. It would be difficult for Microsoft to develop and promote an alternative product with the same open source code and Unix foundation as Linux. Certainly, other firms and organizations are better positioned to develop and promote Linux or a Linux-like alternative. As another example, a pharmaceutical company that holds the patent on an important drug in a particular therapeutic class cannot occupy other locations at will. Other drugs in the same therapeutic class may be protected by patents held by other companies. Potential new locations can only be occupied after an expensive and risky drug development and testing program, and} Firms produce at zero marginal cost and face (avoidable) fixed operating costs of \( F_I \) for the incumbent and \( F_E \) for the entrant. Firms maximize profits, and consumers maximize consumption benefits net of purchase price. A firm cannot price discriminate among consumers. For now, we treat the product characteristics of the incumbent and entrant goods as exogenous.

Let there be \( N = N_I + N_h \) consumers, where \( \lambda = (N_I/N_h) \) is the relative number of type-\( h \) consumers. Each consumer buys one or zero units of the good. Let \( V_h = 0 \) and \( V_I = 0 \) denote the benefits of the incumbent good for type-\( h \) and type-\( I \) consumers, respectively. Likewise, \( W_h = 0 \) and \( W_I = 0 \) denote consumer benefits of the entrant good. We identify type-\( h \) consumers by the requirement that they place a higher value on the incumbent good than type-\( I \) consumers. That is, \( V_h > V_I \).

The \( V \) and \( W \) parameters define locations in product space. Higher values of \( W_I \), for example, are naturally thought of as design improvements that enhance the value of the entrant good for type-\( I \) consumers. However, changes in \( V \) and \( W \) also reflect any other technological or market development that alters the value of a good to one or both consumer types. As an example, let Microsoft Windows be the incumbent product, and consider a rival product (e.g.,
Linux) that initially offers less consumer value, because it is harder to learn how to use or less compatible with complementary products. Now suppose that new software, available at cost $c$, provides a perfect Windows emulator when layered on top of the rival product. As a result, the new "design" characteristics of the entrant good become $W_h = V_h - c$ and $W_l = V_l - c$.

In this particular example, both consumer types assign the same quality ranking to the incumbent and entrant products. However, our specification also allows for different quality rankings by different consumers. Hence, some product design changes may enhance a product’s appeal to some consumers, but lessen its appeal to others. Thus, our specification of the demand structure and product space, simple as it is, imposes neither a vertical nor horizontal structure on product differentiation.

Consider, first, the pre-entry monopoly outcome. Provided that he covers fixed costs, the incumbent monopolist prices at $P^M_i = V_h$ and earns $\pi^M_i = V_hN_h - F_i$ when $V_h > V_l(1 + \lambda)$. He prices at $V_l$ and earns $V_lN - F_i$ when $V_h \leq V_l(1 + \lambda)$. Consumer surplus is 0 when the monopolist sells only to high-value consumers, and it equals $(V_h - V_l)N_h$ when he sells to both types.

The monopoly outcome with sales to high-value customers only is a useful analytical benchmark when entry expands market size but does not displace the incumbent. The monopoly outcome with sales to both types is a useful benchmark when the entrant captures a portion of the incumbent’s customer base but does not expand market size. Entry segments the market in this case, and type-$h$ consumers may pay higher prices after entry. Clearly, in a model with greater consumer heterogeneity, an entrant might expand market size and capture the incumbent firm need not be in the best position to pursue the requisite development and testing program.
part of the incumbent’s customer base at the same time. The two-type model makes it easy to isolate the market expansion and market capture aspects of entry.

To focus on the potential for market capture, much of the analysis below assumes that

\[ V_h \leq V_f (1 + \lambda) \]  \text{and}  \[ \pi^M > 0. \]

Next, consider the post-entry situation. Without loss of generality, assume that

\[ V_h - W_h - (V_f - W_f) \equiv \Delta > 0. \]  Under this condition, if both firms have positive sales, then the incumbent sells to type-\( h \) consumers, and the entrant sells to type-\( l \) consumers. To keep the analysis simple, we shall consider the impact of entry with sequential price setting. The monopolist sets price first, with knowledge of whether the entrant is present, followed by the entrant’s choice of price. Consumers then make purchase decisions. The sequential pricing assumption allows us to sidestep some subtle issues related to the nature of equilibrium with simultaneous price setting, which we treat at length in Davis, Murphy and Topel (2001a). In qualitative terms, the implications discussed below do not hinge on the distinction between sequential and simultaneous pricing.

Consumers of type \( i \) buy the entrant’s good if

\[ P_i - (V_i - W_i) > P_e \] \text{and}  \[ W_i \geq P_e. \]

Hence, ignoring participation constraints for the moment, the entrant prices at

\[ P_i - (V_h - W_h) \] \text{and sells to both types, if} \( N_h + N_f [P_i - (V_h - W_h)] > N_f [P_i - (V_f - W_f)]. \) \text{This inequality is equivalent to} \( P_i > \lambda \Delta + V_h - W_h. \) \text{When the inequality is reversed, the entrant prices at} \( P_i - (V_f - W_f) \) \text{and sells only to type-} l \text{consumers. Thus, provided that participation constraints are not violated, the entrant’s best response function is}

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8 The sequential pricing assumption is also of independent interest, and it may fit better with actual pricing determination in certain market settings. For example, Microsoft routinely commits to a fixed pricing structure for a year at a time in contracts with large personal computer manufacturers. These fixed-price contracts often had a duration of two or three years before Microsoft’s 1995 consent decree with the U.S. Department of Justice, which limited their duration to one year.
\[ P_E = \begin{cases} 
    P_l - (V_h - W_h), & \text{if } P_l > \lambda \Delta + V_h - W_h, \\
    P_l - (V_l - W_l), & \text{if } P_l \leq \lambda \Delta + V_h - W_h. 
\end{cases} \]  
(1)

It follows that \( \lambda \Delta + V_h - W_h \) is the highest price that the incumbent can charge, while still retaining the type-\( h \) consumers.

This analysis establishes the post-entry price and profit outcomes for an \emph{interior separating equilibrium}, which we denote by the superscript \( S \):

\[ P \_I^S = \lambda \Delta + V_h - W_h \quad \text{and} \quad \pi \_I^S = N \_h (P \_I^S - F \_I), \]

\[ P \_E^S = (1 + \lambda) \Delta \quad \text{and} \quad \pi \_E^S = N \_E (P \_E^S - F \_E). \]  
(2)

The qualifier, “interior”, means that participation constraints are slack.

We can verify the existence of an interior separating equilibrium as follows. First, check that both firms make positive profits and that both consumer participation conditions hold at (2). Second, check that the incumbent’s profit at (2) exceeds his profit when he prices low enough to retain the entire market. If both checks hold, then (2) gives the post-entry equilibrium price and profit outcomes.

Now suppose the incumbent prices low enough to retain the entire market. To exclude the entrant, the incumbent must set \( P_l \) so that the entrant cannot make positive profits at any price. Given \( P_l \), the entrant can capture the type-\( l \) consumers by setting \( P \_E = P_l + W_l - V_l \). This response generates entrant profits of \( [P_l + (W_l - V_l)]N \_l - F \_E \). So, in order to exclude the entrant from profitably selling to type-\( l \) customers (only), the incumbent must set \( P_l \) no greater than \( (F \_E / N \_l) + V_l - W_l \). To exclude the entrant from profitably selling to both types, the incumbent must set \( P_l \) no greater than \( (F \_E / N) + V_h - W_h \).

This analysis establishes the incumbent’s post-entry price (and profit) outcome for an \emph{exclusionary equilibrium}, which we denote by the superscript \( x \):
If $\pi^*_i = NP^*_i - P^*_i$ exceeds incumbent profit at the separating outcome, then the incumbent prices at $P^*_i$, thereby excluding the entrant from the market. If $\pi^*_i$ is less than incumbent profit in the separating outcome, with due consideration for participation constraints, then the incumbent’s profit-maximizing price leads to positive sales by both firms in the post-entry equilibrium.

In summary, the post-entry equilibrium outcomes are given by (2) or (3), provided that both consumer participation constraints hold. If one or both of these constraints are violated at (2), then the equilibrium expressions take a somewhat different form. The specification of all possible equilibrium corner outcomes is straightforward, but also tedious, and need not detain us here. We refer the reader to Davis, Murphy and Topel (2001a) for an exhaustive treatment of the various possibilities with simultaneous pricing. Here, we content ourselves with simple examples that illustrate how entry can benefit or harm consumers, and raise or lower total surplus. We compute equilibrium outcomes with due allowance for participation constraints.

**Entry and Segmentation**

Table 1 reports the effects of entry on price, consumer surplus and total surplus for alternative values of the model’s product design and fixed cost parameters. All examples in Table 1 maintain $V_h \leq V_i (1 + \lambda)$, so that the incumbent sells to both consumer types in the

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9 In making this statement, we presume that $P^*_i \leq P^*_i^{1/2}$. If, instead, $P^*_i > P^*_i^{1/2}$, then entry is ineffectual in the sense of having no effect on the incumbent’s price.

10 We set aside the case in which the entrant captures the entire market. Given $V_h > W_h$ and $\Delta > 0$, this cannot happen unless $F^*_i$ is large.
pre-entry monopoly outcome. After entry, he continues selling to both types in the exclusionary outcomes, but he sells only to type \( h \) in the separating outcomes.

The first row of Table 1 illustrates the common intuition that entry puts downward pressure on price. The incumbent lowers price in response to entry and retreats to a segment of the market. Type-\( h \) consumers continue to buy from the incumbent, but at a lower price. Type-\( l \) consumers now buy from the entrant, pay a lower price, and get a more highly valued product to boot. Thus, all consumers pay less after entry, and all consumers are better off.

Observe that the entrant’s product is more highly valued by type-\( l \) consumers \( (W_l > V_l) \) in this example, while the incumbent’s product is more highly valued by type-\( h \) consumers \( (V_h > W_h) \). As a result, the market segmentation induced by entry leads to a gain in total surplus. This beneficial effect on total surplus arises whenever the entrant’s product is more highly valued by some consumers, and those same consumers are the ones who buy the entrant’s product at post-entry prices. Put differently, an efficient allocation of goods to consumers in the post-entry separating equilibrium is necessary for entry to raise total surplus in this model. It is not sufficient, because the beneficial effects of an improved goods allocation can be more than offset by a socially wasteful duplication of fixed costs.\(^{11} \) For example, if we set \( F_e = 1 \) in row (1) and leave the other parameters unchanged, then the entry effects on price and consumer surplus are also unchanged, but entry now leads to a loss of total surplus.

Rows (2) through (4) provide other examples of entry-induced segmentation with an efficient allocation and a gain in total surplus. As these examples show, prices can rise, fall or remain unchanged in response to successful entry. Row (2) illustrates a situation with no price change for any consumers but a gain in surplus for type-\( l \) consumers by virtue of a more highly valued product.
valued product. Row (3) illustrates a situation with a price rise for type-\(l\) consumers but no change in consumer surplus. In row (4), price rises for all consumers, and type-\(h\) consumers are made worse off.

In example (4), type-\(h\) consumers strongly prefer the incumbent’s product, and type-\(l\) consumers strongly prefer the entrant’s product. This configuration of demand and product characteristics leads to a strongly segmented market in which producers extract all of the market surplus. Here, entry leads to a non-cooperative form of price discrimination that is highly effective at transferring surplus from consumers to producers.

A slight modification to example (4) shows that consumers who switch to the entrant’s good can also be hurt by entry. In particular, modify the example to include some type-\(k\) consumers who have product valuations, \(V_k = W_k = 7\). So long as the type-\(k\) consumers are not too numerous, their introduction does not alter pre-entry or post-entry equilibrium prices. Moreover, at the post-entry prices listed in row (4), the type-\(k\) consumers prefer the entrant’s good, so they switch firms. However, they suffer a loss of consumer surplus relative to the pre-entry monopoly situation. Thus, entry can make most consumers worse off, including some consumers who switch to the entrant.

To summarize, price can rise or fall in the face of entry, even when total surplus rises. Many, even most, consumers can be harmed by the entry-induced segmentation of the market. Indeed, successful entry does not assure that any consumers are made better off. Furthermore, the price change induced by entry, either for the incumbent or on average, is not closely aligned with the impact of entry on consumer or total surplus.

\(\text{11} A\) loss of network benefits can also outweigh an otherwise improved allocation of goods to consumers.
Entry-Induced Misallocation of Goods

Rows (5) through (8) in Table 1 provide several additional examples of entry-induced market segmentation. In these examples, unlike the ones in rows (1) through (4), entry leads to an inefficient allocation of goods. That is, the entrant displaces the incumbent from a segment of the market despite the incumbent’s strictly superior product \((V_h > W_h \text{ and } V_i > W_i)\). Because it leads to a misallocation of goods, entry reduces total surplus. This negative effect on total surplus is reinforced by a socially wasteful duplication of fixed costs in row (8). As this example illustrates, the adverse efficiency consequences of entry can be quite large: total surplus after entry is only 72 percent of its pre-entry value.\(^\text{12}\)

As before, price and consumer surplus can rise or fall when entry results in a segmented market with an inefficient allocation. In row (5), prices decline and surplus rises for both consumers, despite the loss of total surplus. The examples in rows (6) through (8) show an increase in the incumbent’s price in response to entry and a loss of surplus for type-\(h\) consumers.

Entry can also reduce total and consumer surplus by pushing some consumers out of the market. To see this point, modify example (8) to include some type-\(k\) consumers with product valuations, \(V_k = 9\) and \(W_k = 3\). Then, provided that the type-\(k\) consumers are not too numerous, their introduction does not alter pre-entry or post-entry equilibrium prices. However, at the post-entry prices, neither good is attractive enough to elicit purchases by type-\(k\) consumers. Hence, as a result of entry, type-\(k\) consumers are pushed out of the

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See examples (1), (2), (5) and (6) in Table 3 below.

\(^{12}\) Total surplus is \(N_h V_h + N_i V_i - F_i = (1)(10) + (1)(8) - 0.8 = 17.2\) prior to entry and \(N_h V_h + N_i W_i - F_i - F_E = (1)(10) + (1)(4) - 0.8 - 0.8 = 12.4\) after entry.
market and suffer a loss of surplus. In addition, total surplus falls by 9 units for each type-
consumer.

Entry and Exclusion

The last two examples in Table 1 illustrate exclusionary pricing behavior by the
incumbent. In these examples, the incumbent lowers price in response to entry, but he retains
the entire market. That is, he earns more profit by pricing at $P_i^*$ in equation (3) and selling to
both consumer types than by pricing at the separating outcome and selling to type-$h$
consumers only.

The exclusionary pricing response benefits all buyers in these examples, illustrating a
general proposition. To see this point, note that consumers purchase the same good under
exclusion as in the pre-entry monopoly outcome, but at a reduced price. Hence, all consumers
are strictly better off.

Exclusionary pricing can also raise total surplus (and further raise consumer surplus)
by expanding the market. To illustrate this effect, modify example (9) to include some type-$k$
consumers with product valuations, $V_k = 5$ and $W_k = 1.8$. Once again, suppose that the type-
$k$ consumers are not numerous enough to alter the pre-entry or post-entry prices. Under these
conditions, the type-$k$ consumers purchase at the exclusionary price reported in row (9), but
not at the monopoly price. Hence, the exclusionary pricing response by the incumbent leads to
an expansion in market size and a gain in total surplus. Thus, an exclusionary pricing response
by the incumbent always benefits consumers, and it may raise total surplus, too.

To appreciate the full relevance of exclusionary pricing, it is important to recognize that
the same logic applies when the “entrant” is actually a potential rival that operates in an
adjacent market. To illustrate this key point, we can build on example (9) as follows.

Suppose there is an adjacent market with \( N_a \) consumers in addition to the primary market described in row (9). Consumers in the adjacent market value the entrant’s product at \( A \) and, for simplicity, place zero value on the incumbent’s product. Assume that the entrant cannot price discriminate between the primary and adjacent markets.

Given these assumptions, the incumbent prices at \( P_{IM}^* = 6 \) prior to entry. After entry, he faces a choice between segmentation and exclusion. To exclude the entrant from the primary market, the incumbent sets \( P_I \) so that the entrant earns greater profit by operating only in the adjacent market: that is, \( AN_a \geq (P + W_I - V_I)(N_a + N_I) \). This formulation presumes that the exclusionary margin involves type-1 consumers, which is the case for the parameter values in row (9). Solving for the incumbent’s exclusionary price,

\[
\hat{P}_I^* = V_I - W_I + AN_a / (N_a + N_I)
\]  

(4)

For example, using the parameter values in row (9) and \( A = N_a = N_I = N_h = 1 \), the exclusionary price is \( \hat{P}_I^* = 6 - 1.8 + (1/2)1 = 4.7 \). It is easy to verify that the incumbent prefers this exclusionary price to segmentation. Thus, the rival’s entry into the adjacent market creates the potential for his entry into the primary market, which in turn leads the incumbent to cut price.

Comparing the expression for \( \hat{P}_I^* \) in (4) to the first branch of equation (3), we see that the presence of the adjacent market raises the exclusionary price. Indeed, this comparison makes clear that the presence of the adjacent market affects the exclusionary price in the same way as the entrant’s fixed operating costs in the primary market. As a related point, the adjacent market makes it more costly for the entrant to operate in the primary market at any level of activity. If the entrant sells at a price above \( A \) in the primary market, he foregoes any
sales in the adjacent market. If he sells at a price below $A$ in the primary market, he lowers his profit in the adjacent market.

In summary, these examples of exclusionary pricing behavior illustrate four important points. First, exclusionary pricing benefits consumers. Second, exclusionary pricing also raises total surplus by expanding market size. Third, entry into an adjacent market can lead the incumbent to adopt an exclusionary pricing stance in the primary market. That is, potential rivals need not operate in the incumbent’s market to discipline his pricing power. Fourth, and related, market share is not a useful indicator of market power in the context of exclusionary pricing behavior. Indeed, high market share coupled with low prices signal an incumbent who has responded to the potential for entry by cutting price.

Retreat from Exclusion

When an incumbent retreats from exclusion, prices rise and consumers suffer. Total surplus may also decline. It follows that an improvement in a rival’s product or a reduction in his costs can -- by breaking an exclusionary pricing equilibrium -- harm consumers and lower total surplus.

Table 2 illustrates the harmful consequences of an incumbent’s retreat from exclusion. The initial situation in these examples is identical to the exclusionary outcome in row (10) of Table 1. That is, the incumbent initially prices at $P_i^x = 6$ and sells to the entire market. In the new situation, it becomes too costly for the incumbent to maintain exclusion because of reduced fixed costs or an improved product design for the rival. So, the incumbent raises price and retreats to a portion of the market (50 percent of unit sales in the Table 2 examples). This type of retreat from exclusion always hurts those consumers who continue to
purchase from the incumbent. Other consumers may also be hurt, as shown in Table 2. Total surplus can fall when the retreat from exclusion involves a socially wasteful duplication of fixed costs or a misallocation of goods to consumers.

These examples of retreat from exclusion reinforce our earlier points about the tenuous connection of market share to consumer surplus, total surplus and the degree of pricing power exercised by the incumbent. As the incumbent’s market share shrinks in the Table 2 examples, the surplus measures fall and price rises.

Entry, Design Incentives, and the Intensity of Price Competition

Rival firms with secure positions in the same market have strong incentives to differentiate their products in ways that relax price competition.\(^{13}\) This observation raises the question of whether and how entry affects product design. To address this question, we show that post-entry design incentives in a separating equilibrium differ sharply from incentives that prevail under exclusion or monopoly. Hence, the event of successful entry -- defined as a positive market share for the entrant -- sharply alters product design incentives. Insofar as product characteristics respond to the shift in design incentives, successful entry has additional effects on pricing, consumer surplus and total surplus through its impact on product design. We develop this theme in several steps.

Initially, let us assume that a firm can freely manipulate one design parameter at a time, within some limits. In other words, a firm can flexibly tailor its design so as to enhance (or detract from) the value of its product to one consumer type without altering its value to the other type. This assumption makes it easy to identify design incentives and the likely impact of

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entry on the direction of product design changes. In reality, firms often have considerable, albeit imperfect, design flexibility of this sort. We discuss the implications of relaxing the design flexibility assumption below.

Consider, first, the design incentives facing an incumbent who sells to both consumer types under monopoly or under an exclusionary pricing regime. As before, focus on the case where \( V_h > V_l \) and \( \Delta > 0 \), so that the marginal consumers are of type \( l \). The exclusionary price given by equation (3) and the monopoly pricing solution \( P^M_l = V_l \) both imply that the incumbent’s price rises one-for-one with marginal improvements in \( V_l \). In contrast, marginal changes in \( V_h \) have no effect on his price. It follows that a profitable design improvement (increase in \( V_l \)) lowers consumer surplus, and a consumer surplus-enhancing design improvement (increase in \( V_h \)) has no effect on profit. Total surplus rises with both \( V_h \) and \( V_l \).

Thus, the incumbent’s design incentives are (weakly) aligned with total surplus but adverse to consumer interests when he sells to both types under monopoly or in an exclusionary pricing regime.

Next, consider design incentives at an interior separating equilibrium. Differentiating equation (2), the separating equilibrium prices vary with the design parameters as follows:

\[
\frac{dP^s_l}{dV_h} = -\frac{dP^s_l}{dW_h} = 1 + \lambda, \quad -\frac{dP^s_l}{dV_l} = \frac{dP^s_l}{dW_l} = \lambda
\]

\[
\frac{dP^e_i}{dV_h} = -\frac{dP^e_i}{dV_l} = -\frac{dP^e_i}{dW_h} = \frac{dP^e_i}{dW_l} = 1 + \lambda
\]

\(14\) Shapiro and Varian (1999) present many examples of design manipulation for software and other information goods. They emphasize “versioning” as a market segmentation device that facilitates price discrimination and “bundling” as a device to exploit demand complementarities or to reduce the diversity of buyer valuations. There are large literatures on each of these topics. See Shapiro and Varian or Davis, MacCrisken and Murphy (1999) for references.
These equations say that a firm can raise price by *improving* its product in the eyes of its own customers, or by *degrading* its product in the eyes of the rival’s customers. Either of these design changes also raises the rival’s equilibrium price. Moreover, a firm’s equilibrium price rises *more* than one-for-one with an increase in the value of its product to its own customers.

Putting the pieces together yields the following conclusion: At an interior separating equilibrium, a marginal improvement in the firm’s product in the eyes of its own customers, or a marginal degradation in the eyes of the rival’s customers, leads to higher profit for the firm and its rival and lower surplus for both consumer types.\(^\text{15}\)

Thus, design incentives are adverse to consumer interests irrespective of entry. However, the design incentives differ before and after successful entry in two noteworthy respects. First, incentives to degrade a product along certain directions arise only in a separating equilibrium.\(^\text{16}\) Second, the event of successful entry dramatically alters the direction of design incentives for the incumbent firm. Prior to entry, the incumbent profits by raising \(V_i\); after entry, he profits by lowering \(V_i\) and raising \(V_h\). This abrupt turnaround in design incentives reflects the incumbent’s desire to soften price competition once an entrant becomes established. The turnaround in the incumbent’s design incentives places additional upward pressure on price beyond the direct impact of retreat from exclusion or market segmentation.

The following analysis highlights the additional price effect that works through the product design channel. Assume that the incumbent can freely choose product design...
parameters before and after entry, subject to \( V_i \in [V_i^{\min}, V_i^{\max}] \) and \( V_h \in [V_h^{\min}, V_h^{\max}] \). For simplicity, make two additional assumptions: First, any incumbent design within this constraint set involves sales by the incumbent to both consumer types under monopoly or an initial exclusionary pricing equilibrium. Second, the post-entry outcome (which may involve a retreat from exclusionary pricing) is a separating equilibrium with sales by the incumbent to type-\( h \) consumers.

Under these assumptions, it is straightforward to calculate the direct effect of entry on price and the indirect effect working through the product design channel. Consider the case in which the incumbent is initially a monopolist. Prior to entry, the incumbent makes design choices \( V_i = V_i^{\max} \) and \( V_h \geq V_i^{\max} \) and prices at \( P_i^M = V_i^{\max} \). After entry, he chooses \( V_i = V_i^{\min} \) and \( V_h = V_h^{\max} \) and prices at \( P_i^S = (1 + \lambda)(V_h^{\max} - W_h) - \lambda(V_i^{\min} - W_i) \). Hence, the entry-induced change in the incumbent’s price is

\[
\Delta P_i = P_i^S - P_i^M = \left\{ (1 + \lambda)(V_h^{\max} - W_h) - \lambda(V_i^{\min} - W_i) \right\} - V_i^{\max} = \left\{ (1 + \lambda)(V_h^{\max} - W_h) - \lambda(V_i^{\min} - W_i) - V_i^{\max} \right\} + \lambda\{V_i^{\max} - V_i^{\min}\}
\]

The second line decomposes the price change into two pieces. The first term, which can be positive or negative, reflects the direct effect of entry-induced market segmentation on price.\(^{17}\) The second term, which is unambiguously positive, reflects the indirect effect working through the design change induced by entry. So, design flexibility means that entry leads to a bigger increase in the incumbent’s price. By softening the intensity of price competition, the incumbent’s design flexibility also leads to a higher price for the entrant’s good.

A similar analysis holds when the initial situation involves exclusionary pricing by the incumbent. For example, consider an excluded rival with zero fixed costs and initial design
characteristics, \( W_h \) and \( W^1_l \). Suppose that the entrant improves his design to \( W^2_l > W^1_l \), thereby causing the incumbent to retreat from his exclusionary pricing stance. Then, making use of equations (2) and (3), the incumbent’s price rises by

\[
P^1_i - P^*_i = [(1+\lambda)(V^\text{max}_h - W_h) - \lambda V^\text{min}_i - W^2_l)] - (V^\text{max}_i - W^1_i)
\]

\[
= [(1+\lambda)(V^\text{max}_h - W_h) - \lambda (V^\text{max}_i - W^2_l) - (V^\text{max}_i - W^1_i)] + \lambda (V^\text{max}_i - V^\text{min}_i)
\]

(8)

The first term in this decomposition is the direct effect of the retreat from exclusion, and the second term is the indirect effect working through the design change. Both terms are unambiguously positive when the rival breaks an exclusionary equilibrium. So, once again, design flexibility means that successful entry leads to a bigger increase in the price of the incumbent’s good.

Now that we have identified the mechanism whereby design flexibility influences the price response to entry, we can step back from the stark assumptions of the preceding analysis and draw some conclusions. First, since product differentiation usually involves some design flexibility, the adverse design incentives identified above are likely to operate in any market setting with entry-induced segmentation. In other words, entry is more likely to bring about higher prices once we recognize the role for design choices to soften price competition. Second, the scope for easy design flexibility varies greatly across product lines and industries.\(^\text{18}\) Hence, the adverse design incentives identified above are more likely to play an important role in the pricing response to entry for products like software that are highly

\(^{17}\) The decomposition in the second line of equation (7) presumes that the incumbent selects the surplus-maximizing product design within the set of profit-maximizing designs.

\(^{18}\) For example, software products and other information goods exhibit a great deal of design flexibility. Moreover, once a new design is developed, high-volume production of the new design is quick and cheap. In contrast, design changes for physical goods like automobiles appear to be more costly. It is clearly very costly to translate a new car design into high-volume production.
malleable. Third, the adverse design incentives induced by entry may not immediately translate into adverse price effects. Presumably, it often takes time for a firm to alter its product design in response to successful entry by a rival. Thus, the price effects of entry and market segmentation are likely to be less favorable over the longer term than in the immediate aftermath of entry. Fourth, in a setting with ongoing innovation, a firm need not actually degrade its product in order to soften price competition. Instead, it can achieve the same objective by simply failing to enhance its product design (as rapidly) for the rival’s customers as for its own customers. If each firm concentrates on design improvements that appeal mainly to its existing customers – a highly plausible scenario – then the strength of market segmentation grows over time, and prices rise.

Thus far, we have focused on post-entry design incentives in a separating equilibrium. It is also instructive to consider an incumbent’s design incentives in the face of potential entry. In the pre-entry situation, an incumbent monopolist has at least two reasons to prefer a product design with broad appeal. First, a design with broad appeal is more likely to substitute closely with an entrant's offering in the post-entry equilibrium. Greater closeness in product space leads to sharper price competition in the post-entry equilibrium. Thus, if prior design attributes place some limits on later design choice, a product with broad appeal can help the incumbent commit to sharper post-entry pricing. In turn, the prospect of sharper price competition deters or discourages entry. In this way, an incumbent design with broad appeal makes entry less attractive.

Second, by raising current unit sales, a design with broad appeal soaking up some of an entrant’s potential future demand. For example, given consumer switching costs and supply-side scale economies, an incumbent product design with broad consumer appeal makes it
harder for an entrant to capture a profitable market presence. Similarly, given network effects on the demand side, a design with broad appeal makes it harder for an entrant to obtain a market toe hold. In these respects, a design with broad appeal is attractive to the incumbent for the same reason as a low price—both help to soak up the future demand for a potential entrant's product.

In short, potential entry also influences a monopolist's product design decisions. Unlike the design incentives induced by actual entry, potential entry encourages the incumbent to select designs with broad consumer appeal. For similar reasons, a dominant firm has strong incentives to innovate in directions that respond to the nascent competitive threats posed by potential rivals. "Me-too" enhancements or other suitably targeted design improvements by an incumbent can limit the appeal of a potential rival's product. As a result, suitably targeted design improvements may enable an incumbent to ward off the threats presented by potential rivals, or to deter a potential rival from competing directly with the incumbent. Furthermore, insofar as targeted design improvements of this sort enable an incumbent monopolist to maintain an exclusionary pricing policy, they can be highly beneficial for consumers. Consumers benefit directly from better products and indirectly as the product improvement makes it attractive for the incumbent to continue pursuing an exclusionary pricing policy.

We can summarize the central message of this section as follows: Successful entry alters the incumbent’s design incentives by creating a motive to soften price competition and by changing the identity of his marginal consumers. The design changes induced by successful entry and market segmentation are a force for higher prices and lower consumer welfare.
Entry-Induced Loss of Network Benefits and Pricing Power

We now introduce a simple form of network effects into the model and pursue two objectives. First, we show that network effects intensify an incumbent’s exposure to the pricing discipline exerted by existing rivals who operate in the same market and to potential rivals who operate in adjacent markets. Second, we construct numerical examples that involve an entry-induced loss of network benefits.

To model network effects, we adopt a general additive specification for consumer spillovers. In particular, an individual type-\(h\) consumer enjoys spillovers of \(\gamma_{hh} \tilde{N}_{hh} + \gamma_{hl} \tilde{N}_{hl}\) when he uses the same product as \(\tilde{N}_{hh}\) type-\(h\) and \(\tilde{N}_{hl}\) type-\(l\) consumers, where \(\gamma_{hh}\) and \(\gamma_{hl}\) are parameters that govern the strength of spillovers on to the type-\(h\) consumer. Analogously, a type-\(l\) consumer enjoys spillovers of \(\gamma_{lh} \tilde{N}_{lh} + \gamma_{ll} \tilde{N}_{ll}\). All spillover parameters are nonnegative.

As a preliminary, consider an incumbent monopolist who sells to both consumer types while pricing to extract all surplus from type-\(l\) consumers. Hence, the incumbent monopolist prices at \(V_{i} + \gamma_{lh} N_{i} + \gamma_{ll} N_{l}\). This price generates consumer surplus of 
\[
N_{h}[V_{i} - V_{l} + (\gamma_{hh} - \gamma_{hl})N_{h} + (\gamma_{hl} - \gamma_{ll})N_{l}],
\]
and total surplus of
\[
N_{h}(V_{h} + \gamma_{lh} N_{h} + \gamma_{ll} N_{l}) + N_{l}(V_{l} + \gamma_{lh} N_{l} + \gamma_{ll} N_{h}) - F_{i}.
\]

The post-entry separating equilibrium can be determined along the same lines as before, but the precise outcome now depends on whether the entrant can coordinate buying among consumers. For example, if the entrant can make price contingent on the number of consumers who adopt his product, he can always attract buyers when it is in the joint interest of (some or all) consumers to defect from the incumbent. In contrast, absent contingent pricing
or some other coordination mechanism, it may be unattractive for a single consumer to defect even though defection is jointly optimal for some or all consumers. Since the scope for this type of coordination is likely to differ across markets and depend on details that we do not model, we consider both possibilities.

The appendix derives post-entry prices for an interior separating equilibrium with network effects, whereby type-\( h \) consumers buy from the incumbent and type-\( l \) from the entrant. These equilibrium prices are given by

\[
\begin{align*}
P_{SN}^I &= \lambda \Delta + V_h - W_h - \lambda (\gamma_{hl} N + \gamma_{lh} N_l) \\
\lambda \Delta &= \lambda \gamma_{hl} N - (1 + \lambda) \gamma_{lh} N_h
\end{align*}
\]

when coordination is feasible, and by

\[
\begin{align*}
P_{SN}^I &= \lambda \Delta + V_h - W_h + (\gamma_{hl} - \lambda \gamma_{lh}) N_l - (\gamma_{hl} + \lambda \gamma_{lh}) N_l \\
\lambda \Delta &= \lambda \gamma_{hl} N - \lambda \gamma_{lh} N_l.
\end{align*}
\]

These equilibrium pricing equations yield some important insights regarding network effects. When coordinated purchasing is feasible, equations (9) and (11) imply that network effects always lead to lower prices in the separating equilibrium and a higher exclusionary
price. It follows immediately that exclusionary pricing is more likely the larger are network benefits. When coordinated purchasing is infeasible, equations (10) and (12) imply qualitatively similar outcomes, except when network effects are dominated by spillovers among type-\( h \) consumers only; that is, except when \( \gamma_{hh}N > \lambda\gamma_{hl}N + (\gamma_{lh} + \lambda\gamma_{ll})N \). This case is a logical possibility but unlikely to characterize most network markets.

The equilibrium pricing equations are also at odds with the view that network effects constitute a barrier to entry that fortifies an incumbent against competitive pressures. In our model, network effects are indeed a barrier to entry in the limited sense of making it more difficult for a rival to acquire a piece of the incumbent’s market. At the same time, network effects undermine entry barriers in an important sense. In particular, network effects intensify the incumbent’s exposure to the pricing discipline exerted by existing rivals and to potential rivals who operate in adjacent markets. This diminished pricing power shows up in two ways. First, larger network effects lead to lower prices in the separating equilibrium. Second, and partly because of the first effect, an incumbent is more likely to adopt an exclusionary (i.e., low) price when network effects operate.

These conclusions about network effects and pricing power do not require that an entrant captures a large, or even positive, share of the incumbent’s market. As in the basic model without network effects, the mere presence of a rival – in the incumbent’s market or an adjacent market – serves to limit the incumbent’s pricing power. In addition, we now see that network effects amplify the competitive impact of actual and potential rivals.

\[\text{For example, when } \gamma_{hh} \text{ is the only positive spillover parameter, network effects raise the incumbent’s separating equilibrium price but have no impact on his exclusionary price. Hence, in this case, larger network effects (bigger } \gamma_{hh} \text{) make exclusionary pricing less likely.}\]
We previously emphasized that consumers benefit from low prices when the incumbent adopts an exclusionary strategy. In a setting with network effects, an exclusionary strategy also benefits consumers by promoting greater enjoyment of network benefits. By the same token, successful entry diminishes consumer enjoyment of product-specific network benefits.

Table 3 presents examples of entry into an initially monopolized market with product-specific network effects. These examples maintain uniform consumer spillovers such that \( \gamma_{ib} = \gamma_{ii} = \gamma_{ai} = \gamma_{ia} = \gamma \). All examples show a loss of network benefits when entry results in market segmentation. Entry can lead to a loss of total surplus because of reduced network benefits, the misallocation of goods to consumers and the socially wasteful duplication of fixed costs.

Examples (1) and (2) illustrate the point that network effects lead to lower separating equilibrium prices. These examples maintain the same parameter values as example (1) in Table 1, except for the spillover parameter, \( \gamma = 1 \). As revealed by the comparison to Table 1, network effects lower the post-entry separating prices for both consumer types. Despite the segmentation-induced loss of network benefits, entry leads to bigger consumer surplus gains in these two examples than in example (1) of Table 1.

Examples (3) and (4) illustrate the point that (stronger) network effects make exclusionary pricing more likely. These two examples maintain the same parameter values as examples (1) and (2), except that the spillover parameter is now set to \( \gamma = 2 \). Stronger network effects further depress the separating price, so that exclusionary pricing becomes the incumbent’s optimal response to entry. The exclusionary pricing response means even bigger gains for consumers and no loss of network benefits.

Examples (5), (6) and (9) show that entry-induced market segmentation can reduce consumer surplus, even though network effects intensify the pricing discipline exerted by rivals.
Entry lowers surplus for type-$h$ consumers in all three of these examples, and it lowers aggregate consumer surplus in examples (6) and (9). Examples (6) and (9) also show that the adverse price impact of market segmentation can outweigh the favorable price impact of competition in a market with network effects. In both of these examples, entry leads to higher prices for the incumbent’s good. Finally, a comparison of example (9) to examples (10) and (11) illustrates how post-entry market structure can be affected by entrant fixed costs and by an entrant’s capacity to coordinate consumer purchasing.

Table 4 presents several examples of retreat from exclusionary pricing in the presence of network effects. The examples differ in terms of the change that triggers a retreat from exclusionary pricing: an improvement in the rival’s product for type-$l$ consumers in examples (1) and (2), a decline in the value of the rival’s product to type-$h$ consumers in example (3), a reduction in the strength of consumer spillovers in examples (4) and (5), the rival’s ability to induce coordinated buying in example (6), and a reduction in the rival’s fixed costs in example (7). All Table 4 examples involve a loss of network benefits. They also show large declines in consumer surplus and sharp price increases. Several examples show large declines in total surplus as well. These examples illustrate even more forcefully than the ones in Table 2 that market share can be an extremely misleading indicator of monopoly pricing power, consumer welfare and economic efficiency.

As a final point, entry can induce a socially undesirable loss of network benefits even when the “entrant” and “incumbent” are the same firm. Ellison and Fudenberg (2000) show that the monopoly supplier of a backward-compatible (but not forward-compatible) software

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20 For given parameter values, an equilibrium with coordinated purchasing often leads to lower prices and higher consumer surplus than one with no coordination, as shown in Table 3. However, this result is not general for our construction of the coordination and no-coordination equilibria. Thus, example (6) in Table 4 involves a large loss in consumer surplus when the rival breaks an exclusionary pricing equilibrium through coordinated purchasing. This example raises the question of whether a rival can bring about coordinated purchasing when it leads to lower equilibrium surplus for consumers. If not, then there would be no retreat from exclusion in example (6).
product may introduce more frequent upgrades than is socially optimal. Whenever the monopolist introduces a new version of a backward-compatible software product, it imposes a negative externality on former customers who might prefer not to upgrade. As Ellison and Fudenberg put it, “Because a monopolist’s revenue depends only on the surplus of the marginal buyer, it may have an incentive to introduce too many upgrades if the negative externality is less strong for the marginal buyer than for the average one.” (page 256) Our analysis shows that a similar problem arises in a multi-firm setting.

Actual and Potential Entry in a Dynamic Setting

Potential entry has additional effects on pricing and consumer welfare in a dynamic setting. Previous research develops three explanations of how potential future entry places downward pressure on an incumbent’s current price. First, when consumers face costs of switching between brands, an incumbent can discourage entry by pricing low in order to build up its customer base. A larger customer base soaks up some of the potential demand facing a prospective entrant and thereby deters entry or lowers its probability, as shown by Klemperer (1987). Second, product-level network effects also give rise to an entry-deterrence motive for low pricing, and for a similar reason, as shown by Fudenberg and Tirole, 2000. A lower price expands the incumbent’s network, which makes it harder for a future entrant to exploit network economies and attract customers. A third class of models focuses on the signaling role of the incumbent’s price when his costs (or demand) are not fully known to prospective entrants. To signal low marginal costs, and thereby deter prospective entrants, it may be

21 Klemperer (1987) emphasizes that a larger customer base does not always deter entry in markets with consumer switching costs. In some circumstances, a customer base discourages the incumbent from competing aggressively with an entrant and thereby makes entry more attractive.
advantageous for the incumbent to price below the monopoly level, as shown by Milgrom and Roberts (1982), Matthews and Mirman (1983) and others.

Actual entry also has additional effects on pricing and consumer welfare in a dynamic setting.

Discuss the distinction between exclusionary pricing when the rival is “waiting in the wings” and a low price that is motivated by a desire to deter or forestall future entry.

Higher Prices Occasioned by the Loss of an Entry Deterrence Motive

While potential entry can depress the incumbent's price through an entry-deterrence motive, actual entry tends to undermine this motive. In an environment that will sustain only one, two or a few firms, actual entry reduces the scope for further entry, thereby relaxing the entry-deterrence motive. We provide examples of this effect in Davis, Murphy and Topel (2001b), where we analyze the pricing effects of actual and potential entry at some length in a dynamic model with consumer switching costs. The relaxation of the entry-deterrence motive is distinct from the segmentation effect and design incentives discussed above. There is also an important distinction between the loss of an entry deterrence motive and a retreat from exclusionary pricing. These four effects – segmentation, adverse design incentives, retreat from exclusion, and the loss of an entry-deterrence motive – can operate separately or in
combination as sources of upward price pressure in the face of entry into a market that is initially dominated by the incumbent.

While the loss of an entry-deterrence motive can cause price to rise in the face of entry in markets with few firms, a very different pricing response is also possible. In particular, the firms may engage in a price-cutting war as part of a contest for market dominance. Elaborate on this point and continue. Might want to mention airport entry by upstart carriers as an example. This type of entry has frequently triggered price wars between the entrant and more established carriers. Usually, but not always, these price wars usually end in victory by the incumbent airlines. Southwest is an example of a one-time upstart that initially triggered price wars with established rivals, but Southwest eventually established a secure, even enviable, position in the market.

In the product differentiation model of Shaked and Sutton (1982), two firms can survive with positive profits, but not three.

Entry with Demand Complementarities Across Markets

Briefly discuss Farrell and Katz (2000), Davis and Murphy (2000), and other articles that treat the price and welfare consequences of entry into markets for complementary products. Discuss Brueckner and Whalen (2000) either in this subsection or in one of the empirical sections below. We also might want to say something about the large literature on anti-competitive uses of tying. Also, recall that both sides in the Explorer case acknowledged the relevance of demand complementarities between Windows and other Microsoft software in the pricing of Windows. In a June 8, 2000 op-ed in the LA Times, Richard Schmalensee writes that “Under assumptions introduced in trial by the government’s chief economic expert,
the price of Windows could triple” if Microsoft were split into separate applications and OS companies.

Here are some remarks and quotations drawn from Farrell and Katz (2000). Integration by a monopolist into the market for a complementary product “can inefficiently reduce the incentives to innovate when consumers differ in their valuations of the innovation.” The monopolist’s “desire and ability to extract rents from independent suppliers after they have conducted their R&D may inefficiently reduce these suppliers’ innovation incentives, perhaps to the overall detriment” of the monopolist. (Farrell and Katz, 414) “By investing in R&D, firm M can squeeze ex post quasi-rents from the B-winner: M’s profits increase if it improves its variant of B to a level between the two highest levels of the independent suppliers’ variants of B. Consequently, an integrated firm M has strictly excessive incentives to improve its B product if there is positive probability that it will end up alone in second place.” (Farrell and Katz, 419) FK develop this claims in the context of a model with completely inelastic demand, which shuts down the main channel through which more aggressive R&D and pricing by the integrated M firm raises social welfare and benefits consumers.

Farrell and Katz offer the following useful summary paragraph on page 419: “The Cournot intuition points that, through firm M’s residual claim on complementary good A, integration may internalize what would otherwise be real externalities from leading-edge innovation in B. The discussion above, however, points out that an integrated firm M may also capture a pecuniary externality from catch-up innovation in B. When there is just one B-firm, the catch-up effect does not arise and the pecuniary effect vanishes. [Why?] With inelastic demand and multiple B-firms, however, the real externality vanishes and the pecuniary externality survives.”
“In our baseline model, independent suppliers conduct the optimal amount of R&D conditional on the investments of other suppliers, while an integrated firm generally conducts socially excessive R&D, for the following reason. Each firm appropriates the full social benefits of innovation when it has the highest quality variant of B. There is no social value to improving the second-best variant, nor is there any value to an independent supplier. Through a squeeze, however, the integrated firm enjoys a private value from improving its variant when it is second best. When demand responds to price, innovation that improves the second-best variant of B has social value – an increase in the quality of the second-best variant drives the price of the best variant closer to cost and thus improves allocative efficiency.” (Farrell and Katz, 427)

Multi-Product Monopoly versus Non-Cooperative Pricing

Non-cooperative pricing can lead to inferior outcomes for consumers and less total surplus than multi-product monopoly for at least three reasons:

1. Demand complementarities across products that are not internalized by competing firms that price non-cooperatively.

2. The misallocation of goods to consumers induced by non-cooperative forms of price discrimination, as explained above. Misallocation can occur under multi-product monopoly, too, but the analysis in Davis, Murphy and Topel (2001a) indicates that the problem is less severe with cooperative pricing (e.g., by a monopolist) than under non-cooperative pricing. Explain contrast to Mussa and Rosen (1978).
3. Adverse design incentives, motivated by a desire to strengthen market segmentation and thereby soften price competition, which are more pervasive under non-cooperative pricing than under multi-product monopoly, as we explained above. The first point is widely appreciated. The second and third are not. Is there a fourth point having to do with cooperative versus non-cooperative pricing when network effects are present?

We have already seen that entry can segment the market in a way that induces a misallocation of goods to consumers. (Recall rows (5) through (8) in Table 1.) This misallocation reduces total surplus and may involve harm to consumers as well. Thus, the non-cooperative pricing occasioned by entry can reduce efficiency relative to either a single-product monopoly benchmark or a multi-product monopoly benchmark.

Also mention that total surplus, even consumer surplus, can be higher when a monopolist sells both goods than when two separate firms sell and price the goods in a non-cooperative manner. Thus, it is not correct to say that segmentation per se induces the misallocation of goods to consumers. Non-cooperative pricing also plays a role. For some configurations of demand and product characteristics, cooperative pricing leads to segmentation with an efficient allocation, even though non-cooperative pricing leads to segmentation with an inefficient allocation.

Emphasize that this benefit of cooperative pricing does not arise from demand complementarities as in the more usual story about the benefits of cooperative pricing. We might want to place this discussion about cooperative vs. non-cooperative pricing below.
Entry in Regulated Markets

Very brief discussion on this topic, mainly to articulate issues that we will not address in our empirical review. It’s probably worthwhile to point out that regulated entry often seems animated by a belief that the socially optimal number of firms is more than one, but not large. See Reiffen, Schumann and Ward (2000).

The Federal Communications Commission (FCC) decision to award two licenses in each metropolitan area for firms to build cellular transmission systems and provide cellular services at the wholesale level clearly reflects a perceived compromise between the scale economies and the benefits of integrating the cellular network with the local telephone exchange carriers, on the one hand, and the benefits of greater competition, on the other. See Reiffen, Schumann and Ward (2000).

3. Principles Guiding the Selection of Empirical Studies

This section is rough and unedited – the material may be placed in other sections.

The preceding theoretical discussion identifies several channels through which entry affects consumers and the price of an incumbent's product. First, when the entrant captures customers who place a low value on the incumbent's product (relative to the value assigned by other incumbent customers), the incumbent responds by raising price as he retreats "up market".22 This incumbent price response reflects the non-cooperative price discrimination

22 Alternatively, but less likely, when the entrant captures the high end of the incumbent's market, the incumbent lowers price as he retreats down market. In this case, price rises for those customers who switch to the entrant.
facilitated by entry. Second, actual entry weakens or eliminates any downward pressure on
the incumbent's price motivated by a desire to deter entry. Third, rather than relinquish
customers, the incumbent may respond to entry by lowering price. This exclusionary price
response can arise for the same reason that potential entry constrains price in a contestable
market for a homogeneous good. Fourth, entry can trigger a price war as the incumbent and
entrant compete for current customers and future market share in an environment
characterized by switching costs, network effects or declining average costs.

We believe that each of these effects can dominate the net price response to entry under
circumstances that are empirically relevant in some markets. However, not all effects will be
(equally) important in any given setting. At a general level, the theoretical analysis identifies the
structure of consumer demand, the nature and extent of product differentiation, sunk entry
costs, fixed operating costs, switching costs and network effects as factors that influence the
relevance of the various entry effects on price.

More specifically, the theory and some elementary facts suggest several points that guide
our selection and assessment of empirical studies on the price response to entry:

- It is essential to distinguish between the average market-wide price response to
  entry and the incumbent's price response. Our theoretical analysis shows that the
  price effects of entry usually differ sharply among consumers. Indeed, prices can
easily rise for some consumers and fall for others in response to entry. This
observation greatly limits the relevance, for our purposes, of studies that focus on the
average price response to entry.

- When the incumbent can effectively price discriminate at the high end of his
  market prior to entry, there is little scope for entry to trigger price increases by the
incumbent as he retreats up market. There is no room for this price effect to operate in the extreme case where the incumbent perfectly price discriminates prior to entry.

There is little price discrimination among final consumers in the market for PC operating systems. Despite enormous differences among final consumers in the willingness to pay for computers and operating systems, most customers have access to essentially the same prices for MS-DOS, Windows 95 and 98, Apple's MacOS and other operating system software.

MS-DOS, Windows, MacOS, Linux and other PC operating systems are highly differentiated by functional characteristics, switching costs and OS-specific complementarities with hardware and applications software. It is highly likely that successful entry in the market for PC operating systems will increase market segmentation and facilitate non-cooperative forms of price discrimination. For this reason, the most relevant empirical studies are those that consider markets in which entry leads to greater market segmentation.

It is highly unlikely that a significant entrant in the market for PC operating systems would fail to capture some customers who would otherwise purchase MS-DOS or Windows. This view follows from two observations. Existing Microsoft customers differ enormously in technical sophistication, intensity of computer usage and nature of computer activities. Hence, entry by a differentiated operating system, if it attracted any customers at all, would almost certainly succeed in attracting some
existing Microsoft customers.\textsuperscript{23} This observation suggests considerable scope for entry to induce a rise in the price of Windows, as Microsoft retreats up market.

With these points in mind, we now turn to empirical studies that shed light on the incumbent price response to entry in markets with differentiated products.

Miscellaneous points or examples:

- “Designer Water” – on product differentiation for drinkable water and the ability of some firms to sustain prices above marginal cost, see Carlton and Perloff (2000), page 199.

4. Studies of the Prescription Drugs Industry

This section is cobbled together from several fragments. Many parts are unedited, and the material is not yet optimally sequenced.

Motivation and Overview

The prescription drugs industry is unusually well-suited for the empirical study of how entry affects price in markets with few firms. New drugs receive patents that grant monopoly production and licensing rights for up to twenty years. Prior to commercialization, new drugs must also pass an expensive, multi-year testing and review process.\textsuperscript{24} This process involves considerable uncertainty, and most patented drugs never reach the market as pharmaceutical products. Even when successful, this lengthy process considerably shortens the effective

\textsuperscript{23} A consensus view, to which we subscribe, holds that it would not be commercially attractive to “clone” Microsoft Windows or otherwise develop a close substitute that would compete head-on with Windows in its existing product space. Citation to Jackson on this point (see Evans Memo). Hence, the empirically relevant entry case involves entry at a distant location in product space.

\textsuperscript{24} In the United States, this process is administered by the U.S. Food and Drug Administration. Most other wealthy countries require a similar testing and review process prior to the commercial introduction of new pharmaceutical products, although the process is longer and costlier in the United States than most other countries. See
period of monopoly privilege, and it adds greatly to the total cost of developing a new drug and bringing it to market.\textsuperscript{25} In recent decades, the introduction of new, commercially successful prescription drugs has proceeded at a rapid pace. The monopoly rights for drugs on patent and the testing and review process create clear barriers to entry. In addition, while under patent, commercially successful prescription drugs typically acquire a brand presence that carries considerable market power after patent expiration.\textsuperscript{26}

The culmination of a successful testing and review process clearly marks the commercial entry date for new drugs. This fact is helpful for identifying the impact of new drug entry on the price of therapeutic substitutes, i.e., therapeutically similar drugs that use a different chemical compound as the active ingredient. When successful drugs come off patent, generic producers typically enter with chemically equivalent products.\textsuperscript{27} Patent expiration and generic entry dates are also clearly marked in time, which helps identify the impact of lost monopoly power on the price of the branded prescription drug and on the average price of drug products that use the same active ingredient. Indeed, several previous studies investigate how generic entry affects the price of the incumbent’s branded version of the same active chemical ingredient. The large numbers of successful drugs that have come off patent in recent decades provide added fuel for this research strategy.

In short, several aspects of the prescription drugs industry facilitate the study of how entry affects price in market settings with few firms: high rates of new drug introduction at different points in time, clear barriers to entry, high rates of patent expiration, clearly marked

\textsuperscript{25} Danzon (1997) reports that research and development expenses account for about 30 percent of total costs in the prescription drugs industry.

\textsuperscript{26} Carlton and Perloff (2000, page 198) summarize some of the evidence on this score.

\textsuperscript{27} While generic producers must also pass a testing and review process prior to commercial entry, it is much less extensive and far less costly than the initial process for a new chemical compound.
entry dates for new drugs and generic substitutes, and clear market boundaries defined by an active chemical ingredient or a class of therapeutically similar drugs. These characteristics provide rich opportunities for estimating the impact of entry on the price of both close and distant substitutes. Rising health care expenditures and the growing importance of prescription drugs care have also stimulated interest in drug price behavior.

Notwithstanding the many attractions of the prescription drugs industry as a laboratory for evaluating entry effects on prices, empirical work on the topic contends with serious data limitations, at least for our purposes. Published studies rely on data that are averaged over major classes of buyers known to pay sharply different prices for some brand name drugs. In particular, it appears that no published study had access to data on direct manufacturer rebates to favored retailers. During the 1990s, and possibly earlier, discriminatory rebates across retail segments (e.g., mail-order houses, HMOs, and traditional pharmacies) became quite large for many brand name drugs. As a result, the conclusions reached in these studies speak mainly to the average price response to entry by generic equivalents or therapeutically similar products. They are much less informative about the differential effects of entry across groups of customers that differ in demand elasticity or market power.

Most studies of prescription drug pricing face other serious limitations as well. First, some studies measure only the average price of all products that use the same active chemical ingredient. Second, the interpretation of results are often clouded by the absence of any measures for differences across markets in the degree of substitutability between the entrant drug and the incumbent drug. We elaborate on this point below. Third, drug prescribing, purchasing and payment behavior has many distinct characteristics that may limit the applicability of the empirical findings to other industries and market settings. In particular,
insurance benefits render many patients insensitive to price differences among substitute products, and the physicians who prescribe drugs may be poorly informed about drug prices or act as imperfect agents for patients. On the one hand, these market characteristics probably lower the price elasticity of demand and expand the scope for profitable market segmentation by drug producers. On the other hand, the development of detailed formularies (i.e., preferred lists of drugs) that govern prescribing and third-party payments for many HMOs and Prescription Benefit Management (PBM) organizations are designed to exercise market power in ways that make demand more price elastic, at least for certain types of buyers.

As a point of departure, several studies note that prices of brand name drugs continued to rise in the face of generic entry during the 1980s and 1990s. Most studies on the topic conclude that generic entry probably caused a modest reduction in the price of the branded equivalent or had little effect. In contrast, generic prices appear to fall significantly in response to additional generic entry. In this respect, the weight of evidence in these studies clearly supports the conclusion that entry by a close substitute causes price to fall sharply, whereas entry by a more distant substitute causes incumbent price to change much less and possibly rise. Consistent with this interpretation of the evidence on generic entry, the best-designed study for our purposes (Perloff, Suslow and Seguin, 1996) reaches similar conclusions by a different route. They find that brand name drug prices rose in response to entry by a distant substitute in the same therapeutic class but fell in response to entry by a closer substitute in the therapeutic class. We turn next to a more detailed description of the paper by Perloff et al (1996), followed by discussions of several other studies.
Perloff, Suslow and Seguin (1996) examine the effect on the price of drugs in a therapeutic class (e.g., anti-ulcer drugs) of entry by patented, imitator drugs. The authors theorize that the price of an existing product rises when the entrant is an imperfect substitute that appeals mainly to customers who are more distant. "After entry, the original firm will have less incentive to lower its price to attract consumers for whom its product is a relatively poor match, so it raises its price and sells to only consumers located near its product in characteristic space whose demand is relatively elastic." (1)

To test the theory, the authors examine anti-ulcer brand name drug prices. Tagamet was first to enter in 1977. Zantac, promoted as having fewer side effects and serious drug interactions than Tagament, entered six years later in 1983 and quickly attained the dominant market share. Pepcid and Axid entered in 1986 and 1988, respectively. Based on the characteristics and qualities of the individual drugs, the authors conclude that the early entrants are clustered closely in product space but are distant from the later entrants, and vice versa. Thus, the authors predict that the entry of Zantac and Axid will cause price to fall for Tagamet and Pepcid, respectively, and that the entry of Pepcid and Axid will cause price to increase for Tagamet and Zantac. Their empirical results confirm these predictions.

The empirical design in this paper is an attractive one from our perspective, because it distinguishes between entry by more distant and closer products. The empirical results support the importance of this distinction. Unfortunately, we are not aware of other studies on prescription drugs that employ a similar empirical design. Instead, most studies focus on the branded incumbent's price response to generic entry. Insofar as a generic equivalent is a
closer substitute for the incumbent drug than other non-equivalent drugs in the same therapeutic class, the results in Perloff et al. suggest that existing studies of generic entry restrict attention entry events that are most likely to result in lower incumbent prices.

Caves, Whinston and Hurwitz

Caves, Whinston and Hurwitz (“CWH”) acknowledge that other studies have found that brand name drug prices do not generally fall after patent expiration or after the entry of competitors but argue that “none of these studies control for what would have happened to innovator’s prices, absent competition, due to either general shifts in market conditions or the normal pattern traced by a drug’s price over its life cycle, nor were the precise responses to the level of entry quantified.” (13). The authors believe this is important because the period after 1982 is peculiar – the “rise in unit labor costs came to a halt, and the cost of bulk pharmaceutical inputs fell, yet the prices of outputs rose quite sharply.” (13). Thus the authors are concerned that something other than generic entry may be affecting brand name price.

CWH analyze the prices of 30 drugs that went off patent over the period 1976-1987. The drugs fell into seven therapeutic classes: cardio-vascular (11), psychoteropeutic (7), systemic anti-infectives (4), diabetic therapy (4), antiarthritics (2), diuretics (1) and antispasmodics (1). The authors used IMS American transactions data of brand name and generic purchases by pharmacies and hospitals from wholesalers and manufacturers.

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28 The authors predict that if the products are very close substitutes, price will fall and if the products are extremely different, price will be unaffected.

29 About 87% of the drugs’ sales were made in pharmacies (versus hospitals), although one drug had a pharmacy share of only 2%. Drug sales ranged from $.3 million to $268.5 million. The drugs whose patents expired before 1982 had average sales of $28.7 million. Drugs with patents expiring after 1981 had
With respect to the measure of generic entry, the authors reject the number of generic sellers provided by IMS. These sellers, the authors argue, are generally distributors rather than manufacturers and therefore do not reflect the number of new drugs in the market. The authors therefore use the dates of approval by the FDA of all pertinent (new drug applications (“NDAs”) and abbreviated drug applications (“ANDAs”). There is some time lag between approval and sales, however. When there are generic sales in IMS data, the authors estimate the number of generic producers as the average of the number of NDAs or ANDAs in the current and previous year. The value of this variable is zero otherwise. Generic sales before patent expiration were ignored on the assumption that these sales were made by the innovator.

CWH conclude that regardless of how the data are analyzed, there is generally a small and significant negative effect of generic entry on brand name price of “roughly 2 percent with the entry of the first generic competitor, 8.5% with five generic competitors, 15% with ten generic competitors, and 22 percent with twenty generic producers.” (28).

These conclusions are questionable for several reasons, however. First, our theory, supported by the results of Perloff, Suslow and Seguin, suggests that individual drugs in a therapeutic class will behave differently in response to entry depending on the degree to which the entrant is substitutable for the brand name drug in question. CWH used drug class-specific year effect dummies in their regressions, because they found significant dissimilarity in the price average sales of $83.9 million. Seven of the drugs’ patents expired before 1980, 16 expired between 1980 and 1984, and seven expired after 1984 (the Hatch-Waxman law which vastly enhanced generic entry was passed at the end of 1984).

After patent expiration, generic drug manufacturers must also pass an approval process from the Food and Drug Administration (FDA) before they can enter. Before the passage of the Hatch-Waxman Act, generics were required to prove the safety and efficacy of their product as if it were a brand new product. (Antibiotics were exempt because they already had an abbreviated approval process.). Under the Act, generics only had to prove “bioequivalence” to an already approved innovator drug (a drug patented on the basis of its chemical formulation or manufacturing process). The Act cut down the average time between patent expiration and generic entry from more than three years to less than three months for top-
movements of the therapeutic classes over the period 1976-1987. They defend the use of these dummies on the grounds that exogenous changes apart from generic entry affected brand name prices. However, as suggested by the results in Perloff et al. and our theoretical analysis, these controls may inappropriately condition out the positive price effect of generic entry on non-equivalent brand name drugs in the same therapeutic class. If so, then the CWH results overstate the degree of downward price pressure caused by generic entry.

Second, CWH treat entry as endogenous and the instruments used may be problematic. The instruments used were “combinations of variables representing the amount of time that has passed since patent expiration, a time trend, a dummy indicating passage of the Hatch-Waxman Act, and measures of the drug’s general level of demand.” The drug’s level of real sales in the year prior to patent expiration was used to proxy demand. The authors acknowledge that this instrument is arguably not exogenous but found that estimates without this instrument were imprecise.

Third, the authors acknowledge that their model should have included a measure of the closeness of substitution between the sampled drugs and others in their therapeutic classes. However, they found the “problem of quantifying the closeness of substitutes a daunting one.” (20) This is because, for example, a drug used for several conditions might face different substitutes in each case, and these patterns change continually as competing drugs enter a therapeutic class, relative prices change, etc.

Finally, the authors also examined whether producers of branded drugs practice some kind of limit pricing during the interval between patent expiration and generic entry or whether lags in doctors’ information about prices might cause producers to expect pricing in any year selling drugs. Further, the percent of top-selling drugs whose patents have expired that face generic competition has increase from 35% in 1983 to nearly 100 % in 1998. See CBO at xii.
to affect only future demand. In the latter case, the authors hypothesize, prices might rise in
the period prior to entry, “because the likelihood of future entry reduces the loss in future sales
revenue caused by a price increase today.” (29). The authors find a positive and significant
effect on price of the time after patent expiration but before entry, which they interpret to
mean that the prices of branded drugs tend to increase in the period between patent expiration
and entry. CWH do not report the values of this variable but the total effect of patent
expiration and generic entry may well be positive.

Grabowski and Vernon

Grabowski and Vernon examined individually the price trends of 18 major products
before and after they experienced generic competition. The data base consisted of annual
Grabowski and Vernon used brand name and generic average cost per unit paid over time by
drugstores and hospitals to manufacturers and wholesalers that they calculated from IMS
America Inc. data. Grabowski and Vernon also use IMS generic entry date data. The
authors decided to only use drug store prices because hospitals utilize a contracting bidding
process which may generate a different price path than for drug stores.

For each drug, the authors regressed the log of price on the year (time) and a
variable DumT. DumT was defined as (time-T*) where T* is the year of generic entry.
When time is less than T*, DumT is zero. The coefficient on time was significant and positive
for 17 of 18 products. The negative coefficient belonged to Motrin for which over the counter
competition was introduced during the regression period. The average rate of price increases
across all products was 8.4%. The coefficient on DumT was negative for fourteen of the
eighteen products but statistically significant at the 10 percent or better level for only two
drugs. Based on these and other results, Grabowski and Vernon conclude that “overall, the effect of generic entry on pioneer pricing is not very significant in economic terms. There is no indication, for example, that any pioneers decreased their nominal prices in response to the much-lower generic prices or attempted any kind of entry-detering price strategies.” (338-339).

**Wiggins and Maness**

Wiggins and Maness studied price competition in the market for antiinfectives over the period 1984 to 1990. They found that market entry by generics had a significant negative effect on brand name price. The entry of other brand name products also had a negative impact but was significant only at the 10% level. In contrast to other brand name drugs, however, very few of the drugs in their sample had high prices. The authors and other writers suggest that their results differ from other studies because antiinfectives have been characterized by rapid entry, significant generic prescriptions, and strong price competition. In addition, physicians are more likely to write prescriptions specifying the chemical name rather than the brand name for drugs in this therapeutic class. (See, e.g. Frank & Salkever at 79, Grabowski and Vernon at 333 and the CBO report at 30 Box 4.) In other words, brand names do not serve to differentiate drugs in this therapeutic class to the same degree as in other therapeutic classes.

**Frank & Salkever**

Frank & Salkever study a sample of 32 brand name drugs that saw generic entry between 1984 and 1987. Generic entry rose sharply after 1983 because of the less onerous approval procedures for generic drugs that were authorized by the Hatch-Waxman law. All of the drugs considered in this study lost patent protection between 1979 and 1987.
Based on several specifications, the authors find that brand name price is positively and significantly related to entry. However, it is not clear whether the sample includes pre-entry data on drug prices. If not, the findings only confirm that prices of brand name drugs rose after generic entry. In addition, the authors caution that their assumption that demand does not vary systematically with time may be incorrect so that the positive relationship may be due to shifts in demand over time.

**Danzon and Chao**

Danzon and Chao (2000) examine price data for prescription drugs in the United States, Canada, Germany, France, Italy and Japan – countries that differ greatly in the regulations that govern drug pricing, generic substitution, physician incentives, patient reimbursements for prescription costs and the introduction of new drug products. These regulatory differences probably create large differences across countries in own- and cross-price demand elasticities, as Danzon and Chao discuss at length. For example, the cross-price elasticity between a brand name drug and its generic equivalent is likely to be higher in the United States, the United Kingdom, and Canada -- where substitution is both allowed and financially rewarding for pharmacists. In several countries, the regulatory regime makes it hard to raise prices for the brand name drug in the face of entry by generic equivalents.

In their statistical analysis, Danzon and Chao use data on acquisition cost for a pharmacy or other dispensary of outpatient prescription drugs. They define a product by an active ingredient crossed by manufacturer crossed by brand or generic name. Thus, for a particular active ingredient, branded and generic versions constitute distinct products whether or not produced by the same manufacturer. Different package sizes, dosage strengths and
presentation forms are aggregated based on the amount of the active ingredient. Danzon and Chao lack information on important forms of price discounting in certain countries.

Unfortunately, their data cover only a single cross section in 1992. Hence, they rely on cross-country variation in the number and price of generic equivalents and the number of therapeutic substitutes to estimate how the number and type of competitors affect prescription drug prices. The underlying identifying assumption is that cross-country differences in regulatory regimes (or perhaps market size) drive these proxies for the intensity of competition. As they acknowledge, reverse causation and omitted variables problems present serious concerns in the interpretation of the results.

Based on their analysis, Danzon and Chao conclude that generic competition has an important negative effect on the brand name price “in regimes with free pricing (the United States) and those with free pricing subject to moderate constraints (the United Kingdom, Germany, and Canada).” For example, they estimate that the U.S. price elasticity with respect to the number of generic competitors is -.50. In contrast, for “countries with strict price or reimbursement regulation (France, Italy, and Japan), generic competition is ineffective [in reducing prices] and may be counterproductive.” (Page 338).

Taken at face value, their results also suggest that drug prices are positively related to the number of therapeutic substitutes. For example, they estimate that the elasticity of price with respect to the number of therapeutic substitutes is .13 for the United States, Germany, France, and the United Kingdom. Danzon and Chao are reluctant to accept this interpretation and suggest, instead, that reverse causation problems probably account for this finding. In particular, higher prices within a country for a particular therapeutic category make entry more attractive and lead to a larger number of therapeutic substitutes. Of course, another possibility
is that a greater number of therapeutic substitutes reduces the intensity of price competition by more effectively segmenting the market.

The problems of identification and data quality make us reluctant to place great weight on the findings in Danzon and Chao. However, their study quite usefully draws attention to the potential role of the regulatory regime in determining the price response to entry.

5. Studies of a Variety of Industries

This section is largely based on material prepared by Sean. I’ve done some editing, but I have not yet reviewed most of the studies.

The Yogurt Market

Kadiyali, Vilcassim and Chintagunta (1999) conduct a careful study of the impact of the introduction of a new yogurt variety on the price of two existing varieties in a local market. They collect data on weekly retail sales of Yoplait and Dannon yogurt for 155 weeks from the Sioux Falls, South Dakota market. In the 59th week of observations, Yoplait introduced Yoplait Lite, which has less fat, less sugar and fewer calories than the two existing varieties. They examine the impact of this new product introduction on prices, profits and competition among the two firms.

They report that there is some variation in prices from week to week both before and after entry of the new product. However, they show that the average weekly price of both of the existing yogurts rose after the introduction of the new product. In addition, while sales of the incumbents fell, total yogurt sales rose after the entry. This is true despite the increase in both incumbents’ prices and the fact that Yoplait Lite was the highest priced variety.
Using a structural econometric framework of estimating demand, cost and competitive interactions in the tradition of the “new empirical industrial organization literature”, they report evidence that the two existing brands were close substitutes for each other and evidence that neither was a close substitute for Yoplait Lite. Furthermore, the results suggest that entry raised the market power of Yoplait relative to Dannon. Despite this, the evidence indicates that entry led to higher profits for both firms.

In summary, the yogurt market was characterized by two firms that had not differentiated their products much and, as a result, were not able to price discriminate. By introducing a new differentiated product, Yoplait effectively segmented the market. This allowed both firms to raise price on the existing varieties because they were now selling to more inelastic demanders.

**The Ready-to-eat Cereal Market**

Thomas (1999) conducts a related study of the ready-to-eat cereal industry. Rather than use prices of an individual product in an individual market, he uses average prices on 13 different product groups between the years 1971 and 1989. The effective market in this study is the product group, like bran cereals with raisins, rather than the cereal market as a whole. Most of the product groups he examined contained only a few products. For 9 of the 13 groups, the maximum number of products within any year was 4 or less.

He asks, other things equal, what happens to prices of existing products in a group when entry occurs? He finds a positive and statistically significant relationship between current price and whether entry occurred in that time period. When lagged entry is used as the dependent variable, the relationship is again positive, though less precisely estimated. He also finds that entry leads to increases in advertising in the same product group. While the exact
interpretation of this effect is open to question, it is a natural response to the increased segmentation induced by entry. By raising markups within the product group, segmentation can raise the returns to advertising.

One caveat regarding the Thomas study merits a mention. He finds that price falls if the new product is introduced by a "new" entrant rather than an incumbent firm This result is not particularly robust. Taking the result at face value, it may be that "new" entrants introduce products that are closer substitutes to existing products than do incumbents.

**Newspaper Advertising Rates**

Ferguson (1983) reexamines the questions raised in Stigler’s famous paper on the impact of competition on advertising rates charged by newspapers. He collects data on both national and retail advertising rates for both daily and Sunday papers. All of the markets considered have either one or two papers.

He asks whether the existence of a competing paper affects the prices that advertisers charge. Controlling for a wide variety of other factors affecting rates, such as market size, he finds that Sunday advertising rates, both national and regional(?), are significantly higher in markets with two papers. He also finds a positive relationship between the presence of a competing paper and daily, national rates, although this relationship is less precisely estimated.

A plausible interpretation of these results is that markets are more segmented if there are two papers rather than one. Since each paper has a more specialized audience in a two-paper market, potential advertisers have more inelastic demand, and this allows newspapers to charge higher advertising rates. While this study does not examine the impact of entry per se, it does suggest that if an additional paper were to open up in a monopolized market, the incumbent paper would be able to charge higher advertising rates.
Automobile Dealerships

Bresnahan and Reiss (1990) use a simple model of entry into a monopoly market that allows them to calculate, without any information on prices or costs, the market size need to support a second firm. They also calculate the impact of entry on variable profits and fixed costs. The information needed for these calculations comes from ordered probit regression of the number of car dealers in small, isolated towns.

For our purposes, the most interesting results pertain to variable profits per customer in the duopoly relative to the monopoly. This ratio depends on the extent to which the firms in a duopoly sell products that are independent in demand. If they are completely independent, the ratio is unity. According to the theory, if the duopolists produce homogeneous goods, the ratio is one half if they collude and produce the monopoly output, and less than one half if they do not collude. Bresnahan and Reis report that the estimated ratio ranges from .62 to .66. Based on this finding, they conclude that “product differentiation increases duopoly margins more than competition lowers them.” They partly attribute this result to the fact that entry in their sample predominantly involved Ford dealerships opening in GM-only towns.

6. Studies of the Software Industry

This section is highly incomplete.

Casual observation suggests that Microsoft has been an aggressive price-cutter in many software application categories including CD encyclopedias, Web browsers, personal financial planning and core business applications. Liebowitz and Margolis (1999) confirm this impression by examining price trends for personal computer software applications in several
market segments during the 1990s. They find that prices tended to decline more rapidly in market segments where Microsoft competes, especially in the first few years after Microsoft’s entry. (Check this.) They also conclude that entry into a particular software market segment precipitated more rapid quality improvements. (Check.)

This empirical evidence resonates with the idea that the monopoly supplier of a key complement has strong incentives to enter the complementary markets and compete aggressively, especially when margins are high and the market segments are large. As a theoretical matter, this type of aggressive behavior by the monopoly supplier of the key complement can be socially harmful, as shown by Katz and Farrell (2000). Even when his product remains inferior to the rival’s product, the monopolist benefits by improving quality in the complementary market. Two observations argue strongly against this interpretation of Microsoft’s behavior in the markets for complementary software applications. First, the nominal price of Windows underwent only modest changes over the course of the 1990s, and it declined in real terms even prior to any adjustment for quality improvements. For the Farrell-Katz (2000) interpretation to hold, Microsoft would have recovered the benefits of its socially excessive R&D by pushing down rivals’ prices in the applications markets and by raising prices in the market for Windows. Second, when demand is elastic, it is socially beneficial for the monopolist to push down price in the complementary markets. Knowledgable observers place the price elasticity of demand for personal computer systems in the range of 2 to 4. (Cite to Schmalensee and/or Fisher expert reports)

7. Product Differentiation in Response to Entry
This section is not yet developed. It may get rolled into earlier sections, depending on how much useful empirical evidence we uncover.

Is there any empirical evidence that speaks to the impact of entry (potential, anticipated and actual) on product design incentives and behavior? I suspect the answer is yes, especially when one approaches the issue the right way.

8. Taking Stock of the Empirical Evidence

This section is highly preliminary and incomplete.

It is important place this study in proper context. A large body of economic theory and empirical evidence underscores the beneficial effects of actual and potential entry on consumer welfare and economic performance. As a widely applicable rule of thumb, entry is beneficial for consumers and artificial entry restrictions are harmful to consumers. That said, we have seen that neither economic theory nor available empirical evidence supports the view that entry always benefits consumers. On the contrary, economic theory points to plausible circumstances in which entry harms some or all consumers. The available evidence supports the empirical evidence of at least some of these harmful effects.

These theoretical and empirical results argue against the simple-minded application of rules of thumb about how entry affects prices and consumer welfare in antitrust policy, the design of regulatory policies that influence entry, and the interpretation of economic outcomes.

Continue. Emphasize the dangers associated with antitrust remedies and regulatory interventions that seek to cause entry that would not otherwise occur. See Easterbrook (2000) on this point. Also emphasize the difficulties of predicting the price and consumer
welfare effects of entry that purportedly would have occurred but for allegedly anti-
competitive or unlawful actions by an incumbent.

Our theoretical analysis of exclusionary pricing behavior highlights the dangers of an
antitrust doctrine that confuses dominant firm behavior that harms competitors with behavior
that harms consumers.
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Appendix

A. Derivation of Post-Entry Prices with Network Effects

We first derive the interior separating equilibrium prices with and without coordinated purchasing. For the case without coordinated purchasing, we also derive the equilibrium prices when the participation constraint binds for type-1 consumers. We then derive the exclusionary equilibrium prices, again with and without coordinated purchasing. As in the analysis of the basic model with no consumer spillovers, we consider sequential pricing equilibria. We verify existence and internal consistency for the equilibrium outcomes reported in Tables 3 and 4 in the main text by calculating whether the incumbent earns greater profit in the separating or exclusionary equilibrium, and by checking the necessary conditions spelled out below.

Separating Equilibrium with Coordinated Purchasing

When coordination is feasible, the necessary conditions for an equilibrium in which both consumer types buy the entrant’s good include the consumer product selection conditions,

\[ W_i + \gamma_{ih} N_h + \gamma_{ih} N_i - P_E \geq V_h + \gamma_{ih} N_h - P_t \]  
(A.1)

\[ W_i + \gamma_{ih} N_i + \gamma_{ih} N_h - P_E \geq V_i + \gamma_{ih} N_i - P_t \]  
(A.2)

and the consumer participation constraints,

\[ W_h + \gamma_{ih} N_h + \gamma_{ih} N_i \geq P_E \]  
(A.3)

\[ W_i + \gamma_{ih} N_i + \gamma_{ih} N_h \geq P_E \]  
(A.4)
Given coordination, another necessary condition is that at least some consumers prefer an outcome in which all consumers purchase from the entrant to one in which all consumers purchase from the incumbent. It is easily shown that this necessary condition boils down to the requirement that at least one of the following inequalities hold:

\[ W_i - P_E \geq V_i - P_l, \quad W_l - P_E \geq V_l - P_i. \]  
(A.5)

The first inequality implies the second when \( \Delta > 0 \), so that (A.5) reduces to the requirement that \( W_i - P_E \geq V_i - P_l \).

The necessary conditions for a separating equilibrium in which type-\( h \) consumers buy from the incumbent but type-\( l \) buy from the entrant include

\[ W_h + \gamma_{hh} N_h + \gamma_{hl} N_l - P_E \leq V_h + \gamma_{hh} N_h - P_l \]  
(A.6)

\[ W_l + \gamma_{lh} N_l - P_E \geq V_l + \gamma_{lh} N_l + \gamma_{hh} N_h - P_l \]  
(A.7)

\[ V_h + \gamma_{hh} N_h \geq P_l \]  
(A.8)

\[ W_l + \gamma_{lh} N_l \geq P_E. \]  
(A.9)

Hence, assuming that (A.2), (A.5), (A.6) and the participation constraints are slack -- and making use of condition (A.1) -- the entrant prices at \( P_l - (V_h - W_h) + \gamma_{hl} N_l \) and sells to both types, if

\[ (N_h + N_l)[P_l - (V_l - W_l) + \gamma_{hl} N_l] > N_h \{P_l - (V_l - W_l) - \gamma_{hh} N_h\}. \]

This inequality is equivalent to \( P_l > \lambda \Delta + V_h - W_h - \lambda(\gamma_{hh} N_h + \gamma_{hl} N_h) \). When the inequality is reversed, the entrant sells only to type-\( l \) consumers and prices at \( P_l - (V_l - W_l) - \gamma_{hl} N_h \) by condition (A.7). Thus, provided that conditions (A.2), (A.5), (A.6) and the participation constraints are slack, the entrant’s best response function is

\[ P_E = \begin{cases} 
  P_l - (V_h - W_h) + \gamma_{hl} N_l, & \text{if } P_l > \lambda \Delta + V_h - W_h - \lambda(\gamma_{hh} N_h + \gamma_{hl} N_h), \\
  P_l - (V_l - W_l) - \gamma_{hl} N_h, & \text{if } P_l \leq \lambda \Delta + V_h - W_h - \lambda(\gamma_{hh} N_h + \gamma_{hl} N_h). 
\end{cases} \]  
(A.10)
It follows that \( P_{1}^{SN} = \lambda \Delta + V_{h} - W_{h} - \lambda (\gamma_{hl} N + \gamma_{lh} N_{h}) \) is the highest price the entrant can charge while retaining the type-\( h \) consumers. This result gives the incumbent’s post-entry price for an interior separating equilibrium with network effects when coordinated purchasing is feasible, which establishes the first line of equation (9) in the main text. To obtain \( P_{E}^{SN} \) in the second line of equation (9), substitute \( P_{1}^{SN} \) for \( P_{1} \) in the second line of the entrant’s best response function, (A.10).

**Separating Equilibrium without Coordinated Purchasing**

When coordination is infeasible, the necessary conditions for an equilibrium in which both consumer types buy the entrant’s good include

\[
W_{h} + \gamma_{hl} N_{i} - P_{E} \geq V_{h} + \gamma_{lh} N_{h} - P_{1} \tag{A.11}
\]

\[
W_{l} - P_{E} \geq V_{l} + \gamma_{ll} N_{l} + \gamma_{lh} N_{h} - P_{1} \tag{A.12}
\]

\[
W_{h} + \gamma_{hl} N_{i} \geq P_{E} \tag{A.13}
\]

\[
W_{l} \geq P_{E} \tag{A.14}
\]

\[
\Delta > 0. \tag{A.15}
\]

Condition (A.15) implies that type-\( l \) consumers defect from the incumbent more readily than type-\( h \) consumers. Conditions (A.11), (A.12) and (A.13) are formulated under the assumption that (A.15) holds. Condition (A.14) reflects the fact that no type-\( l \) consumer will defect to the entrant unless the direct benefits of the incumbent’s good, exclusive of any network benefits, are at least as large as the entrant’s price.

The necessary conditions for a separating equilibrium in which type-\( h \) consumers buy from the incumbent but type-\( l \) buy from the entrant include (A.15) and
\[ W_h + \gamma_h N_i - P_E \leq V_h + \gamma_h N_i - P_i \]  
(A.16)

\[ W_i - P_E \geq V_i + \gamma_i N_i + \gamma_i N_h - P_i \]  
(A.17)

\[ V_h + \gamma_h N_h \geq P_i \]  
(A.18)

\[ W_i \geq P_E. \]  
(A.19)

We include \( \gamma_i N_h \) on the left side of (A.18) under the assumption that type-\( h \) consumers anticipate continued purchases from the incumbent after entry, provided that (A.16) holds.

Hence, assuming that (A.12), (A.15), (A.16) and the participation constraints are slack, and making use of condition (A.11), the entrant prices at

\[ P_i - (V_h - W_h) + \gamma_h N_i - \gamma_i N_i \] and sells to both types, if

\[ (N_h + N_i)[P_i - (V_h - W_h) + \gamma_h N_i - \gamma_i N_i] > N_i[P_i - (V_i - W_i) - (\gamma_h N_i + \gamma_i N_i)]. \]

This inequality is equivalent to \( P_i > \lambda\Delta + V_h - W_h + (\gamma_{hh} - \gamma_{ih}\lambda)N - (\gamma_{ih} + \gamma_{ii}\lambda)N_i \). When the inequality is reversed, the entrant prices at \( P_i - (V_i - W_i) - (\gamma_i N_h + \gamma_i N_i) \) and sells only to type-\( l \) consumers. Thus, provided that conditions (A.12), (A.15), (A.16) and the participation constraints are slack, the entrant’s best response function is

\[
P_E = \begin{cases} 
P_i - (V_h - W_h) + \gamma_h N_i - \gamma_h N_h, & \text{if } P_i > \lambda\Delta + V_h - W_h + (\gamma_{hh} - \gamma_{ih}\lambda)N - (\gamma_{ih} + \gamma_{ii}\lambda)N_i, \\
P_i - (V_i - W_i) - (\gamma_i N_h + \gamma_i N_i), & \text{if } P_i \leq \lambda\Delta + V_h - W_h + (\gamma_{hh} - \gamma_{ih}\lambda)N - (\gamma_{ih} + \gamma_{ii}\lambda)N_i. \end{cases}
\]
(A.20)

It follows that \( P_i^{SV} = \lambda\Delta + V_h - W_h + (\gamma_{ih} - \gamma_{ii}\lambda)N - (\gamma_{ih} + \gamma_{ii}\lambda)N_i \) is the highest price the entrant can charge while retaining the type-\( h \) consumers. This result gives the incumbent’s post-entry price for an interior separating equilibrium with network effects when coordinated purchasing is infeasible, which establishes the first line of equation (10) in the main

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text. To obtain $P_{E}^{SN}$ in the second line of equation (10), substitute $P_{i}^{SN}$ for $P_{i}$ in the second line of the entrant’s best response function, (A.20).

The analysis becomes more complicated when one or both consumer participation constraints bind. In Row (6) of Table 3, the participation constraint (A.19) for type-$l$ consumers binds at the pricing outcome given by equation (10) in the main text. In this example, the lower branch in the entrant’s best response function has two distinct segments – one that holds for values of $P_{i}$ that imply $P_{E} < W_{i}$, and another that yields $P_{E} = W_{i}$. In addition, the discontinuity in the entrant’s best response function occurs at a different value of $P_{i}$. We now derive the entrant’s best response function and the separating equilibrium prices for this case.

When (A.19) binds, the entrant prices at $P_{i} - (V_{h} - W_{h}) + \gamma_{hh} N_{i} - \gamma_{hh} N_{h}$ and sells to both types, if

$$(N_{h} + N_{i}) [P_{i} - (V_{h} - W_{h}) + \gamma_{hh} N_{i} - \gamma_{hh} N_{h}] > N_{i} W_{i},$$

This inequality is equivalent to $P_{i} > (N_{i} / N) W_{i} + V_{h} - W_{h} + \gamma_{hh} N_{h} - \gamma_{hh} N_{i}$. When the inequality is reversed, the entrant sells only to type-$l$ consumers, pricing at $W_{i}$ if (A.19) binds and at $P_{i} - (V_{l} - W_{l}) - (\gamma_{lh} N_{h} + \gamma_{ll} N_{l})$ if (A.19) is slack. Condition (A.19) is tight in the separating regime for any $P_{i} > V_{l} + \gamma_{lh} N_{h} + \gamma_{ll} N_{l}$. Hence, the entrant’s best response function becomes

$$P_{E} = \begin{cases}  
 P_{i} - (V_{h} - W_{h}) + \gamma_{hh} N_{i} - \gamma_{hh} N_{h}, & \text{if } P_{i} > (N_{i} / N) W_{i} + V_{h} - W_{h} + \gamma_{hh} N_{h} - \gamma_{hh} N_{i}, \\
 W_{i}, & \text{if } V_{l} + \gamma_{lh} N_{h} + \gamma_{ll} N_{l} < P_{i} \leq (N_{i} / N) W_{i} + V_{h} - W_{h} + \gamma_{hh} N_{h} - \gamma_{hh} N_{i}, \\
 P_{i} - (V_{l} - W_{l}) - (\gamma_{lh} N_{h} + \gamma_{ll} N_{l}), & \text{if } P_{i} < V_{l} + \gamma_{lh} N_{h} + \gamma_{ll} N_{l}. 
\end{cases}$$

(A.21)
Faced with this best response function, the incumbent in Row (6) of Table 3 sets the highest possible price that leads to a separating outcome rather than one in which the entrant prices to capture the entire market. That is,

\[
P^{SN}_I = (N_i / N)W_i + V_h - W_h + \gamma_{ih}N_h - \gamma_{ih}N_i. \tag{A.22}
\]

We use (A.22) to calculate the incumbent’s price in Row (6) of Table 3. The entrant responds with \( P_E = W_i \).

Exclusionary Equilibrium with and without Coordinated Purchasing

To exclude the entrant, the incumbent must set \( P_I \) so that the entrant cannot make positive profits at any price. Consider the case with coordinated purchasing. Given \( P_h \), the entrant can capture the type-\( l \) consumers by setting \( P_E = P_I - (V_i + \gamma_{ih}N_i + \gamma_{ik}N_h) + W_i + \gamma_{ih}N_i \), which generates entrant profits of \( N_i\{P_I - (V_i + \gamma_{ih}N_h) + W_i\} - F_E \). So, in order to exclude the entrant from profitably selling to type-\( l \) customers (only), the incumbent must set \( P_I \) no greater than \( P^{SN}_I = (F_E / N_i) + V_i - W_i + \gamma_{ih}N_h \). This establishes equation (11) in the main text. When coordinated purchasing is infeasible, similar reasoning shows that the exclusionary equilibrium price is \( P^{SN}_I = (F_E / N_i) + V_i - W_i + \gamma_{ih}N_h + \gamma_{ih}N_i \), which establishes equation (12) in the main text.