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Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organization, Macroeconomics, and International Trade

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We survey recent work on competition in markets in which consumers have costs of switching between competing firms' products. In a market with switching costs (or "brand loyalty"), a firm's current market share is an important determinant of its future profitability. We examine how the firm's choice between setting a low price to capture market share, and setting a high price to harvest profits by exploiting its current locked-in customers, is affected by the threat of new entry, interest rates, exchange rate expectations, the state of the business cycle, etc. We also discuss the causes of switching costs; explain introductory offers and price wars; examine industry profits; and analyse firms' product choices. Moreover, we argue that switching costs between suppliers help explain both the existance of multi-product firms and the nature of competition between such firms.

1. INTRODUCTION

In many markets consumers who have previously purchased from one firm have (or perceive) costs of switching to a competitor's product, even when the two firms' products are functionally identical. These *consumer switching costs* give firms a degree of market power over their repeat-purchasers, and mean that firms' current market shares are important determinants of their future profits. Therefore each firm faces a trade-off, in any period, between investing in market share by charging a low price that attracts new customers who will be valuable repeat-purchasers in the future and, on the other hand, harvesting profits by charging high prices that capitalize on but also run down the firm's existing stock of market share. Examining how this trade-off depends on factors such as the threat of new entry, market growth rates, interest rates, exchange rate expectations, the state of the business cycle, etc., yields insights not only into central industrial-organization issues such as entry deterrence and oligopolists' ability to earn super-normal profits,

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but also into issues of interest to macroeconomists and international-trade theorists. Consumers' unwillingness to switch suppliers can also explain important aspects of competition between multiproduct firms.

This paper surveys some of the recent work on competition in markets with consumer switching costs.[1]

We begin in Section 2 by explaining, and illustrating, the different types of switching costs, or reasons for "brand loyalty", that consumers may face.

Section 3 shows how consumers' switching costs can lead to monopoly profits even for non-cooperative oligopolists. In a two-period model with switching costs in the second period, competition for the resulting second-period profits results in introductory offers, price wars for market share, and strategic entry-deterring behaviour in the first period. However, even with no switching costs in the first period, non-cooperative prices may be higher in *both* periods than if their were no switching costs in the second period.

Section 4 generalizes to a many-period model, and contrasts the overall level of prices in markets with switching costs to prices in their absence. We find a presumption that firms' incentives to exploit repeat purchasers dominate their incentives to attract new customers, and so lead to higher prices in markets with switching costs.

Section 5 uses the comparative statics of price levels in a market with switching costs to address issues such as the variation of price-cost margins over the business cycle, and the "pass through" of exchange rate changes to import prices.

Section 6 shows that when products are artificially differentiated by switching costs, firms' incentives to differentiate their products in any real, functional, way are reduced.

We also argue that consumers' switching costs between suppliers help explain the existence of multiproduct firms: firms that sell a single product only, and thereby force consumers to either incur switching costs or forgo variety, may be at a serious disadvantage relative to a "full-line producer". We draw out some implications for the nature of competition between multiproduct firms.

Section 7 briefly discusses some additional issues. These include the creation of switching costs, adaptations that mitigate their effects, and new entry in markets with switching costs.

Section 8 argues that public policy should seek to minimize switching costs, and concludes.

We concentrate, throughout, on intuition rather than formalities, but to fix ideas we also develop a simple model of switching costs in Examples 0–4 in which our basic results can be obtained. This model (especially the version in Example 1) has been chosen to be as simple as possible, and so may be useful in future research.

Notation

Throughout we will denote firm F's period-t price by p_t^F, quantity by q_t^F, profit by π_t^F, value function by V_t^F, market share by σ_t^F $(=q_t^F/\sum_J q_t^J)$, and per-period discount factor by δ.

1. An early model of oligopolistic competition with "demand inertia" is in Selten (1965). He simply assumed that a firm's current sales depended in part on a discounted sum of the past differences between its own previous-period price and its competitor's previous-price (although he assumed current sales were independent of the competitor's current price). Explicit modelling of consumers' behaviour in the presence of switching costs waited, as far as I am aware, until the 1980s.

2. SWITCHING COSTS; REASONS FOR "BRAND LOYALTY"

A switching cost results from a consumer's desire for compatibility between his current purchase and a previous investment. That investment might be a *physical* investment in (a) equipment or in (b) setting up a relationship, an *informational* investment in finding out (c) how to use a product or (d) about its characteristics, (e) an *artificially-created* investment in buying a high-priced first unit that then allows one to buy subsequent units more cheaply, or even (f) a *psychological* investment. Thus categories of switching costs include those caused by:

(a) *Need for compatibility with existing equipment*

The different components of a computer system must be compatible. Cameras must be compatible with their lenses, razors with their blades, ball-point pens with their refill cartridges, etc.

(b) *Transaction costs of switching suppliers*

Two banks may offer identical current accounts, but there are high transaction costs in closing an account with one bank and opening another with a competitor. Similarly, it may be costly to change one's long-distance telephone service, or to return rented equipment to one firm and rent identical equipment from an alternative supplier.

(c) *Costs of learning to use new brands*

A number of computer manufacturers may make machines that are functionally identical but, if a consumer has learned to use one firm's product line and has invested in the appropriate software, he has a strong incentive to continue to buy machines from the same firm, and to buy software compatible with them.[2] Similarly, when choosing a cake mix it is easiest for a consumer to buy the brand that he already knows exactly how to prepare, even if he knows that all brands are of identical quality.

(d) *Uncertainty about the quality of untested brands*

Consumers re-use medicines that have worked for them, in preference to taking the gamble of trying drugs that they have not tested and that may not suit them. In markets like this one, a consumer behaves as if he faced a cost of switching to a new brand that is equal to the maximum insurance premium that he would be willing to pay to be guaranteed a product of the same value to him as a product he has previously purchased.[3]

(e) *Discount coupons and similar devices*

Airlines enroll passengers in "frequent-flyer" programmes that reward them for repeated travel on the same carrier, and these rewards are convex in the total distance travelled so

2. See Greenstein (1992, Sec. IIId) for estimates of these switching costs. Switching between software products is also extremely costly; e.g. "it costs very roughly $1000 (including both direct costs and lost time from other work while training) to train someone in [Lotus' simple spreadsheet language] 1-2-3 to a minimum level of proficiency" (*Forbes*, March 6, 1989, p. 132).

3. There are several sub-cases. Some brands may be objectively (but ex-ante unobservably) superior to others, brands may be identical (but consumers—perhaps irrationally—unaware of this), or consumers may disagree (that is, there are good matches and bad matches). Note that standard models of switching costs do not apply directly if firms can use prices to signal qualities or some consumers try but dislike brands.

a passenger receives smaller total rewards if he divides his custom (Klemperer and Png (1986), Banerjee and Summers (1987)). Similarly, film developing companies often return developed camera film with new film that can be developed only by the same company, many grocery products are sold with a discount coupon valid for the next purchase of the same item, and ocean shipping firms offer "loyalty contracts" that return a fraction of past payments to customers who continue to patronize them exclusively.

Similar switching costs can be created by contracts. Deferred rebates are illegal in U.S. shipping, so "loyalty contracts" are implemented there by giving customers current discounts in return for contracts committing the customers to pay damages if they do not repeat-purchase; signing such a contract specifying damages of s is exactly equivalent to paying s for a discount coupon of present-value s that is valid for the next purchase.

In these examples, the switching costs are simply transfers between consumers and firms; there are no direct social costs of brand switching. Note, however, that since firms are not committed to their future prices, these examples are quite distinct from quantity discounts.

(f) *Psychological costs of switching, or non-economic "brand-loyalty"*

Even where there is no clearly identifiable economic reason for consumers to exhibit brand loyalty, there may be psychological costs of switching brands. Social psychologists cite evidence that people change their own preferences in favour of products that they have previously chosen or been given in order to reduce "cognitive dissonance" (Brehm (1956)). For example, most of us like our own mother's cooking because we grew up on it, and learned to like it! Thus if consumers are initially indifferent between competing products, the fact of using one brand will change consumers' relative utilities for the products so that they perceive a cost of switching brands.[4]

Each of these types of switching cost is sufficient for ex-ante homogeneous products to become, after the purchase of any one of them, ex-post heterogeneous. Of course in many markets switching costs arise for more than one reason. For example the markets for the professional services of doctors, consultants, accountants etc. involve switching costs of several, and perhaps all, kinds.

Note that a consumer who has not previously bought from any firm very often incurs a start-up cost similar to the new investment (switching cost) that a brand switcher must make. We will use the term "switching cost" to include these start-up costs. Thus, a consumer may have a "switching cost" of making a first purchase.

Switching costs paid by firms

Many of consumers' costs of switching to new suppliers have parallels in firms' costs of serving new customers. In particular, corresponding to the classification above, firms may

4. Addictions (see Becker and Murphy (1988)) may be considered goods with psychological switching costs. The bias towards repeat purchase may be reinforced if the purchaser has to rationalize his choices not just to himself but also to others. See Samuelson and Zeckhauser (1988) for several examples of "status quo bias", and Brehm (1956) for evidence from laboratory experiments. When two (highly rational, I am told) consumers (a) my wife (a microeconomic theorist) and (b) my mother (a former director of *Which?*—the U.K. equivalent of *Consumer Reports*) recently wanted to buy new cars, each showed a very strong preference for the manufacturer from which she had previously purchased (Honda and Volkswagen, respectively)—indeed would hardly consider alternatives—even though each wanted to change the model and size of her car. A reader has commented that the hypothesis of psychological switching costs is irrefutable, since it can be defended by our own reluctance to drop it!

face (b') transactions costs in opening new customer accounts, (c') costs of learning to work with new customers, and (d') uncertainty about the quality of new customers, e.g. in insurance and credit markets (Nilssen (1990), Sharpe (1990)). Whether the firm or the customer initially pays the switching cost, this relationship-specific investment is lost if either party discontinues the relationship. Thus the total prices (including any switching costs) paid by consumers, and the implications of switching costs discussed in this paper, may not be much affected by whether firms or consumers actually pay the switching costs.[5]

Other related phenomena

Clearly many of the effects of consumer switching costs also arise if consumers have search costs of finding out the prices, or even existence, of competing brands. However, an important distinction is that consumers who have not yet developed switching costs play an important role in markets with switching costs.

Similarly, some of the effects of switching costs also arise if bandwagon effects (Leibenstein (1950)) or network externalities (Katz and Shapiro (1985), Arthur (1989)) mean that consumers wish to buy brands similar to, or compatible with, other consumers' purchases.[6]

Most of the results of Sections 3.1, 3.2 and 5 apply wherever a firm's current sales depend positively on its past sales volume, whether this is due to consumer switching costs or to other reasons. Such a dependence could also be through firms' costs, rather than demands, if, for example, firms have learning curves (Spence (1981)). The remaining sections apply more specifically to markets with switching costs.

3. COMPETITION FOR MARKET SHARE

3.1. *Switching costs yield monopoly power*

The most obvious effect of switching costs is to give firms some market power over their existing customers, and thus to create the potential for monopoly profits.

Begin by considering, for simplicity, a single-period duopoly in which products are homogeneous but a fraction σ^A of the consumers has previously purchased firm A's product and so each has a switching cost, s, of buying from the rival firm B, while the complementary fraction $(1-\sigma^A=\sigma^B)$ of consumers has previously bought B's product and each has a switching cost, s, of buying from A. Thus this is a "mature market" in which consumers' switching costs have already been built up. Then if s is large enough, the unique non-cooperative (Nash) equilibrium, in either price competition or quantity competition, yields firms' joint-profit-maximizing outcome. The reason is that firm A cannot attract any of "B's customers" unless it lowers its price at least s below B's price (or, in the case of quantity competition, increases its output far enough that its price falls to this extent). If A must charge the same price to all its customers, such a large price cut gives up more profits on its own captive customers than it gains by stealing B's customers, so A does better to act as a monopolist against its own customer base.

5. If firms can discriminate between consumers, we expect the initial price to be s higher if the firm pays the switching cost, s, than if the consumer pays it, and subsequent prices to be unaffected (see Sec. 3.3). Even if firms cannot discriminate between consumers, results may not depend importantly on who pays switching costs (see Beggs and Klemperer (1989, Sec. 5.1)).

6. Note that switching costs can cause network externalities: if firms currently offering the same prices have economies of scale, consumers prefer to buy from the firm that others buy from, since this firm will have lower costs and offer lower prices in the future (indeed may be the only surviving firm). See Beggs (1989).

Example 0. Each of N consumers has reservation price R for one unit of a good produced by two firms, A and B, at constant marginal costs c^A and c^B respectively. Each of fraction σ^A of the consumers must pay a switching cost, s, to buy B's product, while each of fraction $\sigma^B=(1-\sigma^A)$ must pay s to buy from A. Let $s \geqq R-c^A>0$, $s \geqq R-c^B>0$. Firms simultaneously and non-cooperatively choose prices p^A and p^B, respectively.

In the unique equilibrium firms set the prices a monopolist would set, $p^A=p^B=R$, and earn profits $\pi^A=\sigma^A N[R-c^A]$ and $\pi^B=\sigma^B N[R-c^B]$. ‖

The conditions for firms to act exactly as monopolists in their shares of the market depend on the details of the model.[7] They are less likely to be satisfied if there are many firms, or if the firms' market shares are very asymmetric, because a firm with a small market share has little to lose and a lot to gain by cutting price. However, the result that switching costs built up in the past generate current profits that depend on firms' previous market shares is very general. Thus switching costs explain why market share may be valuable, and so why it may be rational for businesspeople to care as much as they seem to about their market shares.

3.2. *A two-period switching costs model: price wars for market share*

If market share is valuable, there will be competition for it. We now consider two-period models in which consumers have no switching costs in the first period but develop switching costs as a result of their first-period purchases, so firms have some market power in the second (final) period, as in Section 3.1 above. (Examples of such models can be found in Klemperer (1987*a*, *b*), Basu and Bell (1991), Padilla (1992) and, in a particularly simple form, in Example 1.)

The general method for solving a two-period model is first to solve for firms' optimal second-period behaviour and hence firms' second-period profits, for any given first-period market shares (since a firm's first-period market share determines the number of consumers who have a switching cost of buying from any other firm in the second period). That is, given the sizes of the switching costs and the nature of second-period competition, we solve for the functions $\pi_2^F(\sigma_1^F)$ that determine firm F's second-period profits, π_2^F, as a function of its first-period market share, σ_1^F.[8]

In the first period each firm aims to maximize its total discounted future profits,

$$V^F=\pi_1^F+\delta\pi_2^F(\sigma_1^F). \tag{1}$$

7. The switching costs need not be large: with symmetric firms, linear demand, constant marginal costs, homogeneous products and quantity competition, the monopoly outcome is the unique equilibrium if the switching costs exceed one-fifth of the resulting price-cost margin (Klemperer (1987*a*)). Note, however, the contrast with Diamond's (1971) much more dramatic result that even ε search costs can lead to monopoly pricing.

In Ex. 0, if any consumers have no switching cost, there is in general no pure-strategy equilibrium. See Deneckere *et al.* (1992) or Padilla (1992) for the mixed-strategy equilibrium. Pure-strategy equilibrium can be restored either by incorporating some real (functional) differentiation between products (Klemperer (1987*b*)), or by modelling switching costs as continuously distributed on a range including zero, in which case the equilibrium price falls continuously from the monopoly price to marginal cost as the average level of the switching costs decreases (Klemperer (1987*a*)). (The latter model is unusual in having consumers differ in their switching costs; it would be useful to have more models with this feature.)

8. Most existing models restrict to two firms and assume all consumers buy in the first-period equilibrium, so no information is lost by working with this single state variable σ_1^F. More generally, π_2^F might also depend on the relative sizes of rivals or on the number of consumers who did not purchase from any firm in the first period.

Since our main interest will be in prices, we assume for simplicity that firms choose prices in period one. (Everything we will say applies equally to cases in which firms choose quantities or other strategic variables.) Maximizing with respect to first-period price, firm F's first-order condition for equilibrium is

$$0=\frac{\partial \pi_1^F}{\partial p_1^F}+\delta \frac{\partial \pi_2^F}{\partial \sigma_1^F}\frac{\partial \sigma_1^F}{\partial p_1^F}. \tag{2}$$

Now provided the firm's first-period market share decreases in its first-period price, $\partial \sigma_1^F/\partial p_1^F<0$, and the firm's second-period profits are increasing in its first-period market share, $\partial \pi_2^F/\partial \sigma_1^F>0$, (this assumption is not as innocuous as it might seem—see Section 3.3) we have $\partial \pi_1^F/\partial p_1^F>0$. Therefore, p_1^F is lower than the price at which $\partial \pi_1^F/\partial p_1^F=0$. That is, price is lower than if the firm ignored the effect of switching costs on its second-period profits.[9] This suggests (but does not prove—see Section 3.3) that second-period switching costs lower first-period prices:

Example 1 (*Extension of Ex.* 0 *to two periods*).[10] Let competition in period two be as in Example 0, in which σ^A and σ^B are the fractions of consumers that bought from A and B in the first period.

Assume that in period one the N consumers view the firms' products as differentiated, and the consumers can be thought of as being uniformly distributed along a line segment [0, 1], with firms A and B at 0 and 1 respectively. (For example, consumers differ in their costs of learning how to use the different products; we are assuming no product differentiation in period two except for switching costs.) A consumer at y has a "transport" cost Ty of using A's product or $T(1-y)$ of using B's product, and in period one values consuming one unit of the product at r less his transport cost. The good cannot be stored. Firms and consumers use the same per-period discount factor $\delta \leqq 1$.

Firms have period-t marginal costs c_t^A and c_t^B and simultaneously and non-cooperatively choose prices p_t^A and p_t^B, respectively, in each period t. Assume $r-2T>c_1^F$, $R>c_2^F$, $F=A, B$, and $T>|c_t^A-c_t^B|$, $t=1, 2$.

Proposition 1. *In Example* 1, *prices are lower in the first period and are higher in the second period than if there were no switching costs in the second period.*

Proof. As in Example 0, $p_2^A=p_2^B=R$, so a consumer's second-period utility is the same whichever firm he buys from in period one. Therefore a consumer at y buys from A in period one if

$$p_1^A+Ty\leqq p_1^B+T(1-y) \Rightarrow y\leqq \frac{1}{2}+\left[\frac{p_1^B-p_1^A}{2T}\right],$$

so A's total profits over both periods (discounting second-period profits at rate δ) are

$$V^A=\sigma^A N[p_1^A-c_1^A]+\delta\sigma^A N[R-c_2^A] \tag{E1}$$

9. We are assuming π_1^F, π_2^F and σ_1^F are differentiable, that π_1^F is quasiconcave in p_1^F and that the first-order condition specifies an equilibrium. (In general we require either some product differentiation, as in Ex. 1, or the use of quantity competition, as in Klemperer (1987*a*), for differentiability.) These conditions apply in Ex. 1. In many simple models they do not apply, but the result and its intuition nevertheless remain valid. (See, e.g. Padilla (1992).)

10. The published model closest to this is Klemperer (1987*b*), but that model includes real (functional) product differentiation in period two as well as in period one, and also allows for changing tastes and for some uncommitted consumers in period two, so is considerably harder to solve.

where

$$\sigma^A = \frac{1}{2} + \left[\frac{p_1^B - p_1^A}{2T}\right] \tag{E2}$$

and symmetrically for B. It is now elementary that in equilibrium

$$p_1^A = T + \left[\frac{2c_1^A + c_1^B}{3}\right] - \delta\left[R - \left(\frac{2c_2^A + c_2^B}{3}\right)\right] \tag{E3}$$

and $p_2^A = R$. (It is easy to check that $p_1^A < p_2^A$ provided $(r - T) < R$, that is, unless all consumers' demands are considerably higher in period 2 than in period 1.)

In the absence of switching costs there is no connection between the markets in periods 1 and 2 (and in period 2 the lower-cost firm can serve the entire market at its rival's marginal cost), so

$$p_1^A = T + \left[\frac{2c_1^A + c_1^B}{3}\right] \quad \text{and} \quad p_2^A = \max\{c_2^A, c_2^B\}. \quad \|$$

The intuition, of course, is that firms' first-period prices are lower than if they were simply maximizing first-period profits, because they are competing for market share that will be valuable to them in the future. Examples of this aggressive competition for market share in the early stages of a market, before consumers have developed switching costs, include

- Banks give college students gifts and free banking services to induce them to open current accounts (and the banks then impose high charges after the students graduate).
- When deregulation has allowed banks to introduce new types of accounts they have often initially offered well-above-market rates of interest or cash bonuses for opening accounts.[11]
- Computer equipment is offered cheaply to educational institutions in the hope of generating future sales from current students.
- Unregulated TV stations show fewer advertisements at the beginning of a film than they show later on when viewers are "hooked".[12]
- Auto companies accept low profits on their bottom-of-the-line models because these models attract new customers who will later become valuable repeat-purchasers of larger, more profitable, models.[13]
- Auto insurance sold to new customers is less profitable than that sold to old customers (Nilssen (1990)).

11. When money-market checking accounts were introduced in the U.S. in December 1982, after industry deregulation, there was a promotional frenzy of high interest rates (more than 10% above the rates of money-market funds) and cash bonuses (25 dollars was typical) for opening accounts. Two years later the average interest rate paid was $\frac{1}{2}$% below that of money-market funds (*Wall Street Journal*, 21/11/1984). Spanish banks behaved similarly in 1990.

12. This is true of local U.S. stations (*Economist*, 10/9/1988) and TV stations in several other countries. It is not true of the three major U.S. networks (perhaps for reasons of collusion; local U.S. stations have smaller audiences so might gain by not colluding).

13. This is a common view among industry analysts. Statements such as "The Metro will . . . entice buyers into the bottom end of the Rover range, where they will be ready to climb higher" (CAR magazine, April 1989, p. 99) are also common.

Price wars

In all these examples the low price in the "first period" is followed by higher prices to exploit the mature market in the "second period".

Thus the presence of switching costs can explain "price wars" when (a) new markets open (as in the second example) or (b) a new group of customers enters the market and can be sold to separately from others (in the first example, each cohort of students can be treated as a separate sub-market) (Klemperer (1987*a*, *b*), Padilla (1992), and Example 1 above). Extensions of the model show that price wars also arise when (c) new firms enter the market; a new firm must charge a low price to attract consumers who know they will be exploited in the future, and an incumbent must also cut price when entry occurs so that its price is not too far above the entrant's, but all firms raise price subsequently (Klemperer (1983, 1989)).[14]

Limit pricing

Another variant of this model can explain how limit pricing deters entry (Klemperer (1987*c*, 1989)). If only one firm is present in the first period, then the larger the customer base it builds up in this period, the smaller is the share of customers available to any new entrant in the second period. Large enough first-period sales may therefore completely deter entry. Furthermore, even if entry in period two is unavoidable, larger first-period sales typically increase second-period profits so equation (2) (re-interpreting σ_1^F, in this variant of the model, as the incumbent firm's number of first-period sales) again implies that the pre-entry period (first-period) price is below the short-run profit maximizing price.[15]

3.3. *More general two-period switching costs models: second-period switching costs might increase first-period prices*

Example 1 was constructed so that firms' second-period prices were independent of their market shares; this makes the model (and extensions of it) much more straightforward to solve. However, more general models that include some consumers who are not completely locked-in in the second-period typically give the result that a firm with a lower market share sets a lower price, unless there are very substantial economies of scale. The reason is that a firm with fewer old customers is relatively more interested in setting a low price to attract new customers than in setting a high price to exploit old customers. In some models this effect can be so strong that a firm can actually be made worse off by increasing its market share, because reducing the competitor's market share makes the competitor so much more aggressive; this generally arises when the competitor's strategy changes discontinuously from a high-price strategy (to exploit its current customers) to a low-price strategy (to win new customers). In this case $\partial\pi_2^F/\partial\sigma_1^F<0$, so firms compete less fiercely

14. Klemperer (1983, 1989) shows this for an oligopoly and a dominant-firm-plus-fringe model, respectively. Elzinga and Mills (1991) provide empirical support for the latter model. Green and Scotchmer (1987) and Padilla (1992) show switching costs explain price dispersion across firms within a single period. Gallini and Karp (1989) show a monopolist holds sales in a market in which consumers have start-up costs.

15. Note that in contrast to the traditional literature (Gaskins (1971) etc.) this limit pricing reduces the entry of *rational* potential entrants; moreover unlike the more recent literature (Milgrom and Roberts (1982) etc.) it does not involve the incumbent dissipating substantial profits to signal information that could often be credibly revealed more cheaply (e.g. by hiring accountants to certify costs).

than they otherwise would in the first period in order to avoid gaining market share. First-period prices and profits are then higher than in the absence of second-period switching costs (Banerjee and Summers (1987)). Similarly, an incumbent may "limit overprice", that is, produce *less* than the short-run profit-maximizing output level, in order to reduce its customer base and so deter entry by its commitment to be more aggressive if entry does occur (Klemperer (1987*c*)).[16,17]

Example 1 was also constructed so that consumers' second-period utilities were independent of their first-period choices. In more general models, since a consumer who buys in period one is to some extent committing himself to buy the same product in period two, the consumer must consider his expected period-two utility when making period-one decisions. Therefore he will be more influenced by any real (functional) differentiation between products that will remain relevant in period two, and will be less influenced by any current price cut that applies only to period one, than if he could costlessly switch firms and so make each period's decision independently. In addition, the consumer will recognize that because a firm that sets a lower period-one price will obtain a larger share such a firm will, as noted above, generally set a higher price in period two.[18] For both these reasons, consumers will be less attracted by a first-period price cut than if there were no switching costs in the second period; that is, first-period demand is typically made less elastic by the presence of switching costs in the future. Therefore although equation (2) implies that firms charge lower first-period prices than if they ignored the effect of switching costs on their second-period profits, it is possible that first-period prices and profits may still be higher than in an otherwise identical market without second-period switching costs. Exactly this happens in Klemperer (1987*b*), which extends Example 1 to include real product differentiation (i.e. "transport" costs) in period two as well as period one, and also to allow for changing tastes and some new uncommitted customers in period two.

Finally, note our analysis has focused on prices net of switching costs. If consumers must pay a start-up cost in the first period in which they buy from any firm, then the real cost (price plus any start-up or switching cost) paid by consumers in the first period can of course be higher than in the absence of switching costs. Alternatively, if firms pay new consumers' start-up costs for them, or bear other costs of dealing with new consumers, then equilibrium prices to new consumers (but not, of course, profits from them) are raised by these costs and may be higher than in the absence of switching and start-up costs. In such cases prices may fall over time.[19]

16. In a growing market, the strategic advantage of a small (or zero) customer base can be so strong that a firm that can commit to not entering a market until the second period may make higher profits than its rival: the rival then prefers to enter in the first period and build up a (small) customer base to "milk" in the second period, than also to enter in the second period and compete directly with the first firm (Klemperer (1987*c*)).

17. The possibility of such perverse results is just the application in the switching-costs context of the ambiguous results about entry deterrence and the possibility of "limit pricing" developed in Schmalensee (1983), Fudenberg and Tirole (1984) and Bulow, Geanakoplos and Klemperer (1985). It is simplest to see this in a quantity competition model such as Klemperer (1987*c*) in which having previously sold to consumers with switching costs shifts a firm's current reaction curve *upwards* up to the quantity previously sold (because these consumers will pay more than otherwise this period) but *downwards* for a range thereafter (because increasing quantity slightly to serve any new consumers this period cuts the firm's price discontinuously by an amount equal to the switching cost, s, to all consumers).

18. Except if consumers infer that firms with lower prices have lower costs and will charge lower prices in the future (Bagwell (1987)) or if, with elastic demand and not-too-large switching costs, a firm that cut price deeply cannot raise price far without losing its new customers. However, the argument of this paragraph requires only that consumers do not expect the price cut to be maintained in full. See also Farrell (1986*a*).

19. If switching costs are created by repeat-purchase coupons, so new customers (who do not receive a discount) pay more than old customers, first-period prices may be either lower (Banerjee and Summers (1987), Klemperer (1987*a*, note 10)) or higher (Caminal and Matutes (1990)) than second-period prices.

4. DO SWITCHING COSTS MAKE MARKETS LESS COMPETITIVE?

4.1. *Extension to a many-period switching costs model*

A two-period model is appropriate either where there is a natural beginning to the market and we wish to distinguish "early periods" from "later periods", or where firms can distinguish new customers from old customers (as with banks offering current accounts to students) and so can treat every cohort of new customers as a separate sub-market.[20] However, a two-period model is less useful for analysing competition over many periods when new consumers are entering the market in every period (and some old consumers are leaving), and when firms are unable to discriminate between old and new consumers.

In the general, tth, period of a many-period model each firm maximizes its total future discounted profits starting from period t,

$$V_t^F = \pi_t^F + \delta V_{t+1}^F(\sigma_t^F) \tag{1'}$$

in which its value function from period $t+1$ will depend on its period-t market share.[21] (Of course π_t^F, and so also V_t^F, are themselves functions of σ_{t-1}^F, but we do not need to show this explicitly.) Maximizing with respect to its period-t price, firm F's first-order condition is now

$$0 = \frac{\partial \pi_t^F}{\partial p_t^F} + \delta \frac{\partial V_{t+1}^F}{\partial \sigma_t^F} \frac{\partial \sigma_t^F}{\partial p_t^F}. \tag{2'}$$

Thus, we obtain a result similar to our earlier one. Provided a lower current price raises the firm's current market share, $\partial \sigma_t^F / \partial p_t^F < 0$, and the firm's future total discounted profits are increasing in its current market share, $\partial V_{t+1}^F / \partial \sigma_t^F > 0$, we have $\partial \pi_t^F / \partial p_t^F > 0$. That is, the firm prices lower than it would if it ignored the fact that its market share will be valuable in the future. However, this does *not* tell us whether the firm prices higher or lower than in the absence of switching costs, because the firm's current demand is made more inelastic by the switching costs of its old customers who want to repeat purchase. (We are assuming firms cannot charge different prices to new and old consumers.) The firm must therefore in every period balance the incentive to charge a high price to exploit its locked-in customers, against the incentive to set a low current price to attract new customers that build up the firm's current market share and so increase future profits. Nevertheless, the next sub-section explains that we generally expect the first incentive to

20. It seems more likely that firms will have the information to discriminate between old and new consumers when switching costs are transaction costs (such as opening an account or forming a personal relationship) than when they are informational or psychological.

21. We are assuming period-$t+1$ profits depend on history only through σ_t^F. This might not be the case if consumers' switching costs increase over time, or if some consumers try more than one product and then have no switching costs of using any of these products. (See also note 8 and Nilssen (1992).) Our formulation (and Prop. 2) also rules out firms using "punishment" strategies which might support (non-Markov) "collusive" equilibria in an infinite-horizon game. (Klemperer (1987*a*) argues informally that switching costs may facilitate collusive outcomes, but Padilla (1995) argues the opposite.) We assume π_t^F are bounded and $\delta < 1$, so V_t^F are bounded and, as in Sec. 3.2, we assume the first-order condition specifies an equilibrium, and π_t^F is quasiconcave in p_t^F. All our assumptions and discussion are consistent with Ex. 2, which is due to Beggs and Klemperer (1989). To (1995) analyzes a variant of this model. Farrell and Shapiro (1988) also has firms setting prices in each of many periods, but has a number of unusual features: consumers are myopic, and in each period one firm sets price first and sells to all the repeat purchasers while the other firm sells to all the new consumers. (Chen and Rosenthal (1994) and Padilla (1995) analyze similar models with firms choosing prices simultaneously.) von Weizsäcker's (1984) continuous-time model restricts firms to constant-price strategies, but Wernerfelt's (1991) continuous-time model, Holmes' (1990) model of a monopolist, and Phelps and Winter's (1970) and Sutton's (1980) models of search costs have some similar features to those we discuss.

dominate; that is, we expect prices to be generally higher than in the absence of switching costs.

4.2. *Price levels*

To compare the price in the steady-state of a market with switching costs, with the price in an otherwise similar market without switching costs, it is useful to re-write the firm's value function, (1'), as an explicit function of its and its rivals' prices in both periods,

$$V_t^F = \pi_t^F(p_t^F, p_t^G) + \delta V_{t+1}^F(p_t^F, p_t^G, p_{t+1}^F, p_{t+1}^G). \tag{1'a}$$

Here p_t^G and p_{t+1}^G are vectors of the rivals' prices if firm F has more than one competitor, but for simplicity—it does not affect our results—we shall proceed as if F had one competitor only. (Equation (1'a) is the same equation as (1'), but (1') recognizes that provided firms optimize in period $t+1$, V_{t+1}^F can be re-written (abusing notation) as a function just of $\sigma_t^F(p_t^F, p_t^G)$.[22]) Firm F's first-order condition as an explicit function of all the prices is then

$$0 = \frac{\partial \pi_t^F}{\partial p_t^F} + \delta\left(\frac{\partial V_{t+1}^F}{\partial p_t^F} + \frac{\partial V_{t+1}^F}{\partial p_{t+1}^G}\frac{\partial p_{t+1}^G}{\partial p_t^F}\right) \tag{2'a}$$

since firm F chooses its period-t price taking p_t^G as given (i.e. $\partial p_t^G/\partial p_t^F = 0$) and also later chooses its period-$(t+1)$ price optimally (so $\partial V_{t+1}^F/\partial p_{t+1}^F = 0$). (Equation (2'a) is, of course, just a re-statement of equation (2').)

Relative to a market without switching costs, there are two main effects on prices:

First, customers who previously bought from a firm are to some degree locked-in to repeat-purchasing from the same firm. Therefore, if firms cared only about current profits, they would exploit these customers by charging higher prices than if no consumers had switching costs. That is, firms' demands are less elastic, so $\partial \pi_t^F/\partial p_t^F$ is larger at any price, in the relevant range, so the firm must raise price to bring (2'a) into balance. This is the effect that arises in the second period of a two-period model.

On the other hand, firms recognize that a lower price today increases future profits by attracting new customers who will become tomorrow's repeat-purchasers. That is, $\partial V_{t+1}^F/\partial p_t^F < 0$, so the firm lowers price to bring (2'a) into balance, just what we found was generally the dominant effect in the first period of a two-period model.

These two main effects can exactly balance in a simple model in which there is no discounting and each firm commits once and for all to a price that it cannot subsequently change; in this case, prices are the same with switching costs as without them.[23] However, in a more realistic model, there are several additional effects that make prices higher than in the absence of switching costs:

First, discounting reduces the importance of the desire to attract new customers relative to the desire to exploit current customers. The simple fact that $\delta < 1$ multiplies

22. Writing V_{t+1}^F as in (1'a) is an abuse both because we have changed the arguments of V_{t+1}^F and because, as we recognize below, p_{t+1}^F is chosen to maximize V_{t+1}^F.

23. Consider Ex. 2: if firms committed to constant prices, consumers would never wish to switch, so new consumers' behaviour would be the same as without switching costs. Furthermore, with no discounting and an infinite horizon, current consumers would have no weight relative to future new customers, so it would be irrelevant that firms could if they wished exploit any old locked-in consumers at the date of commitment.

the second term of (2'a) suggests that prices are higher in the presence than in the absence of switching costs.[24]

Second, as discussed in Section 3.3, if one firm raises price today, its competitor(s) will gain share today and so, in most markets with switching costs, will raise price tomorrow. Thus each firm has an incentive to price high today, to make its competitor "fatter" and less aggressive tomorrow. That is, $\partial p^G_{t+1}/\partial p^F_t > 0$, so since also $\partial V^F_{t+1}/\partial p^G_{t+1} > 0$, the last term of (2'a) is positive and counteracts the negative sign of $\partial V^F_{t+1}/\partial p^F_t$, that is, counteracts the desire to attract new consumers.

Third, as also discussed in Section 3.3, even new consumers' demand is less elastic than in the absence of switching costs, both because consumers recognize that a lower price today presages a higher price tomorrow, and because consumers are less influenced by current prices and more influenced by permanent product characteristics than if they could costlessly switch firms. Therefore, $\partial \pi^F_t/\partial p^F_t$ is more positive and $\partial V^F_{t+1}/\partial p^F_t$ is less negative at any price so (2'a) implies a higher equilibrium price.[25]

These three reasons suggest a strong presumption that switching costs raise prices to both new and old customers when firms cannot discriminate between them. Since oligopolists' prices are generally below the joint-profit-maximizing price, this suggests switching costs raise oligopolists' profits.[26]

Example 2 (*Extension of Ex.* 1 *to many periods*). In each period t of infinitely-many discrete periods, N_t "new" consumers enter the market and their tastes in this period are exactly those of the consumers in period one of Example 1. Each "old" consumer (i.e. consumer who purchased in a previous period) has tastes exactly like those of consumers in period two of Example 1 (and a switching cost large enough that he never buys from the firm other than the one from which he previously bought). After each period a fraction $(1-\phi)$ of both new and old consumers leaves the market ("dies"); where an individual's probability of dying is independent of history. Firms A and B have marginal costs c^A and c^B, and in each period simultaneously and non-cooperatively choose prices p^A_t and p^B_t.[27] We assume $N_{t+1} = gN_t$, so $g > 1$ represents a steadily growing market, while $g = 1$ represents a market of constant size. We consider the case in which the fraction of consumers who are old is in steady state, so equals $\phi/g < 1$. (The fraction who are old converges to this

24. Of course, if $\delta < 1$ welfare is not a function of steady-state prices, but we expect the subsequent reasons we give for higher prices to apply even as $\delta \to 1$ (and this is true in Ex. 2). Note that constant prices committed to when *all* customers are new may not be higher than without switching costs; although we expect constant prices committed to when some customers are old to be higher, this reflects only the value of the locked-in customers at the time of commitment (see note 23). Note also that discounting reduces the willingness of new customers to enter the market (since a new customer is not just buying the product today but is also investing in the right to buy tomorrow without paying a switching cost) and that this might lead firms to lower prices.

25. Both this effect and the previous effect are reduced by discounting. Note also that we are assuming that products' real (functional) characteristics, and consumers' tastes for these characteristics, change more slowly than firms are able to change their prices—it is irrelevant that firms' *equilibrium* prices are in fact constant over time. von Weizsäcker (1984) obtained the result that switching costs may lower prices because he assumed that consumers' tastes change but firms are committed to constant prices, so the effect we are discussing is reversed.

26. By contrast, a monopolist's profits would be lowered by raising prices. Thus, for example, with overlapping generations of consumers who live two periods, a monopolist who cannot pre-commit to future prices generally lowers its steady-state profits if it requires every customer to pay s for a discount coupon that repays s in present value when the customer repeat-purchases; the first and third of the three reasons given in the text mean that the steady-state time-consistent price exceeds the original monopoly price (which would also be the steady-state price if the firm could pre-commit to future prices).

27. Since all a firm's customers pay the same price, this model does not apply directly to discount coupons etc. (see Sec. 2(e)). However Beggs and Klemperer (1989, Sec. 5.1) amends the model to cover this case, and shows that the results are very similar.

value from any starting point if $\phi < g$.) Consumers and firms use a per-period discount factor $\delta < 1/g$ (so value functions are bounded).

Proposition 2. *In Example 2, for a range of parameters there exists a Markov-perfect equilibrium (i.e. equilibrium in which firms' prices depend only on their previous-period market shares and not otherwise on history) in which firm A sets prices* $p_t^A = c^A + \alpha + \beta\sigma_{t-1}^A + \gamma(c^B - c^A)$ *where* α, β, *and* γ *are positive constants that depend on* δ, g, ϕ *and* T, *firm B behaves symmetrically, all consumers buy in every period and no consumer switches between firms. In this equilibrium, if* $c^A = c^B$, *both firms' prices are higher than in the absence of switching costs whatever their previous-period market shares, in steady state* $\sigma^A = \sigma^B$, *and firms' steady-state prices are increasing in* ϕ *and* T *and decreasing in* δ *and* g.

Proof. See Beggs and Klemperer (1992).[28] ||

Note that higher anticipated rates of growth increase the relative importance of the future and so reduce prices—Slade (1989) provides empirical evidence for the importance of this and other market-share effects in metals markets. Nevertheless, in Example 2 prices are higher than in the absence of switching costs for all growth rates.

Elastic demand

Example 2 assumes perfectly inelastic industry demand in the relevant range. More generally, switching costs may reduce industry demand by making it costly to consume multiple brands (this reduces demand if consumers value variety) or simply by imposing a start-up cost of using any brand. These effects further reduce welfare, but may lead to lower prices than in the absence of switching costs. Even if prices are not lower, profits may be reduced relative to the case of no switching costs.

5. APPLICATIONS TO MACROECONOMICS AND INTERNATIONAL TRADE

This section uses the comparative statics of equation (2′) to explore implications of firms' tradeoff between charging a high price to concentrate on current earnings, and charging a low price to invest in future profits: in particular, increasing a parameter x that raises the marginal present value of a firm's market share, $\delta(\partial V_{t+1}^F/\partial\sigma_t^F)$, requires a larger value of $\partial\pi_t^F/\partial p_t^F$ for (2′) to continue to hold and hence a lower current price p_t^F in the new equilibrium, provided that $\partial\sigma_t^F/\partial p_t^F < 0$ and that x does not directly significantly affect $\partial\pi_t^F/\partial p_t^F$ and $\partial\sigma_t^F/\partial p_t^F$. More formally, (2′) implies that in stable, symmetric, oligopoly, we have

$$\operatorname{sign}\left[\frac{dp_t^F}{dx}\right] = \operatorname{sign}\frac{\partial}{\partial x}\left[\frac{\partial\pi_t^F}{\partial p_t^F} + \delta\frac{\partial V_{t+1}^F}{\partial\sigma_t^F}\frac{\partial\sigma_t^F}{\partial p_t^F}\right]. \tag{3′}$$

The applications of this that we explore below can be illustrated either in a many-period model (such as Example 2), or by examining the first-period of a two-period model

28. This model is non-trivial to solve because both firms' and consumers' current choices depend on, and must be consistent with, their predictions about how future prices will evolve as a result of those choices. However, Beggs and Klemperer (1989, 1992) derive formulae for α, β and γ. They show $\alpha > T$, $\beta > 0$, and $\gamma \approx \frac{1}{3}$, whereas if all consumers were "new", that is, there were no switching costs, then $\alpha = T$, $\beta = 0$, and $\gamma = \frac{1}{3}$. Chow (1995) offers an alternative solution method.

(such as Example 1) since the same basic tradeoff between current and future profits is present in all but the last period of a finite-period model. (Our comparative statics assume the number of firms in the industry is unaffected, but we discuss the effects of entry and exit in Section 7.3.)

5.1. *Interest rates, costs, and exchange-rates*

(a) *Interest rates and inflation*

A higher (real) interest rate corresponds to a smaller discount factor δ. Examining (3′) (with $x=\delta$) and conjecturing that the dominant effect is the direct effect, we expect firms' current prices, p_t^F, to be higher. That is, firms charge higher prices because a higher interest rate reduces the marginal present value of an investment in market share (i.e. reduces $\delta(\partial V_{t+1}^F/\partial\sigma_t^F)$) just as it reduces the value of any other investment. Fitoussi and Phelps (1988) have argued that this effect helps explain the high rates of inflation in Europe in the early 1980s (though they expressed their argument slightly differently, in terms of search costs rather than switching costs). The result is not unambiguous. For example, an interest rate change also affects consumer behaviour, and hence $\partial\sigma_t^F/\partial p_t^F$ and $\partial\pi_t^F/\partial p_t^F$. Furthermore if high current prices reduce the size of firms' captive markets, firms may in the future have incentive to lower prices.[29] Nevertheless it is immediate from equation (E3) that $dp_1^F/d\delta<0$, so higher interest rates raise current prices in the first period of Example 1. It is also easy to confirm for the steady state of the symmetric case of Example 2 that a current increase in interest rates raises the current price level, and that a permanent increase in interest rates permanently raises the price level with a concomitant temporary increase in inflation.

(b) *Anticipated future changes in market conditions*

Anticipated future changes in market conditions will have immediate effects on prices in markets with switching costs. For example, a future cost or tax increase that will lower the future marginal value of market share, $\partial V_{t+1}^F/\partial\sigma_t^F$, will raise current prices, p_t^F, and profits (see (3′)). In fact, an increase in the future marginal tax rate on profits could even *raise* oligopolists' total discounted future after-tax profits. (It is immediate from (E3) that $dp_1^F/dc_2^F>0$ in Example 1, and a similar result can be obtained for Example 2.)

(c) *Exchange rate pass-through to import prices*

In a market with switching costs, import prices may be relatively insensitive to current exchange rate changes that are expected to be only temporary, but highly sensitive to expectations about future exchange rate changes.

To see why, observe that a temporary exchange rate change, say an appreciation of the domestic currency, has two effects on a foreign firm. First, there is the standard "cost effect" that would also be present in the absence of switching costs, that the foreign firm's current costs measured in the domestic currency are lower so, ceteris paribus, we expect it to lower its (domestic currency) price. Second, however, current revenues from the

29. There are also other theories about the links between search costs and inflation and market power, e.g. inflation increases price dispersion (if there are menu costs to changing prices) and so may increase search and hence increase competition (Bénabou and Gertner (1993)). Similar results may, perhaps, apply with switching costs.

market are now worth more to the firm than revenues in the future when the appreciation of the currency will have been reversed. Equivalently, the interest rate applied to future domestic-currency earnings has increased so, as Section 5.1a showed, current prices are raised. This "interest-rate effect", that the firm has an incentive to raise price to take domestic currency profits while they are most valuable, opposes the standard "cost effect", and so may result in prices being relatively insensitive to exchange rate changes that are expected to be only temporary.[30]

An anticipated future appreciation of the domestic currency also has a "cost effect" and an "interest rate effect" on current prices. First, the future appreciation will lower the foreign firm's future costs, measured in the domestic currency so, as Section 5.1b showed, typically lowers current prices. Second, the future appreciation raises the value of future revenues, so lowers the interest rate applied to future domestic-currency earnings, so by the logic in Section 5.1a also lowers prices. Since the two effects are now in the same direction, current import prices may be very sensitive to expectations about future exchange rates.[31]

Example 3 (*Extension of Ex.* 1 *to international trade*).[32] Consider Example 1 generalized so that each firm is foreign and incurs its costs, c, in its own currency (for simplicity, the same currency and we are assuming $c^A = c^B \equiv c$). In period t each unit of the foreign currency is worth $1/e_t$ domestic currency units. We assume firms' own-currency interest rate, and hence their own-currency discount factor, δ, is independent of e_1 and e_2 (see note 30). Write $\tilde{c}_t = c/e_t$ and $\tilde{\delta} = (e_2/e_1)\delta$, so $\tilde{c}_t$ equals firms' period-t costs expressed in domestic currency units and $\tilde{\delta}$ equals the discount factor firms apply to domestic currency revenues. We assume $r - 2T > \tilde{c}_1$, $R > \tilde{c}_2$, and that all agents know all parameter values in advance of period 1.

Proposition 3. *In Example* 3, *the effect on the current* (*domestic currency*) *price of an exchange rate change that is expected to be temporary* (*i.e. a change in* e_1, *holding* e_2 *constant*) *is* $dp_1^F/de_1 = [-\tilde{c}_1 + \tilde{\delta}(R - \tilde{c}_2)]/e_1$, *and the effect on current price of an anticipated future exchange rate change* (*i.e. a change in* e_2, *holding* e_1 *constant*) *is* $dp_1^F/d\tilde{e}_2 = -\tilde{\delta}R/e_2$, $F = A, B$.

It follows that current prices are more sensitive to a proportional change in the future exchange rate than to the same proportional change in the contemporaneous exchange rate, i.e. $|e_2 dp_1^F/de_2| > |e_1 dp_1^F/de_1|$ *if* $\tilde{\delta} > \tilde{c}_1/(2R - \tilde{c}_2)$, *and the effect of a contemporaneous temporary exchange rate change is "perverse", i.e.* $dp_1^F/de_1 > 0$, *if* $\tilde{\delta} > \tilde{c}_1/(R - \tilde{c}_2)$.

30. Our discussion (and Ex. 3) assumes for simplicity that foreign-currency real interest rates remain constant, so if capital is mobile the domestic interest rate must rise to prevent riskless arbitrage. If instead domestic real interest rates remain constant and interest rates in firms' home countries fall, a firm competing in more than one market would reallocate some of its output away from the domestic market with the same results for prices. (See Froot and Klemperer (1989, esp. p. 642).) If the temporary exchange rate change were anticipated, the standard effect on prices would be further counteracted by the fact that prices would have been lower than usual in the previous period (see next paragraph).

31. A permanent appreciation is equivalent to the sum of a current temporary appreciation and a (proportionately equal) expected future appreciation. The "interest rate effects" cancel, leaving the (relatively standard) "cost effects". To separate the "cost" and "interest rate" effects in Ex. 3 we can write

$$\frac{dp_1^F}{de_t} = \frac{dp_1^F}{d\tilde{c}_t}\frac{d\tilde{c}_t}{de_t} + \frac{dp_1^F}{d\tilde{\delta}}\frac{d\tilde{\delta}}{de_t}$$

(since $\tilde{\delta}$ is the discount factor that the firms apply to future profits).

32. These results can also be demonstrated by extending Ex. 2, see Beggs and Klemperer (1989, Sec. 5.3), but the two-period model is easier to work with. See Froot and Klemperer (1989) for a more general two-period model.

Proof. Firm A's total profits, measured in its own currency, are (see eqn. (E1))

$$V^A = \sigma^A N[e_1 p_1^A - c] + \delta\sigma^A N[e_2 R - c] = e_1(\sigma^A N(p_1^A - \tilde{c}_1) + \tilde{\delta}\sigma^A N(R - \tilde{c}_2))$$

in which σ^A is as defined in (E2) above, so in equilibrium (see (E3)), $p_1^A = T + \tilde{c}_1 - \tilde{\delta}(R - \tilde{c}_2)$ and $p_2^A = R$, and symmetrically for firm B, and the proposition follows directly. ‖

Froot and Klemperer (1989) and Sapir and Sekkat (1993) present empirical evidence that supports these results. In particular, the very large swings in the value of the dollar in the 1980s were thought to have unusually large temporary components, and the "pass-through" from these exchange rate changes to import prices was much lower than historically.[33]

5.2. *Price-cost margins across the business cycle*

Models of markets with switching costs can explain not only why price-cost margins might be different in "booms" than in "busts", but also why there may be significant variation among industries.[34]

In an industry in which higher current demand reflects larger demands from given proportions of old and new consumers, we can model a "boom" by simply multiplying up the value of current-period profits by a factor, $K > 1$. This has the same effect on pricing as dividing δ by K, hence just as in Section 5.1a, *raises* prices, because firms prefer to take profits in the current period rather than in the relatively less attractive future.[35]

On the other hand, if a boom in the industry's demand is caused by more new customers entering the market (but these new customers will subsequently become repeat purchasers with switching costs) firms *cut* prices because demand is more elastic and because the boom is also an easier period than usual in which to build market share.[36] (Using (3'), $\partial\sigma_t^F/\partial p_t^F$ and $\partial\pi_t^F/\partial p_t^F$ are both decreased at any given price, so p_t^F falls. Beggs and Klemperer (1989, Section 5.3) provides formal demonstrations for this and the previous argument in the context of Example 2.)

Another reason why switching costs may generate counter-cyclical margins is that firms are more likely to be liquidity-constrained in recessions, hence place a greater weight on short-run profits than on future profits, and so cut their investments in market share

33. "*J*-curves", and hysteresis, are other international trade phenomena which switching costs can explain, because even if prices respond rapidly to exchange rates, locked-in customers do not switch, so sales quantities respond only slowly as new uncommitted consumers replace old customers in the market. See Hartigan (1995). To (1994) presents a model in which it is optimal government policy to subsidize exports if, and only if, foreign consumers have switching costs.

34. Applied economists disagree about the variation of margins across the business cycle, see Carlton (1989). Rotemberg and Woodford's (1991) recent evidence favours counter-cyclical margins. They interpret this as supporting Rotemberg and Saloner's (1986) argument that prices are lower in "booms" because the increased relative importance of the present makes collusion harder to sustain. However, their evidence is also consistent with theories based on switching costs.

35. Demand increases can of course increase prices in a standard (single period) oligopoly model. The effects we are discussing here are additional to any that arise in a standard model, and arise even if there is no change in prices in the standard model.

36. A similar argument is in Bils (1989). He considers consumers who do not initially know how much they will enjoy a product, but whose uncertainty is resolved after one purchase (see Sec. 2(d)). Consumers who like the good will then be willing to pay more for it than before, and so are analytically similar to consumers with switching costs. Bils shows that a monopolist who cannot commit to future prices will lower prices in periods with high inflows of potential new customers. Bils also provides evidence concerning which markets are characterized during booms more by the inflow of new customers than by larger demands from old customers.

by raising price. Chevalier and Scharfstein (1993) derive this result by introducing capital-market imperfections into our Example 1.[37] They also provide evidence for this view from the supermarket industry; they show that during regional and macroeconomic recessions, the most financially constrained supermarket chains tend to raise their prices relative to less financially constrained chains. Okun (1981, especially pp. 149–151) makes a verbal argument along similar lines; he suggests "managers prefer to report to shareholders a record of profit that is less volatile over the cycle" (p. 150), so that in bad times a firm will dis-invest in market share and raise price, while in good times (when profits are high anyway) the firm cuts price to invest in market share and so shift profits into the future.[38]

6. PRODUCT VARIETY AND MULTIPRODUCT COMPETITION

6.1. *Is competing head-to-head less competitive?*

When firms are artificially differentiated by switching costs, they have less incentive to differentiate themselves in any real way: if firms differentiate their products, some consumers may, in spite of their switching costs, buy from more than one firm in order to increase product variety. These consumers may then be relatively sensitive to price competition; that is, a small price cut may persuade these consumers, who are anyway patronizing more than one supplier, to move a large part of their business. If, instead, firms offer functionally identical products, then functional differences are never a reason to pay the switching cost of buying from a new firm. A small price cut might induce a few consumers with small switching costs to move all their business to the firm from its rival(s), but no consumer moves only a fraction of his purchases. The result may be that prices are *higher* with identical than with differentiated products, in contrast to the standard argument that differentiating products reduces price competition.

Example 4 (*Extension of Ex.* 0 *to multiple varieties*). Consider Example 0, but assume each firm first chooses which of two functionally different versions, X and Y, of the product to sell. As before, each consumer has inelastic demand for a total of one unit of the product, and his utility (before accounting for prices and switching costs) from consuming one unit of either X or Y is R. However, each consumer values variety and his gross utility from consuming f units of X together with $(1-f)$ units of Y is $R+v-\mu(\frac{1}{2}-f)^2>R$, if $0<f<1$. (Thus v is the value of maximum variety ($f=\frac{1}{2}$) relative to complete specialization, while μ measures the consumer's loss from consuming the goods in less equal proportions.) For simplicity, let $\sigma^A=\sigma^B=\frac{1}{2}$, $c^A=c^B=c$ and assume $v>2s>(R-c)>\mu>0$.[39]

37. Klemperer (1990) also suggested this result, and Gottfries (1991) obtains this result in a model with search costs that is equivalent to a model with switching costs. In our setting a simple, if *ad hoc*, way to capture these effects is to rewrite the firm's period-t value function as $V_t^F=\sum_{i=t}^{\infty}\delta^{i-t}U(\pi_i^F)$ in which $U(\cdot)$ is concave in current-period profits, so $V_t^F=U(\pi_t^F)+\delta V_{t+1}^F$ and the term $\partial\pi_t^F/\partial p_t^F$ in (2′) and (3′) is therefore multiplied by $\partial U/\partial\pi_t^F$. Since a boom raises π_t^F it lowers $\partial U/\partial\pi_t^F$ so, using (3′), lowers price.

38. Note that if all firms behave this way their market shares never actually change, although firms will succeed in shifting profits between periods. Note also that a more fundamental analysis of how managers respond to a firm's incentive scheme is required to verify Okun's views. Managers may reduce earnings volatility for signalling reasons as well as reasons of risk aversion and credit-market constraints, and signalling reasons create additional complications, e.g. a manager may increase the observable component of a firm's increase in value in order to get a better job elsewhere. Also current period actual profits (on which the text focuses) are synonymous with neither reported earnings nor the observable component of a firm's increase in value. Fudenberg and Tirole (1995) model managers' incentives to smooth reported earnings.

39. In this example, consumption utility is discontinuous at $f=0$ and $f=1$, but it is trivial that Prop. 4 also holds for all (continuous) utility functions $U(f)$ with $U(0)=U(1)=R$, $U(f)=R+v-\mu(\frac{1}{2}-f)^2$ for $\theta\leqq f\leqq(1-\theta)$, $U(f)\leqq U(\theta)$ otherwise, in which θ is an appropriately chosen constant. The example can be obtained as a special case of Klemperer (1992).

Proposition 4. *In Example* 4, *firms' profits are higher if they sell functionally identical products (i.e. both sell X or both sell Y) than if they sell functionally different products.*

Proof. If both firms sell the same product, $\pi^A=\pi^B=\frac{1}{2}N(R-c)$, as in Ex. 0. If firms sell different products, a consumer "attached to" firm A obtains net utility $R-p^A$ by buying only from A, obtains net utility $R-p^B-s$ by buying only from B, and obtains net utility $R+v-\mu(\frac{1}{2}-f)^2-fp^A-(1-f)p^B-s$ by buying f units from A and $(1-f)$ units from B, which latter function is maximized when $f=\frac{1}{2}+(p^B-p^A)/2\mu$. Provided v is large enough, all consumers do buy from both firms, so $\pi^A=[p^A-c][\frac{1}{2}+(p^B-p^A)/2\mu]N$. It follows easily that provided $v>s+(\mu/4)$, the unique equilibrium of the game that follows after firms choose to produce different products has $p^A=p^B=c+\mu$, so $\pi^A=\pi^B=\frac{1}{2}N\mu$. ‖

Thus far we have assumed firms sell a single variety each. However, the same reasoning applies when each firm sells several varieties but, perhaps because of fixed costs of selling additional brands, no firm can sell all possible varieties: in the presence of switching costs between suppliers, firms may choose to compete "head-to-head" by making product choices that directly match their competitors', rather than choose interlaced ranges of products that "fill in the gaps" between their competitors' offerings (Klemperer (1992); Lindsay and Mulherin (1992) offer empirical support for this theory).

6.2. *Multiproduct competition*

The above discussion immediately suggests a rationale for multiproduct firms: if consumers value variety, but have costs of switching suppliers, firms that sell a single product only, and thereby force consumers to either incur these switching costs or forgo variety, may be at a serious disadvantage relative to a "full-line producer".[40] Thus, for example, the Airbus Consortium has explained that its reason for producing a full line of aircraft is that "without a family of aeroplanes to rival Boeing's, Airbus would be at a serious disadvantage in the market".[41,42]

Since switching costs between suppliers can help explain the existence of "product lines", it seems natural to incorporate switching costs into models of competition between multiproduct firms. Trivially, switching costs can explain mergers that broaden product lines. For example, "one of the stated main strategic objectives of [Aerospatiale and Alenia in their 1991 bid to acquire] de Havilland is to obtain coverage of the whole range of commuter aircraft", a market in which the consumers "derive cost advantages from buying different types [of aircraft] from the same seller".[43]

40. This explanation of multiproduct firms—purchasing economies of scope on the demand side—parallels the explanation provided by economies of scope on the production side (see, for example, Panzar and Willig (1981)).

41. Quoted from the *Economist*, 3/9/1988, survey p. 9. The benefits of "commonality"—the savings in training costs and maintenance facilities from buying from a single manufacturer—create switching costs to commercial airlines of 10%–20% of an aircraft's price, according to the *Economist*, 30/1/1988, p. 51. Consistent with this, "British Airways, for example, estimates that it saved around $100 million by adding 11 767s (rather than A310s) to its fleet of 37 757s because of shared pilot training, flight training, spare engine, parts, ground training and equipment, test equipment, etc." (March (1990, p. 28)).

42. Consumers may exhibit switching costs between brands rather than firms. Thus marketing practitioners often recommend "umbrella branding" (selling goods in related markets under the same brand name) and "brand extension" (selling a new product under a brand name that is well-established in a related market) to exploit "brand-loyalty".

43. Quoted from the *Official Journal of the European Communities*, 5/12/1991, p. 51. (No. L334/42). Note that depending on the nature of the switching costs, firms may be able to achieve the same outcome by signing compatibility and exclusivity and/or joint-marketing agreements as by merging.

Similarly, switching costs can help explain the number of products that each firm offers: Klemperer and Padilla (1995) show that firms may offer too many varieties from the social point of view. The intuition is that when consumers prefer to concentrate their business with a single supplier, a firm that offers an extra product captures consumers' business not just for that product, but for other products also. Likewise a shop that opens on Sundays may win the regular Monday to Saturday business of consumers who prefer to visit stores with which they are familiar. Thus forbidding firms to introduce a new product, or forbidding Sunday shopping, can be an appropriate public policy, and the same analysis justifies the verbal argument the European Commission made when it forbade the proposed takeover of de Havilland that would have extended Aerospatiale–Alenia's product line (see preceding paragraph).

As another example of the importance of switching costs for product line decisions, Klemperer (1992) uses the intuition developed in the previous subsection to explain why competing firms sometimes offer very similar ranges of products.

These examples suggest that explicitly modelling the effects of switching costs should also yield insights into other aspects of competition between multiproduct firms.

7. OTHER ISSUES

7.1. *Firms' incentives to create switching costs*

The preceding analysis has treated switching costs as exogenous, but how and when switching costs arise are important questions. While some kinds of switching costs, e.g. transaction costs and psychological switching costs, may be unavoidable, their sizes are generally not immutable, and other kinds of switching costs are typically the result of deliberate firm actions.

The simplest way to endogenize switching costs is to add to existing models an initial ("zeroth") period, in which firms make compatibility or other choices that determine whether or not switching costs subsequently arise; we expect switching costs to be chosen where they raise future profits more than any current costs to firms of creating them. Thus in Example 2 both firms prefer large switching costs to no switching costs, unless their costs and market shares are very asymmetric. Koh (1993) analyses a model in which each firm independently chooses consumers' average costs of switching to its own product and in his model one firm chooses a large switching cost while the other chooses a smaller switching cost. On the other hand Matutes and Regibeau (1988) and Economides (1989) present models in which firms prefer their product lines to be compatible rather than incompatible. Firms are more likely to choose compatibility if, as in the latter two models, their products are not functionally identical, both because compatibility directly increases demand when consumers value variety and because, as discussed in Section 6.1, product differentiation mitigates the anti-competitive effects of switching costs by giving consumers an incentive to use more than one supplier.[44]

In the above examples, firms choose the size of "real" switching costs. Banerjee and Summers (1987) and Caminal and Matutes (1990) have shown firms may wish to commit

44. Similarly, Stahl (1982) shows firms selling imperfect substitutes may choose physically close locations to reduce consumers' search costs.

In Ex. 1 switching costs reduce firms' discounted profits if $c_2^A \neq c_2^B$, but this is due to the particular (different) demands in the two periods. In Klemperer (1987*b*) which is similar except that demand would, absent switching costs, be the same in both periods, switching costs usually raise profits, as explained in Sec. 3.3.

Of course it can matter how individual firms' choices affect switching costs (e.g. is compatibility achieved only if both firms wish it?). See David and Greenstein (1990) for further references on choice of compatibility standards.

to offering repeat-purchase coupons before competing in a two-period duopoly. The intuition, as usual, is that committing to treat different groups of consumers differently makes consumers less homogeneous in their preference between firms. Both firms commit to coupons in order to commit to focusing on their own consumers, and so relax competition in the second period. (Of course committing to give some consumers a future discount is not directly costly in the absence of any commitment to future prices—it would be equivalent to commit instead to a surcharge on the remaining consumers.) In a different vein, Aghion and Bolton (1987) have shown that a firm may sign contracts with its customers to create switching costs that deter new entry—the incumbent firm and its customers increase their expected joint profits by forcing any potential entrant to pay a fee to break these contracts or, equivalently, forcing any entrant to set a low enough price that the customers would pay the switching costs (the "liquidated damages") of breaking the contracts.

7.2. *Mitigating the effects of switching costs*

Conversely, actions may be taken to avoid some of the effects of switching costs. Where companies sell incompatible products, third-parties may supply converters that reduce switching costs (Farrell and Saloner (1992)).

Companies may license "second-sources" to create competitors to themselves to which consumers have no costs of switching, thus reducing their future monopoly power over customers and so making themselves more-attractive current suppliers (Farrell and Gallini (1988)). More obviously, suppliers may develop reputations for behaving as if switching costs are not significant, may write long-term contracts with their customers (Farrell and Shapiro (1989)), or in extreme cases even vertically integrate with them (Williamson (1975), Klein, Crawford, and Alchian (1978)).[45]

We have assumed consumers are "small" so that their individual decisions have no effect on firms' prices. Where a customer represents a significant fraction of the market (or firms offer customer-specific contracts) customers may incur the switching (or start-up) cost of using more than one supplier, in order to force suppliers to behave more competitively (Greenstein (1992, Section IVb)). A similar strategy is for a buyer to precommit to ignoring the switching cost in deciding whether to switch to a new entrant (Cabral and Greenstein (1990)).

Our analysis is therefore most relevant where these adaptations to switching costs are relatively costly, especially markets with large numbers of anonymous consumers each of whose demand is not too large.

7.3. *New entry*

We have concentrated mainly on switching costs in a closed oligopoly. When the turnover of consumers is slow, new entry into a market with switching costs may be very hard (see Section 3.2 and Schmalensee (1982), Farrell (1986*b*), Klemperer (1987*c*)). Because of the switching costs incurred in buying from a new entrant, new entry may also be socially very costly, even when it is possible (Klemperer (1988)). However, if there is rapid market growth or a rapid turnover of customers in the market, switching costs may actually

45. Gilbert and Klemperer (1995) show that rationing arises naturally in equilibrium when a firm can precommit to prices that compensate consumers for their start-up or switching costs; although rationing results in ex-post inefficiency, the resulting distribution of ex-post surplus compensates the marginal consumer for his start-up cost at a lower cost to the firm than would state-dependent market-clearing prices.

facilitate entry, because incumbents cannot charge high prices to exploit their old customers and at the same time charge low prices to compete with a new entrant for the new customers (Klemperer (1987*c*), Farrell and Shapiro (1988), Beggs and Klemperer (1989), Gabszewicz *et al.* (1992).)

The possibility of new entry would also affect the earlier discussion in our paper. Consider the extreme case of completely free entry with constant marginal costs c, into a market in which each consumer has a switching cost s, and in any period each consumer has probability ϕ of surviving into the next period. Then new entrants with discount factor δ would offer price $c-\phi\delta s$ and sell to any unattached consumers, while established firms charge $c+(1-\phi\delta)s$ in every period. (No "old" consumers switch, and new entrants' expected discounted profits are zero.) Thus we obtain the same pattern as in Section 3.2, of low "introductory" prices followed by high prices to exploit ex-post monopoly power. As in Section 5.1a, higher interest rates (small δ) raise prices, so exchange-rate expectations matter much as before (see Section 5.1c), and several of the other results of Section 5 apply, at least if we focus on average prices in the industry.[46]

8. CONCLUSION

We have argued (in Section 2) that consumer switching costs (whether real or perceived) are widespread, and our analysis suggests that the resulting welfare losses may be substantial: switching costs generally raise prices and create deadweight losses of the usual kind in a closed oligopoly (Section 4),[47] and may also discourage new entry and so further reduce the market's competitiveness (Sections 3.2 and 7.3). Switching costs reduce the product variety available to consumers by reducing firms' incentives to differentiate their products in any real (functional) way (Section 6.1), as well as by directly preventing switching between different products. To the extent that some consumers nevertheless switch between firms, direct welfare losses are suffered. Finally, because switching costs tend to reduce competition, firms may dissipate more social surplus in costly activities to create them.

While there are exceptions to some of these conclusions, they suggest a presumption that public policy should discourage activities that increase consumer switching costs (such as airlines' frequent-flyer programmes), and encourage activities that reduce them (such as standardization that enhances compatibility and reduces learning costs of switching, and quality regulation and information sources that reduce consumer uncertainty about untested brands).

We have restricted our discussion to *consumer* switching costs. It will be apparent that some of the same ideas may apply to switching costs in other contexts, such as labour markets.[48]

46. With intermediate entry barriers, the profitabilities of firms' sinking entry fees depend in part on how consumers' expectations of future prices affect consumers' willingnesses to sink the costs of switching to an entrant. Thus uncertainty might lead to quite complex dynamics, perhaps rather different from those studied by Dixit and Pindyck (1994) etc. Absent uncertainty about future values of parameters, we expect intermediate entry barriers would reinforce the results of Sec. 5.1a and 5.1b, and their applications in Sec. 5.1c and 5.2, but a current appreciation (even temporary) of the domestic currency may stimulate entry or reduce exit (Baldwin (1988)), counteracting the first result of Sec. 5.1c.

47. In Ex. 2, demand is perfectly inelastic so high prices simply cause a transfer from consumer surplus to profits, but more generally high prices will create deadweight losses.

48. However, different models than ours may be more useful in contexts where, for example, there are switching costs on both sides of the market, neither side has the unilateral power to set prices (or wages) and/or reputations are very important. See Basu (1993) and Basu and Bell (1991) for applications in development economics. They employ a similar model to Klemperer (1987*a*) to explain disguised unemployment and interlinkage in backward agrarian economies.

Furthermore, we doubt that existing research has fully explored the implications even of consumer switching costs. For example, they may help explain firms' internal organizations—e.g. by divisionalizing by type of customer rather than by product, a multi-product firm ensures that any consumer has only a single relationship with it and so is more likely to buy a full range of products from it.[49] They might also explain firms' financial structures—the purchasing decisions of consumers with switching costs depend on expectations about firms' futures, so can be influenced by financial structures.

In this survey we have shown that consumer switching costs (or "brand loyalty") may have important implications for issues arising in macroeconomics and international trade, as well as for the traditional questions of industrial economics. One might conjecture that as technology continues to develop, products will become more complex on average, and the extent and importance of switching costs will increase.

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49. For example, Britain's dominant telecommunications company (British Telecom) reorganized its structure "to revolve around the customer rather than products and geography" and so "allow British Telecom to provide a world-wide service to multi-national clients" because, its chairman said, "big companies want to deal with one supplier". (*Times* (of London) 30/3/1990, p. 21.)

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