Coordination and Lock-In: Competition with Switching Costs and Network Effects

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1 Introduction

2 Switching Costs and Competition

2.1 Introduction

A consumer faces a switching cost between sellers when an investment specific to his current seller must be duplicated for a new seller. That investment might be in equipment, in setting up a relationship, in learning how to use a product, or in buying a high-priced first unit that then allows one to buy subsequent units more cheaply (when firms’ prices are non-linear). Switching costs may even be psychological.\(^1\) Klemperer (1995) gives many examples of each of these kinds of switching costs, and Section 2.2 discusses empirical evidence for switching costs.

Switching costs may be learning costs, in which case consumer who switches from firm A to firm B has no switching cost of later buying from either firm. Alternatively, switching costs may be transactional, in which case a consumer who switches from A to B would incur an additional switching cost if he reswitched back to A (an example is the cost of returning rented equipment and renting from a new supplier). Of course, many switching costs have both learning and transactional aspects.

We will generally assume that switching costs are real social costs, but there can also be contractual or pecuniary switching costs (that are not social costs). Examples include airlines’ “frequent-flyer” programs, and “loyalty contracts” that rebate a fraction of past payments to consumers who continue to patronise the firm. These pecuniary switching costs are a form of quantity discount or bundling. Lars Stole (forthcoming) discusses such price discrimination strategies elsewhere in this Volume, so we will focus mainly on “real” switching costs.

We assume consumers have perfect information about the existence and qualities of all firms’ products, even before purchasing any. So “new” consumers who have not yet developed an attachment to any particular prod-

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\(^1\)Social psychologists have shown that consumers change their own preferences in favour of products that they have previously chosen or been given, in order to reduce “cognitive dissonance” (Brehm, 1956).
uct are especially important in markets with switching costs. In contrast, “search costs” directly affect even consumers’ initial purchases. But, search costs and switching costs have much in common, and models of the effects of switching costs can also apply to search costs. For example, either kind of friction makes a firm’s market share important for its future profitability (see Section 2.6) and much empirical work does not distinguish between search and switching costs. For a survey of search costs, see, for example, Stiglitz (1989) in Volume 1 of this Series.

“Experience-good” markets in which consumers need to purchase a product to determine its quality (see Nelson, 1970) also have much in common with switching-cost markets, but with experience goods, unlike with switching costs, complications can arise from the possibility of prices signaling qualities, and from the existence of consumers who disliked the product they last purchased.

Switching costs not only apply to repeat-purchases of identical goods. An important class of examples involves “follow on” goods, such as spare parts and repair services, bought in “aftermarkets”: buyers face additional “switching” costs if the follow-on goods are not compatible with the original.

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2For example, empirical findings about the credit card (Ausubel (1991) etc. – see note CC) and telecommunications (see, e.g., Knittel (1997)) markets, and about the effects of firms’ discount rates on prices (Froot and Klemperer (1989), Chevalier and Sharfstein (1996), Fitoussi and Phelps (1988) etc.) could be the result of either switching or search costs. On the other hand, Moshkin and Schachar (2000) develop a discrete-choice empirical model to estimate how many consumers behave as if they have switching costs and search costs respectively. Their test is based on the fact that whereas the switching probability of a consumer facing search costs depends on the match between his tastes and the attributes of the alternative he last chose, the switching probability of a consumer facing switching costs depends on the match between his tastes and the attributes of all available alternatives. Using panel data on television viewing choices, they suggest 72% of viewers act as if they have switching costs between TV channels, while 28% act as if they have search costs.

3[Note V] Schmalensee (1982) and Villas Boas (2000) analyse models of experience goods that show similarities to switching costs models. For related models in which consumers differ in their “quality” from firms’ point of view, and firms are uncertain about consumers they have not supplied and can exploit those they know to be of “high quality”, see, for example, Nilssen (2000) and Cohen (2001) on insurance markets and Sharpe (1990) and Zephirin (1994) on bank loan markets.
Consumers may also incur switching costs, or “shopping costs”, at a single date by buying related products from multiple suppliers rather than from a single supplier. (These “shopping costs” can also be real social costs or contractual costs created by quantity discounts and “bundling”.) However, most of the literature focuses on dynamic problems and emphasises the resulting commitment problems.

In the simplest cases, when firms can commit to future prices and qualities, a market with switching costs is closely analogous to a market with economies of scope in production; with switching costs each individual consumer can be viewed as a “market” with economies of scope between “purchases now” and “purchases later”. Just as a market with production economies of scope is entirely captured by the firm with the lowest total costs in the simplest price-competition model, so in a simple model with complete contracts each individual buyer’s lifetime’s requirements in a market with switching costs are filled by the lowest-cost supplier of those requirements. That is, firms compete on “lifecycle” prices and the market lifecycle price is determined by lifecycle costs, with any subdivision of the lifecycle price

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4 Aftermarkets have been much studied since a US Supreme Court decision (ITS v. Kodak, [cite]) held that it was conceptually possible for ITS, an independent repair firm, to prove that Kodak had illegally monopolized the aftermarket for servicing Kodak photocopiers: see e.g. Shapiro (1995), Shapiro and Teece (1998), MacKie-Mason and Metzler (1999), and Borenstein, MacKie-Mason, and Netz (1995, 2000).

5 Similar issues arise when retailers each advertise the prices of only some of their products (often the “loss leaders”), but expect consumers who enter their stores to buy other products also. See, for example, Lal and Matutes (1994). The unadvertised product may actually be the “quality” of the advertised product (Ellison (2003), Vickers (2003)).

6 Typically, a consumer who has not previously bought from any firm incurs a start-up cost similar to (or greater than) the new investment (switching cost) that a brand switcher must make. We will use the term “switching cost” to include these start-up costs. So a consumer may have a “switching cost” of making a first purchase. In many models consumers have high enough willingnesses to pay that this cost has little consequence since it does not affect consumers’ preferences between firms.

7 Sometimes costs of forming a new relationship fall upon the supplier, not (or as well as) on the customer, and firms’ costs of serving new customers have parallels to consumers’ switching costs (see Klemperer (1995)). Firms’ switching costs have been less studied, but in some contexts, such as the simple model of the next subsection, the total prices (including any switching costs) paid by consumers are unaffected by whether firms or consumers actually pay the switching costs. Thus the equilibrium incidence need not coincide with the apparent incidence of switching costs.
being arbitrary and meaningless. In this case, the outcome is efficient and switching costs confer no market power on firms.

This simple analogy—including the efficiency of the outcome—can survive even if firms cannot credibly commit to future prices or qualities. But even small steps outside the simplest story suggest ways in which the analogy and the efficiency break down (Section 2.3). The analogy is still weaker if firms cannot discriminate between different customers (Section 2.4), or consumers use multiple suppliers (Section 2.5). After treating these cases (and having discussed empirical evidence in Section 2.2), we analyse the “market share” competition that switching costs generate (Section 2.6). All this discussion takes both the switching costs and the number of firms as exogenous, so we then consider entry (Section 2.7) and endogenous switching costs (Section 2.8), before addressing implications for competition policy (Section 2.9).

2.2 Empirical Evidence

The empirical literature on switching costs is much smaller and more recent than the theoretical literature. Some studies test specific aspects of the theory (see later sections), but only a few studies directly attempt to measure switching costs.  

Where micro data on individual consumers’ purchases are available, a discrete choice approach can be used to explore the determinants of a consumer’s probability of purchasing from a particular firm. Greenstein (1993) analyses federal procurement of commercial mainframe computer systems during the 1970s, and finds that an agency is likely to acquire a system from an incumbent vendor, even when controlling for factors other than the buyer’s purchase history that may have influenced the vendor-buyer match; he suggests switching costs were an important source of incumbent advantage in this market.  

Shum (1999) analyses panel data on breakfast cereal consumption and finds that consumers are more likely to switch to a new brand if they have tried it before, indicating that switching costs may be an important consideration in this market.  

Breuhan (1997) studies the switching costs associated with the windows and DOS interfaces of personal computers and finds that consumers are more likely to switch to a new OS if they have had a positive experience with it in the past.  

These studies illustrate the importance of switching costs in determining consumer behavior, but further research is needed to fully understand the extent to which switching costs influence market outcomes.
purchases, and finds that households switching brands incur average implicit switching costs of $3.43—which exceeds every brand’s price! (However he also finds advertising can be effective in attracting customers currently loyal to rival brands).

Because switching costs are usually both consumer-specific and not directly observable, and micro data on individual consumers’ purchase histories are seldom available, less direct methods of assessing the level of switching costs are often needed. Kim et al. (2003) estimate a first-order condition and demand and supply equations in a Bertrand oligopoly to extract information on the magnitude and significance of switching costs from highly aggregated panel data which do not contain customer-specific information. Their point estimate of switching costs in the market for Norwegian bank loans is 4.12% of the customer’s loan, which seems substantial in this market, and their results also suggest that switching costs are even larger for smaller, retail customers. Shy (2002) argues that data on prices and market shares reveal that the cost of switching between banks varies from 0 to 11% of the average balance in the Finnish market for bank accounts. He also uses similar kinds of evidence to argue that switching costs in the Israeli cellular phone market approximately equal the price of an average phone.

One defect of all these studies is that none of them models the dynamic effects of switching costs that (as we discuss below) are the main focus of the theoretical literature; in effect, these empirical studies assume consumers myopically maximise current utility without considering the future effects of their choices.

Other empirical studies, many of which we will discuss below in the context of specific theories, provide evidence for the importance of switching costs for creditcards (Ausubel (1991), Calem and Mester (1995), Stango (2002)); cigarettes (Elzinga and Mills (1998, 1999)); supermarkets (Chevalier and Scharfstein (1996)); alliances of airlines in different frequent-flyer pro-

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10Sharpe (1997) studies the bank retail deposit market and argues that the data support the model of Klemperer (1987b). See also Waterson (2003).
11But Viard (2003) studies the impact of number portability on prices in the US market for toll-free numbers using a dynamic model in which consumers consider the future effects of their choices.
grammes (Fernandes (2001)); individual airlines for different flight-segments of a single trip (Carlton Landes, and Posner (1980)); phone services (Knittel (1997), Gruber and Verboven (2001), Viard (2003)); television viewing choices (Moshkin and Schachar (2000)); online brokerage services (Chen and Hitt (2002)); electricity suppliers (Waterson (2003)); and automobile insurance (Schlesinger and von der Schulenberg (1993), Israel (2001), Waterson (2003)). There is also an extensive empirical marketing literature on brand loyalty (or “state dependence”) which often reflects, or has equivalent effects to, switching costs. Seetharam et al (1999) summarise this literature; a widely cited paper is Guadagni and Little’s (1983) analysis of the coffee market.\textsuperscript{12} Finally, Klemperer (1995) gives many other examples of markets with switching costs, and U.K. Office of Fair Trading (2003) presents useful case studies.

2.3 Firms who Cannot Commit to Future Prices

2.3.1 Bargains Followed by Ripoffs

The core model of the switching costs literature posits that firms cannot commit to future prices.

The simplest model has two periods and two symmetric firms, with costs $c_t$ in periods $t = 1, 2$.\textsuperscript{13} A single consumer has a switching cost $s$ and reservation price $r_t > c_t + s$ for one unit of the period--$t$ good, firms set prices, and there is no discounting. Then in period 2 the firm that sold in period 1 will exercise its ex post market power by pricing (just below) $c_2 + s$ (the rival firm will offer price $c_2$ but make no sale). Foreseeing this, firms are willing to price below cost in period 1 to acquire the customer who will become a valuable follow-on purchaser in period 2; undifferentiated competition to win the customer drives period-1 prices down to $c_1 - s$.\textsuperscript{14}

\textsuperscript{12}Jacoby and Chestnut (1978) survey earlier attempts in the marketing literature to measure brand loyalty. Theoretical marketing papers include Wernerfelt (1991) (see note W(\textsuperscript{28})), Villas Boas (2000) (see note V(\textsuperscript{10})), and Kim et al (2001) who study incentives to offer reward programs that create pecuniary switching costs.

\textsuperscript{13}$c_2 \neq c_1$ is especially natural if the second-period good is spare parts/repair services/consumables for a first-period capital good.

\textsuperscript{14}[Note 2.2.1]. Because firms are symmetric and so charge the same price in period 2, the consumer is indifferent in period 1. If firms A, B had different costs $c_{A2}$ and $c_{B2}$ in period 2, then if A made the period-1 sale, its period-2 price would be $p_{A2} = c_{B2} + s$.
Although first-period prices are below cost, there is nothing predatory about them, and this pattern of low “introductory offers”, or “penetration pricing” (see section 2.6), followed by higher prices to exploit locked-in customers is familiar in many markets. For example, banks offer gifts to induce customers to open new accounts, and Klemperer (1995) gives more examples. This “bargains-then-ripoffs” pattern is a main theme of many two-period models in the switching-costs literature, including Klemperer (1987a, b, 1995 [Sec 3.2]), Basu and Bell (1991), Padilla (1992), Basu (1993), Ahtiala (1998), Lal and Matutes (1994), Pereira (2000), Gehrig and Stenbacka (2002), and Ellison (2003). Of these models, Klemperer (1995; Section 3.2) is particularly easy to work with and to extend for other purposes.

Although the switching cost strikingly affects price in each period, it does not affect the life-cycle price \( c_1 + c_2 \) that the consumer pays in the simple model of this subsection. As in the case of full commitment noted in section 2.1, we can here view the life-cycle (the bundle consisting of the period-1 good and the period-2 good) as the real locus of competition, and competition in that product has worked exactly as one would hope. In particular, the absence of price commitment did not lead to any inefficiency in this very simple model.

### 2.3.2 Inefficiency of the Price-Path

Although the outcome above is socially efficient, the inability to contract in period 1 on period-2 prices in general leads to inefficiencies, even if firms still

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15 Skott and Jepsen (2000) argue that a tough drug policy may encourage the aggressive marketing of illegal drugs to new users, by increasing the costs of switching between dealers.

16 For example, the many-period extension of this model is Beggs and Klemperer (1992).
earn zero profits over the two periods. Even slight generalizations of the simple model above show this.

In particular, if the consumer has downward-sloping demand in each period and firms are restricted to linear pricing (i.e. no two-part pricing), or if firms face downward-sloping demands because there are many heterogeneous consumers with different reservation prices among whom they cannot distinguish, then there will be excessive sales in period 1 and too few sales in period 2 (Klemperer (1987a)).

Our simple model also assumed that ex-post profits can feed through into better early deals for the consumers. In practice this may not be possible. For example, setting very low introductory prices may attract worthless customers who will not buy after the introductory period. If for this or other reasons firms dissipate their future profits in unproductive activities (e.g., excessive advertising and marketing) rather than by offering first-period customers truly better deals, or if, for example, risk-aversion and liquidity concerns limit the extent to which firms charge low introductory-period prices to the consumers whom they will exploit later, then consumers are made worse off by switching costs, even if competition ensures that firms are no better off.

In our simple model firms make zero profits with or without switching costs. But switching costs and the higher ex-post prices and lower ex-ante prices that they create can either raise or lower oligopolists’ profits. The reason is that, in cutting its first-period price, each firm sets its marginal first-period profit sacrifice equal to its marginal second-period gain, so the total first-period profit given up can be greater or less than the total second-period gain (see, especially, Klemperer (1987a,b)). However, the arguments we will review in Section 2.4 (which also apply to two-period models) suggest firms typically gain from switching costs (see, especially, Klemperer (1987b)).

\[17\] Thus discussions of aftermarket power point out the possibility of sub-optimal trade-offs between aftermarket maintenance services, self-supplied repair, and replacement of machines. See Borenstein, MacKie-Mason, and Netz (2000), for instance.

\[18\] There may also be limits on firms’ ability to price discriminate in favour of new customers without, for example, antagonizing their “regular” customers. See Section 2.4 for the case in which price-discrimination is infeasible.

\[19\] Ellison (2003) argues that firms gain from switching costs for a natural type of demand
Finally note that while we (and the literature) primarily discuss firms exploiting locked-in consumers with high prices, consumers can equally be exploited with low qualities. And if it is hard to contract on future quality, contracting on price does not easily resolve the inefficiencies discussed above.  

2.4 Firms who Cannot Discriminate Between Cohorts of Consumers

In our first bargains-then-ripooffs model, we assumed firms could distinguish between “old” and “new” consumers, perhaps because “old” consumers are buying “follow on” goods such as spare parts. But when old consumers buy the same good as new consumers, it is often difficult for firms to distinguish between them. Several papers analyse this context in multi-period models in which a new generation of consumers arrives in the market in every period.

2.4.1 Free Entry Model

Even if firms cannot distinguish between cohorts of consumers, we may get the same pricing pattern if firms specialize sufficiently. In particular, in a simple model with free entry of identical firms, in each period some firm(s) will specialize in selling to new consumers while any firm with any old locked-in customers will sell only to those old customers.

If consumers have probability $\phi$ of surviving into each subsequent period, new-entrant firms with constant marginal costs $c$ and discount factor $\delta$ offer price $c - \phi \delta s$ and sell to any new consumers, while established firms charge $s$ more, that is, charge $c + (1 - \phi \delta)s$ in every period.\footnote{This assumes all consumers have reservation prices exceeding $c + (1 - \phi \delta)s$ for a single unit in each period, and that all consumers survive into the next period with the same probability, $\phi$, so a consumer’s value is independent of his age. If consumers live for exactly two periods the price paths in general depend on whether firms can directly distinguish between old and new consumers (as in the previous subsection) or cannot do this (as in this section).} That is, the established firms charge the highest price such that no “old” consumers want to structure.

\footnote{Farrell and Shapiro (1989) show that price commitments may actually be worse than pointless. See note FS [Section 2.8].}
switch, and new entrants’ expected discounted profits are zero. Thus the price paths consumers face are exactly as if firms could perfectly discriminate between them. In either case one can think of every (new and old) consumer as getting a “discount” of $\phi s$ in every period reflecting the present value of the full extent to which he can be exploited in the future by his existing seller, given his option of paying $s$ to switch to an entrant; simultaneously, every “old” consumer is indeed exploited by $s$ in every period. The outcome is socially efficient.

### 2.4.2 Price Patterns in a Closed Oligopoly

Just as in the free-entry model, if there is a small number of firms who face no threat of entry and who cannot distinguish between cohorts of consumers, it is possible that in every period one firm might hold a “sale”, setting a low price to attract new consumers, while the other(s) set a higher price to exploit their old consumers. Farrell and Shapiro (1988) explore such an equilibrium, but their model in effect has just one new and one old consumer in each period. Since it is therefore inevitable that at the beginning of any period one firm has no customer base while the other already has half the market “locked-in”, it is not surprising that this model yields firms offering asynchronous sales. However, Padilla (1995)’s many-customer model has similar features to Farrell and Shapiro’s; in his model, although firms mix across prices, the firm that currently has more locked-in customers has greater incentive to charge a high price to exploit them, and so sets high prices with greater probabilities than its rival.

More generally it seems unclear whether oligopolists will hold sales simultaneously or not. For example, it might make most sense to forgo short run profits to go after new customers when your rivals are not doing so. But if switching costs are learning costs, then staggered sales cause switching between firms and thus create a pool of consumers who have no further costs of switching, thus intensifying future competition (see Section 2.5). Indeed Klemperer (1983, 1989) and the extension of the latter model in Elzinga and
Mills (1999) all have simultaneous sales. Another possibility is that rather than holding occasional sales, each oligopolist in every period sets a single intermediate price that trades off its incentives to set a low price to attract new consumers and to set a high price to exploit its old customers. In a steady-state model each firm’s price will then be the same in every period. This can only be an equilibrium under certain conditions: If the flow of new consumers is too large, at least one firm would deviate from any candidate equilibrium by cutting price significantly to specialise in new consumers. If some consumers’ switching costs and reservation prices are too large, at least one firm would deviate by raising price significantly to exploit old customers while giving up on new ones. And if firms’ products are undifferentiated except by switching costs, there cannot easily be a symmetric pure-strategy equilibrium because each firm would have incentive to undercut the other slightly to win the new consumers. But when none of these conditions applies, there may be a stationary “no-sales” equilibrium, and much of the literature examines such equilibria.

Elzinga and Mills’ model fits with observed behaviour in the cigarette market. See also Elzinga and Mills (1998).

Numerous papers (Baye et al (1992), Padilla (1992), Deneckere et al (1992), Fisher and Wilson (1995), Green and Scotchmer (1986), Rosenthal (1980), Shihony (1977), Varian (1980), analyse single-period models in which consumers have exogenously given switching costs (or models that can be interpreted in this way) that yield mixed strategy equilibria, and Padilla (1995) is a multi-period model yielding mixed strategy equilibria. However, adding more real-world features to some of these models yields either asymmetric pure-strategy equilibria or symmetric pure-strategy Bayesian-Nash equilibria (if information is incomplete) rather than mixed-strategy equilibria.

The former (asymmetric) outcome can be interpreted as asynchronous sales. Deneckere et al obtain this kind of equilibrium when they allow firms to choose the times at which they set their prices; they find that the firm with fewer locked-in customers sets price second and holds a “sale”.

The latter (symmetric) outcome corresponds to “tradeoff pricing” of the kind discussed in the next paragraph. Bulow and Klemperer (1998, Appendix B) give an example of this by incorporating incomplete information about firms’ costs into a one-period model with exogenous switching costs that would otherwise yield mixed-strategy equilibria.

However, if consumers have rational expectations about future prices, a small price cut may win only a fraction of new consumers. We discuss consumers’ expectations below.

In the case of monopoly, both stationary “no-sales” models (see Holmes, 1990) and models in which periodic sales arise in equilibrium (see Gallini and Karp, 1989) can be constructed.
An example of a no-sales model is Beggs and Klemperer (1992), in the equilibrium of which, in period $t$, firm $i$ sets price

$$p_i^t = c^i + \alpha + \beta \sigma_{i-1}^i + \gamma(c^j - c^i)$$

(1)

in which $c^i$ is $i$'s cost, $\sigma_{i-1}^i$ is the fraction of consumers $i$ sold to in the previous period, or $i$'s previous-period “market share”, and $\alpha$, $\beta$, and $\gamma$ are positive constants. These constants depend on the discount factor between periods, the market growth rate, the rate at which individual consumers leave the market, and the extent to which the firms’ products are functionally differentiated; when firms are symmetric, the steady-state equilibrium price increases in the last of these parameters and decreases in the other three.\(^{26}\)

2.4.3 Industry Dynamics

We have seen that sometimes a firm with few locked-in customers holds a sale while its rivals with larger customer bases do not. Similarly, in most no-sale models in which all firms sell to both old and new consumers, firms with more old locked-in customers have a greater incentive to exploit them and therefore price higher and so win a smaller share of new unattached consumers. In both cases, the result is stable industry dynamics as more aggressive smaller firms catch up with larger ones.

In the equilibrium of Beggs’ and Klemperer’s (1992) no-sale duopoly model, described in (1) above, for example, $\beta > 0$, so larger firms charge higher prices, yielding stable dynamics. Indeed, it can be shown that

$$\sigma_i^t = \sigma^i + (\mu)^t(\sigma_0^i - \sigma^i)$$

in which $\sigma^i$ is firm $i$’s steady-state market share and $0 < \mu << \frac{1}{2}$, so the duopoly converges rapidly and monotonically back to a stable steady state after any shock. Chen and Rosenthal (1996) likewise demonstrates a tendency for market shares to return to a given critical value, while in Taylor (2003) any initial asymmetries in market shares between otherwise symmetric firms may persist to some extent but are dampened over time.

However, the opposite is possible. If larger firms have lower marginal costs, and especially if economies of scale make it possible to drive smaller firms completely out of the market, then a larger firm may charge a lower price than its smaller rivals. In this case, any small advantage one firm obtains can be magnified and the positive-feedback dynamics can result in complete dominance by that firm. This is just as is typical with network effects (see Section 3.X)—indeed, switching costs create positive network effects in this case, because it is more attractive to buy from a firm that other consumers buy from (Beggs, 1989).

So switching-costs markets can “tip” like network-effects markets. But the simple models suggest a presumption that markets with switching costs are stable, with larger firms acting as less-aggressive “fat cats”.²⁷

### 2.4.4 The Level of Profits

Most multi-period models suggest switching costs raise firms’ profits.

In a model which generates asynchronous sales, a duopoly can earn positive profits in price competition even if firms’ products are undifferentiated except by switching costs. The switching costs segment the market, and when one firm (generally the firm with the currently larger customer base) charges a high price to exploit its locked-in customers, the other firm can then exercise market power even over new consumers. Farrell and Shapiro (1988) illustrate this in their very simple model which has just one new customer in every period and firms setting prices sequentially, and although these assumptions can be criticised, Padilla (1995) generates the same phenomenon in a many-customer model in which firms set prices simultaneously. In both these models, a duopolist earns positive profits even in a period in which it starts with no locked-in customers. (Of course, if there were two identical new firms entering in every period, they would not generally earn any profits.) Furthermore, if switching costs are heterogenous, this effect does not require the assumption that firms do not discriminate between their old

²⁷In the terminology introduced by Fudenberg and Tirole (1984). In the terminology introduced by Bulow, Geanakoplos, and Klemperer (1985), there is strategic complementarity between a firm’s current price and its competitors’ future prices. See also Farrell (1986a).
customers and customers who are new to them—see our discussion of Chen (1997) and Taylor (2003) in Section 2.5.1, below.

We now show that the symmetric stationary price of a “no-sales” equilibrium of the kind described in the previous section is also usually higher than if there were no switching costs. There are two reasons:

First, price levels may be raised by switching costs through the “fat cat” effect discussed above; firms price less aggressively because they recognise that if they win fewer customers today, their rivals will be bigger and (in simple models) less aggressive tomorrow.

Second, when consumers face switching costs, they must form expectations of future prices. Depending on how these expectations are formed, this may make the demand of new customers, who are not yet locked into any firm, either more or less elastic. However, as we now discuss, the presumption is that it makes it less elastic than absent switching costs, thus raising firms’ prices and profits.

2.4.5 The Effect of Consumers’ Expectations on Prices

How consumers use current prices (including any departures from the current prices that they had expected to see) in forming expectations about future prices critically affects competition and the price level—just as in other parts of the lock-in literature. Consumers’ expectations about their own future tastes also matter in a market with real (functional) product differentiation; we assume consumers expect some positive correlation between their current and future tastes.

In a static differentiated products market, or in each period of a repeated market without switching costs, each consumer compares differences between products’ prices with differences between how well the products match his current tastes. But with switching costs, the consumer recognises that the product he chooses today will, because of those costs, very likely be the

28 Consumers’ expectations about how future prices depend on costs are, of course, also important in determining whether firms have the correct incentives to invest in future cost reduction. This issue does not seem to have been directly addressed by the switching-costs literature, but we discuss in Section 3.7 how a network-effects model can be reinterpreted to address it. See also [note 2.3.1].
product he buys tomorrow. So switching costs raise or lower the consumer’s willingness to change brands in response to a price cut if, roughly speaking, he expects that price cut to be more or less permanent than his tastes.

(i) Consumers who Assume any Price Cut below their Expected Price will be Maintained in the Future

If consumers expect that a firm that cuts price today will maintain that price cut forever then, relative to the case of no switching costs, they are more influenced by such a price cut than by their current product preferences which are not fully permanent.\(^{29}\) (In the limit with infinite switching costs, consumers are choosing a product for the whole of time and, if they do not know their future preferences, products are in effect much less differentiated.) So switching costs then lower equilibrium prices; see von Weizsäcker’s (1984) model in which each firm chooses a single price (and quality) to which it is committed forever, but in which consumers are uncertain about their future tastes.\(^{30}\)

We will see that a similar effect arises when there are strong network effects and differentiated products (see Section 3.7). With network effects and incompatible competition, consumers’ desire to be compatible with others overwhelms their differences in tastes and tends to drive the firms towards Bertrand competition. Here, with switching costs, each consumer’s desire to be compatible with his future self (who in expectation has tastes closer to the average) likewise drives the firms towards undifferentiated-products Bertrand competition.

(ii) Consumers whose Expectations about Future Prices are

\(^{29}\)A related model with these consumer expectations is Borenstein, Mackie-Mason and Netz (2000) in which infinitely lived consumers purchase a differentiated durable good (“equipment”) in one period from one of two firms and an aftermarket product (“service”) in the next period which must be purchased from the firm from which the durable was purchased. High service prices generate profits from locked-in customers purchasing service, but deter new customers from purchasing equipment because the latter expect high service prices in the following period. So the stationary equilibrium service price lies between marginal cost and the monopoly price.

\(^{30}\)The effect we discussed in the previous subsection, 2.4.4—that firms moderate price competition in order to fatten and so soften their opponents—is also eliminated by von Weizsäcker’s precommitment assumption.
Unaffected by Current Prices

If consumers expect that a firm that unexpectedly cuts price this period will return to setting the expected price next period, then price changes are less permanent than taste differences; thus switching costs raise price levels. Each consumer is making a product choice that his future selves must live with, and his future selves’ preferences (while possibly different from his own) are likely to be closer to his currently-preferred product than to other products. So consumers are less influenced by a current price cut than absent switching costs.

(iii) Consumers with Rational Expectations

If consumers have fully rational expectations they will recognise that a lower price today generally presages a higher price tomorrow. As we discussed above, a firm that wins more new consumers today will be a “fatter cat” with relatively greater incentive to price high tomorrow. So consumers with rational expectations will be even less sensitive than in (ii) to price cutting, and switching costs thus raise prices.

In summary, while there is no unambiguous conclusion, Beggs and Klemperer (1992) conclude that there is a presumption that switching costs raise prices when new and old customers are charged a common price. There is therefore also a presumption that switching costs usually raise oligopolists’ total profits.

31This is true in existing models, e.g., Beggs and Klemperer (1992), Klemperer (1987a,b,c), Padilla (1992, 1995). One caveat is that, as discussed above, the fat cat effect can sometimes be reversed. Another caveat is that with incomplete information about firms’ costs a lower price might signal lower costs, so consumers might rationally infer that a lower price today presaged a lower price tomorrow. On the other hand, incomplete information about costs could also result in firms signalling to each other and, since firms might signal higher costs to their rivals in order to soften future competition, this might be a force for higher prices.

32Holmes (1990) analyses price-setting by a monopolist facing overlapping generations of consumers who must sink costs before using the monopolist’s good. He finds that if consumers have rational expectations, then prices are higher than those that would prevail if the firm could commit to future prices for essentially this reason: rational consumers are insensitive to price cuts because they understand that a low price today will encourage consumers to sink more costs which in turn results in higher prices in subsequent periods.

33[Note Ex] This presumption seems widespread: see for example, Porter (1980, 1985). We know of no convincing empirical evidence, but Cason and Friedman (2002) provide supportive laboratory evidence.
2.4.6 Collusive Behavior

The arguments above do not consider collusive behavior in which high prices are supported by firms punishing any other firm thought to have deviated.\textsuperscript{34}

With complete information, switching costs make deviating from a collusive agreement less profitable because it is harder to quickly “steal” another firm’s customers, but for the same reason switching costs make it harder to punish a deviating firm. So it is not obvious whether collusion is easier or more difficult than absent switching costs, and in Padilla’s (1995) model, switching costs actually make collusion harder.\textsuperscript{35}

With incomplete information, however, there are additional effects: switching costs may possibly make it easier for firms to monitor collusion, because the large price changes necessary to win away a rival’s locked-in customers may be very easy to observe. Switching costs may perhaps also facilitate collusion by breaking up a market into well-defined submarkets of customers who bought from different firms thus providing “focal points” for tacitly collusive division of the market. However, while these arguments are discussed in Stigler (1964) and Klemperer (1987a), they have not yet been well explored in the literature, and do not seem easy to formalise satisfactorily. Furthermore, if collusion is only easier after most customers are already locked-in, this is likely to induce fiercer competition prior to lock-in.

While many people’s intuition is that switching costs support collusion, this remains unclear as a theoretical matter.

2.5 Consumers Who Use Multiple Suppliers

In the models above, as in most leading models of switching costs, switching costs affect prices but there is no switching in equilibrium. In reality a consumer may use different suppliers in different periods, either because

\textsuperscript{34}For example, Beggs and Klemperer assume each firm’s price depends only on its current market share and not otherwise on history, thus ruling out the kind of strategies described by, for example, Abreu (1988) or Green and Porter (1984) that support collusive outcomes in contexts without switching costs.

\textsuperscript{35}Gabrielson and Vagstad (2000) explore how the heterogeneity of switching costs affects the ability of duopolists to support a collusive outcome.
firms’ products are differentiated and the consumer has (sufficiently) changing tastes, or because the differences between firms’ prices to the consumer change (sufficiently) over time—the latter case often arises when firms offer lower prices to new customers than to existing customers.

Furthermore, although we have thus far assumed each consumer buys at most a single unit from a single firm in each period, a consumer who values variety may buy multiple products even in a single period. Consumers may therefore use multiple suppliers in a period or, as we will discuss, firms may each produce a range of different products.

2.5.1 Paying Consumers to Switch

Most papers in the switching costs literature assume a firm offers the same price to all consumers in any given period. However, firms may want to price discriminate between old locked-in customers and customers who find it costly or difficult to switch to them. And indeed firms often pay consumers to switch to them from rivals. For example, long-distance phone carriers make one-time payments to customers switching from a rival; credit card providers offer lower interest rates only for balance transfers from another provider; and economics departments pay higher salaries to faculty members moving from other departments, etc.

Chen (1997) analyses a two-period, two-firm, model in which each firm can charge a price to its old customers that is different from the price it charges to other consumers in the same period. In effect, the consumers are in two separate markets in the second period according to which firm they bought from in period 1. Each firm acts like an incumbent monopolist in the market for its old customers, and like a new entrant in the market for the other firm’s customers, so each of the two period-2 markets is like the single period-2 market of our core (section 2.3.1) two-period model. In that model all consumers had the same switching cost, so the period-2 incumbent charged a price that was higher than the entrant’s price, but that was nevertheless just low enough that there was no actual switching. (Similarly, Nilssen (1992) allows each firm to charge a different price to each consumer, but generates
no actual switching.\textsuperscript{36,37} However, if, as in Chen’s model, old consumers have heterogenous switching costs (and firms cannot discriminate between them, perhaps because firms are imperfectly informed about the magnitude of individual consumers’ switching costs), then firms charge higher prices than their rivals to their old consumers and consumers with low switching costs switch firms. In Chen’s model firms’ profits are lower than if they were unable to discriminate between old and new customers, but consumers are not necessarily better off, because of the deadweight losses from switching. Firms’ total discounted profits are nevertheless higher than absent switching costs because (as in Section 2.4.4) the switching costs allow the firms to segment the market, so firms can exercise some market power even over customers who are new to them in the second period.

Because in Chen’s model a firm’s old and new customers are effectively in unconnected markets, both of the firm’s prices are independent of its previous-period market share\textsuperscript{38}—by contrast with the results of the no-price discrimination models discussed above. This feature turns out to be useful in subsequent models such as Taylor (2003) which extends Chen’s model to many periods and many firms.

An important point that Taylor makes is that when there are just two firms the low switching cost consumers who leave their current supplier have only one firm to switch to, and this other firm can therefore make positive profits even on its new customers (when switching costs are heterogeneous). Therefore duopolists earn positive economic profit in equilibrium. But with three or more firms, there are always at least two new firms vying for any consumers willing to leave their current supplier and, if the new firms’ products are undifferentiated, these firms will bid away their entire expected lifetime

\textsuperscript{36}Nilssen showed that prices depend on whether switching costs are learning costs or transactional costs: compared with the case of learning costs, transactional costs give consumers lower incentives to switch which yields lower prices for new consumers and higher prices for loyal consumers (and so lower social welfare since he assumes downward-sloping demand).

\textsuperscript{37}Likewise, the simple model of section 2.4.1 shows that if firms can price discriminate, the price will be \(c + (1 - \phi) s\) to all old consumers, and will be \(s\) lower to new consumers, but no consumers will ever actually switch.

\textsuperscript{38}However Arbatskaya’s (2000) two-period model with some functional product differentiation as well as switching costs does not yield this “independence” result.
profits from serving the consumers in their competition to attract them. So with three or more firms, firms earn positive rents only on their base of current customers, and these rents merely exactly offset the up-front investment required to attract the current customers.

These “paying customers to switch” models emphasise that switching costs, at least in theory, tend to generate higher rather than lower prices to repeat purchasers—contrary to many people’s perceptions that customers are rewarded for loyalty. Taylor’s model provides one possible resolution of this apparent contradiction. He shows that if switching costs are transactional, consumers may move between suppliers to credibly signal their (already) low switching costs and so secure more favourable terms of trade. Because this switching is socially costly, equilibrium contracts may discourage it through “loyal customer” pricing policies that give better terms to loyal customers (who have always purchased from the same firm) than to other old customers who patronised other firms in the past. But Taylor nevertheless finds that firms charge the lowest prices to new customers.

Shaffer and Zhang (2000) study a single period model which is similar to the second period of Chen’s model but in which the distributions of switching costs from the two different firms are different. In this case if one firm’s customers have lower and less heterogeneous switching costs than the other firm’s customers, then from the first firm’s perspective its loyal-customer demand is more elastic than its new-customer demand and it may therefore charge a lower price to its loyal customers than to customers switching from the rival. But in this model it is never possible for both firms to charge lower prices to loyal customers than to switching customers.39

There are also models of contractual switching costs that result in lower

39Lee (1997) also studies a one-period switching cost model which has similarities to the second period of Chen’s model. Fudenberg and Tirole (2000) explore a two-period model with some similar features to Chen’s, in which firms price discriminate between consumers based on their past demands, but in a context with real functional product differentiation between firms and without real (socially costly) switching costs; they too find that loyal customers are charged higher prices than switchers. However, they also show that firms may wish to offer long-term contracts that in effect offer consumers a high period-one price in return for a guaranteed low period-two price (see Section 2.8.3). (Villas-Boas (1999) analyses a many-period model similar to Fudenberg and Tirole’s but does not consider long-term contracts.) Acquisti and Varian (2002) present a related two-period monopoly model which can be interpreted as being of consumers with switching costs.
effective prices to repeat customers than to new customers, and contracts that favour repeat customers arise endogeneously in some of these models (see Section 2.8.3). But the literature has found it hard to explain how real switching costs might generate discrimination in favor of old customers.

2.5.2 Is There Too Much Switching?

Consumers decide whether or when to switch, and pay the switching costs. For them to make socially correct switching decisions, the switching costs they bear must be real social costs, and the differences between firms’ prices must equal the differences between firms’ costs and be unaffected by consumers’ decisions.40 In particular, there will generally be the wrong amount of switching if (i) firms’ relative prices to a consumer fail to reflect their relative marginal costs, or (ii) consumers switch (or not) in order to affect firms’ future prices, or (iii) the switching costs are not real social costs.

(i) \textit{price differences don’t reflect cost differences}

In the previous subsection (2.5.1) firms charge lower prices to their new consumers, and the differences between firms’ prices to a given consumer generally fail to reflect any cost differences between firms, so inefficient switching results. Importantly, this arises even when firms price symmetrically (i.e., all firms charge high prices to old customers and lower prices to new customers), because prices to any given consumer are then \textit{not} symmetric.

Furthermore, we saw in Section 2.4 that even when firms do not price discriminate between new and old consumers, firms with larger customer bases will charge larger markups over their marginal costs. So if consumers have differing switching costs, the incumbent or dominant firm charges a price that exploits its old high switching-cost customers while allowing its low switching-cost consumers to switch to a smaller firm or new entrant. See, for example, Gabszewicz, Pepall and Thisse (1992), Farrell and Shapiro (1988), Wang and Wen (1998); in all these cases there is excessive switching.

\footnote{Consumers must also have rational expectations about future price differences, etc. Consumers can, of course, make socially correct decisions if the distortions are not too large, as for example in the model of Section 2.3.1 in which the consumer’s current supplier raises price in the second period by an amount that just avoids the consumer switching.}
to smaller firms and entrants.\[^{41}\]

(ii) **consumers switch in order to affect prices**

If a consumer is a large fraction of the market, or if firms can discriminate between consumers (so each consumer is, in effect, a separate market), a consumer may switch to affect future prices.

If switching costs are learning costs, switching strengthens a consumer’s outside option, so if each consumer is a separate market we might observe excessive switching as consumers switch in order to strengthen their bargaining positions—by switching a consumer effectively creates a second source of supply and thereby increases the competition to supply him in the future (Lewis and Yildirim, 2003). On the other hand, if firms cannot discriminate between consumers, there is an opposite effect: with learning switching costs a consumer who switches usually lowers prices and so improves the efficiency of other consumers’ trades with sellers, so there may be less switching than is socially desirable.

We discussed in section 2.5.1 that if switching costs are transactional (and firms are imperfectly informed about their magnitude), consumers may engage in socially costly switching to credibly signal that their switching costs are not too high and so improve their terms of trade.

Consumers may also commit to ignore switching costs in making future purchase decisions, in order to force the incumbent supplier to price more competitively (Cabral and Greenstein (1990));\[^{42}\] this will generally lead to socially excessive switching *ex post*.

(iii) **switching costs are not real social costs**

\[^{41}\] Even if all consumers have the same switching costs, if an entrant’s production cost combined with consumers’ switching cost exceeds the incumbent’s production cost, then in a quantity-competition model the entrant will charge a smaller markup than the incumbent to the incumbent’s old consumers and sell to some of them, thus inducing inefficient switching (Klemperer (1988)). This result is exactly analogous to the standard oligopoly result that a higher-cost firm charges a smaller markup and so wins a socially excessive market share. It does not depend on whether or not the model allows price discrimination.

\[^{42}\] The literature has largely assumed that consumers have no commitment power (see Section 2.8 for exceptions); in most contexts this assumption is both natural and also probably unimportant.
If switching costs are contractual, and not social costs, consumers will *ceteris paribus* switch less than is efficient. But if real (social) switching costs exist, then contractual switching costs may prevent socially inefficient switches of the types discussed above.43

### 2.5.3 Multiproduct Firms

A consumer who buys several related products in a single period may incur additional “shopping costs” for each additional supplier used. These shopping costs may be the same as the switching costs incurred by consumers who change suppliers between periods. However, the dynamic issues that switching-cost models usually emphasise no longer arise. In particular, firms and consumers can contract on all prices, so the analogy with economies of scope in production is particularly strong. Thus shopping costs provide an efficiency reason for multiproduct firms just as economies of scope in production do.

The analogy is not perfect, because switching costs and shopping costs are based on specific consumer-firm matches, whereas the production-side economies of scope emphasised by Panzar and Willig (1981) and others depend only on the total numbers of sales a firm makes of each product and not on whether the same consumers are buying the firm’s different products or whether some consumers use multiple suppliers.44

However, the analogy is particularly good if firms’ product lines are sufficiently broad that most consumers use just one supplier. For example, Klemperer and Padilla (1997) demonstrate that selling an additional product can provide strategic benefits for a firm in the markets for its current products if consumers have shopping costs of using additional suppliers (because selling an extra variety can attract demand away from rival suppliers for this firm’s *other* varieties). This parallels Bulow et al (1985)’s demonstration

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43 In Fudenberg and Tirole (2000) firms endogenously offer long term contracts that create contractual switching costs that reduce inefficient switching to less preferred products and increase social welfare, conditional on firms being permitted to price discriminate between old and new customers.

44 As we noted in Section 2.1, if firms can discriminate between consumers, then each consumer becomes an independent market which, in the presence of switching costs, is closely analogous to a market with production economies of scope.
of the same result if consumers’ shopping costs are replaced by production-
side economies of scope (because selling an additional variety lowers the
firm’s marginal costs of its current products). In both cases each firm, and
therefore the market, may therefore provide too many different products.
More obviously, mergers can be explained either by consumer switching costs
(Klemperer and Padilla (1997)) or by production economies of scope.\footnote{Dranove and White (1996) models hospitals as multi-product providers with switching costs between providers.}

Some results about single-product competition over many periods with
switching costs carry over to multiproduct competition in a single period
with shopping costs. For example, we suggested earlier in this section that
oligopolists might benefit by synchronizing their sales to minimize switching
and so reduce the pool of highly price-sensitive (no-switching cost) customers.
Likewise multiproduct firms competing in a single period may have a joint
incentive to minimize the number of consumers who buy from more than one
firm. Indeed Klemperer (1992, 1995 ex.4) shows that firms may inefficiently
offer similar products to each other, or similar product lines to each other,
for this reason. Taken together with the previous paragraph’s result, this
suggests that each firm may produce too many products, but that there may
nevertheless be too little variety produced by the industry as a whole.

An important set of shopping-cost models are the “mix-and-match” mod-
els pioneered by Matutes and Regibeau (1988), Economides (1989) and Ein-
horn (1992). Most of this literature takes each firm’s product-line as given,
and asks whether firms prefer to be compatible (no shopping costs) or in-
compatible (effectively infinite shopping costs); see Sections 2.7.3 and 2.8.

Similarly, when firms “bundle” products (see, e.g., Whinston (1990),
Nalebuff (1999, 2000)) they are creating contractual shopping costs between
their products; we discuss bundling briefly in Sections 2.7.3 and 2.8.\footnote{Varian’s (1989) and Stole’s (forthcoming) surveys describe models of quantity discounts and bundling in detail in Volume 1 and the current volume of this Series, respectively.}

Since shopping costs are not technologically distinct from switching costs
(the term “shopping costs” merely seems more natural in a single-period
context), we henceforth use the term switching costs to cover all these costs.


2.6 Battles for Market Share

2.6.1 The Value of Market Share

We have seen that with switching costs (or indeed proprietary network effects—see Section 3.7), a firm’s current customer base is an important determinant of its future profits.

We can therefore write a firm’s current-period value function, (i.e., total discounted future profits), $V_t$, as the sum of its current profits, $\pi_t$, and its discounted next-period value function $\delta V_{t+1}(\sigma_t)$, in which $\delta$ is the discount factor and the next-period value function, $V_{t+1}(\cdot)$, is a function of the size of its current-period customer base, $\sigma_t$.

$$V_t = \pi_t + \delta V_{t+1}(\sigma_t) \quad (2)$$

Obviously, this is a simplification. In general, the firm’s future profits depend on which customers it has sold to and these customers’ full histories, how market share is distributed among competing firms, how many consumers in the market make no purchase, etc. However, in the simplest models $V_{t+1}$ depends only on current-period market share—for example, this is true of Klemperer (1987b, 1995), Farrell and Shapiro (1988), Beggs and Klemperer (1992), Padilla (1992, 1995), and Chen and Rosenthal (1996) which all model just two firms and a fixed set of consumers whose reservation prices are sufficient that they always purchase. (For example, equation (1) shows for Beggs and Klemperer’s model how prices, and therefore also quantities, and hence value functions, in a period are a function of the firm’s previous-period market share.) So $\sigma_t$ is often interpreted as “market share”, and this explains firms’ very strong concern with market shares in markets with switching costs and/or (we shall see) network effects.\footnote{Because switching costs make current market share such an important determinant of a manufacturer’s future profits, Valletti (2000) suggests they may provide a strong motive for vertical integration with retailers to ensure sufficient investment in a base of repeat subscribers.}
2.6.2 Penetration Pricing

The firm’s first-order condition for the optimal choice of its period-
price given rivals’ strategies is then

\[ 0 = \frac{\partial V_t}{\partial p_t} = \frac{\partial \pi_t}{\partial p_t} + \delta \frac{\partial V_{t+1}}{\partial \sigma_t} \frac{\partial \sigma_t}{\partial p_t} \] (3)

Provided that the firm’s value fraction is increasing in its market share, \( \partial V_{t+1}/\partial \sigma_t > 0 \), therefore, the firm charges a lower price or sets a higher quantity than would be short-run profit maximising in order to raise its customer base and hence its future profits. That is, \( \partial \pi_t/\partial p_t > 0 \) (since we assume \( \partial \sigma_t/\partial p_t < 0 \)). (Similar results apply if, as in section 2.5, the firm sets different prices to different groups of consumers in any period.)

In the early stages of a market, therefore, when few consumers have switching costs, so even short-run profit-maximising prices are not high relative to costs, equation (3) implies low, “penetration”, pricing. This is, of course, just the generalisation of the period-1 “bargain pricing” that arises in the simple two-period model described in Section 2.3.1.

It is clear from (3) that the larger the value of the future market, \( V_{t+1} \), the deeper, ceteris paribus, the penetration pricing will be. For example, a more rapidly growing market will have lower prices.\(^49\)\(^50\) Of course, as noted in Section 2.3.2, in a more general model the “penetration” might be through advertising or other marketing activities rather than just low prices.

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\(^{48}\)This need not apply: stealing customers from rival(s) may make the rival(s) so much more aggressive that the firm is worse off. See Banerjee and Summers (1987), Klemperer (1987c). Usually, however, \( \partial V_{t+1}/\partial \sigma_t > 0 \).

In Beggs and Klemperer (1992), \( V_{t+1} \) is quadratic in \( \sigma_t \). (The fact that the sum of the duopolists’ value functions is therefore maximised at the boundaries is consistent with stable dynamics because lowering current price is less costly in current profits for the firm with the smaller market share. See Budd et al (1993).)

We can perform a similar analysis with similar results for a quantity-setting firm.

\(^{49}\)See, for example, Beggs and Klemperer (1992), Borenstein, Mackie-Mason and Netz (2000) and also Holmes’ (1990) steady-state model of a monopolist selling a single product to overlapping generations of consumers who incur set-up costs before purchasing the product.

\(^{50}\)It seems unclear whether we should expect “penetration pricing” patterns from a monopolist, since the magnitude of \( \partial V_{t+1}/\partial \sigma_t \) may be smaller in monopoly—where consumers have nowhere else to go—than in oligopoly, and durable-goods effects imply falling prices in monopoly absent switching-cost effects (equation (3) only implies that early period prices are lower than in the absence of switching-costs, not that prices necessarily rise). Cabral et al (1999) show it is hard to obtain penetration pricing in a network-effects monopoly model (see Section 3.6).
2.6.3 Harvesting vs Investing: Macroeconomic and International Trade Applications

Equations (2) and (3) show that any firm must in every period \( t \) balance the incentive to charge high prices to “harvest” greater current profits (Equation (3) showed \( \pi_t \) is increasing in \( p_t \)) against the incentive for low prices that “invest” in market share and hence increase future profits (\( V_{t+1} \) is increasing in \( \sigma_t \), which is decreasing in \( p_t \)).

Anything that increases the marginal value of market share will make the firm lower price further to invest more in market share. Thus, for example, a lower \( \delta \), that is, a higher real interest rate, reduces the present value of future market share (see (2)) so leads to higher current prices (see (3): lower \( \delta \) implies lower \( \partial \pi_t / \partial p_t \) implies higher \( p_t \)).

Chevalier and Scharfstein (1996) develop this logic in a switching-costs model based on the two-period model in Klemperer (1995). They argue that liquidity-constrained supermarkets perceive very high real interest rates and therefore set high prices, sacrificing future profits in order to raise cash and survive in the short term. Their theory is supported by empirical evidence that shows that the most financially-constrained supermarket chains do indeed raise their prices relative to less financially-constrained chains during recessions.\(^{52}\)

Fitoussi and Phelps (1988) use a similar logic (although emphasising search costs rather than switching costs) to argue that high interest rates contributed to the high rates of inflation in Europe in the early 1980s.

Froot and Klemperer (1989) also apply the same logic to international trade in a general model of competition for market share motivated by switching costs and network effects. A current appreciation of the domestic currency lowers a foreign firm’s costs (expressed in the domestic currency) so tends to lower prices, but if the appreciation is expected to be only temporary then the fact that the domestic currency will be worth less tomorrow is

\(^{51}\)This assumes stable, symmetric, oligopoly and that the dominant effect of lowering \( \delta \) is the direct effect. All these arguments are discussed in more detail in Klemperer (1995).

\(^{52}\)Beggs and Klemperer (1989, Section 5.3) and Klemperer (1995) provide further discussion of how “booms” and “busts” affect the trade-offs embodied in equation (3) and hence affect price-cost margins.
equivalent to an increase in the real interest rates which raises prices. So exchange-rate changes that are expected to be temporary may have very little impact on import prices. Conversely, if the currency is anticipated to appreciate in the future, both the “cost effect” and “interest-rate effect” are in the same direction—market share tomorrow is probably worth more if future costs are lower, and tomorrow’s profits are worth more than today’s profits, so for both reasons today is a good time to invest in market share rather than harvest current profits. So import prices may be very sensitive to anticipated exchange-rate changes. Both Froot and Klemperer (1989) and Sapir and Sekkat (1995) provide empirical support for these theories.53

2.7 Entry

Switching costs may have important effects on entry: with real, exogenous switching costs, small scale entry to win new, unattached, consumers is often easy and indeed often too easy, but winning even part of the business of old “locked-in” customers may not just be hard, but also be too hard from the social standpoint.

Furthermore, these results take the switching costs as given. Firms may also create unnecessary switching costs purely in order to discourage entry.

2.7.1 Small-Scale Entry is (Too) Easy

We saw in Section 2.4 that if firms cannot discriminate between old and new consumers, then the “fat cat” effect may make small scale entry very easy: incumbent firms’ desire to extract profits from their old customers creates a price umbrella under which entrants can profitably win new unattached (or low switching cost) customers. And even after entry has occurred, the erstwhile incumbent(s) will continue to charge higher prices than the entrant, and lose market share to the entrant so long as they remain “fatter” firms with more old consumers to exploit.

53For other applications of switching-costs theory to international trade, see Tivig (1996) who develops “J-curves” (since sales quantities respond only slowly to price changes if there are switching costs), Gottfries (2002), To (1994), and Hartigan (1995).
So even an entrant that is somewhat less efficient than the incumbent(s) can enter successfully at a small scale that attracts only unattached buyers. (See Klemperer (1987c), Farrell and Shapiro (1988), Gabszewicz, Pepall and Thisse (1992), Wang and Wen (1998), etc.)

2.7.2 Large Scale Entry is (Too) Hard

But while new entrants have an advantage in competing for new customers (at least in simple models in which the “fat cat” effects operates), it is very hard for them to compete for old customers who are already attached to an incumbent, and any consumers who switch are likely to be less loyal, hence less valuable, ones.\textsuperscript{54} So entry may be hard if small-scale entry is impractical, due perhaps to economies of scale, or to network effects. Furthermore, even new consumers may be reluctant to invest in a relationship with a new supplier if they know that the supplier can only survive at a large scale, since with switching costs consumers care about the future prospects of the firms they deal with.

Of course, this does not imply that there is necessarily too little large-scale entry. If switching costs are social costs, then large-scale entry may not be efficient even if the entrant’s costs are modestly lower than an incumbent’s.\textsuperscript{55}

One argument why entry may be too hard, that is, why efficient entry may be prevented, arises if the entrant cannot discriminate between consumers. Then large-scale entry requires charging \textit{all} consumers a price equal to the incumbent’s price less the marginal old buyer’s switching cost. But socially the switching cost applies only to the \textit{old} switching buyers, not to the new

\textsuperscript{54} There is a small literature on the credit card market (Ausubel (1991), Calem and Mester (1995), Stango (2002)) that emphasises the adverse selection problem that an entrant faces: creditworthy borrowers may have been granted high credit limits by their current card issuers so have higher switching costs. Furthermore, low-default risk customers may be less willing to switch (or even search) because they do not intend to borrow—but these customers often do borrow nevertheless (Ausubel, 1991). Calem and Mester provide empirical evidence supporting the view that this adverse selection is important, Ausubel provides evidence that the US bank credit card market earns positive economic profit and attributes this, at least in part, to switching costs or search costs, and Stango also argues that switching costs are an important influence on pricing.

\textsuperscript{55} Similarly, low cost incompatible entry can be inefficient in the presence of network effects.
consumers, and only applies to switching buyers at the average level of their switching cost, not at the marginal switching cost. So the social returns to entry are not fully captured by the entrant, and efficient entry may be blocked.

Furthermore, efficient entry can sometimes be strategically blockaded. In particular, an incumbent may “limit price”, that is, cut price to increase output prior to threatened entry, to lock in more customers and make entry unprofitable at the necessary scale, when entry at the same scale would have been profitable, and perhaps efficient, if the additional customers had not been “locked-up” prior to entry (see Klemperer (1987c)).

Of course, new entry can be too easy or too hard for more standard reasons. New entry can be too hard if it expands market output, and consumers rather than the entrant capture the surplus generated. And entry is too easy if its main effect is to shift profits from the incumbent to the entrant. But these caveats apply whether or not there are switching costs; the arguments specific to switching costs suggest that entry that depends for its success on consumers switching is not just hard, but too hard.

2.7.3 Single-Product Entry May Be (Too) Hard

We saw in Section 2.5.3 that switching costs (or shopping costs) can “tie” sales together so consumers prefer not to patronise more than one firm, and it follows that a new entrant may be forced to offer a full range of products to attract new customers (let alone any old consumers). If offering a full range is impractical, entry can effectively be foreclosed. Thus in Whinston (1990), Nalebuff (1999), and Klemperer and Padilla (1997), the tying of a product to a product in a different market can foreclose firms that can only sell single products. In Whinston and Nalebuff the “switching costs” are contractual.

Klemperer (1988) illustrates the latter case, showing that new entry into a mature market with switching costs can sometimes be socially undesirable. The point is that just as entry of a firm whose costs exceed the incumbent’s is often inefficient in a standard Cournot model without switching costs (Bulow et al, 1985, section, VI E, Mankiw and Whinston, 1986) so entry of a firm whose production cost plus consumers’ switching cost exceeds the incumbent’s production cost is often inefficient in a quantity-setting model with switching costs (see note K88).
while in Klemperer and Padilla the products are “tied” by real switching costs.\textsuperscript{57} If the switching costs are real, entry need not be too hard \textit{given} the switching costs, but the arguments of the previous subsection suggest it often may be.

### 2.7.4 Artificial Switching Costs Make Entry (Too) Hard

The previous discussion addressed whether entry is too easy or too hard, taking the switching costs as given. However, the larger issue is probably whether the switching costs either are, or need to be, real social costs. They may instead be contractual such as those imposed by “loyalty contracts” that return a fraction of past payments to customers who continue to patronise the firm, or by “exclusive contracts” that require customers to pay damages if they fail to do so, or by “bundling” or “tying” products to make it uneconomical for consumers to buy single products from different firms. Or the switching costs may be real but caused by an unnecessary technological choice that an entrant cannot copy. In these cases, large-scale entry is probably too hard (see Section 2.7.2), but it is the incumbent’s ability to choose incompatibility that is the crucial entry barrier.

### 2.8 Endogenous Switching Costs: Choosing How to Compete

[Market participants may seek to either raise or to lower switching costs in order to reduce inefficiencies (including the switching cost itself), to enhance market power, to deter new entry, or to extract returns from a new entrant.]

#### 2.8.1 Reducing Switching Costs to Enhance Efficiency

As we have seen, a firm that cannot commit not to exploit its ex-post monopoly power must charge a lower introductory price. If the price-path (or quality-path) is very inefficient for the firm and consumers jointly, the firm’s surplus as well as joint surplus may be increased by nullifying the switching

\textsuperscript{57}Choi (1996a) shows that the tying of markets where R\&D is critical can allow a firm with an R\&D lead in just one market to pre-empt both. The welfare effects are ambiguous.
costs. Thus, for example, a company may license a second source to create a future competitor to which consumers can costlessly switch (Farrell and Gallini (1988)).

Likewise, firms producing differentiated products (or product lines) may deliberately make them compatible (i.e., choose zero switching costs). This increases the variety of options available to consumers who can then “mix-and-match” products from more than one firm without paying a switching cost. So eliminating switching costs can raise all firms’ demands, and hence all firms’ profits.

Where suppliers are unwilling to reduce switching costs (see below), third parties may supply converters, or regulators may intervene.

We have also already noted that customers may incur the switching (or start-up) cost of using more than one supplier, or may pre-commit to ignoring the switching costs in deciding whether to switch, in order to force suppliers to behave more competitively.

Finally, firms may be able to mitigate the inefficiencies of distorted prices and/or qualities by developing reputations for behaving as if there were no switching costs.

2.8.2 Increasing Switching Costs to Enhance Efficiency

Firms may also mitigate the inefficiencies of distorted prices and qualities by vertically integrating with their customers. Likewise Taylor (2003)

\[58\text{In Gilbert and Klemperer (2000) a firm precommits to low prices that will result in rationing but will not fully exploit the consumers ex-post, to induce them to pay the start-up costs of switching to the firm.}\]

\[59\text{See Matutes and Regibeau (1988), Economides (1989), Garcia Marinoso (2001), Stahl (1982), etc. But the mix-and-match models reveal other effects too; see Section 2.8.4.}\]

\[60\text{[reference? discussion? see section 3.X}]\]

\[61\text{Greenstein (1993) discusses the procurement strategies employed by U.S. federal agencies in the late 1970s to force suppliers of mainframe computers to make their systems compatible with those of their rivals.}\]

\[62\text{See Cabral and Greenstein (1990).}\]

\[63\text{See Eber (1999). Perhaps more plausibly firms may develop reputations for, or otherwise commit to, treating old and new customers alike (since this behaviour is easy for consumers to understand and monitor); this behaviour may also mitigate the inefficiencies due to the distorted prices.}\]

\[64\text{See Williamson (1975) and Klein, Crawford, and Alchian (1978).}\]

[Note FS] However incomplete contracts to protect against suppliers’ opportunism may be less desirable than no mitigation at all of the effects of switching costs. Farrell and
finds firms might set lower prices to loyal consumers to reduce inefficient switching. Of course, a downside of these strategies of increasing switching costs is that they also limit the variety available to consumers unless they pay the switching costs.

2.8.3 Increasing Switching Costs to Enhance Oligopoly Power

Although switching costs typically reduce social surplus, we saw in Sections 2.3-2.5 that they nevertheless often increase firms’ profits. If so, firms jointly prefer to commit to real social switching costs than to no switching costs before they compete, so firms may artificially create or increase switching costs.

Of course, a firm may prefer switching costs from but not to its product if it can achieve this, especially where the switching costs are real social costs, but Koh (1993) analyses a model in which each duopolist chooses a real social cost of switching to it, and shows the possibility that each chooses a positive switching cost in order to relax competition.

In Banerjee and Summers (1987) and Caminal and Matutes (1990) firms have the option to generate contractual switching costs by committing in period zero to offering repeat-purchase coupons in a two-period duopoly, and both firms (independently) take this option.\textsuperscript{65} Similarly Fudenberg and Tirole (2000) explore a two-period model in which firms can price discriminate between consumers based on their past demands; if firms can also offer long term contracts—that is, generate contractual switching costs—then firms do offer such contracts in equilibrium, in addition to spot contracts.\textsuperscript{66}

Shapiro (1989) call this the Principle of Negative Protection. The point is that it is better for customers to be exploited efficiently than inefficiently ex-post. So if contracts cannot set all future variables (e.g. can set prices but not qualities), so customers anyway expect to be exploited ex-post, it may be better that there are no contracts.

\textsuperscript{65}However, Kim and Koh (2002) find that a firm with a small market share may reduce contractual switching costs by choosing to honour repeat-purchase coupons that its rivals have offered to their old customers.

\textsuperscript{66}These papers are discussed in more detail elsewhere in this Volume, in Stole (forthcoming).
2.8.4 Reducing Switching Costs to Enhance Oligopoly Power

An important class of models which suggests that firms may often be biased towards too much compatibility from the social viewpoint is the “mix-and-match” models (see Section 2.5) in which different firms have different abilities in producing the different components of a “system”. Consumers’ ability to mix-and-match the best product(s) offered by each firm is an efficiency gain from compatibility, but firms’ private gains from compatibility may be even greater:

Einhorn (1992) found in a simple Bertrand duopoly model that firms (jointly) more than appropriate the efficiency gain from compatibility (that is, from zero rather than infinite shopping costs) and so are biased towards excessive compatibility. The reason is that when a single consumer wants one each of a list of components produced by firms A, B, with production costs $a_i$ and $b_i$ respectively for component $i$, then in compatible competition the price for each component is $\max\{a_i, b_i\}$, so the consumer pays a total price $\sum_i \max\{a_i, b_i\}$ for the system. But if the firms are incompatible, the Bertrand price for a system is $\max\{\sum_i a_i; \sum_i b_i\}$ which is lower unless the same firm is best at everything. In words, if different firms are best at providing different components, then the winning seller on each component appropriates its full efficiency margin in compatible competition, but in incompatible competition the winner’s margin is its efficiency advantage where it is best, minus its rival’s advantage where its rival is best.

Of course, this depends on (among other assumptions) duopoly at each level. With more than two firms producing each component, the sum of the second-lowest cost of each component (which the consumer pays under compatibility) may easily be lower than the second-lowest system cost when firms are incompatible, so consumers often prefer compatibility and firms’ incentives may be biased either way (see Farrell, Monroe and Saloner (1998)).

The “order-statistic” effect emphasised in these models is not the only force, however. Matutes and Regibeau (1988) stressed that under compati-

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67Einhorn’s results, but not those of Farrell, Monroe and Saloner, are qualitatively unaffected by whether or not firms know their own efficiencies in each component. The analysis of these two papers is related to Palfrey (1983).
bility a price cut by one firm in one component increases the demand for the other firms’ complements, so compatibility reduces incentives to cut prices. Economides (1989) argued that, unlike the Einhorn result, this logic does not depend on duopoly, so provides a clear argument why firms may try too hard to reduce switching costs and shopping costs.

2.8.5 Increasing Switching Costs to Prevent or Exploit Entry

We have seen (Section 2.7) that an incumbent firm may protect a monopoly position against entry by writing exclusionary contracts, or by artificially creating real switching costs through technological incompatibility with potential entrants. Imposing contractual switching costs (but not real social switching costs) can also be a mechanism for extracting rents from an entrant without preventing its entry—the entrant is forced to pay a fee (the “liquidated damages”) to break the contracts.

68 Matutes and Regibeau (1992) allowed firms to set separate prices for bundles (not necessarily the sum of the component prices) and found that the force toward compatibility weakens. Furthermore, compatibility also changes the structure of demand, so even Matutes and Regibeau (1988) found that firms are sometimes biased towards incompatibility. And Klemperer (1992) also shows that firms may prefer incompatibility to compatibility when the latter is socially preferred, and that the firms may even distort their product choices to sustain incompatibility. Garcia Mariño (2001) examines a mix-and-match model in which purchase takes place over two periods, and finds that firms are biased towards compatibility because it reduces the intensity of competition in the first period—see also Hancap (2003) and Garcia Mariño (2003). (All these models assume some product differentiation between firms’ components even under compatibility). See also Anderson and Leruth (1993).

69 Most of the “mix-and-match” literature assumes that each firm offers a full line of products, but DeNicolo (2000) analyzes competition with one full-line and a pair of specialist firms. In our terminology, there are then no additional shopping costs of buying from an additional specialist firm after having bought from one of the specialist firms, but the specialist firms do not internalize the complementarities between them.

70 Imposing switching costs would not be worthwhile for the incumbent if they reduced consumers’ willingnesses to pay by more than the gains from excluding entry. In models such as Rasmussen, Ramseyer, and Wiley (1989), Segal and Whinston (2000), entry is only possible above some minimum efficient scale that is greater than any single customer’s demands, so no individual customer loses by forgoing the possibility of using an alternative supplier if other customers have already forgone the possibility, and so no customer needs to be compensated for signing an exclusive contract.

Deterring entry is also profitable if it can transfer rents from an entrant to the incumbent.

71 See Aghion and Bolton (1987) and Diamond and Maskin (1979).
2.9 Switching Costs and Policy

As we have seen, with (large) switching costs firms compete over streams of goods and services rather than over single transactions. So one must not jump from the fact that buyers become locked in to the conclusion that there is an overall competitive problem. Nor should one draw naive inferences from individual transaction prices, as if each transaction were the locus of ordinary competition. Some individual transactions may be priced well above cost even when no firm has (ex-ante) market power; others may be priced below cost without being in the least predatory.\footnote{For instance, in an aftermarket context such as the Kodak case, the fact that repair services are priced well above cost does not by itself prove that there is a serious competitive problem.} Thus switching-cost markets can be more competitive than they look, and switching costs need not generate supernormal profits, even in a closed oligopoly.

But while switching costs need not cause competitive problems, they probably do make competition more fragile, especially when they coexist with ordinary scale economies. Because large-scale entry into switching-cost markets is hard, there may be much more incentive for monopolizing strategies such as predation or merger than there is in markets in which easy entry limits any market power. Thus switching costs, in combination with other factors, could justify heightened antitrust scrutiny.\footnote{Another naïve argument is that if one observes little or no switching, then firms do not constrain one another’s prices: firms that compete on a life-cycle basis (rather than on an individual transaction basis) constrain one another’s life-cycle prices and, of course, firms may be constrained even ex post by the threat of customer switching even when that threat is not carried out in equilibrium.}

Furthermore, while sometimes (as in simple bargain-then-ripoff models) firms must give all their ex post rents to consumers in ex ante competition, that is not always true. The ex post rents may be less than fully competed away, as in the most of the oligopoly models we discussed. Alternatively the \footnote{For example, the UK Competition Commission in July 2001 blocked the proposed merger of two banks, Lloyds TSB and Abbey National, even though Abbey National accounted for only 5 per cent of the market for personal banking. An important part of the Commission’s reasoning was that consumer switching costs, combined with some scale economies, make new entry very hard, and that existing firms with low market shares tend to compete more aggressively than firms with higher shares in markets with switching costs, so smaller firms are particularly valuable competitors to retain. (Klemperer is a UK Competition Commissioner, but was not involved in this decision.) See also Lofaro and Ridyard (2003).}
ex post rents may be dissipated in unproductive activities such as excessive marketing or advertising in which case consumers are harmed by switching costs, even though firms may be no better off. So switching costs often do raise average prices. Moreover, switching costs often cause an inefficient bargain-then-ripoff pattern of prices even when the average level of prices remains competitive; they make matching less efficient by discouraging re-matching or the use of multiple suppliers; and, of course, they result in direct costs when consumers do switch.

For these reasons, despite the warnings in our first paragraph, markets may indeed perform less well with switching costs than without, so policy intervention to reduce switching costs may be appropriate. For example, policy might cautiously override intellectual property rights, especially of copyright-like intellectual property that may have little inherent novelty, if those rights are used only as a tool to enforce incompatibility and so create private rewards that bear no relationship to the innovation’s incremental value.

In general firms may be biased either towards or against compatibility relative to the social standpoint. But switching costs seem more likely to lower than to raise efficiency, so when firms favor switching costs the reason is often because they enhance monopoly or oligopoly power by directly raising prices or by inhibiting new entry. This suggests that policy-makers should take a close look when firms with market power choose to have switching costs (through contract form or product design) when choosing compatibility

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75 Gans and King (2001) examine the regulatory trade-offs in intervening to reduce switching costs and show that who is required to bear the costs of ameliorating switching costs may be an important determinant of the efficiency of the outcome. See also Galbi (2001).

Viard (2003) found that the introduction of number portability for U.S. toll-free telephone services substantially reduced switching costs and led to the largest firm substantially reducing prices; the U.S. wireless industry has strongly resisted the FCC’s proposals to introduce number portability in the wireless market. Aoki and Small (2000) and Gans, King, and Woodbridge (2001) also analyse number portability in the telecoms market.

76 A caveat is that firms often do not make a coordinated joint choice of whether to compete with switching costs or without, and different firms may be able to control the costs of different switches. See Section 2.8.
would be no more costly.  

3 Network Effects and Competition

3.1 Introduction

4 CONCLUSION

\footnote{For example, the Swedish competition authority argued that Scandinavian Airlines’ “frequent-flyer” program blocked new entry on just one or a few routes in the Swedish domestic air-travel market in which entry on the whole range of routes was impractical (see Section 2.7.3), and the airline was ordered to alter the program from October 2001. A similar decision was made by the Norwegian competition authority with effect from April 2002. Fernandes (2001) provides some support for these decisions by studying alliances formed by U.S. airlines, and showing that “frequent-flyer” programs that cover more routes are more attractive to consumers and confer greater market power on the airlines operating the programs. See also Klemperer and Png (1986).}

\footnote{A caveat is that the policy debate is often held ex-post of some lock-in. At this point incumbents obviously favor maintaining high switching costs and their preference is not evidence that switching costs raise prices overall (nor is it necessarily inefficient). Reducing switching costs ex-post also expropriates the incumbents’ ex-ante investments, possibly raising concerns about harming dynamic efficiency.}
References