Abstract

In this paper we show that when a monopolist incurs certain costs for servicing or maintaining its customer-base, price markups may decrease with high demand — i.e. markups are countercyclical. Indeed, for a given market share when demand booms each customer on average will purchase more output and the costs of servicing clients are spread across a larger volume of output sold. This increasing-return effect raises the incentive for the monopolists to expand its market-share by reducing markups. We also find evidence on UK data that industries with higher maintenance costs tend to have a higher degree of counter-cyclical markups as compared with industries with lower such costs.

JEL classification: D4; E32; C61

1. Introduction

The demand-supply theory shows that movements in price partially absorb demand shocks in the short run. Also, the short-run supply curve is upward sloping because some factors of production are fixed, with the remaining factors subject to diminishing returns. However, a lengthy strand of empirical literature has established that demand shocks mostly lead to movements in output instead of prices1. This observation known as price-stickiness has been the focus of un-remitting interest. In this paper we revisit this issue both at a theoretical and an empirical level.

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The literature identifies two strands of research which centre their explanation for price-stickiness on imperfect competition. The first focuses on *nominal rigidities* whereby firms minimize the costs of changing prices by leaving them unchanged or by changing them infrequently (e.g. Mankiw (1985), Taylor (1979), Ball and Cecchetti (1988) and Parkin (1986)).

The second strand concentrates on *real rigidities* where the functioning of the product market is identified as the root cause for price stickiness. Thus, when the marginal cost is increasing in output one potential explanation for price stickiness is that imperfectly competitive firms decide to charge countercyclical markups. There are a handful of reasons why this may be so (see Rotemberg and Woodford (1999) for a survey). Bils (1989) and Barsky and Warner (1995) argue, for different reasons, that elasticities tend to be procyclical and hence firms reduce markups in times of booms. Along similar lines Gali (1994) explore the idea that demand by firms and consumers constitute aggregate demand where firms have a higher demand elasticity relative to consumers. Now, following the observation that the ratio of consumption to GDP is high in recessions the conclusion of countercyclical markup results as the share of consumer-elasticity in total elasticity would be higher in recessions. Rotemberg and Saloner (1986) advance the idea that as demand rises firms use countercyclical markups as a mechanism to reduce the incentives for firms to leave some implicit collusion between firms. Ireland (1998) show that large purchases encourage household’s search activity meanwhile product search costs remain fixed. This in turn undermines firm’s monopoly power in periods of high demand and a markup reduction follows. Our contribution is very much along this second strand of research.

We examine pricing in a Phelps and Winter (1970) type customer-market
model. In this model price-setting firms compete for customers that are reluctant to change supplier fearing switching costs. As a result, the firm has a short-run monopoly vis-à-vis its customers and faces a trade-off: it can charge customers a price higher than the industry average at the expense of driving away potential customers. Therefore, the long-run consequences of its pricing policy must be taken into consideration. The original Phelps-Winter (1970) model as well as later variants such as Phelps (1992) have ambiguous implications for the cyclicity of markups and, if anything, are believed to result in procyclical markups. Indeed, a firm gains more from raising its prices in a boom and in a recession it gains little extra business by lowering its prices to attract customers. Furthermore, numerous extensions\(^2\) of the Phelps and Winter focus on the consumer side (e.g., endogenising search costs) to generate the countercyclical markup variation and are therefore difficult to evaluate empirically. These have led to doubts about the empirical relevance of the customer-market model raised by Rotemberg and Woodford (1991, 1993).

In this paper we propose an extension of the Phelps and Winter framework that overcomes this limitation and instead focus on the firm’s side. We show that when firms have customer-care (or maintenance/servicing) costs markups can be countercyclical and provide empirical evidence. We find that when customer care –CC hereafter– costs are convex in the customer base and demand rises, the servicing costs per customer are spread over a larger number of units sold. This makes it more attractive for firms to expand their customer-base by way of lowering their markups where we define the markup in the traditional sense as the ratio of

\(^2\)Bils (1987) in an exception. They report mixed evidence on the procyclical pattern of the share of new purchases as opposed to replacement purchases. This was especially relevant for durable goods. Therefore, elasticities may be procyclical.
price to marginal cost of production\(^3\). In fact, at the margin, the marginal cost of expanding the market share is now lower.

Customer care costs have generally been ignored in this literature, perhaps due to the lack of detailed data which might have highlighted their importance. Okun (1981, P. 127) originally pointed that firms may incur relationship costs with customers. Recent media attention helps underline their importance. For example, the Financial Times (FT) on 01/28/2000 reported that: “Customer costs hit eToys shares: eToys shares fell 20% as the online children’s retailer detailed the cost of tripling its customer base.” Generally these costs can be observed in the form of courtesy services such as free account set-up, exchange policies, product cataloging and tagging, product booklets, parking facilities, on-line help desks, free trials/samples, operatives involved in sales, building and delivering goods and all other administrative expenses related to clients. As highlighted by the FT’s quote these costs are also relevant from an e-commerce viewpoint in that companies maintain profiles and databases of customers (Shapiro and Varian (1999), Choi, Sthal and Whinston (1997)). There are at least two reasons why firms have customer care. First, it may help them to retain clients. Second, it helps them to satisfy the ‘consumer code of practice’ which encourages firms to provide some level of customer-care when they interact with consumers. The Office of Fair Trading in the UK spent in 2004 in excess of £40 million in reinforcing the consumer code of practice\(^4\). There is also commercial interest in CC; for example the FT Spring 2000 reported estimates predicting that by 2003 the business of servicing and managing customers would be worth £10.6bn, a seven fold increase compared

\(^3\) A model that comes theoretically close to our theory is Chevalier and Scharfstein (1996) which shows within a customer-market context that during booms firms are less constrained by liquidity and therefore can afford to expand market-share by trimming the markup.

with 1998. According to our estimates the average non-production costs that are loosely related to CC range between 5-15% of total costs for 8 British industries during 1972-1991. Hence, there is strong evidence which highlights the importance of CC and we believe it is a deserving research topic.

In the next section we present our theory and briefly compare the results with related research. The crucial empirical implication of our model is that markets with significant CC costs may be associated with countercyclical markups and also markets with relatively higher CC costs are expected to be relatively more countercyclical. Indeed, in a penultimate section we present evidence that supports these implications for eight British industries during 1968-1991. This section is followed by a brief discussion after which we conclude.

2. Basic Setup

Consider an industry with an arbitrary number of identical firms. A representative firm, acting as a monopolist, decides on its price and the level of service provision at each moment in time taking the price and the level of service provision by the other firms as given. We let \( x_i \) be firm \( i \)'s proportion of customers. Increasing its price, \( p_i \), relative to the industry average, \( p \), lowers the quantity demanded by its current customers and is captured by the following standard demand curve

\[
y_i = f \left( \frac{p_i}{p}, A \right) = A \left( \frac{p_i}{p} \right)^{-\eta}, \quad f' < 0, \quad 0 \leq f'' \leq \frac{-2f'}{f'^2 - 1}
\]

(1)

where \( \eta, p_i/p, y_i, A \) denote demand elasticity, relative price, output per customer and an exogenous shift parameter respectively. The first condition in Eq. (1) guarantees a downward-sloping demand and the second condition ensures that the marginal revenue curve is downward sloping and convex to the origin. Al-
though the demand relation (1) is standard, it can also result from a model where consumers have search costs as we discuss later.

In this model we do not allow demand to be influenced by the CC levels. The reason for this is that we focus on consumers who primarily search for goods on the basis of relative prices and treat the CC element as a by product. Although we admit the possibility that this may only be true for certain types of goods.

Consistent with Phelps and Winter (1970), changes in the firm’s customer base is assumed to be proportional to the flows of customers between suppliers and depend on its past pricing behaviour as well as customer-care it provides. For example, in the presence of switching costs not all customers switch suppliers when discrepancies in relative prices emerge but only gradually drift towards better sellers (we discuss this shortly). An analogous interpretation is obtained when it is assumed, as in Phelps and Winter’s original work, that there are delays in the spread of information which in turn generates a gradual drift of customers between sellers. In our model the firm can also retain its customers by providing a superior customer service, $s_i$, relative to the industry’s average, $s$. It is assumed that the probability a customer moves between sellers is a function of prices and customer-care provided by the existing supplier relative to the rest of the market. Phelps and Winter suggest that one way customers may exchange new information is through random encounters; a mechanism not modeled here explicitly. As a result, the customer flow dynamics are represented by the rate of change in firm $i$’s proportion of customer, $x_i$, and are given by

$$dx_i = g \left( \frac{p}{p_i} - \frac{s_i}{s} \right) x_i dt. \quad (2)$$
The function $g(\cdot)$ is assumed to take the following form,

$$
g(p_i, s_i) = \gamma - \gamma \left( \frac{p_i}{p} \right)^\mu \left( \frac{s_i}{s} \right)^{-\beta},
$$

(3)

$$
g(1, 1) = 0, \quad g_{p_i} < 0, \quad g_{s_i} > 0, \quad g_{p_i} g_{s_i} < 0.
$$

The first condition attached to this function show that when there are no customer dynamics ($g(1, 1) = 0$) all firms set the same price and provide similar customer-services. However, if the firm sets its price above the industry average the marginal change in its customer base is $-\mu \gamma \left( \frac{p_i}{p} \right)^{\mu-1} \left( \frac{s_i}{s} \right)^{-\beta}$. The term $\gamma \mu$ is strictly positive and measures how sensitive customers are to changes in relative prices and may capture the informational restriction which give rise to customer dynamics in Eq.(2). We further require that $\mu > 1$, so that, $g_{p_i} g_{s_i} < 0$. As $g_{p_i} \to -\infty$, we get the traditional model of a perfectly competitive market with a horizontal demand curve. When, $g' = 0$, we have a complete monopoly because the demand curve faced by the firm has the same elasticity as that of the whole industry. In contrast to other customer-market models, we allow firms to use customer-care as a mechanism for reducing customer dynamics. Thus, when the firm provides better than average customer-care ($s_i > s$), other things being equal, it reduces the outflow of customers by $\beta \gamma \left( \frac{p_i}{p} \right)^{\mu} \left( \frac{s_i}{s} \right)^{-\beta-1}$ where $\gamma \beta$ measures how sensitive clients are to customer-care.

The Eqs. (1) and (2) conveniently capture the idea that households have search-costs in the spirit of the studies such as Gottfries (1986), Klemperer (1987), Farrell and Shapiro (1988), Beggs and Klemperer (1992) and Ireland (1998). Studies such as Phelps and Winter (1970), Telser (1962), Maccini (1978) and Rodriguez (1985) and Rotemberg and Woodford (1993) use a similar setup. More importantly,
Ireland (1998) build a rich general-equilibrium model where customers have a fixed cost for searching a new supplier. These fixed search costs give the firm some monopoly power over its customers. By promising to charge a lower price relative to the other suppliers it can deter clients from searching and hence augment their future expected utility; giving the Phelps-Winter effect. For our purpose Eqs\(^5\). (1) and (2) capture the basic idea of a household’s optimization problem with endogenous search costs such as in Ireland (1998). Nonetheless, Ireland (1998) and the present paper are distinct. There, the issue is that of search costs faced by the consumer and here the issue is of customer relation costs faced by the firm. But the common feature is the Phelps and Winter framework.

The innovative feature of this model are the CC costs denoted by the function \( M(x^i, s^i) \) below. We model CC costs in two parts. The first term is a semi-fixed cost that grows with the number of customers and can be thought of as the set-up costs of CC operations for a given level of the customer base. The second term is a variable cost and consists of the services a firm uses to pamper its clients. The latter depends on the level of care provided, \( s^i \), as well as the customer-base since all customers are provided CC without preferential treatment. Therefore, the total costs of servicing clients are

\[
M(x^i, s^i) = m(x^i) + \bar{m}s^i x^i, \quad \bar{m} > 0, \quad M_{x^i}, M_{s^i x^i} > 0, \quad M_{s^i} > 0,
\]

The CC costs are convex in the customer base \( x^i \). This is because as the customer base grows so does the diversity of customer type and their needs, driving up costs.

\(^5\)Carlson and McAfee (1982) show that the demand relation in Eq. (1) can result from a setting where the households conduct sequential search for the cheapest product with a uniform distribution of search costs across buyers.
The dynamic maximization problem of the representative firm under an exogenous real interest rate, $\rho > 0$, is described by the following system,

$$
F(x^i) = \max_{p^i, s^i} \int_0^\infty e^{-\rho t} \left[ (p^i - \bar{c}) y^i x^i - M(x^i, s^i) \right] dt
$$

subject to

$$
\dot{x}^i = x^i g\left( \frac{p^i}{p}, \frac{s^i}{s} \right) \text{ and } x(0) = x_0,
$$

where $F(x^i)$, $p^i$, $s^i$, $\bar{c}$, $y^i$ and $M(x^i)$ denote the firm’s value, its own price and customer-care level, the unit cost of production, demand per customer and the total CC costs respectively. The term $x_0$ is firm $i$’s initial proportion of customers and $y^i x^i$ is the total number of units sold. The firm maximizes the present-value of future profits by choosing a path for prices and the level of customer-care.

The choices of a price and a customer-care level are an intertemporal investment decision and the customer base, $x^i$, is the state variable.

Using optimal control theory, the following current-value Hamiltonian function is obtained,

$$
H(p^i, s^i, x^i, q) = \left[ (p^i - \bar{c}) x^i y^i - M(x^i) + q(t) g\left( \frac{p^i}{p}, \frac{s^i}{s} \right) \right] x^i.
$$

The first two terms on the right-hand side represent the immediate profit for a given proportion of customers. The third term captures future profits from customers, where $q(t)$ is the shadow value of customers. By substituting the functional forms of the demand function and the customer dynamics, the following current-value Hamiltonian is obtained:
\[ H(p^i, s^i, x^i, q) = \left( \frac{p^i}{p} \right)^{-\eta} p^i x^i - A \left( \frac{p^i}{p} \right)^{-\eta} \tilde{c} x^i - m(x^i) - \tilde{m}s^i x^i \]
\[ -q(t) \left[ \gamma - \gamma \left( \frac{p^i}{p} \right)^{\mu} \left( \frac{s^i}{s} \right)^{-\beta} \right] x^i. \]  
\[ (6) \]

The optimal solutions for the control variables \( p(t) \) and \( s(t) \) must maximize \( H(.) \) at each point in time so that,

\[ H_p = 0, H_s = 0. \]  
\[ (7a) \]

If \( \tilde{p}(t) \) and \( \tilde{s}(t) \) are the optimal time paths for the firm’s price and customer-care levels then there exists a function \( \tilde{q}(t) \) that satisfies the differential equation,

\[ \dot{\tilde{q}}(t) = \rho \tilde{q}(t) - \frac{\partial H}{\partial x^i}. \]  
\[ (7b) \]

The function \( \tilde{x}(t) \) solves the differential equation

\[ \dot{\tilde{x}}^i = x^i g \left( \frac{p^i}{p}, \frac{s^i}{s} \right), \]  
\[ (7c) \]

where the initial and the transversality conditions are given by

\[ x(0) = x_0, \lim_{t \to \infty} e^{\int_0^t -\tilde{p} \tilde{s} \tilde{t} q(t) x(t)} = 0. \]  
\[ (7d) \]

Using the first-order conditions we get the following equations which define the optimal paths \( \tilde{p}(t), \tilde{s}(t), \tilde{x}(t) \) and \( \tilde{q}(t) \):

\[ A \tilde{x}^i \left( \frac{p^i}{p} \right)^{-\eta} - A \eta \tilde{x}^i \left( \frac{p^i}{p} \right)^{-\eta} + A \eta \tilde{x}^i \left( \frac{p^i}{p} \right)^{-\eta} \tilde{c} \]
\[ -q(t) \left[ \mu \gamma \left( \frac{p^i}{p} \right)^{\mu} \left( \frac{s^i}{s} \right)^{-\beta} \right] x^i = 0 \]  
\[ (8a) \]
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\[-\bar{m} x^t + q \bar{\beta} \gamma (s^t / s)^{-\bar{\beta}} / s^t = 0\]  \hspace{1cm} (8b)

\[\dot{q}(t) = \rho q(t) - A \left( \frac{\tilde{s}^t}{p} \right)^{-\eta} \frac{p^t}{p} + A \left( \frac{\tilde{s}^t}{p} \right)^{-\eta} \frac{\bar{c}}{s^t} + m^t + s \]  \hspace{1cm} (8c)

\[\gamma = \gamma \left( \frac{\tilde{s}^t}{p} \right)^{-\gamma} \left( \frac{s^t}{s} \right)^{-\bar{\beta}}\]  \hspace{1cm} (8d)

\[\dot{x}^t = x^t g \left( \frac{p^t}{p} \cdot \frac{s^t}{s} \right)\]  \hspace{1cm} (8e)

Eq. (8a) gives the optimal price that maximizes the Hamiltonian for given values of \(x^t\) and \(q(t)\). The left-hand side in Eq. (8a) gives a trade-off between current and future profits. The first three terms capture the net instantaneous benefit of selling to current customers where the first two terms are the marginal revenue and the third term is the marginal production cost. The fourth term shows the net future benefit from charging a lower markup. On the one hand, when the firm assigns no value to its customer base, i.e., \(q(t) = 0\), the customer-market model gives the monopoly solution, i.e., MR=MC. On the other hand, when \(q(t) > 0\) the monopolist’s marginal revenue is lower than the marginal costs (see Eq. (8a)). This is because the firm faces a trade-off: the marginal benefit from raising prices – in the form of higher current profits – is equal to the marginal cost – in the form of a smaller customer base and lower profits in the future. As a result, the markup charged is lower and the output produced is higher than under a pure monopoly. The Eq. (8b) gives the optimal level of customer-care that maximizes \(H(p^t, s^t, x^t, q)\). This equation shows that at the optimum, the marginal cost of providing care, the first term on the left-hand side, must equal the marginal benefit a firm gets from providing this service in the form of continued patronage, i.e., the
second term.

2.1. Phase Diagram Analysis with Symmetric Equilibrium

Figure 1 illustrates the phase-diagrams associated with the system (8). The \( \dot{x} = 0 \) curve is the \((x,q)\) combination for which the steady-state values of \( \tilde{p} \) and \( \tilde{s} \) are given by (8a) and (8b), i.e., the locus is defined by substituting the optimal values of our control variables in (8c) and then totally differentiating and assuming a symmetric equilibrium, i.e., \( p^i = p, s^i = s \) we find that

\[
\frac{\partial q}{\partial x_i} \bigg|_{\tilde{p}, \tilde{s}} = \frac{-(A(1-\eta) + A\bar{c}/\bar{p}^i - \mu \gamma q/\bar{p}^i - \beta \gamma q/s^i)}{(-\mu \gamma/\bar{p}^i + \beta \gamma/s^i)x_i} = 0.
\] (9)

Thus, the slope of the curve evaluated at the optimal values of the control variables and assuming symmetric equilibrium is zero (i.e., horizontal). The positive intercept of \( \dot{x} = 0 \) curve with the \( q \) axis is given by (9).

\[
q = \frac{-A(1-\eta) - A\bar{c}/\bar{p}^i + \bar{m}}{\mu \gamma/\bar{p}^i - \beta \gamma/s^i} > 0
\]

which is positive since \( \bar{m}, \bar{c}, \beta, \gamma, \mu > 0, \eta < 0 \) and assuming that \( \mu > \beta \). This last condition implies that customer-flows respond more to price differentials in comparison with differences in customer-care which is not an unreasonable condition given the demand curve.

The \( \dot{q} = 0 \) curve is found by setting \( \dot{q} = 0 \) in Eq. (8c), and substituting the optimal values for \( p^i \) and \( s^i \) from (8a) and (8b) in the resulting equation to find that \( \dot{q} = 0 \) schedule is negatively sloped.

\[
\frac{\partial q}{\partial x_i} \bigg|_{\tilde{p}, \tilde{s}} = \frac{-m x_i s^i}{\rho + \mu \gamma/(\eta - 1) + \beta \gamma} < 0.
\]
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Fig. 1 shows the saddlepath stability and it displays the dynamics implied by the equation of motions in each of the four region

2.2. Derivation of the Steady-State Equilibrium.

Assuming that the equilibrium is symmetric, so that \( p^i = p, s^i = s \), we obtain the equations;

\[
\dot{q} - \rho q = -Ap^i + A\bar{c} + \bar{m} s^i + m'(x^i),
\]

\[
p^i = \frac{\eta \bar{c}}{\eta - 1} - \frac{q \gamma \mu}{A(\eta - 1)},
\]

The sufficient conditions for our maximization problem can be established using the Arrow theorem. This theorem says that (See Phelps and Winter (1970)), if \( x(t), p(t), s(t) \) and \( q(t) \) meet the conditions (8), if \( (x, q) \) converges to the limit \( (\bar{x}, \bar{q}) \), and if a function \( H^o = H(x, \bar{p}, \bar{s}, q) \) is concave in \( x \) for a given \( q \), then these functions define an optimal path. We first check if the values of \( p^i \) and \( s^i \) which solve \( H_{p^i}, H_{s^i} = 0 \) for a nonnegative \( x \) and \( q \) maximize \( H(.) \). It is known from (8a) and (8b) that \( H_{p^i}, H_{s^i} > 0 \). The concavity of \( H^o \) in \( x \) for given values of \( q \) can be verified by assuming symmetry across firms and substituting the optimal values of our two control variables to find that \( H_{x^i,x^f} = -M_{x^i,x^f} < 0 \).
$$s^t = \frac{q^\gamma \beta}{m},$$  \hspace{1cm} (12)$$

Eq. (10) describes the equilibrium path of the customer-value while Eq. (11) is the pricing formula for a given customer-value. The first term in the latter equation is the textbook monopoly markup over marginal cost and the second term shows the effect of considerations of expected changes in the future market share. Finally, Eq. (12) determines the level of CC a firm provides and is positively affected by customer-worth and the sensitivity to customer-care and negatively by the costs of providing extra customer care.

Upon substituting Eqs. (11) and (12) in (10) we obtain,

$$\dot{q} - kq = -\frac{A\bar{c}}{\eta - 1} + m'(x^t) \text{ where } \kappa = \rho + \frac{\mu \gamma}{\eta - 1} + \beta \gamma > 0$$  \hspace{1cm} (13)$$

The steady-state solution (i.e., the \((\bar{q}, \bar{x})\) combination in Fig. 1) of this customer-value differential equation is given by

$$\bar{q} = \frac{\bar{c}A}{\kappa (\eta - 1)} - \frac{m'(x^t)}{\kappa}.$$  \hspace{1cm} (14)$$

The first term captures the usual Phelps-Winter effect that the marginal revenue is smaller than marginal cost. The second term captures the effect of customer-care costs on customer-value. In particular, a higher marginal customer-care cost reduces customer worth as it affects profits negatively since \(\kappa > 0\). When \(m'(x^t) = 0\) the steady-state customer-value is that of Phelps-Winter (1970).

2.3. The Determinants of Market Pricing and Customer Care.

Upon substituting Eq. (14) in (11) we get the general pricing formula,

$$p^t = \frac{\eta \bar{c}}{\eta - 1} + \left[ \frac{\mu \gamma \bar{c}}{(\rho (\eta - 1) + \mu \gamma + \beta \gamma)(\eta - 1)} \right] + \frac{\mu \gamma m'(x^t)}{\kappa (\eta - 1) A}$$  \hspace{1cm} (15)$$
If we set the sensitivity parameter \((\gamma\mu)\) and the change in our semi-fixed cost \((m'(x^i))\) equal to zero, Eq. (15) would give the traditional monopoly solution—the first term on the Right Hand Side. In this instance the price markup over marginal cost, \(\bar{c}\), simply depends on the demand elasticity. However, letting \(\gamma\mu\), \(m'(x^i) > 0\) our model uncovers a nontrivial pattern for pricing.

Starting with the customer costs which are only present in the third term in Eq. (15) (the main innovation in our model) and rewriting it we get

\[
\frac{p^i}{\bar{c}} = B + \frac{\phi}{\bar{c}} \left( \frac{m'(x^i)}{A} \right),
\]

where \(\phi = \frac{\mu\gamma}{\kappa(\eta - 1)} > 0\), and \(B\) comprises of the first two terms of Eq. (15). Using this relation, we get

\[
\frac{d(p^i/\bar{c})}{dA} = -\frac{\phi m'(x^i)}{\bar{c}A^2} < 0.
\]

This implies that a rise in demand, \(A\), reduces the level of markups, \(\frac{p^i}{\bar{c}}\), for a given level of marginal change in semi-fixed customer costs. The intuition is that the semi-fixed customer-care costs for the marginal customer are spread over a larger number of items sold leading to an increasing-returns-to-scale effect. This in turn raises the incentive for a firms to reduce markups and expand its market share. In fact, at the margin, it is now cheaper to expand the market-share.

To understand the remaining two terms of Eq. (15) assume that customer-care costs are zero and rewrite this equation as

\[
\bar{c} = p^i \left[ \frac{\eta^*}{\eta^* - 1} \right] \text{ where } \eta^* = \eta + \frac{\mu\gamma}{\rho + \beta\gamma} \text{ and } \eta + \mu\gamma/(\rho + \beta\gamma) > 1.
\]

Note that the model allows us to define the mark-up in this traditional manner. This same definition will also be used in the empirical work.
The above equation gives the equilibrium condition $MR = MC$ with a twist. Indeed, total demand elasticity, $\eta^*$, is composed of two terms. The first term is the instantaneous price elasticity of demand. The second term is the longrun price elasticity and captures the present value of the effect on pricing of customer flow dynamics. For prices to be positive we need the above condition and it is similar to Phelps and Winter (1970). This condition implies that the total elasticity of demand is large enough so that an increase in the price above the industry average will always result in a marginal loss in the present value of firm’s revenue.

Our pricing equation also generates familiar results. First, a higher cost of capital or marginal costs—whether production or CC—raise markups. Second, high shortrun or longrun elasticity of demand lower markups.

The optimal level of customer-care can be obtained by substituting the Eq. (14) in (12) to find that

$$s'\hat{m} = \frac{\gamma \beta \hat{c} A}{\kappa (\eta - 1)} - \frac{\gamma \beta m'(x^t)}{\kappa}.$$ 

The first point to note is that provision of customer-care only makes sense when it helps to reduce customer flows. The second point is that desire to provide customer-care entirely depends on how much the firm values its clients. Thus, the first term on the right-hand-side in the equation above is the usual Phelps-Winter effect. The second term shows that a higher semi-fixed CC cost for the marginal customer reduces provision of CC as it affects customer-worth negatively since $\kappa > 0$. 
3. Are Markups Countercyclical?

In this section we present the evidence on the existence of countercyclical markups. We construct a measure for customer-care costs from the data on “costs of non-industrial services” and “costs of operatives” provided for eight industries in UK’s “Annual Manufacturing Survey” for 1972-1991. Non-industrial services expenditures comprise of customer relation management, telecommunications, all forms of shipping costs, market-research and advertising. This figure is a remainder and is obtained from subtracting the reported costs of non-industrial services from the reported rent, bank fees, licensing fees, water charges and insurance premium. We also include the wage bill of operatives who are builders, fitters, maintenance workers and also staff engaged in transporting and employed in warehouses, stores and shops. The sum of all these elements constitute our highest measure of customer-care costs. Table 1 shows two estimates for the average share of these costs in total costs for eight industries. The difference between the two estimates is that the latter excludes the costs of operatives employed for activities not related to production (see above). This is so as it may be argued that some employment of customer-care operatives may be sensitive to the amount of output sold and not the number of customers. Note that our measures of CC costs include advertising expenditure which may be problematic since a number of papers argue that these expenditures are procyclical. Unfortunately, our data does not allow us to separate such costs from other non-production costs.

According to our estimates of customer-costs Motor Vehicles, Clothing and Footwear, Textiles, and Metal Manufacturing have a lower proportion of customer-costs than Electrical and Mechanical Engineering, Chemicals and other Metal
product industries. Our next step is to test to what extent does these costs help generate countercyclical markups.

Table 1: A Measure of the Share of CC Costs in Total costs for 1973-1991

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<tr>
<th>Industries</th>
<th>% High</th>
<th>% Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering</td>
<td>19.47</td>
<td>5.72</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>18.29</td>
<td>5.71</td>
</tr>
<tr>
<td>Chemicals</td>
<td>15.8</td>
<td>7.8</td>
</tr>
<tr>
<td>Other Metal Product</td>
<td>14.58</td>
<td>5.76</td>
</tr>
<tr>
<td>Motor Vehicles</td>
<td>11.96</td>
<td>5</td>
</tr>
<tr>
<td>Clothing and Footwear</td>
<td>12.79</td>
<td>5</td>
</tr>
<tr>
<td>Textiles</td>
<td>11.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Metal Manufacturing</td>
<td>8.9</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

We carry out two separate tests. First, we estimate the cyclical movements of markups in UK industries that are associated with customer costs and other traditional variables measuring cyclicality.

We estimate how markups respond to detrended output per worker, detrended hours and detrended employment. These are constructed as follows. We first use the Hodrick-Prescott filter to obtain a smooth trend for each series for each industry. We then subtract the originally untrended series from its trended version and to obtain trend deviations. We also use the log of ratio of servicing costs to total costs per unit of output to capture the cyclical impact of CC costs on markups. This variable proxies for the second term in on the right-hand side of Eq. (16) which is the ratio of marginal maintenance costs to marginal production costs per unit of output. One special point about that term was that it compared
marginal change in the fixed element of CC costs to the marginal production costs, but they are defined on different scales (servicing costs as per customer and production as per unit of output). Unfortunately, our data is not intricate enough for us to be able to measure this exact ratio. Instead, we use the ratio total CC costs in total costs per unit of output. The attractiveness of using this approximation is that it is important to know how large servicing costs have to be as a fraction of total costs to generate countercyclical markups. Although this variable is unique to our work, the general issue of the cyclical nature of the markup has been studied before. Indeed, Bils (1989) and Rotemberg and Woodford (1989) find countercyclical markups movement on US data whereas Haskel, Martin and Small (1995) and Small (1997) find procyclical markups on UK data.

As a second test we test the hypothesis that markups should be less procyclical in industries where our total servicing costs are higher. The data provided in the table above helps to sort industries in two groups. Indeed, Clothing and Footwear, Textiles, Motor Vehicles Metal Manufacturing and have a lower proportions of customer-costs than Mechanical Engineering, Chemicals, Electrical, Other metal Product and Other Mineral industries. We use these two groups to measure the strength of the cyclicality coefficient.

3.1. The Data and the Estimation of markups

The data\textsuperscript{8} was collected for 8 industries over the period of 1968-1991\textsuperscript{9} for the industries listed in Table 1. The data is composed of value-added, total employment, capital stock, nominal value-added and actual labor hours and customer costs as a proportion of total costs (see Appendix for sources).

\textsuperscript{8}We thank Ian Small for generously providing the basic data.
\textsuperscript{9}We do not use data after 1991 due to the change in industrial classification.
We use the following modified version of Hall’s (1988) equation\textsuperscript{10} and estimate markups in a fixed-effects model,

\[ \Delta (y - k)_{i,t} = \theta_i + a_i \text{dum7480} + b_i \text{dum8191} + \mu_i \Delta (l + h - k)_{i,t} \text{shK} \text{L} \]

where \( i = 1 \ldots 8 \) and \( t = 1, 2, \ldots 24 \).

where \( \Delta (y - k) \) is growth output per capital, \( \Delta (l + h - k) \), is growth in labour per capital, \( \mu \)\textsuperscript{11}, is the markup, \( h \), is actual labor hours, \( l \) is labour and \( \theta \) is the Solow residual. Lower case letters represent logs.

Eq. (18) is an enhanced version of Hall’s equation in that \( N = LH \), where \( L \) is employment and \( H \) is hours as in Haskel, Martin and Small (1995) and Small (1997). Secondly, \( \theta \) is allowed to vary by industry in view of Layard and Nickell (1989) who provide evidence that UK’s TFP growth varies substantially across industries. To accomplish this we follow Haskel et al. (1995), Small (1997) and Bean and Symons (1989) by including in Eq. (18) two time dummy variables: One for 1974-1980 to control for the for the oil price shock and the other for 1981-1991 for the world recession.

Hall (1988) also pointed out that the estimation of Eq. (18) suffers from endogeneity in that the growth in output per unit capital, \( \Delta (y - k) \), and the weighted growth in labor per unit capital, \( \Delta (l - k) \), are jointly determined. Indeed, we successfully carry out the “Wu-Hausman Test\textsuperscript{12}” rejecting the hypothesis of

\textsuperscript{10}The first author will provide notes on the derivation of this equation.
\textsuperscript{11}This is the traditional measure for the mark-up and ignores servicing costs. It is also consistent with our theoretical work.
\textsuperscript{12}The Wu-Hausman Test is as follows: let \( y_{it} = \alpha_i + \beta_i x_{it} + u_{it} \) be the equation suspected for endogeneity where \( x_{it} \) is the explanatory variable for \( y_{it} \). Assume, \( z_{it} \) is a chosen set of instrument for \( x_{it} \). By running \( x_{it} = \gamma_i + \delta z_{it} + v_{it} \), I recover the estimated \( \hat{v}_{it} \). Finally, run \( y_{it} = \alpha_i + \beta_i x_{it} + \lambda \hat{v}_{it} + u_{it} \). The test for \( \lambda = 0 \), is the Wu-Hausman test for exogeneity of \( x_{it} \).
exogeneity for \( sh_{i,t}^L \Delta (l + h - k)_{i,t} \). As a result, we use the following instrumental variables: Current growth in OECD total output, growth in real GDP and labour-capital ratio in the UK, lagged change in industry’s labour-capital ratio and a constant. The choice of instruments was based on their explanatory power, \( R^2 \), for, \( sh_{i,t}^L \Delta (l + h - k)_{i,t} \), and low standard error.

3.2. The Level of Imperfect Competition in UK Industries

Table 2 shows the estimated average markups for each industry during the period of 1968-1991. The method of estimation is fixed-effects model with a within-group estimator where the markups are allowed to vary by industry but are assumed to be constant over time.

A first glance at Table 2 suggests that during the 1968-1991 period UK industries were operating in imperfectly competitive markets. The estimated markups for individual industries are statistically above zero and greater than unity for all industries except for clothing and footwear. The average markup in these industries is 1.40. The Chi-Squared test, \( \chi^2 \), in Table 2 rejects the hypothesis that markup is the same across industries and is equal to unity. The \( J \) statistic for overidentification is below the critical value for the \( \chi^2 \) distribution with four degrees of freedom.
Table 2: Estimates of Markups

<table>
<thead>
<tr>
<th>Industries</th>
<th>Markup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Manufacturing</td>
<td>2.20 (0.36)</td>
</tr>
<tr>
<td>Chemicals</td>
<td>1.77 (0.56)</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>1.49 (0.51)</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>1.27 (0.38)</td>
</tr>
<tr>
<td>Motor Vehicles</td>
<td>1.23 (0.21)</td>
</tr>
<tr>
<td>Other Metal Product</td>
<td>1.21 (0.23)</td>
</tr>
<tr>
<td>Textiles</td>
<td>1.14 (0.24)</td>
</tr>
<tr>
<td>Clothing and Footwear</td>
<td>1 (0.31)</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 24.9; \ p = 0.02 \]

\[ J = 4.28 \]

3.3. The Cyclical Movements of Markups.

The suggestion that markups, \( \mu \), change over the business cycle can be formulated as,

\[ \mu_i = \bar{\mu}_i + \varphi Z_{i,t} \quad i = 1..13; \quad t = 1..24 \]  \hspace{1cm} (19)

where, \( \bar{\mu}_i \), \( \varphi \), denote the non-cyclical and the cyclical components of the markup. The variable \( Z_{i,t} \) captures the cyclical movements in the markup (see Domowitz, Hubbard and Peterson (1988), Haskel et al. (1995), Small (1997)). Substituting Eq. (19) in (18) gives

\[ \Delta (y - k)_{i,t} = \theta_i + a_i dum7480 + b_i dum8191 + \bar{\mu}_i \Delta (l + h - k)_{i,t} + \varphi Z_{i,t} \Delta (l + h - k)_{i,t} \]  \hspace{1cm} (20)

\[ + \varphi Z_{i,t} s_h \Delta (l + h - k)_{i,t} \]
where $i$ and $t$ denote industry and time. The conditions $\varphi < 0$, $\varphi > 0$, $\varphi = 0$ imply either countercyclical or procyclical or acyclical markup movements respectively. To estimate this equation we use the period 1968-1991 with the exception that when CC costs are used as the cyclical variable the period of estimation is 1972-1991. The non-cyclical component of the markup is allowed to vary across industry and the cyclical component is constrained to be the same for all industries.

We start by using the cyclical variable at the heart of our model that is the log of the ratio of servicing costs to total costs per unit of output. We call this the “customer-care cost” variable. We use both high and low estimates of these costs (see Table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient of $\varphi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low CC Cost</td>
<td>-0.13 (0.10)</td>
</tr>
<tr>
<td>High CC cost</td>
<td>-0.10 (0.13)</td>
</tr>
<tr>
<td>Detrended Output</td>
<td>-16.1 (2.56)</td>
</tr>
<tr>
<td>Detrended Hours</td>
<td>-23.55 (8.08)</td>
</tr>
<tr>
<td>Detrended Employment</td>
<td>4.15 (1.16)</td>
</tr>
</tbody>
</table>

Table 3. Estimation of Eq. (19)

In Table 3 the coefficient on our first cyclical variable is negative and significant at 10% thus supporting our hypothesis of countercyclical markups in our modest estimates for CC costs. The result on the higher estimate for CC costs is in the same direction but is less significant. The results on the remaining three variables capturing cyclicality are also reported in Table 3. The cyclical coefficients on detrended output and detrended actual work hours (suggested by Bils (1987) and Rotemberg and Woodford (1991)) are significant and negative. However, the
cost coefficient on detrended industrial employment (as in Haltiwanger and Abraham (1995)) is positive suggesting procyclical markups. The question now remains which of these variables best measures the business cycle. If we assume that labour hiring is a lengthy process and firms initially respond to higher demand by labour hoarding then detrended hours appears to be a better choice for measuring the cycle. In this case markups would be countercyclical (Bils (1987) find this result as well). However, if supply of labour and hours are equally elastic then the choice is less clear.

We now turn to the second test of our model. Here we separate industries into two groups. As explained earlier, this separation is based on the share of servicing costs in total costs. The group with the higher share of CC costs in total costs is expected to have a higher coefficient of cyclicality, \( \varphi \), in Eq. (26). For this purpose, we use the two more widely accepted measure of cyclicality: Detrended output and hours. Table 4 suggests that industries with a higher CC costs tend to be more countercyclical than ones with lower such costs.

On the one hand, our results are in contrast with the findings of Haskel et al. (1995) and Small (1997). These are down to three reasons, the first is down to their choice of cyclicality variables: capacity shortages, capacity utilization, unemployment for Haskel et al. and CSO coincident indicators, capacity shortages for Small (1997). The second is the difference in estimation procedure – Small (1997) estimates individual equations but uses our instruments, while Haskel et al. (1995) use similar estimation technique but employ a different set of instruments. Finally, our time dummies are different from both papers.
Table 4: Results on the strength of the cyclicality coefficients, $\varphi$.

<table>
<thead>
<tr>
<th></th>
<th>Detrended Output</th>
<th>Detrended Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Cost Group</td>
<td>−25.7</td>
<td>−27.72</td>
</tr>
<tr>
<td></td>
<td>(3.89)</td>
<td>(10.91)</td>
</tr>
<tr>
<td>Low Cost Group</td>
<td>−13.6</td>
<td>−24.25</td>
</tr>
<tr>
<td></td>
<td>(3.62)</td>
<td>(10.69)</td>
</tr>
</tbody>
</table>

Standard Errors in Brackets

On the other hand this study finds, results similar to Bils (1987, 1989), Rotemberg and Saloner (1986) and Rotemberg and Woodford (1991, 1999), who using similar cyclical variables find evidence of countercyclical markups on the US data.

3.3.1. Empirical Results on Customer Care

The model developed in Section 2 also predicts in Eq. (12) that a firm’s desire to provide customer-care is related to how much it values its customers. In fact, firms that value their customers more are expected to have higher CC costs. In order to test this prediction, we gather data on real share price index by industry and we use that as a proxy for customer-value as in Phelps (1999) and Choudhury (2005). We gather data from Datastream on industrial share-price index from 1973-1991 for four of the industries in our group. Those industries are Chemical, Electrical Engineering, Motor Vehicle and Textile.
We estimate the following equation using a fixed-effect estimator

\[ CC_{Cost_{it}} = \alpha + \beta_i (Customer_{Value_{it}}) + \xi_{it}. \]

Our expectation is that \( \beta \) will be higher for industries that spend larger amounts on both of our estimates of CC costs and Table 5. lends support to this hypothesis. Indeed, industries such as Chemical and Electrical Engineering which have a higher share of CC costs place a higher valuation to their customer base.

4. Brief Discussion

In this final section we critically evaluate our work with closely related papers and also discuss the shortcomings.

Bils (1989) argue that a state of boom is associated with an influx of new and highly price-elastic customers. This in turn raises incentive for the firms to reduce markups and expand market-share. Along similar lines Barsky and
Warner (1995) argue that an increased flow of customers during booms provides seller incentives to make informative advertising expenditures which then reduces household’s costs of product search. These cost reductions allow for easier price comparisons across firms hence raising elasticities and the markdowns ensue. One interesting relationship of these studies with our paper is that the presence of CC costs may limit the amount of new customers a firm can take on board as the market expands. As long as CC cost do not rise too swiftly with the number of customers the above arguments hold.

Further, unlike Ireland (1998), the consumer switching decisions are exogenous and instead we focus on servicing costs. Would our main result on countercyclical markups change with endogenous switching costs? Intuition suggests that the results would not change. Indeed, in Ireland (1998) large purchases increase household’s search activity while search costs stay fixed, which compromises firm’s monopoly power. Here, large purchases with servicing costs faced by the firm remaining fixed make it optimal for firms to enlarge their customer base by lowering the markup. Therefore, the two channels are distinct and not mutually exclusive. Furthermore, the present model highlights the role of the firm in generating countercyclical markups.

Finally, the ideas in the recent work by Ravn et al. (2006) and this paper can be complimentary. Indeed, both paper are based on the ideas in Phelps and Winter (1970) and have countercyclical markups in line with empirical evidence. Ravn et al. (2006) is a general equilibrium model with households having habits in consumption at the level of a variety. This gives the firm some degree of monopoly power. In this environment, a rise in demand increases the importance of the elasticity of the non-habitual component in total demand, encouraging firms to reduce
markups. Again, our partial-equilibrium model also has countercyclical markups but without the behaviour of optimizing households. Furthermore, the main idea in our paper may have interesting implications for Ravn et al. (forthcoming) in that the CC expenditures can generate and strengthen internal habits in Ravn et al. (2006)\textsuperscript{13}. Formally, linking the two models is a promising research topic.

5. Conclusion

We examined price dynamics in a customer-market framework and studied the implications of introducing customer-care costs which purely depend on the customer base of the firm. Assuming convex customer-care costs we reach the conclusion that in a boom (recession) servicing cost per unit of output sold falls (rises) because customer-care costs per client are spread over a larger (smaller) number of units sold resulting in a fall (an increase) in the average costs. This in turn induces firms to trim (raise) markups to expand (shed) their customer base. This new channel for increasing returns to scale blunt the effect of the higher average sales per customer in a boom and make countercyclical markups possible. Two empirically robust results that use proxy data for customer-care costs show that during 1968-1991 markups in the UK may have been countercyclical.

Data Appendix

The Data covers the period of 1968-1991 and is taken from the following sources: (1) Real value added output: GDP at constant factor cost: Table B4, Census of Production (The Blue Book), (2) Costs data: Census of Production (Currently known as Annual Manufacturing Survey), (3) Nominal value-added: Table B3 Census of Production, (4) Nominal total wages: Table 3.3, Census of

\textsuperscript{13}We thank an anonymous referee for raising this point.
Costly Customer Relations and Pricing

Production, (4) Real Gross capital stock: Table A3.8 Census of Production, (5) Total employment: Table A2 Employment Gazette, (6) Actual hours data: Table 5.4, Employment Gazette, (7) OECD, industrial output and GDP at factor cost, oil prices indices, government defense expenditure and real share price index are from Datastream. The definitions are as follows: (1) y-log of real GDP at factor cost that is taken from the “Blue Book” Table B4, (2) k- log of real capital stock taken from “Blue Book” Table A3.8, (3) n- log of total hours and l- log of total employment are taken from and Employment Gazette Table 5.4 and A2 respectively.

References


Effects of Aggregate Demand on Economic Activity,” Working Paper No. 3206, NBER.


