Markets with Search and Switching Costs

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Abstract: By incorporating the additional existence of switching costs into an oligopoly search model by Stahl (1989), this paper dispels the misleading idea that search costs can simply be treated as a form of switching cost. Due to the assumption that search costs, unlike switching costs, are incurred unconditionally on the decision to switch suppliers it is shown that the anticompetitive effects of search costs are consistently larger than those from an equivalent level of switching costs. The finding suggests that obfuscation practices that aim to deter consumers from searching, such as competing on deliberately complex tariffs, may be particularly powerful relative to practices that increase the costs of substitution between firms, such as loyalty programs or termination fees.

Keywords: Search costs, Switching costs, Obfuscation

JEL Classification: L13, D43, D83

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1. Introduction

Most previous research into the effects of search and switching costs has considered each cost in isolation. Here, an oligopoly model is presented that allows consumers to face both a cost of finding and a cost of trading with, an alternative supplier. This dual-cost approach allows us to better understand the relative effects of search and switching costs on competition and welfare.

As will be discussed more formally, search and switching costs can differ in several ways. However one can clearly observe that the two costs are functionally different by noting, as in Table 1, that many consumers choose to search without then choosing to switch suppliers. As distinct from previous single-cost approaches, the paper is able to characterise consumers' optimal 'search to switch' strategies in order to better describe how extensively consumers should search the market and to which firm, if any, the consumer should switch.

Table 1: Search and Switching Behaviour across Eight UK Markets[1]

Market	Prob (Search)	Prob (Switch∣Search)
Electricty	0.28	0.71
Mobile Phone	0.29	0.68
Car Insurance	0.40	0.67
Nat/Overseas Calls	0.17	0.62
Mortgage	0.22	0.55
Fixed Line	0.14	0.51
Broadband Internet	0.26	0.51
Bank	0.08	0.51
Average	0.23	0.62

By doing so, this paper dispels the misleading idea that search and switching costs are some synonymous form of transaction cost. By incorporating the additional existence of switching costs into a standard oligopoly model of search costs by Stahl (1989), it is shown that the differences between the two

[1] This data comes from a detailed survey of 2027 UK consumers in June 2005, conducted by MORI for the ESRC Centre for Competition Policy at the University of East Anglia. The full results of this survey are analysed by Chang et al (forthcoming).

costs are important enough for the (potentially) anti-competitive effects of the two costs to differ in magnitude. Indeed, the model proposes that the anti-competitive effects of search costs exceed the effects of an equivalent level of switching costs. Despite this result being dependent upon how one, perhaps arbitrarily, defines and distinguishes between the two costs, the differences in effects are demonstrated to derive from one key assumption. Crucially, the search activity of consumers is discouraged relatively more from a unit increase in search costs because search costs are incurred unconditionally, while switching costs are only incurred conditional on having found a worthwhile alternative. The expenditure of search costs, unlike switching costs, is not a sufficient condition for switching suppliers.

Although the model only considers the levels of the two costs exogenously, this finding may suggest that, with all else equal, industry practices that aim to increase the difficulty with which consumers access and comprehend price and product information, such as practices that involve competing with deliberately complex tariffs or disrupting search engine results, could be more potent than practices that aim to increase the cost of substitution between firms, such as the provision of loyalty programs or termination fees. Obfuscation strategies appear to be particularly powerful in increasing firms' profits. It is further found as can be the case when consumers face search costs alone, that the effect of an increase in the number of competitors can be potentially ambiguous for consumer welfare. It is therefore suggested that in such markets, it may be the case that policy is best targeted at reducing search costs rather than increasing competition or reducing switching costs.

Finally, unlike some previous single-cost studies that confuse the empirical effects of the two costs, this approach can provide some equilibrium conditions that may offer the potential to separately identify search and switching costs in future research.

Section 2 provides a more detailed description of the differences between search and switching costs and gives an overview of their respective literatures. The model is presented in section 3, with its main results in section 4. In Section 5 the implications and limitations of the paper are discussed, before section 6 concludes.

2. Definitions and Previous Literatures

Under one of several, largely equivalent definitions, switching costs are said to arise when 'there is a cost incurred by changing supplier that is not incurred by remaining with the current provider' (OFT 2003). As search costs can be thought of similarly, they are often treated as another member of the wider family of switching costs that also includes other forms of transaction costs, the costs resulting from lost compatibility with already existing physical or human capital, the costs of increased product uncertainty and any lost loyalty benefits from the original supplier (Klemperer 1995). However, as Klemperer and the OFT point out, the two costs differ in several respects. Unlike switching costs, search costs i) might have to be paid before any purchase in the market, ii) have to be paid regardless of whether the consumer chooses to switch suppliers and in a related sense, iii) may be incurred repeatedly before switching[2].

To emphasise and sharpen these differences, and to clearly set out how this paper will treat the two costs, the following definitions are proposed.

Search costs are the total costs spent by a consumer in identifying and interpreting a firm's product and price offering, regardless of whether the consumer buys the product from that firm or not.

Switching costs are the total costs incurred by a fully informed consumer through deciding to change suppliers that would not have been incurred by remaining with the current supplier.

[2] A further difference may arise in the case, not considered in this paper, where switching costs differ across firms. If so, it is possible that the incurring of search costs may lower the effective level of a consumer's switching cost.

The first definition includes Ellison and Ellison's (2004) proposal of classifying search costs, not only as the costs of collecting information, but also as the (boundedly rational) effort costs of interpreting and processing the information. Specifically, under the assumption of product homogeneity as will be considered later, search costs will refer both to the costs of finding a firm's price and to the possible effort involved in understanding how such a price ranks against the consumer's reservation price and other firms' prices.

The second definition emphasises how switching costs differ from search costs by making switching costs dependent upon the consumer being fully informed of all firms' price and product offerings. Thus, switching costs will now only refer to any transaction, loyalty, or compatibility costs, as all other costs associated with information and uncertainty have been categorised as search costs. While one may argue that the assumed attributes of the two costs are arbitrary, it is later shown how each of the costs' attributes act to generate the differing welfare effects.

Despite their similarities and obvious interdependence most previous analyses of search and switching costs have remained largely independent of each other. The two theoretical literatures have found that increased levels of both search and switching costs can increase equilibrium market power by reducing the substitutability between competing product offerings. While this finding is very clear cut with regard to search costs, it is not universally true for switching costs due to their additional ability to generate pro-competitive effects that result from firms fiercely competing for any new consumers that are yet to be locked in[3]. The empirical literatures have documented the existence of the two costs across many markets. Superseding the older literatures that examined the effects of switching cost proxies on consumers' choice to switch suppliers or the nature of price dispersion, more modern

[3] See the search cost review by Baye et al (forthcoming), the switching cost reviews by Klemperer (1995) and Farrell and Klemperer (2006) and the overview and discussion in Waterson (2003). Beggs and Klemperer (1992) conclude that in most reasonable circumstances, the anti-competitive effects of switching costs will dominate.

studies have used equilibrium restrictions from theoretical models of competition of switching costs or search costs alone to recover estimates of the magnitude of either cost[4]. While these twin literatures have provided a deep theoretical and empirical understanding of search or switching costs, they may be criticised for considering each cost in isolation. The theoretical models fail to understand the combined effects of the two costs and are unable to assess their relative effects on welfare to aid policy decisions. Perhaps, more worryingly, previous empirical estimates of the two costs may be biased as a result of only analysing one cost at a time. As the observable effects of the two costs can be similar, using the theoretical restrictions from a model that only considers one cost may lead to potentially large identification problems. This paper attempts to address both of these problems. By providing an oligopoly model that considers both costs, the paper firstly, provides welfare and policy assessments, and secondly, begins to establish a set of equilibrium restrictions that may be useful for future empirical work.

Only a limited selection of theoretical papers has previously considered the combined role of search and switching costs. Rather restrictively, Padilla (1995) assumes that consumers have infinite switching costs and either zero or infinite search costs, while Sturluson (2002a) assumes that consumers have either search costs or switching costs, but not both. Schlesinger and von der Schulenburg (1991) allow consumers to face both forms of costs, but offer a counter-intuitive, pure strategy price equilibrium where it is not clear why consumers are searching. They suggest that search and switching costs have symmetric effects on market prices. Closest to this paper, is the theoretical section of Knittel (1997) that provides (almost) comprehensive characterisation of consumers' behaviour for any level of search and switching cost. Knittel, however does not extend the analysis to consider the endogenous choice of prices by firms, nor does he consider the welfare effects of the two costs. Empirical assessments of the two costs together have also

[4] See for example Kim et al (2003) and Moraga-González and Wildenbeest (2006).

been rare. A set of papers that use individual consumer data to analyse the relative effects of the two costs on switching decisions provide contradictory results. Indeed, the effects of search costs have been shown to be smaller than switching costs (Sturluson 2002b), larger than switching costs (Giulietti et al 2005), or even insignificant (Rangel 2005). A notable paper by Moshkin and Shachar (2002) introduces a methodology to identify the effects of the two costs when consumers are constrained by either cost, but not as in the case of this analysis, by both[5]. Using a panel dataset of US television viewers they suggest that 71% of consumers' behaviour is more consistent with the existence of search costs rather than switching costs.

3. Model

The model incorporates switching costs into a simplified version of Stahl (1989)[6]. Let there be n firms, each selling a single homogeneous good of known quality to a unit mass of consumers, who each have a unit demand with a maximum willingness to pay of V >0. Firms are assumed to pick a single price, $p_i \in \Re^+$, and since it is assumed that firms neither have production costs nor capacity constraints, firm profits can be denoted as $\pi_i = p_i q_i \ \forall \ i = \{1,...n\}$.

Consumers are located symmetrically such that a (1/n) share of consumers is 'local' to each firm. A consumer who is local to any given firm has the ability to costlessly learn the local firm's price and trade with that firm if desired, but may face positive costs of searching and trading with other, non-local firms. More specifically, consumers are divided into two types. A proportion, $\mu > 0$, of consumers, referred to as shoppers, have zero search and switching costs.

[5] Specifically, their method relies on the differences in the effects of each cost following a change in the quality of consumers' alternative options. They show that a consumer who is constrained by switching costs will be equally likely to switch following a reduction in the quality of the current product choice relative to an equivalent increase in the quality of an alternative product, whereas a reduction in the quality of the current choice will produce an asymmetrically larger effect in a consumer constrained by search costs.

[6] As in Janssen et al (2005) consumers are assumed to exhibit unit, not general demand functions.

Shoppers treat all firms as if they were local; being free to learn all market prices and trade with any firm they choose. In contrast, the remaining $(1-\mu)$ proportion of captive consumers, face both a positive search cost, c >0, to learn a non-local firm's price and a positive switching cost, s >0, to trade with a non-local firm, where both costs are common knowledge and exogenous[7].

When compared to shoppers, captives can be thought of as consumers who perhaps dislike, have little time for, or are not so savvy at shopping around for the best market deals. Instead of the current specification where captives face both costs and shoppers face neither, it could have been assumed, that the shoppers face zero search costs and positive switching costs. As will be further discussed in section 5, although this second specification may be more realistic, it fails to provide a like for like comparison of the effects of the two costs. Sturluson (2002a) considers a market consisting of consumers that either face search or switching costs alone.

In a model of a market for a homogeneous good, it is perhaps harder to imagine the possible sources of switching costs. One useful example may be an energy market where consumers, even after searching between suppliers, have to spend time cancelling an old account and setting up a new one. Alternatively, one can relax the assumption of homogeneous products, by thinking of the switching cost as resulting from some form of symmetric product differentiation, where the consumer have a preference for the local product.

The captives shall be assumed to be able to sequentially search firms at a cost of c per firm with the perfect recall ability of returning to a previously searched firm if desired. With the increasing use of price comparison sites on the Internet, some may argue that this assumption is unrealistic, but this assumption is used for two reasons. Firstly, the sequential approach actually provides a generalisation of the case of 'simultaneous' search. This is shown

[7]The possibilities when firms are able to choose the level of costs are discussed in section 5.

in Appendix B where all the results of the paper are replicated (except Result 1, as shall be explained) under the assumption that consumers can, instead, simultaneously search any number, $x \leq (n-1)$, of non-local prices for a single search cost of c. Secondly, as Ellison and Ellison (2004) point out, the sequential assumption may still be more realistic. Faced with fiercer price competition, firms face an incentive to disrupt search engines' results by offering optional add-on charges that consumers can only fully assess by manually visiting individual websites.

In solving the model, the paper will consider the set of symmetric Nash equilibria for the following static, simultaneous game where all agents are assumed to be risk-neutral with orthodox preferences. Firms simultaneously select a (perhaps degenerate) pricing distribution F(p), with density f(p) and support $[\underline{p}, \overline{p}]$, while at the same time, consumers each select, what I term as, a 'search to switch' strategy. Such a strategy must prescribe how extensively the market should be searched, if at all, and to which firm, if any, the consumer should switch. An optimal strategy will do this in a way that maximises consumers' net expected trading surplus.

'Search to Switch' Strategies

The analysis proceeds by firstly finding the consumers' optimal search to switch strategies for any price distribution, F(p), and then given this, by finding the firms optimal pricing response. While the shoppers' optimal strategy is straightforward, we shall find that the captive consumers' optimal strategy will be largely dependent upon the use of two reservation prices. A captive should begin searching only if its local firm's price exceeds a first, local reservation price, and then stop searching and switch to an alternative supplier only if a price is discovered that is below the level of a second, standard reservation price.

To find the optimal strategies for the two consumer types, it is useful to introduce some notation. Let us denote the vector of selected market prices as

$P^n = \{p_1,...p_n\}$, which, before search, for any consumer i, can be partitioned into the consumer's (known) local price p_L, and the vector of (unknown) non-local prices, $P^{NL} = \{P^n \setminus p_L\}$ (ignoring any labelling for consumer i). If consumer i is a captive engaging in search, his (initially empty) vector of known non-local prices shall be referred to as $K^{NL} \subseteq \{P^{NL}\} \cup \{\phi\}$, while $B = \min\{p_L, \min\{K^{NL}\} + s\}$ will refer to his best known 'deal'.

The optimal strategy for shoppers is trivial. Shoppers costlessly learn all market prices and will costlessly trade with the firm offering the best market price, $\min P^n$, conditional on this price being less than or equal to V. In the case that some number of firms, m>1, tie at the lowest market price, shoppers are assumed to randomly choose between the m firms.

To find the optimal strategy for captives, the well-known optimality of reservation price rules for search problems (e.g. DeGroot 1970) will be extended to include positive switching costs. The optimal search and switching strategy for any captive consumer is described in Lemma 1 (with the minor simplification of $p_L \leq V$, which will be consistent with the final equilibrium.)

Lemma 1: *For any given local price, $p_L \leq V$, pricing distribution F(p), switching cost, s, and sequential search cost, c, an optimal search to switch strategy can be described by the following algorithm.*

Start:	*If* $B = p_L$	*go to Step 1.*
	If $B \neq p_L$	*go to Step 2.*
Step 1:	*If* $p_L > r_L^*$	*search an unsearched firm and return to Start. If all firms have been previously searched go to Step 3.*

	If $p_L \le r_L^*$	*buy from the local firm without search.*
Step 2:	*If* $\min\{K^{NL}\} > r^*$	*search an unsearched firm and return to Start. If all firms have been previously searched go to Step 3.*
	If $\min\{K^{NL}\} \le r^*$	*stop searching and switch to the firm j offering* $\min\{K^{NL}\}$
Step 3:		*Trade with the firm offering* $B^n = \min\{p_L, \min\{P_{NL} + s\}\}$

Where the local reservation price, r_L^**, is the value of* r_L *that satisfies (1) and where the standard reservation price,* r^**, is the value of* r *that satisfies (2).*

$$\int_{\underline{p}}^{r_L - s} (r_L - p - s) f(p) dp = c \tag{1}$$

$$\int_{\underline{p}}^{r} (r - p) f(p) dp = c \tag{2}$$

Proof: See Appendix

The optimal search to switch strategy comprises of three components. Step 1 provides a local reservation price rule to decide whether or not the consumer should begin to participate in search, or equivalently, whether the consumer should continue to further search, having received no offer better than that of the local firm. The expected payoff from an initial search can be expressed as in (3), where the discovery of a non-local surplus offer of $(V - p - s)$ may be discarded or preferred to the local option, depending on whether p is larger or smaller than $p_L - s$.

$$\int_{\underline{p}}^{p_L - s} (V - p - s) dF(p) + \int_{p_L - s}^{\overline{p}} (V - p_L) dF(p) - c \tag{3}$$

The local reservation price, r_L^*, can then be found by finding the level of the local price, p_L, at which the consumer is indifferent between searching, to gain an expected payoff of (3), and not searching to gain $(V - r_L^*)$. Intuitively, this results in an expression for the local reservation price in (1) that sets the expected net gains from search, $\int_{\underline{p}}^{r_L - s}(r_L - p - s)f(p)dp$, equal to the marginal cost of search, c, and suggests that search is optimal for any $p_L > r_L^*$.

Alternatively, one can understand the derivation of r_L^* through inspection of (1) and (2). The standard reservation price in (2) is the price at which a consumer is indifferent between searching and not, in the classical search problem without switching costs. Using the equality of (1) and (2), it must be true that $r_L^* = r^* + s$, and so intuitively, the introduction of switching costs increases the price at which the consumer is indifferent between searching by an amount equal to the switching cost.

On finding a potentially attractive non-local price, $p < p_L - s$, the consumer moves to Step 2, (via START), to decide whether to accept this price or to search yet further by using a second reservation price rule. This reservation price differs from the local reservation price, because importantly, the decision is now independent of the switching cost, as the consumer is comparing only across non-local firms.

Step 3 follows trivially for the scenario in which the consumer has chosen to exhaustively search all the alternatives, becoming fully informed. In this case, switching costs can still act to reduce the incentive to switch to a non-local supplier.

Lemma 1 suggests that switching costs actively affect the way in which consumers search in two ways. In Step 1, switching costs can act to make the consumer less willing to engage in any price search at all, and in Step 3, switching costs can make the consumer less willing to switch suppliers having searched the entire market. Although the effects in Step 3 may offer a partial explanation for the large numbers of consumers who search without switching as seen in Table 1, such a phenomenon may not be fully explained by purely introducing switching costs into a static model of search. Further explanations are likely to rest outside the model and may include consumers choosing to search for additional reasons, to learn for example, about the distribution of prices itself or firms' heterogeneous product offerings.

Importantly, Lemma 1 implies that search and switching costs are likely to have asymmetric effects on a consumer's participation in search (as seen in Step 1). This distinction between the effects of the two costs is contrary to most previous findings that suggest that the effects are equivalent and symmetrical[8]. For example, Schlesinger and von der Schulenburg (1991) and many of the empirical investigations into search and switching costs propose, (under our notation) that a consumer should search if $p_L - E(p_{NL}) > s + c$. The symmetrical effects result from the assumption that switching costs are automatically incurred in the same way as search costs. By incorporating the possibility that after an initial search, the consumer may choose not to switch, or indeed to search further, Lemma 1 removes this symmetry. Further, note that this effect is not dependent upon the assumed method of sequential search. Lemma B1 shows that the optimal search to switch strategy under simultaneous search can be treated as a special case of Lemma 1.

Firms' Optimal Pricing Strategies

Given both the shoppers' and captives' optimal search to switch strategies, the firms' optimal response is now found. In parallel to both the search and switching cost literatures, firms face some familiar mixed incentives. They can either set a low price to compete for one set of consumers (the shoppers) or they can set a higher price to exploit another set of consumers (their local captives). As in Stahl (1989), the firms' pricing decision can be found through a series of steps.

Firstly, while a firm's captive consumers may, in principle, find it optimal to search elsewhere it will never be optimal for a firm to let its captive consumers do so. Given the pricing decisions of the other firms, a firm will always find it profitable to ensure the trade of its local captives by pricing below the captive's local reservation price, $r_L^* = r_L^*(F(p), c, s)$ and reservation value, V, as expressed by (4). Captives will now never search in equilibrium, and so steps 2 and 3 from Lemma 1 will be made redundant.

$$\overline{p} = \min\{r_L^*, V\} \tag{4}$$

Secondly, while each firm chooses a price low enough to guarantee the trade of its captives, firms still face the incentive to lower prices further in order to compete for the shoppers. Indeed, in any price tie, a firm can always do better by reducing its price by epsilon to attract the proportion of shoppers until some price $\underline{p}$, where the firm would prefer to price only to its captives. This fact implies that no pure strategy pricing equilibrium can exist, nor can there be any mass in a mixed strategy equilibrium pricing distribution, F(p).

Finally, one can find the equilibrium pricing distribution by noting that the expected profits of firm i with price p, given all other firms are pricing with F(p) can be expressed as in (5)

$$\pi_i(p, F(p)) = p[((1-\mu)/n) + \mu(1-F(p))^{n-1}] \qquad \forall \ p \le \overline{p} \tag{5}$$

where firm i can guarantee the custom of its $((1-\mu)/n)$ local captives and gain the custom of the μ shoppers if it prices below all the other firms, which it does with probability $(1-F(p))^{n-1}$.

[8] With the exception that Knittel (1997) who offers an equivalent version of Step 1 but fails to provide the remaining parts of Lemma 1.

Equilibrium profits must be equal to those received by pricing at the upper price bound where the firm has an exactly zero chance of attracting the shoppers; $\overline{\pi} = \overline{p}((1-\mu)/n)$. Setting (5) equal to this value provides a unique expression for the equilibrium pricing distribution as shown in (6), while setting this to zero and solving provides the lower price bound, given in (7).

$$F(p) = 1 - \left(\frac{(1-\mu)(\overline{p} - p)}{\mu n p} \right)^{1/(n-1)} \tag{6}$$

$$\underline{p} = \left(\frac{(1-\mu)\overline{p}}{\mu n + (1-\mu)} \right) \tag{7}$$

F(p) can then be shown to be well behaved in that $\pi = \overline{\pi} \;\; \forall \;\; p \in [\underline{p}, \overline{p}]$, with $\pi < \overline{\pi}$ if not, and with $F'(p) \geq 0 \;\; \forall \;\; p \in [\underline{p}, \overline{p}]$.

4. Results

This section now carries out some comparative static results. Of particular interest will be the equilibrium effects on firm and consumer welfare following a) a change in the level of search costs, b) a change in the level of switching costs, and in understanding how these effects compare to c) a change in the number of competing firms. In what follows, firms' equilibrium profits shall be denoted as π and CW_S and CW_C will refer to the expected ex ante consumer surplus (welfare) for a shopper and captive, respectively. As a benchmark, Result 1 firstly, shows the limit effects of an increase in the number of firms.

Result 1: *As the number of competitors, $n \to \infty$, firm profits, $\pi \to 0$, shopper welfare $CW_S \to V$, and captive welfare, $CW_C \to 0$.*

Proof: See Appendix

This result is not new in models of search – it follows directly from Proposition 4 of Stahl (1989) and is similar to that in Varian (1980) and Morgan et al (2006) – but shows that these rather perverse effects remain with the introduction of switching costs. Despite providing more orthodox effects on firms' profits and shoppers' welfare, (large) increases in the number of competing firms can damage captive consumers' welfare. This effect can be explained by what Janssen and Moraga-González (2004) refer to as the business stealing and surplus appropriation effects. The business stealing effect results from industry profits being divided between more and more firms. It prompts firms to compete harder by reducing the lower price bound, $\underline{p}$, resulting in the expected minimum market price – the price paid by shoppers, to tend to zero. The surplus appropriation effect however prompts firms to move more probability mass towards the higher end of the price distribution, as the chance of attracting the shoppers, $(1-F(p))^{n-1}$, decreases as the number of firms increases. Captives' search opportunities worsen as a result, allowing firms to shift yet more probability mass upwards so that the expected market price – the price paid by captives, tends to the consumer reservation value.

The effects of increasing the number of competitors when search is simultaneous, rather than sequential, are more complex, and may not be consistent with Result 1. Consequently, it is the only result in the paper that is not replicated in Appendix B[9].

Result 2 now considers the effects of changes in the level of search and switching costs.

[9]The effects may differ due to the fact the captives' reservation price is related to the expected minimum price from the set of searched firms, not the average price of a searched firm, as was the case in sequential search. As discussed above, the expected minimum and the average price can move in opposing directions. See Janssen and Moraga-González (2004).

Result 2: *The increase in profits and the decrease in consumer surplus that result from an increase in search costs, c, are at least as large as the effects that result from an equivalent increase in switching costs, s, for any $c, s > 0$. That is,*

$$\frac{d\pi}{dc} > \frac{d\pi}{ds} > 0 \qquad \forall\ r_L^* < V \text{, with equalities if not.}$$

$$\frac{dCW_t}{dc} < \frac{dCW_t}{ds} < 0 \qquad \forall\ t = \{S, C\} \text{, and } \forall\ r_L^* < V \text{, with equalities if not.}$$

Proof: See Appendix

When the levels of search and switching costs are so large that the local reservation price becomes constrained by the consumers' maximum willingness to pay, $r_L^* \geq V$, any further increases in the levels of the two costs have no effect on equilibrium prices, profits or welfare. However, in the more interesting case, when $r_L^* < V$, any increase in search or switching costs will produce a new equilibrium price distribution that (first order) stochastically dominates the former distribution, such that firms' profits and the expected price paid by *both* types of consumers increases. More specifically, Result 2 confirms the asymmetry found in Lemma 1 by suggesting that, for any level of the two costs, the absolute increases in prices and profits are larger following an increase in search costs, relative to an equivalent increase in switching costs.

The intuition behind this result is quite simple. A unit increase in search costs relative to a unit increase in switching costs allows firms to price relatively 'higher' as the unit increase in search costs is more powerful in deterring the captives from searching. To understand why this might be so, one might think that the effect is most likely driven by the fact that consumers may have to repeatedly incur search costs. However, as captives do not search in equilibrium and as this result still exists under the assumption of simultaneous search where the consumer pays a single search cost (see Result B2 in the appendix), this effect can, instead, attribute this effect to the fact that search costs must be paid regardless of whether the consumer finds a worthwhile switching option or not. The conditional payment of switching costs makes them less influential in consumers' search decisions and in firms' ability to price above marginal cost.

5. Implications and Limitations

While bearing in mind the several caveats that are subsequently discussed, this section now examines the implications of the model's results. For a competition authority concerned with choosing a policy with the best chance of improving the welfare of consumers, the results would suggest that while reducing switching costs or increasing the number of competitors may both have (aggregate) benefits, reducing search costs might be the most reliable and powerful policy option. With all else equal, it would appear that rather than reducing transaction costs or regulating contract termination fees and excessive contract cancellation periods, policy may be better targeted at improving consumers' access to easily understood, verifiable, price and product information.

Conversely, the corollary of this argument implies that firms' profits may benefit more from a (binding) agreement or practice that aims to increase the industry level of search costs, rather than an equivalent practice that increases the industry level of switching costs. That is, the increase in profits following any practice that makes the identification and comprehension of non-local firms' price offers more costly may be higher than the increase in profits following any practice that makes it relatively more costly to trade with non-local firms. Indeed, one could allege that such practices exist in the mobile phone market, where firms commonly offer a host of bewildering multi-part, multi-contingent tariffs, perhaps with a view to obfuscate price comparisons. However, it is harder to imagine how such practices that aim to raise either industry level search or switching costs could be individually profitable. While endogenising the individual firm's choice of search and switching costs is beyond the current paper, one can easily imagine the ideal scenario for a firm where it aims to make its own price offers easy to identify, understand and switch to, while keeping its rivals' offers hard to identify, understand and switch to its local consumers[10]. Result 2 suggests such strategies may be potentially very powerful for firms and underlines the importance for research into obfuscation, as previously argued by Ellison and Ellison (2004)[11].

These results and implications should, however, be treated with caution due to the following limitations. Firstly, it is important to note that the conditional payment feature that generates the differing welfare effects may not be unique to switching costs. Some forms of search cost may also be paid probabilistically. For example, in searching between stores a consumer may not only have to pay (unconditionally) for fuel, but may also have to pay the cost of a new tyre, conditional on the probability of having a puncture[12]. With a similar logic to that used in Result 2, one could suggest that the associated anti-competitive effects from a unit increase in conditional search costs may be weaker than those from a unit increase in unconditional search costs.

Secondly, to provide a tractable and equivalent comparison of the welfare effects of the two costs, it has been supposed that the proportion of consumers facing the two costs has been equal. Under this assumption, with all else equal, it has then been suggested that policy should focus on reducing search costs. However, in practice, this conclusion could be less clear cut as unit increases in switching costs could provide larger anti-competitive effects if there existed a sufficient number of additional consumers that faced only

[10] These arguments mirror some findings in the switching cost literature that allow firms to offer price discriminatory discounts in order to compete for non-local consumers while retaining high prices for local consumers (Chen 1997, Shaffer and Zhang 2000).
[11] For examples of this research see Ireland (forthcoming), Spiegler (2005) and Wilson (2005).
[12] I thank Greg Shaffer for this comment and example.

switching costs. Policy should therefore consider the full consumer distribution of search and switching costs before deciding which cost reduction would be most beneficial.

Finally, the model is limited, most obviously, by the omission of any dynamic competition. Indeed, as mentioned in section 2, the effects of introducing competition for pre-purchase consumers can be strong enough to offset any anti-competitive effects resulting from lock-in, making the total welfare effects of switching costs ambiguous. Nevertheless, using the hitherto unused third distinction between search and switching costs; the fact that search costs are likely to be faced both before and after any initial purchase, we argue that the incorporation of any dynamic effects can only strengthen Result 2. While introducing dynamic competition will weaken the effects of switching costs, the effects, and the relative potency of search costs will remain. However, the static nature of our model does inhibit its ability to understand the longer-term effects of search and switching costs on competition. Search and switching costs have been shown to have potentially ambiguous effects on the ability of firms to tacitly collude as it becomes both harder for a firm to deviate and for firms to punish a deviation (see Padilla 1995 and Møllgaard and Overgaard 2005). Switching costs, in particular may also have an impact on the profitability of entry (e.g. Klemperer 1987). Thus, in individual markets where issues of tacit price collusion and/or entry are of particular importance, the general validity of Result 2 could be questioned.

6. Conclusion

By introducing switching costs into a standard search-theoretic model of competition by Stahl (1989), we have shown search costs may have a consistently larger, anti-competitive effect than switching costs. We suggest that this result derives not from the fact that search costs may be incurred repeatedly before searching, but rather that search costs must be paid regardless of whether the consumer chooses to switch or not. The conditional nature of the payment of switching costs makes them less influential in firms' ability to price above marginal cost.

The paper indicates that, with all else equal, firms may face a powerful, collective incentive to increase the industry-level of search costs that can be stronger than the incentive to raise the industry-level of switching costs. This prompts future research in two directions. Firstly, while this collective incentive for obfuscation exists, it is not clear how such strategies might be profitable at the individual level. Secondly, it is possible to widen the paper's main result by interpreting switching costs as a crude specification of symmetric product differentiation. In this case, obfuscation strategies would appear to be more profitable for firms than differentiating their product. Generalising this and generating more results of the relative welfare effects across a wider ranger of strategy options would be very useful in further understanding firm behaviour and guiding competition policy.

References:

Baye M.R., Morgan J. and Scholten P. (forthcoming) *"Information, Search and Price Dispersion"* in Handbook on Economics and Information Systems, Elsevier

Beggs A. and Klemperer P. (1992) *"Multiperiod Competition with Switching Costs"* Econometrica vol.60 p. 651-666

Chang Y., Waddams Price C. and Wilson C.M. (forthcoming) *"Search and Switching Across Relationship Markets"* ESRC Centre for Competition Policy Working Paper

Chen Y. (1997) *"Paying Consumers to Switch"* Journal of Economics and Management Strategy vol.6 p.877-897

DeGroot M.H. (1970) *"Optimal Statistical Decisions"* McGraw-Hill New York

Ellison G. and Ellison S.F. (2004) *"Search, Obfuscation and Price Elasticities on the Internet"* NBER Working Paper 10570

Farrell J. and Klemperer P. (2006) *"Coordination and Lock-In: Competition with Switching Costs and Network Effects"* Preliminary Draft 2006

Giulietti M., Waddams Price C. and Waterson M. (2005) *"Consumer Choice and Competition Policy: A Study of UK Energy Markets"* Economic Journal vol. 115 p.949-968

Ireland N. J. (forthcoming) *"Posting Multiple Prices to Reduce the Effectiveness of Consumer Price Search"* Journal of Industrial Economics

Janssen M. and Moraga-González J.L. (2004) *"Strategic Pricing, Consumer Search and the Number of Firms"* Review of Economic Studies vol.71 p.1089-1118

Janssen M., Moraga-González J.L. and Wildenbeest M.R. (2005) *"Truly Costly Sequential Search and Oligopolisitic Pricing"* International Journal of Industrial Organisation vol.23 p.451-466

Kim M., Kliger D. and Vale B. (2003) *"Estimating Switching Costs: The Case of Banking"* Journal of Financial Intermediation vol.12 p.25-56

Klemperer P. (1987) *"Entry Deterrence in Markets with Consumer Switching Costs"* Economic Journal vol.97 p.99-117

Klemperer P. (1995) *"Competition When Consumers Have Switching Costs: An Overview with Applications to Industrial Organisation, Macroeconomics and International Trade"* Review of Economic Studies vol.62 p.515-539

Knittel C.R. (1997) "*Interstate Long Distance Rates: Search Costs, Switching Costs and Market Power"* Review of Industrial Organisation vol.12 p.519-536

Moraga-González J.L. and Wildenbeest M.R. (2006) *"Maximum Likelihood Estimation of Search Costs"* Working Paper January 2006

Morgan J., Orzen H. and Sefton M. (2006) *"An Experimental Study of Price Dispersion"* Games and Economic Behaviour vol. 54(1) p.134-158

Moshkin N.V. and Shachar R. (2002) *"The Asymmetric Information Model of State Dependence"* Marketing Science vol. 21(4) p.435-454

OFT (2003) *"Switching Costs"* Office of Fair Trading, Economic Discussion Paper 5, April 2003

Overgaard P.B. and Møllgaard H.P. (2005) *"Information Exchange, Market Transparency and Dynamic Oligopoly"* in Issues in Competition Law and Policy (Ed) Collins W.D., American Bar Association

Padilla A. (1995) *"Dynamic Duopoly with Consumer Switching Costs"* Journal of Economic Theory vol. 67 p.520-530

Rangel L. (2005) *"Should I Stay or Should I Go?: The Determinants of Consumer's Decision to Switch Suppliers"* Working paper May 2005

Schlesinger H. and Schulenberg J.G. (1991) *"Search Costs, Switching Costs and Product Heterogeneity in an Insurance Market"* Journal of Risk and Insurance vol.58 p.109-19

Shaffer, G. and Zhang Z.J. (2000) *"Pay to Switch or Pay to Stay: Preference-Based Price Discrimination and Markets with Switching Costs"* Journal of Economics and Management Strategy vol.9 p.397-424

Spiegler R. (2005) *"Competition Over Agents with Boundedly Rational Expectations"* Theoretical Economics vol. 1(2) p.207-231

Stahl D. O. (1989) *"Oligopolisitic Pricing with Sequential Consumer Search"* American Economic Review vol.79 p.700-712

Sturluson J.T. (2002a) *"Price Duopoly in a Default Service Market with Search and Switching Costs"* Working Paper

Sturluson J.T. (2002b) *"The Importance of Consumer Search and Switching Costs for Competition in Electric Power Retailing"* Working Paper July 2002

Varian H.R. (1980) *"A Model of Sales"* American Economic Review vol.70 p.651-659

Waterson M. (2003) *"The Role of Consumers in Competition and Competition Policy"* International Journal of Industrial Organization vol.21 p. 129-150

Weitzman M.L. (1979) *"Optimal Search for the Best Alternative"* Econometrica vol. 47 p.641-654

Wilson C.M. (2005) *"The Effects of Consumer Protection on Deception, Consumer Search and Competition"* ESRC Centre for Competition Policy Working Paper 05-9

Appendix A:

Lemma 1 Proof: The proof is a simple extension of a standard search problem where each of the (n-1) search options offers a surplus of $(V-p-s)$ where p is distributed by $F(p)$. Following the standard results of reservation price rules (e.g. DeGroot 1970) and in particular the results by

Weitzman (1979) for search over a limited number of options, the following algorithm can be shown to be optimal. To show Step 1, where $B = p_L$, note that the consumer will be indifferent between accepting p_L and searching when $p_L = r_L^*$. r_L^* will then be the value of r_L that satisfies (A1), noting that any discovered price p will only be preferred to the local price iff $p < p_L - s$. Simplifying yields (1).

$$V - r_L = \int_{r_L - s}^{\bar{p}} (V - r_L) dF(p) + \int_{\underline{p}}^{r_L - s} (V - p - s) dF(p) - c \qquad \text{(A1)}$$

Step 2 allows for the possibility that $B \neq p_L$, where the best known deal, unlike the local offer, may have an associated switching cost. A new reservation price rule follows whereby the consumer will be indifferent between i) stopping search and switching to firm offering $\min\{K^{NL}\}$ and ii) continuing search, when $\min\{K^{NL}\} = r^*$. r^* will be the value of r that satisfies (A2), noting now that any discovered price p will only be preferred to $\min\{K^{NL}\}$ iff $\min\{K^{NL}\} + s > p + s$. Similar simplifications can yield (2).

$$V - r - s = \int_r^{\bar{p}} (V - r - s) dF(p) + \int_{\underline{p}}^{r} (V - p - s) dF(p) - c \qquad \text{(A2)}$$

Step 3 follows trivially once that the consumer is fully informed.•

For the proofs of Result 1 and 2, it will be useful to rewrite (1) and (2) by using integration by parts as

$$\int_{\underline{p}}^{r_L - s} F(p) dp = c \qquad \text{(1′)}$$

$$\int_{\underline{p}}^{r} F(p) dp = c \qquad \text{(2′)}$$

Result 1 Proof: Following Stahl (1989), one can redefine $F(p) = 1 - (w/n)^{1/(n-1)}$ where $\forall\ p < \bar{p}$, $w > 0$ so that $F(p) \to 0$ as $n \to \infty$, with all the mass converging on $p = \bar{p}$. Given this, it is easy to see from (1′), $\int_{\underline{p}}^{r_L - s} F(p) dp = c$, that as $n \to \infty$, r_L^* will increase beyond V so that $\bar{p} \to V$, and $\underline{p} = (1-\mu)\bar{p}/(\mu n + (1-\mu)) \to 0$. Consequently, as $n \to \infty$, $\bar{\pi} = \bar{p}((1-\mu)/n) \to 0$. To see that $CW_C = V - E(p) \to 0$, note that $E(p) = \int_{\underline{p}}^{\bar{p}} p dF(p) = \bar{p} - \int_{\underline{p}}^{\bar{p}} F(p) dp \to V$, and to see that $CW_S = V - E(\min\{P^n\}) \to V$, note that $E(\min\{P^n\}) = \int_{\underline{p}}^{\bar{p}} p(1-(1-F(p))^n) dp = \underline{p} + \int_{\underline{p}}^{\bar{p}} (1-F(p))^n \to \underline{p} \to 0$.•

Result 2 Proof: Consider the case when $r_L^* < V$. Note that $\overline{p}$, $\underline{p}$ and π are all increasing in r_L^*, while $dF(p)/dr_L^* \leq 0$ $\forall$ p. Therefore any increase in r_L^* will increase profits and produce a first-order stochastically dominant new pricing distribution, such that $CW_C = V - E(p)$ and $CW_S = V - E(\min\{P^n\})$ will both fall. We now only need show that $dr_L^*/dc > dr_L^*/ds > 0$. This can be shown by differentiating (1′), $\int_{\underline{p}(r_L)}^{r_L - s} F(p;r_L)dp = c$, with the use of the implicit function theorem and Leibniz's equation to give

$$\frac{dr_L^*}{ds} = \left(\frac{F(r_L - s)}{F(r_L - s) + \int_{\underline{p}}^{r_L - s} (dF(p)/dr_L)dp} \right) \qquad \frac{dr_L^*}{dc} = \left(\frac{1}{F(r_L - s) + \int_{\underline{p}}^{r_L - s} (dF(p)/dr_L)dp} \right)$$

Firstly, note that $dr_L^*/ds > 1$ as the denominator must be smaller than the numerator. One can show this by rewriting the denominator as $\int_{\underline{p}}^{r_L - s} f(p) + (dF(p)/dr_L)dp$ and then showing that it must lie in the region $(0, F(r_L - s))$ because

$$dF(p)/dr_L < 0 \text{ and } f(p) + (dF(p)/dr_L) = \frac{1}{(n-1)\mu np}\left(\frac{(1-\mu)(r_L - p)}{\mu np}\right)^{1/(n-1)} > 0 \qquad \forall p < r_L$$

Secondly, it then follows that $dr_L^*/dc > dr_L^*/ds$ $\forall$ s, c as $F(r_L - s) < 1$. Finally, in the case that $r_L^* \geq V$, $\overline{p} = V$ and so any increase in s or c will leave $\overline{p}$, $\underline{p}$, F(p) and π unchanged. •

Appendix B: Simultaneous Search

Lemma B1: *For any given local price, $p_0 \leq V$, pricing distribution F(p), switching cost, s, and simultaneous search method that searches an exogenous number of $x \leq (n-1)$ non-local firms for a total search cost of c, an optimal search to switch strategy can be described by the following decision rule.*

Search if $p_i^L > R*$, and if not, buy from the local firm without search. Having searched, trade with the firm offering $B^n = \min\{p_i^L, \min\{K_i^{NL}\} + s\}$.

Where $R*$ is the value of R that satisfies (B1) and where $G(p) = 1 - (1 - F(p)^x)$ and g(p)=G′(p).

$$\int_{\underline{p}}^{R-s} (R - p - s)g(p) = \int_{\underline{p}}^{R-s} G(p)dp = c \qquad \text{(B1)}$$

Proof: Lemma B1 forms a special case of Lemma 1. Steps 2 and 3 are not applicable, and we simply need to provide an amendment to step 1. In particular, on searching, the consumer will only switch if the $\min\{K_i^{NL}\} + s < p_i^L$ where the $E(\min\{K_i^{NL}\})$ for a given number of searched firms, x, will be distributed with $G(p) = 1-(1-F(p))^x$. Thus, the consumer will be indifferent between searching when $p_i^L = R*$

$$V - R = \int_{R-s}^{\overline{p}} (V-R)dG(p) + \int_{\underline{p}}^{R-s} (V-p-s)dG(p) - c \qquad \text{(B2)}$$

where $R*$ will be the value of R that satisfies (B2) using similar simplifications or integration parts to above.•

Firms' Best Response: As before, with only the change that $\overline{p} = \min\{R^*, V\}$.

Result B2: *For any level of simultaneous search cost,* $c > 0$*, and switching cost,* $s > 0$*,*

$$\frac{d\pi}{dc} > \frac{d\pi}{ds} > 0 \qquad \forall\ s, c \text{ and } \forall\ R^* < V\text{, with equalities if not.}$$

$$\frac{dCW_t}{dc} < \frac{dCW_t}{ds} < 0 \qquad \forall\ s, c, \forall\ t = \{S, C\}\text{, and} \forall\ R^* < V\text{, with equalities if not.}$$

Proof: From before, it follows we need only show that $dR^*/dc > dR^*/ds > 0$ for $R^* < V$. Using (B1), $\int_{\underline{p}}^{R-s} G(p)dp = c$,

$$\frac{dr_L^*}{ds} = \left(\frac{G(R-s)}{G(R-s) + \int_{\underline{p}}^{R-s} d(G(p)/dR)dp} \right) \qquad \frac{dr_L^*}{dc} = \left(\frac{1}{G(R-s) + \int_{\underline{p}}^{R-s} (dG(p)/dR)dp} \right)$$

This is very similar to before and we need only show that the denominator is still positive, to show that $dR^*/dc > dR^*/ds > 1$. Rewriting the denominator as $\int_{\underline{p}}^{R-s} (G'(p) + (dG(p)/dR))dp$ and using the fact that $G(p) = 1-(1-F(p)^x) = 1 - \left(\frac{(1-\mu)(R-p)}{\mu np} \right)^{\frac{x}{n-1}}$, one can easily show this to be true as $G'(p) + (dG(p)/dR) = \frac{x}{(n-1)} \left(\frac{(1-\mu)(R-p)}{\mu np} \right)^{\frac{x}{n-1}} \left(\frac{1}{\mu np} \right) > 0$, $\forall p < R$.•