NBER WORKING PAPER SERIES

CYCLICAL PRICING OF DURABLE GOODS

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Working Paper No. 3050

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 1989

For helpful comments I thank Andrew Caplin, Glenn Hubbard, James Kahn, David Romer, Ross Starr, and participants at several seminars. I also wish to gratefully acknowledge financial support from the National Science Foundation. This paper is part of NBER's research program in Economic Fluctuations. Any opinions expressed are those of the author not those of the National Bureau of Economic Research.

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ABSTRACT

I examine price markups in monopolisticly-competitive markets that experience fluctuations in demand because the economy experiences cyclical fluctuations in productivity. Markups depend positively on the average income of purchasers in the market. For a nondurable good average income of purchasers is procyclical; so the markup is procyclical. For a durable good, however, the average income of purchasers is likely to decrease in booms because low income consumers of the good concentrate their purchases in boom periods; so the markup is likely countercyclical. This is particularly true for growing markets. I find markups make the aggregate economy fluctuate more in response to productivity if goods are sufficiently durable.

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1. Introduction

There is a long literature on cyclical pricing. This literature was largely motivated by the very related empirical observations that real wages fail to vary countercyclically, as predicted by traditional business cycle theory, and that firms in many industries appear to price cyclically according to average cost rather than marginal cost. Geary and Kennan (1982) give a good summary of the evidence on real wage behavior. An example of the empirical literature on pricing is Eckstein (1972). One explanation for why prices might not rise relative to wages in boom times is that procyclical movements in productivity (as in Kydland and Prescott, 1982) lower marginal labor cost as much as it is raised by short-run diminishing returns to labor. Bils (1987), however, shows that the procyclical movements observed in a "marginal real wage" are much too large to be explained by observed movements in productivity.

Recently much work has focused on costs of price adjustment as a rationale for price rigidity (e.g., Mankiw, 1985, Blanchard and Kiyotaki, 1987, Ball and Romer, 1987). This paper takes a different tact. It asks whether optimal price-marginal cost markups for firms that are monopolistic competitors increase or decrease from slack to boom periods. If the answer is decrease, then such firms might appear to price according to average cost, but are actually purposefully moving price markups countercyclically relative to a procyclical marginal cost. This is not a new idea. Pigou (1927), Kalecki (1938), and Keynes (1939) each considered countercyclical movements in market power as a potentially important contributor to fluctuations, though none gave a compelling argument for such behavior. More recently, Stiglitz (1984), Rotemberg and Saloner (1986), Bils (1985), and Gottfries (1986) have each constructed arguments along these lines.

Here I extend the Chamberlinian (1931) model of monopolistic competition to a general equilibrium with many consumers and many goods markets. Consumers are distinguishable by their productivities; some are more productive workers than others. Goods differ in their luxuriousness (their ratio of utility provided to cost). Less luxurious goods are purchased by most consumers, very luxurious goods are purchased only by the most productive consumers. Within each goods market there are a number of firms competing for consumers. Rather than being perfect substitutes, it is assumed that firms provide differentiated brands of the good. Following Chamberlain, Lancaster (1979), and others, I assume that there is free entry into markets, but that existence of any increasing returns to scale allows only a finite number of firms in each goods market. In turn this gives firms some market power with respect to their customers.

Section 2 examines the partial equilbrium pricing problem in a single goods market producing and selling a good of given luxuriousness that is completely nondurable. An important assumption I make is that goods are sold and consumed in indivisible units. This has two implications. The first is that firms would like to charge high-income (high-productivity) consumers a higher price. High-income consumers have less price-elastic demands because they place a lower shadow value on real income. The second is that firms cannot actually price discriminate against high-income consumers because all consumers buy equal amounts. I then examine how firms price if demand fluctuates between periods because consumers' total expenditures are fluctuating. Disallowing entry between low and high periods, markups will go up in boom periods, but by less for more luxurious goods.

Section 3 incorporates durable goods into the problem. I find that markups on durable goods are much more likely to fall in booms. The reasoning is as follows. In boom periods consumers purchase goods that they are not quite wealthy enough to purchase in slack times. Therefore the persons who enter and exit any particular market over the cycle are the poorest consumers purchasing that particular good. Furthermore, consumers who enter durable markets in boom times will purchase to cover any depreciation since the previous boom period; steady consumers, by contrast, will only purchase to cover any depreciation since the preceding period. Thus the relatively poorer consumers entering in boom periods receive a disproportionate weight in firms' pricing decisions; so optimal markups are likely to fall, particularly on more luxurious goods.

Section 4 extends the model to a simple general equilibrium. Consumers choose work effort as well as the range of goods to consume in both boom and slack times. There is an array of increasingly luxurious goods, so that for consumers at all levels of wealth there corresponds a marginal good. I examine whether introducing market power in this economy makes it respond more or less drastically to aggregate movements in productivity of a given size. I find that this depends crucially on how durable are the goods produced in the economy. If goods are sufficiently durable then markups will typically fall in boom periods, inducing larger movements in labor effort and outputs than those corresponding to a competitive economy.

Section 5 considers extensions. I consider how my results are altered by firms entering and exiting within cycles. Short-run entry will be procyclical for most goods. This means markups are more likely to be variety. Thus for any consumer with ideal variety i, utility from consuming brand j of the good can be written as:

$$(2) \quad U(i,j) = V - bh_{ij} ,$$

where h_{ij} measures the arc distance on the market circle between variety i and brand j.

Consumers' purchase decisions for this market have two components. They must decide whether to purchase and, if the answer is yes, from which firm to purchase. It dramatically simplifies the derivations to follow if these two decisions can be separated. To achieve this separation I make the following simple and arguably natural assumption. Consumers do not observe individual firms' brand types or prices until they "travel to the market". By this I mean they must incur a shopping cost of size σ. This cost is in the form of a loss of utility (as opposed to a loss of labor endowment). I assume that consumers do know the equilibrium price in the market as well as the number of brands prior to shopping. Consumers can solve for this equilibrium price and number of sellers because they have knowledge of the structure of the market. (Alternatively consumers could be viewed as gaining information on these market averages costlessly because of word of mouth.)

I assume that each period the n firms become newly distributed around the circle of possible varieties. This implies that a consumer does not learn about the availability of particular brands by virtue of having purchased in prior time periods. This redistribution might be viewed as product styles changing across periods. The simple characterization of variety space I employ, however, is not able to address such issues.

Because consumers do not know the available brands or individual brand prices prior to going to the market, a consumer's decision to purchase is independent of his particular taste in brands. All consumers will enter the market for whom the good's expected utility is greater than its price in terms of foregone utility. This condition is:

$$(3) \quad V - \sigma - b/4n \geq \mu_i P \quad .$$

The market equilibrium, described below, will be symmetrical with all firms charging the same price, which I have already denoted here by P. Condition (3) reflects consumers anticipation of paying the equilibrium price P and purchasing from the firm selling the brand closest to their ideal. Because a consumer's ideal variety is equally likely to be any distance from zero to 1/2n from the closest brand the expected loss in utility from being away from the ideal variety is b/4n. After entering the market some consumers will in fact be as far as 1/2n from the closest brand, which equals 1/4n more than expected. I assume that the shopping cost to utility, σ, is greater than b/4n. This insures that no consumer will enter the market (shop) and then exit without purchasing purely because no brand was near enough to his ideal variety. Near perfect competition (for which b/n equals zero) this shopping cost can be viewed as arbitrarily small.

P is the market price expressed in terms of an arbitrary numeraire good. μ_i is the shadow utility value that consumer i places on real income (income in terms of the numeraire). It is convenient to work with the inverse of μ_i; call it y_i. Consumers with more resources will place a lower shadow value on income and thus have higher values for y. In the general equilibrium presented in Section 4 more productive consumers in turn have higher incomes and higher values for y. From equation (3) consumers' incomes, reflected in y, is the sole variable determining who purchases the good. There is a critical income level, y^*, such that consumers who purchase are those with values of y greater than y^*. This condition is purchase if and only if:

$$(4) \qquad y_i \geq y^* = \frac{P^*_j}{Z - b/4n} \quad .$$

Z is equal to V minus σ, that is the utility of the ideal variety net of shopping cost.

Throughout the paper I assume that y is distributed across individuals according to a first-order gamma distribution. That is:

$$(5) \qquad f(y) = (4y/\bar{y}^2)\exp(-2y/\bar{y}) \qquad \text{for } 0 < y < \infty \quad ,$$
$$= 0 \qquad \text{otherwise,}$$

where f denotes p.d.f.; and exp denotes the exponential. $\bar{y}$ is the mean of the distribution. In Section 4 this will similarly imply first-order gamma distributions both for relative productivities and relative incomes. I choose this distribution for two reasons. Firstly it is analytically very tractable. Secondly, Barro (1976) has shown that this distribution has a coefficient of variation very close to a lognormal distribution fitted to U.S. post-World War II family income data. In fact the first-order gamma fits this data virtually as well as a fitted lognormal.[1]

Given equation (5) and normalizing the total number of consumers to equal one, the number of consumers who actually enter the market is:

$$(6) \quad 1 - F(y^*) = \int_{y^*}^{\infty} f(y)\, dy = (2y^*/\bar{y} + 1)\exp(-2y^*/\bar{y}) \quad .$$

where F() denotes the cumulative gamma distribution and y^* is defined in equation (4).

Now consider the consumer's problem of choosing a particular seller contingent on having entered the market. Consumers want to get the best brand for the money. This means choosing the seller that minimizes the loss in utility from being less than the ideal brand plus the loss in utility necessitated by paying for the good. This problem is:

$$(7) \quad \text{Min}_j \quad bh_{ij} + P_j/y_i \quad .$$

h_{ij} is the distance in variety space between individual i's ideal variety and the variety sold by firm j. P_j is the price charged by the firm selling brand j. It is apparent from equation (7) that higher wealth consumers will have less price elastic demands as they are less willing to trade off variety for price.

The remainder of the paper hinges on the result that higher wealth consumers have less price elastic demands; so it merits further discussion. Here it directly results from the assumption that goods are purchased and consumed in indivisible amounts. If goods are divisible then higher wealth consumers will purchase larger amounts. Then it is no longer true in general that price elasticity is negatively related to wealth. If, however, the cost of consuming the next closest brand were reinterpreted as a time cost, rather than a utility cost then results very similar to those below should obtain even if goods are consumed divisibly. Higher wealth consumers will presumably have a higher value of time and therefore a less price elastic demand.

The other critical assumption is that richer consumers consume all goods that poorer consumers consume. The opposite extreme assumption is that each good (in addition to coming in different varieties) is available in a continuum of qualities, with consumers who have higher wealth consuming higher quality versions of the good. If there is an infinitely fine grade of such qualities then each good will be consumed by consumers of a unique wealth level. This implies firms in a given market would observe no cyclical variation in the real income of consumers. Thus that model predicts no cyclical effects on pricing except for that arising from cyclical entry of firms. More generally, if there is not so fine a gradation of qualities of each good, then each good will be consumed by consumers varying over some range of wealth levels. This means weakened versions of my results will still be relevant, where they are more weakened the narrower the range of consumers who consume any single good. I do not find this potential weakening troubling. For one reason, empirically we observe a number of goods of given quality that are purchased by consumers of a wide range of wealth (e.g. black and white televisions, car stereos, water heaters, telephones, personal computers, tennis balls, and so forth). Furthermore, the results below, particularly those in Section 5, are sufficiently dramatic that they could bear considerable weakening.

Now consider a representative firm's view of the market. The shopping cost implies that firms take the total market as given in equation (6). A cut in a firms' price increases its sales by increasing its share of the market rather than the total size of the market. This both simplifies the analysis and makes my results distinct from results from monopoly pricing problems. For a monopolist price markup is driven by the inverse of Mill's ratio (in present notation, $f(y^*)/[1 - F(y^*)]$). In this monopolistic competition setting price markups are determined by the number of sellers, the substitutibility of brands, and the average wealth of purchasers. The results for pricing are much less sensitive to the distribution of consumer reservation prices than in monopoly pricing.

Call the representative firm in the market firm j. Firm j's demand is:

$$(8) \qquad Q_j(P_j) = \int_{y^*}^{\infty} 2h^*(y, P_j) f(y) dy \quad .$$

y^* and $f(y)$ are as defined above. $2h^*(y, P_j)$ is firm j's market share among consumers of wealth y. h^* signifies the distance in variety space between firm j's brand and the ideal variety of a consumer who is exactly indifferent to consuming brand j or the next brand, brand j+1. h^* is pictured in Figure 1. The consumer brand-choice problem in equation (7) defines this market share as:

$$(9) \qquad 2h^*(y, P_j) = 1/n - \frac{(P_j - P)}{by} \quad .$$

From equation (9) it is clear that the response of market share to price is declining in wealth, y. Equation (9) assumes that firms j-1 and j+1 charge the same price, P. In the symmetric equilibrium this will in fact be true. Firm j's net profits are:

(10) $\pi_j = (P_j - c)Q_j(P_j) - F$.

The firm chooses price to maximize these profits. Firm j's profits clearly depend on its competitors prices as well as its own. Its choice of price similarly depends on how it views other firms will react to its price. I assume, following the literature, that firms act as Bertrand competitors. That is, they view other firms' prices as independent of their own price. The first-order condition for profit maximization with respect to price dictates that firms set price markup (actually (P - C)/P) equal to the inverse of its elasticity of demand. As noted above, the elasticity of consumer demand is inversely related to consumer wealth. This is illustrated in Figure 2. Figure 2 gives firm j's market demand for P_j less than, equal to, and greater than neighboring firms' prices. Market share is more responsive to price at lower values of y.

All firms solve an identical problem. By construction the equilibrium is symmetrical, with all firms charging price P. Evaluating the first-order condition at this equilibrium, yields:

$$(11) \quad \frac{P - c}{c} = \frac{b}{cn} \frac{\int_{y^*}^{\infty} f(y)dy}{\int_{y^*}^{\infty} [f(y)/y]dy} = \frac{b}{cn} (\bar{y}/2 + y^*) \quad .$$

The markup will be larger if there are few firms and/or differing varieties are poor substitutes. This reproduces results of Lancaster, Salop (1979), and others. I define a good's luxuriousness by its y^*, the level of wealth for the poorest consumer in the market. In turn, this is approximately the good's ratio of marginal cost to utility yielded. (y^* equals P/[Z-b/4n]; but for P close to c, this will nearly equal c/Z.) Markups are increasing in luxuriousness, y^*. The markup is also larger if consumers have high wealth ($\hat{y}$ large) relative to the marginal cost of the good.

Roberts and Sonnenschien (1977) and others have stressed that in monopolistic-competition models symmetric equilibrium may not exist. As illustrated by Salop, firms can have an incentive to undercut their competitors price by a discrete amount in order to take the entirety of their market. That is not the case here. This is illustrated in footnote 2.[2] The symmetric markup in equation (11) is stable in that no firm has an incentive to diverge from this price by marginal or discrete amounts.

The markup expressed above is not yet in reduced form as y^* depends on price. The reduced form is:

$$(12) \qquad \frac{P - c}{c} = \frac{\frac{b}{n}\left[\frac{1}{Z - (b/4n)} + \frac{\hat{y}}{2c}\right]}{1 - \frac{b/n}{Z - (b/4n)}} \approx \frac{b}{n}\left(\frac{1}{Z} + \frac{\hat{y}}{2c}\right) .$$

The approximately equals means linearly approximating the markup near the competive solution, b/n equal to zero.

So far all results are conditioned on the number of firms in the market, n. This is incomplete as entry is endogenous. I presume entry occurs to the point that all firms make zero profits. (In a moment, however, when considering fluctuations I assume entry does not occur in the short run.) Evaluating near the competitive solution, equations (8), (10) and (11) imply an equilibrium number of firms:

$$(13) \qquad n = (2b/F\hat{y})^{1/2}(y^* + \hat{y}/2)\exp(-y^*/\hat{y}) \qquad ,$$

where, again, y^* is approximately (c/Z) near perfect competition. Consistent with prior results (e.g., Salop), n is increasing in b and decreasing in F. Not surprisingly, n is increasing in average wealth, $\bar{y}$. Although market demand strictly decreases with luxuriousness, y^*, the number of firms does not. n increases with y^* until y^* reaches $\bar{y}/2$ (the mode of the distribution), then decreases thereafter. This is because markups rise sufficiently with luxury at low levels to induce greater numbers of firms to enter despite the declining number of purchasers.

Substituting (13) into (11), the equilibrium markup is:

$$(14) \quad \frac{P - c}{c} = \frac{(bF\bar{y}/2)^{1/2}}{c} \exp(y^*/\bar{y}) \approx \frac{(bF\bar{y}/2)^{1/2}}{c} \exp(c/Z\bar{y}) \quad .$$

That markups should increase with b and F is a standard result. The absolute markup is increasing in luxuriousness, y^*. Markup as a percentage increases with $(1/Z)$, but is ambiguous with respect to marginal cost. It decreases with marginal cost for less luxurious goods (y^* less than $\bar{y}$) and increases with marginal cost for more luxurious goods. Markups are increasing in $\bar{y}$ for less luxurious goods (y^* less than $\bar{y}/2$) and decreasing in $\bar{y}$ for more luxurious goods. For luxuries the positive effect wealth has on markups by lowering the elasticities of purchasers' demands is more than offset by the increased entry it induces. Thus one empirical implication of this pricing model is that, for nontraded goods, markups in rich economies compared to poor economies should be relatively high on necessity goods and relatively low on luxury goods.

Suppose there are fluctuations in market demand of the following form. In odd time periods a consumer's inverse of μ (the shadow value of wealth) is equal to $y(1 - \epsilon/2)$, and in even time periods is equal to $y(1 + \epsilon/2)$. (In the general equilibrium presented in Section 4 these movements are due to countercyclical movements in the real interest rate that are caused by aggregate fluctuations in productivity.) Thus for all consumers we have:

$$(15) \quad y_b/y_s = \frac{1 + \epsilon/2}{1 - \epsilon/2} \approx 1 + \epsilon \quad ,$$

where the subscripts b and s denote boom (even) and slack (odd) periods respectively. The approximation in equation (15) holds closely for small fluctuations. Throughout the paper comparitive statics results with respect to fluctuations are given for small fluctuations in the sense that terms involving ϵ^2 and higher are ignored.

How do markups compare in boom and slack periods? From equations (11) and (14), the answer depends on how luxurious is the good and on whether firms can enter and exit in the short run.

I restrict attention here to the case where firms do not enter and exit in the short run. (The impact of allowing n to vary with the cycle is discussed at length, however, in the Section 5.) I have two rationales for restricting short-run entry. The first is empirical. Although short-run fluctuations in numbers of firms are no doubt important, short-run entry does not appear to occur to the extent this model would imply with continually free entry. The most obvious evidence is that measured profits are quite procyclical. The second rationale is conceptual. I have represented the fixed cost giving rise to market power as a continuously incurred cost F. It is probably more realistic, however, to imagine that part of fixed costs are dynamic in that they only need to incurred upon entry into the market, or only at intervals. Examples of such costs include investment in initial capacity, or investment in initial advertising expenditures. These costs will penalize free entry and exit.

Absence of short-run entry can be motivated in the model in a number of ways. The simplest is the following. Suppose that fixed costs have to be incurred for an additional time period after a firm chooses to shut down production. This implies that a firm that wishes to enter in high demand periods and exit in low demand periods would have to incur the fixed cost of production in all periods. For reasonably small movements in demand no firms will choose that course; so n will be constant across fluctuations. If the economy exists for a number of periods this extra period of fixed cost will have no noticeable effect on the long-run number of firms.

From equation (12), for small fluctuations the percentage change in the markup from slack to boom periods is:

$$(16) \quad \frac{M_b - M_s}{M} = \frac{\epsilon}{1 + 2y^*/\bar{y} - 2M} \approx \frac{\epsilon}{1 + 2y^*/\bar{y}} .$$

The approximately equals denotes linearly approximating near the competitive solution (M equal to 0). The denominator is the long-run markup from equation (14). Equation (16) is unambiguously positive; for nondurable goods markups should be procyclical. Markups are less procyclical for more luxurious goods. For luxuries average resources of purchasers is less procyclical because the relatively poorer purchasers who purchase only in boom times are a more important share of the boom-time market.

3. Durable Goods

For expositional reasons it was convenient to begin with a good that is completely nondurable. The results, however, depend crucially on durability. For durable goods it is very possible that the average income of purchasers in a market will fall in boom periods, causing price markups to fall.

I introduce durability in a simple way. Now suppose that the good in question is durable; with a probability α the good will remain for the following period. Thus depreciation is stochastic, taking values of zero or one hundred percent. I assume α is independent of the age of the machine. Because each consumer will be assumed to consume a continuum of goods, this stochastic depreciation creates no uncertainty for a consumer's budget. With durability goods now have an expected life of $1/(1-\alpha)$ periods instead of a single period. To reflect this durability I now denote marginal cost by c', where c' equals $c/(1-\alpha)$. This normalization is useful because it makes the parameter c remain a measure of the marginal cost of the good per period of expected life. In turn this will be the meaningful concept for defining a good's luxuriousness.

With the exception of durability, the market setup is identical to that of the prior section. In particular, total market size remains independent of any individual firm's price due to consumers' need to travel to the market. Furthermore, in this setting there is no durable-goods monopolist problem (e.g. Bulow, 1982). No firm increases its future sales by pricing away consumers today because all consumers driven away will purchase from a competing firm.[3]

Consumers must now solve a dynamic problem. I assume that no resale market exists for the durable good. A consumer will purchase if the utility of consuming the good this period plus α times the value of having a stock of the good next time period exceeds the cost of the good this period. Because the purchase decision is a discrete one, in general it will depend on the entire future path of the consumer's shadow value of income (or its inverse y) and the entire future path of price. For this reason, I will not try to solve for the market equilibrium as a function of an arbitrary path for consumers' y's. Instead I consider the particular problem in which I am interested--how do firms price across fluctuations in demand? Again let all consumers' y's behave across time according to equation (16). That is, all consumers experience recurring movements of ϵ percent in their shadow value of wealth between odd and even periods.

This simplifies the consumer's problem to two recurring decisions. The consumer must decide whether to replenish the good in slack periods and whether to replenish the good in boom periods. All consumers who purchase in slack times will also purchase in booms; but the reverse is not true.

First consider slack periods. A consumer who already possesses the good will not purchase. A consumer who does not possess the good will purchase if this provides more expected utility than waiting to purchase the following boom period. Thus the consumer will purchase if:

$$(17) \quad Z - \frac{b}{4n} - \frac{P_s}{y(1 - \epsilon/2)} + \frac{\alpha P_b}{y(1 + \epsilon/2)} \geq 0 \quad .$$

The s and b subscripts denote slack and boom periods respectively. The gain of purchasing is not only the utility received today, but also the probability α that the consumer will not have to incur the cost of buying the good the following period. Strictly speaking it is the expectation of P_b rather than P_b that matters. Consumers have perfect foresight, however, with respect to P_b (as well as prices further in the future) because the deterministic fluctuations in y allow consumers to calculate future equilibrium prices. To simplify presentation, equation (17) assumes no discounting of future utility. Below (footnote 4) I give results for the more general case where future utility is discounted.

From equation (17) I can write a critical value for wealth, y_s^* that corresponds to that of the nondurable case.

$$(18) \qquad y_s^* = \frac{1}{(Z - b/4n)} \left[\frac{P_s}{1 - \epsilon/2} - \frac{\alpha P_b}{1 + \epsilon/2} \right] .$$

y_s^* is the level of wealth, y, for the lowest wealth consumer who enters the market in slack periods.

Now consider a typical firm j's view of the market in slack periods. Total market demand equals $(1-\alpha)$ times the number of consumers with y greater than y_s^*. It is necessary to multiply by $(1-\alpha)$ because a fraction α of the consumers will still have a working unit of the good from having replenished the prior period (a boom period). Denote firm j's price in slack periods by P_{sj}. Firm j's demand equals:

$$(19) \qquad Q_{sj} = (1-\alpha) \int_{y_s^*}^{\infty} 2h_s^*(y, P_{sj})\, f(y)\, dy .$$

As before, h_s^* is defined by the consumer who is just indifferent to purchasing from firm j or firm j+1. This defines market share:

$$(20) \qquad 2h_s^*(y, P_{sj}) \quad = \quad 1/n \quad - \quad \frac{(1 - \alpha)(P_{sj} - P_s)}{by(1 - \epsilon/2)} \quad .$$

For slack periods the profit maximizing price has the percentage markup:

$$(21) \qquad M_s \quad = \quad \frac{b(1 - \epsilon/2)(y_s^* + \hat{y}/2)}{cn} \quad ,$$

where y_s^* is given in equation (18).

Now consider a consumer's decision in boom periods. A consumer who possesses a nondepreciated unit of the good will not purchase. A consumer who chooses to replenish in slack periods will also always choose to replenish in boom periods when resources are less dear. Thus all consumers with y greater than y_s^* will purchase with probability $(1-\alpha)$ in boom periods.

There will also be consumers who have insufficient wealth to replenish in slack periods, but who will choose to replenish in boom periods. For these consumers y is less than y_s^*, but for boom periods the following holds:

$$(22) \qquad Z - \frac{b}{4n} - \frac{P_b}{y(1 + \epsilon/2)} + \alpha(Z - \frac{b}{4n}) + \frac{\alpha^2 P_b}{y(1 + \epsilon/2)} \geq 0 \quad .$$

The cost of replenishing is the real resource cost of the price of the good today. The benefit from replenishing has three components. There is utility from consuming today. There is a probability α that the good will remain for the following period, allowing the purchaser to receive utility from consumption then. This is a direct utility gain because this consumer will not be purchasing in the following period, as it is a slack period. There is also a probability α^2 that the good will remain for two more periods, allowing the purchaser to save the resources needed to purchase the good then. We know this is a saving in resources, rather than a direct gain through consumption, because if equation (22) holds today then it will also hold in two periods--so the consumer will be replenishing in two periods. Given that the consumer will be replenishing in two periods there are no effects of the purchase decision today beyond that point.

Equation (22) gives a critical value for wealth, y_b^*, that corresponds to the lowest wealth consumer who purchases the good in boom periods.

$$(23) \qquad y_b^* = \frac{(1 - \alpha)P_b}{(Z - b/4n)(1 + \epsilon/2)} \quad .$$

The relative positions of y_b^* and y_s^* for a good of hypothetical luxury are pictured in Figure 3. y_s^* will always be to the right of y_b^*. (More consumers replenish in boom periods.) If price markups were to remain constant over cycles then y_s^* would be $\epsilon/(1-\alpha)$ percent above y_b^*.

The key point is that in boom periods consumers with y between y_b^* and y_s^* are more likely to purchase than consumers with y greater than y_s^*. Consumers with y greater than y_s^* will have replenished, if necessary, the preceding period; so they will purchase with probability $(1 - \alpha)$. Consumers with y between y_b^* and y_s^* will not have replenished since the previous boom period two periods prior; so they will purchase with the higher probability $(1 - \alpha^2)$.

Now consider typical firm j's view of the market in boom periods. Its demand can be written:

$$(24) \quad Q_{bj} = (1-\alpha) \int_{y_s^*}^{\infty} 2h_b^*(y, P_{bj}) f(y) dy + (1-\alpha^2) \int_{y_b^*}^{y_s^*} 2h_b^*(y, P_{bj}) f(y) dy .$$

The firm must view its demand in two segments. Because consumers who are only wealthy enough to purchase in boom times flood into the market in booms, the firm must give them a disproportionate weight in its pricing decision.

The border of firm j's market in boom periods, h_b^*, is determined in a similar fashion as before.

$$(25) \quad 2h_b^* = 1/n - \frac{(1 - \alpha)(P_{bj} - P_b)}{by(1 + \epsilon/2)} .$$

Comparing equations (20) and (25) shows that a consumer who purchases in both boom and slack periods will be more price responive in slack periods. For durable goods, however, the positive effect this has on price markups is likely to be dominated by the impact of many price-sensitive purchasers entering the market in booms.

Evaluating firm j's first-order condition for boom periods at the symmetric equilibrium yields:

$$(26) \quad M_b = \frac{b(1 + \epsilon/2)[\bar{y}/2 + y_b^* - \alpha(y_s^* - y_b^*)]}{cn} .$$

where y_s^* and y_b^* are given in equations (18) and (23).

Before comparing price markups for boom and slack periods, it is useful to calculate the long-run average markup. I approximate this by the markup that would occur in the absence of fluctuations. This is found by setting ϵ

equal to zero in either equation (21) or (26).

$$(27)\qquad M = \frac{b(y^* + \bar{y}/2)}{cn} \quad .$$

This is an incomplete picture because n is endogenous. Setting long-run profits equal to zero yields:

$$(28)\qquad n = (2b/\bar{y}F)^{1/2}(y^* + \bar{y}/2)\exp(-y^*/\bar{y}) \quad .$$

Substituting this for n in equation (27) gives long-run markup:

$$(29)\qquad M = \frac{(bF\bar{y}/2)^{1/2}}{c}\exp(y^*/\bar{y}) \quad .$$

Equations (27) through (29) correspond exactly to equations (12), (13), and (14) from the nondurable case. That is, given the normalization that the marginal cost of a good is proportional to its expected life, the long-run behavior of the market is independent of durability.

I can now calculate the change in the markup from slack to boom periods. Combining equations (21), (26), and (27):[3]

$$(30)\qquad \frac{M_b - M_s}{M} = \frac{\dfrac{[(1-\alpha)\bar{y}/2 - 2\alpha y^*]\epsilon}{(1-\alpha)(\bar{y}/2 + y^*)}}{1 - \dfrac{(1+\alpha)y^*M}{(1-\alpha)(\bar{y}/2 + y^*)}} \approx \frac{[(1-\alpha)\bar{y}/2 - 2\alpha y^*]\epsilon}{(1-\alpha)(\bar{y}/2 + y^*)} \quad .$$

The approximately equal again relates to near perfect competition. y^* is the lowest wealth consumer who purchases for ϵ equal to zero. Two factors determine whether a good's markup rises or falls with booms: its luxuriousness and its durability. The markup will fall in a boom if:

$$(31) \quad y^{*}/\bar{y} \quad > \quad (1 - \alpha)/4\alpha \quad .$$

Figure 4 graphs this relationship. As an example, for α equal to .5 (a good with an expected life of exactly one cycle) the markup will fall if $y^{*}/\bar{y}$ is greater than .25. In turn, this implies all goods that are consumed by 91 percent or less of the population.

Table 1 presents the percentage movement in the markup for various values of luxury and durability calculated near perfect competition. Consider fluctuations of 10 percent (ϵ equal to 0.1) in conjunction with long-run markups of 10 percent. Whereas the most any good's markup rises with booms is from 9.5 to 10.5 percent, durable luxuries may show very extreme falls in their markups. For a good with α equal to .75 (a good with expected life of two cycles) that is consumed by all consumers above mean wealth the markup would fall approximately from 12 percent to 8 percent. If instead α equalled .9, the fall would be from 16 percent to 4 percent.

I have restricted attention to where entry and exit does not occur within cycles. Profits are generally procyclical in these markets even when markups are quite countercyclical; so entry would be procyclical. I show in Section 5 that this makes countercyclical markups even more likely. Section 5 also allows for trend growth as well as fluctuations in market demand. I find markups are much more likely to be countercyclical in a growing market.

4. General Equilibrium Results

I now imbed this cyclical pricing model into a very simple general equilibrium setting. I solve explicitly for consumers' choices for labor as well as consumption. Differences in consumers' wealths are linked to differences in their productivities. I posit a range of goods of varying luxury; for consumers of every productivity there corresponds marginal goods that they would replenish in boom periods but not in busts.[5] The cycle is assumed to stem from aggregate movements in productivities. In boom periods productivity is high causing real interest rates to decrease and consumers to expand their spending. More generally, however, the shocks to the economy could arise from alternative, less neoclassical sources. The important issue is whether in periods of high spending consumers spend disproportionately on goods they are marginally wealthy enough to afford, not what causes the periods of increased spending.

The question I examine is whether introducing market power into this economy will cause it to respond more or less dramatically to aggregate shocks. The key variable is durability of the goods produced. If goods have little durability then markups tend to be procyclical; and market power causes the economy to fluctuate less. For goods of sufficient durability, however, many markups will be countercyclical, causing the economy to have larger fluctuations in labor and output.

Instead of describing consumers as differing in terms of their shadow values of wealth, I now want to go behind this to an assumption that consumers differ in terms of their productivities. Workers' productivities are ranked by the variable a. Thus a worker of productivity a who puts in an amount of labor L, creates aL units of effective labor. I assume productivities vary over the population according to a first-order gamma distribution.

$$(32) \quad f(a) = (4a/\bar{a}^2)\exp(-2a/\bar{a}) \quad \text{for } 0 < a < \infty \;, \quad 0 \quad \text{otherwise} .$$

where $\bar{a}$ is the mean of the distribution. The defense for this distributional assumption was given above.

All goods in the economy have a common rate of durability, α. (At the end of the section I discuss relaxing this assumption.) I choose an effective unit of labor as the numeraire. Effective labor can be viewed as an input good.

I assume that goods are potentially available in a varied range of luxuriousness. Above I defined a good's luxuriousness by its ratio of marginal cost to utility provided. Thus goods could differ in luxury either because of their costs or their utility provided. For convenience I now assume that goods all have the same marginal cost and differ solely in terms of the utility they provide. Let all goods require $1/(1-\alpha)$ units of effective labor per unit of output. This maintains the proportionality of marginal cost to goods' expected life. I assume goods range continuously from zero to an uppermost value of Z' in terms of the utility they provide. I will allow Z' to be arbitrarily large. Let m(Z) be the number of potential goods that yield utility Z. I assume that:

$$(33) \quad m(Z) = (\mu-1)\, Z^{-\mu} \quad , \quad \text{for } 0 \le Z \le Z' \;, \quad \mu > 1 \quad .$$

This distribution implies that there are infinitely many imaginable goods that yield zero utility, but no goods that yield infinite utility.

Consumers' utility functions are assumed time separable as well as separable in consumption and leisure. For time period t utility is:

$$(34) \quad \Phi = \int_0^\infty m(Z)[Z - bh(Z)]\theta_t(Z)\, dZ - L_t .$$

As before, utility of consuming a good is discounted to the extent it is of the wrong variety. $\theta(Z)$ is an indicator variable that takes the value one if the consumer consumes the good and zero otherwise. L is labor effort. For convenience, I have made the extreme assumption that the marginal disutility of labor is constant. It is possible to generalize the results to the more realistic case of increasing marginal disutilily of labor. This is not a particularly interesting extension, however, because increasing disutility simply tends to make the competitive as well as the markup economy fluctuate less with productivity.

In period t consumers face the flow budget constraint:

$$(35) \quad \int_0^\infty m(Z)\Gamma_t(Z)P_t(Z)\, dZ + A_{t+1} = w_t(a)L_t + R_tA_t .$$

$\Gamma(Z)$ is an indicator variable that takes the value one if the consumer purchases the good and zero otherwise. Consumers can borrow and lend freely at a given market rate of interest. A equals the individual's net value of loans in terms of the numeraire. R is the gross rate of return on loans. w(a) is the wage rate for a consumer of productivity a. Consumers maximize discounted or long-run utility subject to a series of these flow constraints.

On the production side of the economy firms are minimizing costs. Given the competitive labor market, firms pay relative wages that correspond exactly to relative productivities. The choice of an effective unit of labor as the numeraire good implies an absolute as well as relative correspondence between wages and productivities. In slack periods an individual's wage, w, is given by $a(1 - \epsilon/2)$; in boom periods it is given by $a(1 + \epsilon/2)$.

The economy as a whole also faces a period-by-period constraint on the amount of goods produced and purchased. For arbitrary time t this is:

$$(36) \qquad c \int_0^\infty \left[\int_0^\infty m(Z)\Gamma_t(Z)\, dZ \right] da \quad + \quad F \int_0^\infty m(Z)n_t(Z)\, dZ$$
$$= \int_0^\infty f(a)a(1 + X_t)L_t\, da \qquad .$$

The constraint states that workers must provide enough effective labor to cover the marginal costs of all purchases as well as the fixed costs of all firms. All decision variables are implicitly indexed by a. X_t signifies a productivity realization for time period t. I consider an economy with recurring productivity movements of ϵ percent for all workers between odd and even periods. This simplifies the consumer's problem to choosing critical utility values for boom and slack periods such that durable goods are replenished if and only if they provide at least that utility level.

As a benchmark, I first consider how this economy would behave if perfectly competitive. This requires setting b and F equal to zero. Setting ϵ equal to zero yields the noncyclical steady-state behavior for consumers. For ϵ equal to zero, it is straightforward to show that for consumer of productivity a:

$$
\begin{aligned}
(37) \quad & (a) \quad & y(a) &= a \\
& (b) \quad & Z^{*}(a) &= 1/a \\
& (c) \quad & L(a) &= a^{\mu-2}
\end{aligned}
$$

These solutions are obtained by evaluating at the limit where consumers do not discount future utility at all. A positive rate of time discount would reduce L, increasing Z^{*}. The solutions also assume a value for Z' that approaches infinity. Equation (37) gives values for a single individual of productivity a. Aggregates for the economy are given by integrating over a.

For two reasons I view it as desirable for a consumer's long-run labor supply to be independent of a. The first is that empirically long-run labor supply appears to be reasonably independent of productivity. The second is that I motivated the assumption of a gamma distribution for productivity partly on the basis of empirical income distributions; but the distribution of long-run income for the model economy will only have a first-order gamma distribution if long-run labor supply is independent of a. For this model economy to exhibit long-run labor supply that is independent of productivity requires the particular value for μ of two. Therefore, for the remainder of this section I set μ equal to two. It is possible to generalize the results beyond this assumption; however, similarly to the case of allowing increasing disutility of labor, this generalization is not very interesting. Larger values for μ than two simply tend to make both the competitive and markup economies fluctuate proportionately more with productivity, and conversely for smaller values for μ than two.

In response to recurring ϵ percent movements in productivity the competitive economy will behave according to:

$$(38)\quad (a)\quad (y_b - y_s)/y = \epsilon$$

$$(b)\quad (Z_b^* - Z_S^*)/Z^* = -\epsilon/(1-\alpha) \quad .$$

The percentage movement in y can also be interpreted as the percentage movement in the gross real rate of return on consumption loans between slack and boom periods. Because productivity goes up by ϵ percent in booms, the real interest rate has to fall by ϵ percentage points so that workers will be willing to work in slack periods as well as booms. Given disutility of labor is a constant, it is impossible to tie down the labor effort for a single worker for a single time period. From the constraint in equation (36), however, aggregate output (in terms of effective units of labor) shows percent increases in booms of:

$$(39)\quad \frac{\int_a f(a)a[(1+\epsilon/2)L_b - (1-\epsilon/2)L_s]da}{\int_a f(a)aL(a)da} = \frac{(1+\alpha)\epsilon}{1-\alpha} \quad .$$

Subtracting from this the direct productivity component, productivity-weighted labor supply (consumers' labor supplies weighted by their individual a's) increases by $[2\alpha/(1-\alpha)]\epsilon$ percent in booms. Labor and output are more procyclical if goods are durable.

Now consider the markup economy. I first examine long-run values for the economy by taking the case of ϵ exactly equal to zero. It remains true for the markup economy that y(a) is identically equal to a.

A consumer will purchase all goods for which:

$$(40) \quad Z - \frac{b}{4n(Z)} \geq (1 - \alpha)P(Z)/a \quad .$$

P(Z) and n(Z) denote equilibrium price and number of firms for a good that provides utility Z. Let $Z^*(a)$ be the utility provided by the most luxurious good (good with lowest utility) consumed by an individual with productivity a. $Z^*(a)$ is given by:

$$(41) \quad Z^*(a) = (1 - \alpha)\frac{P(Z^*)}{a} + \frac{b}{4n(Z^*)} \quad .$$

The consumer's labor supply is found by combining $Z^*(a)$ with the consumer's budget constraint and firms' pricing policies as described in Section 3. Putting $Z^*(a)$ into the consumer's budget constraint yields:

$$(42) \quad L(a) = \frac{(1-\alpha)}{a} \int_{Z^*(a)}^{\infty} m(Z)P(Z)dZ \quad .$$

This displays three effects of market power on long-run labor supply. One is a negative substitution effect due to markups lowering real wages. This causes consumers to purchase a smaller range of goods (Z^* is larger) than in the competitive case. On the other hand, markups negatively affect income, which in turn raises labor supply. (In general equilibrium it is not the markups that lower income because firms receive the markups. The markups, however, do cause a like amount of resources to be expended via the fixed costs of firms operating.) The substitution effect will tend to dominate in this economy because more luxurious goods have higher markups. This means the markup on a consumer's marginal good, which determines the size of the substitution effect, is larger than the markup on the inframarginal goods, which constitutes the income effect. The third effect is a negative taste effect. Z^* is slightly raised because consumers expect each good to yield $b/4n(Z)$ less utility than their ideal variety of the good.

Substituting pricing equation (26) into (42) gives labor supply in reduced form. This reduced form is highly nonlinear. For ease of exposition, here I present labor supply linearly approximating near the case of perfect competition:

$$(43) \quad L(a) \approx 1 - \tau\exp(a/\tilde{a}) + \tau(\tilde{a}/a)[\exp(a/\tilde{a})-1] - \frac{\tau\exp(a/\tilde{a})}{4 + 2a/\tilde{a}} \quad ,$$

$$\text{where} \quad \tau = (bF\tilde{a}/2)^{1/2} \quad .$$

τ equals the markup on the least luxurious good; that is the good that all consumers purchase. By comparison the average markup on all goods consumed in this economy is equal to 3τ. One is the competitive-economy labor supply. The other three terms correspond to the negative price substitution effect, the positive effect from income, and the negative taste effect. It is clear that the negative substitution effect from price is the largest component. It dominates the positive effect from income by the ratio $e/(e-1)$ for the consumer of mean wealth. It is at least four times the magnitude of the effect from tastes for all consumers. We can also see that markups reduce labor supply for all consumers, but more so for more productive consumers.

Integrating over all consumers yields aggregate labor supply of:

$$(44) \quad \int_a f(a)L(a)da \approx 1 - 4\tau + 2\tau - \tau/2[1 - (1/2)\exp(1/2)Ei(-1/2)]$$

$$\approx 1 - 2.729\,\tau \quad .$$

The separate terms in the first line again represent the three separate effects from the markups. Ei denotes the exponential-integral function. Because labor is reduced more for more productive workers, aggregate output is reduced to a greater extent than labor supply.

$$(45)\quad \int_a f(a)aL(a)da \approx \tilde{a}\,\{\,1 - 8\tau + 3\tau - \frac{7\tau}{4}[1 + \frac{\exp(1/2)Ei(-1/2)}{14}]\,\}$$

$$\approx [1 - 6.635\,\tau]\,\tilde{a} \quad .$$

Finally, I consider how the markup economy reacts to fluctuations in productivity. It remains true that y increases by ϵ percent from slack periods to boom periods. For an individual consumer the cyclical increase in consumption is given by the decrease in Z^*, the critical utility level, in boom periods. From equations (17) and (22) this decrease is given by:

$$(46)\quad \frac{Z_s^* - Z_b^*}{(1/a)} \approx \frac{\epsilon}{(1-\alpha)} - [M(Z_b^*) - M(Z_s^*)] - \frac{[M_b(Z^*) - M_s(Z^*)]}{(1-\alpha)} + \frac{b}{4n(Z^*)}\frac{[n(Z_b) - n(Z_s)]}{n(Z^*)}$$

$$\approx \{\,1 - M(Z^*)[\,\frac{a}{\tilde{a}} + \frac{\tilde{a} - 4\alpha a/(1-\alpha)}{2a + \tilde{a}} - \frac{a^2(2a - \tilde{a})}{2\tilde{a}(2a + \tilde{a})^2}]\,\}\,\frac{\epsilon}{(1-\alpha)} \quad .$$

The approximately equals denotes linearly approximating near the competitive solution. Equation (46) displays three distinct influences from market power. The first effect derives from the fact that markups are positively related to luxuriousness. Because in boom times consumers move into more luxurious goods this raises the marginal markup even if the markups on no individual goods were to actually change. This effect unambiguously acts to reduce fluctuations in purchases. The second effect depends on whether the markup on the marginal good, Z^*, rises or falls in boom periods. As discussed at great length above, the sign of this effect is ambiguous, depending on how durable is the good. The third effect is that as the marginal good becomes more luxurious in boom periods the number of available brands for the marginal good changes. This effect dampens the response in Z^* for more productive consumers, but actually magnifies it slightly for less productive consumers (those with a below $\hat{a}$). This third effect is relatively small.

Because the disutility of working is a constant, again it is impossible and irrelevant to determine a single consumer's movement in labor supply. It is possible to calculate the aggregate movements in output and labor. Manipulating the aggregate economy constraint (36) yields the percentage movement in aggregate output:

$$(47) \qquad -\frac{\int_a f(a)a[(1+\epsilon/2)L_b - (1-\epsilon/2)L_s]da}{\int_a f(a)aL(a)da} = \frac{(1+\alpha)\epsilon}{(1-\alpha)}\left[1 - \frac{29.596\,\tau}{(1-\alpha)}(1 - 1.504\alpha)\right].$$

This shows that the markup economy will fluctuate more than the competitive economy if α is greater than 0.665, or, that is, if goods have an expected life of 1.5 cycles or longer. Equation (47) also shows that markups can have a very dramatic impact on the magnitude of fluctuations. Suppose the average markup on all purchases is only 5 percent. (This implies τ is equal to .01667.) For α equal to .665 there is no impact; but consider the two cases α equal to .5 and α equal to .8. In the first case markups reduce the magnitude of fluctuations by 24 percent. In the second case they amplify fluctuations by 50 percent.

In this illustration all goods were equally durable. It is worth considering how an economy with goods of mixed durabilities might behave. Equation (47) shows that the importance of a goods' markup in affecting fluctuations dramatically increases with durability. Thus the more durable goods will have much more importance. This suggests that average durability of goods could be quite low and yet market power could magnify fluctuations because the goods for which markups will fall in booms, durables, are those whose price consumers will respond to strongly.

5. Extensions

The results in Section 3 suggest that many markups are likely to be countercyclical. For example, for goods with expected life of only one cycle, markups go down in booms for all goods consumed by less than 91 percent of the population. For goods with expected life of two cycles, the fraction rises still higher to all goods consumed by less than 99 percent of the population. Section 4, however, showed that even if the markups on most goods fall in booms it may or not imply larger fluctuations than those of a competitive economy. I now consider two natural extensions to the partial equilibrium pricing problem. One is short-run entry and exit of firms; the other is long-run trend growth in demand. Both extensions imply more countercyclical markups. In general equilibrium they imply a markup economy that would respond more drastically to fluctuations in productivity. In contrast to Sections 2 and 3 above, all comparitive statics presented in this section are linear approximations near the perfectly-competitive solution.

A) Short-run entry and exit

To this point I have ignored short-run entry for reasons outlined in Section 2. Now I consider the alternative extreme assumption, that entry and exit occur so as to make profits equal exactly zero period by period. In the absense of entry profits are procyclical in virtually all markets. This is because the markets where markups are very countercyclical are those in which quantity demanded is very procyclical. The exception to procyclical profits are very durable goods that are consumed by almost all consumers. The cyclical movement in number of firms required to keep profits at zero is:

$$(48)\qquad \frac{n_b - n_s}{n} = \epsilon\left[\, 1/2 + \frac{(1+\alpha)y^*(2y^* - \hat{y})}{(1-\alpha)\hat{y}(2y^* + \hat{y})}\,\right] .$$

As before, y^* is approximately equal to (c/Z) near perfect competition.

Incorporating the effect of movements in the number of firms on the cyclical behavior of the markup gives:

$$(49)\qquad \frac{M_b - M_s}{M} \approx \epsilon\left[\, 1/2 - \frac{(1+\alpha)y^*}{(1-\alpha)\hat{y}}\,\right] .$$

Entry makes countercyclical markups much more likely. In fact, even for completely nondurable goods the markup falls for all goods consumed by less than 74 percent of consumers (y^* greater than $\bar{y}/2$). More generally, markups fall in booms for all goods for which:

$$(50) \quad y^*/\bar{y} \quad > \quad \frac{(1 - \alpha)}{2(1 + \alpha)} \quad .$$

This condition is graphed in Figure 5 along with the comparable condition without entry from Section 3. Whereas there can be only small procyclical movements in markups, very large countercyclical movements are possible. This is illustrated in Table 2 which gives the percent movement in the markup for goods of varying durability and luxury.

This suggests that in general equilibrium the markup economy is more likely to display large fluctuations. Markups will be more likely to fall in booms magnifying output movements. Furthermore, procyclical entry will directly make output more procyclical, as the larger number of firms in booms requires more output for covering aggregate fixed costs.

b) Trend market growth

So far I have restricted the long-run rate of growth in market demand to zero. I now consider how my prior results are altered by market growth. The results are clearly very dependent on market growth. For example, consider a market where market demand is declining sufficiently rapidly so that demand falls through time even when going from a slack to a boom period. This implies there is no effect from lower wealth consumers flooding into the market in boom periods; so pricing in the durable goods case will look much like pricing in the nondurable goods case. Conversely, in a growing market the countercyclical pricing effect from lower wealth consumers flooding into markets in boom periods is magnified. With sufficient market growth the consumers who are just wealthy enough to purchase when a boom arrives will now purchase with probability one, because not only were they not wealthy enough to purchase the preceding slack period, they also were not wealthy enough to purchase the prior boom period. (With sufficient market growth there will also be consumers entering markets for the first time in slack periods; but there will be fewer entering than in boom periods.) By comparison, the consumers who were willing to purchase the preceding slack period will still only be purchasing with probability $(1-\alpha)$. Thus the lowest part of the distribution will now receive a disproportionate relative weighting of $1/(1-\alpha)$. Before, without growth, their relative weighting was only $(1-\alpha^2)/(1-\alpha)$, or $(1+\alpha)$. For fairly durable goods the ratio $1/(1-\alpha)$ is much larger than the ratio $(1+\alpha)$. For these goods the countercyclical impact on pricing from low wealth consumers flooding into the market in boom periods will be much stronger with growth.

Here I examine markups for a market that has a sufficiently high rate of market growth that no one ever stops consuming the good after they start. For lower positive rates of growth some consumers might not replenish in slack periods. That case is intermediate to the zero growth case of Section 3 and the case here.

A consumer will choose to purchase the good if they do not already possess a nondepreciated unit and if the cost of the good today is less than its utility value plus α times the value of having a nondepreciated unit of the good tomorrow. For an arbitrary time period t, this latter condition is:

$$(51)\quad Z - \frac{b}{4n} - \frac{P_t}{X_t y} + \frac{\alpha P_{t+1}}{X_{t+1} y} > 0 .$$

X is a time series that reflects a trend as well as cyclical movements in consumers' shadow value of wealth. I represent trend growth as a declining shadow value of wealth. It could equivalently be represented as a declining marginal cost of the good. I am assuming that X grows in all periods, but it grows more rapidly in boom periods. Growth in X behaves according to:

$$(52)\quad \text{a)}\quad X_t/X_{t-1} = \beta + \epsilon \quad \text{for boom periods,}$$

$$\text{b)}\quad X_t/X_{t-1} = \beta - \epsilon \quad \text{for slack periods,}$$

where β is the trend rate of growth; and ϵ is the cyclical fluctuation.

Similarly to before, I can define a critical value for y, $(y^*)_t$, such that consumers consume the good as of period t if and only if they have a value of y greater than $(y^*)_t$.

$$(53)\quad (y^*)_t = \frac{1}{(Z - b/4n)} \left(\frac{P_t}{X_t} - \frac{\alpha P_{t+1}}{X_{t+1}} \right) .$$

It is useful to delineate three sets of consumers. Consumers for whom y is less than $(y^*)_t$ will not purchase. Consumers who purchased last time period will purchase with probability $(1-\alpha)$. The consumers who will have purchased the previous period will be those for whom y is greater than $(y^*)_{t-1}$, which is defined by simply lagging equation (53) one period. The key group of consumers are those who first become wealthy enough to purchase the good in period t. These are consumers with y less than $(y^*)_{t-1}$ but greater than

$(y^*)_t$. They will purchase with probability one.

Very similarly to the boom period pricing problem in Section 3, firms must view the market in two segments, giving the poorest consumers who purchase a disproportionate weight because they purchase with a higher probability. The difference is that here the weight is even more disproportionate because the poorest consumers purchase with probability one rather than $(1-\alpha^2)$. The pricing problem is so similar to that for boom periods presented in Section 3 that I will dispense with details. The profit maximizing markup is:

$$(54) \quad M_t = \frac{bX_{t-}}{cn}\{ y_t^* + \bar{y}/2 - \frac{\alpha}{(1-\alpha)}[(y^*)_{t-1} - (y^*)_t] \} \quad .$$

If there were no fluctuations $[(y^*)_{t-1} - (y^*)_t]$ would simply equal approximately $\beta(y^*)_t$. With fluctuations it will take the value:

$$(55) \quad a) \quad (y^*)_{t-1} - (y^*)_t \approx [\beta + \frac{(1+\alpha)\epsilon}{(1-\alpha)}] (y^*)_t$$

if time period t is a boom period, or:

$$(55) \quad b) \quad (y^*)_{t-1} - (y^*)_t \approx [\beta - \frac{(1+\alpha)\epsilon}{(1-\alpha)}] (y^*)_t$$

if t is a slack period.

Combining equations (54) and (55), it is possible to compare the optimal price markups for neighboring boom and slack periods. For small β the difference in the markup between boom and slack periods is:

$$(56) \qquad \frac{M_b - M_s}{M} \approx \frac{\epsilon\left[\hat{y}/2 - 4\alpha y^{*}/(1-\alpha)^2\right]}{\hat{y}/2 + y^{*}} \quad .$$

where the markup in the denominator is the trending markup that would occur in the absence of fluctuations. Equation (56) assumes that entry and exit are unaffected by the shortrun fluctuations.

With long-term growth the markup will be countercyclical if:

$$(57) \qquad y^{*}/\hat{y} > \frac{(1-\alpha)^2}{8\alpha} \quad .$$

Figure 6 depicts this boundary together with the earlier case for no market growth. Equation (57) will hold for most goods even if goods are only slightly durable. For example, if α equals .25 (expected life of three-eighths of a cycle) then markups will fall on all goods that fewer than 89 percent of consumers consume. For α equal to .5 the comparable figure is all goods consumed by less than 99 percent of the population.

With growth markups are more likely to show drastic declines in booms. Table 3 gives the cyclical behavior for goods of varying durability and luxuriousness. As an example suppose that the markup equals 10 percent and ϵ equals 10 percent. For a good that everyone above mean wealth consumes and that has durability of α equal to .5, the markup would decline in boom periods from 12.5 percent to 7.5 percent. If instead α equals .667, then the decline would be from 17.8 percent to 2.2 percent. The very countercyclical markups for growing markets imply that in an economy where there are more markets growing than declining markups are likely to cause larger aggregate fluctuations in labor and output in response to shocks.

6. Testing

To summarize, markups are very likely to be countercyclical in goods markets where the good is durable and/or luxurious, and where the market is growing. These markets are exactly those for which intertemporal substitution in response to price movements should be important. The results suggest countercyclical markup movements can be very dramatic.

I found it possible (though not certain) that countercyclical markups will cause a monopolisticly-competitive economy to exhibit larger labor and output responses to aggregate disturbances than a comparable competitive economy. This result is of particular interest in light of the difficulty of competitive real business cycle models in accounting for the magnitude of cyclical movements in labor effort (Prescott, 1986).

The model lends itself clearly to empirical testing. The steady-state model predicts longrun markups that are higher for luxuries, and that increase with an economy's wealth for necessity goods and decrease with an economy's wealth for luxury goods.

The model predicts differing cyclical pricing behavior across industries. As stated, markups should be particularly countercyclical in industries producing goods that are durables, are nonnecessities, or that have growing markets. Recent papers by Bils (1987) and Domowitz, Hubbard, and Peterson (1987) find that for the post-War period many manufacturing industries have had very countercyclical markups. Domowitz, Hubbard, and Peterson find that the industries with pronounced countercyclical markups are durable-goods industries. I am unaware of cross-industry evidence on cyclical pricing behavior that breaks industries down by luxury of good or market growth. It would be particularly useful to consider the pricing of goods that are durable luxuries with a growing market. Examples are automobiles in the first part of this century, electrical household appliances shortly after World War II, and personal computers in recent years.

According to the model markups rise on durables in downturns because the poorer consumers who purchase the good drop out of the market, causing the average income of purchasers of the the good to actually rise in recessions. Therefore, a more direct test of the model would be to examine the cyclical behavior of average income of purchasers of given goods. The Bureau of Labor Statistics' Consumer Expenditure Survey collects data on respondents' income as well as purchases. From this one could construct average income of purchasers for each year for a set of goods. For example, we can see the cyclical behavior of average income of purchasers of dishwashers.

Notes

1. I have suppressed the issue of how the dispersion of income affects pricing by choosing the first-order gamma, which has a given value for the coefficient of variation of .71. Dispersion does matter for pricing in this model. As I describe in Bils (1986), an increase in dispersion raises markups. This is because only a truncated portion of the distribution consumes any good. Greater dispersion in general raises the mean income for a truncated sample, thereby raising optimal markups.

2. If all consumers had the the same value for y, say y', then there would be a discontinuity in firm j's demand curve at the price $P - (b/n)/y'$. This price would attract all of firm j+1's and firm j-1's customers. With the smooth distribution, f(y), there is no discontinuity in firm j's demand curve, but there is a flattening of the curve at the price $P - (b/n)/y^*$. At prices below this firm j attracts all of firms j+1 and j-1's consumers who have y's between y^* and y^{**}, where y^{**} equals $(P - P_j)(n/b)$.

Diverging from the symmetric equilibrium, firm j's demand is:

$$Q_j(P_j)|\text{diverging} \quad = \quad \int_{y^*}^{\infty} 2h^*(y,P_j)f(y)dy \quad + \quad (1/n)\int_{y^*}^{y^{**}} f(y)dy \quad .$$

Choosing y^{**} (and so P_j) to maximize profits from diverging, the difference between profits diverging and pricing at the symmetric equilibrium equals:

$$\left[\frac{2(y^*)^2}{\bar{y}} - \frac{2(y^{**})^2}{\bar{y}} - 3y^{**} - \frac{4y^*y^{**}}{\bar{y}}\right]\exp\left(\frac{-2y^*}{\bar{y}}\right) \quad + \quad [2y^{**} - y^*]\exp\left(\frac{-2y^{**}}{\bar{y}}\right) \quad .$$

This is unambiguously negative as y^{**} is greater than y^*.

Firm j faces further flattening points in its demand curve at $P - (2b/n)/y^*$, $P - (3b/n)/y^*$, and so forth. But diverging to these regions will be even less profitable because the price cuts lose profits on a greater number of inframarginal purchasers.

3. Domowitz, Hubbard, and Peterson (1987) examine whether the durable-goods monopolist problem can help explain cyclical insensitivity of prices.

4. The text assumes a zero rate of time discount. Suppose instead that consumers weight utility a period into the future at a ratio of δ to utility received today. Then the movement in the markup approximating near perfect competition is:

$$\frac{M_b - M_s}{M} \approx \frac{[y/2 - (1+\delta)\alpha y^*/(1-\delta\alpha)]\epsilon}{y/2 + y^*}.$$

Discounting reduces the effective durability of the good with respect to pricing.

5. Jones (1983) provides existence results for economies with an infinite number of consumers and an infinite number of differentiated goods.

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Figure 1: Varieties and Brands Around the Market Circle

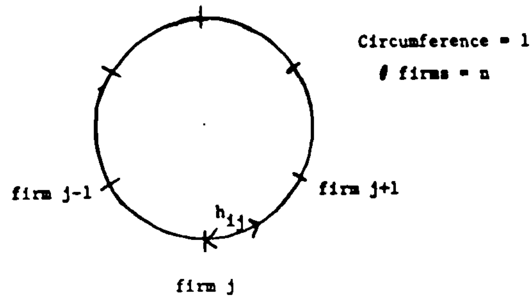

Figure 2: Firm j's Market at Varying Prices

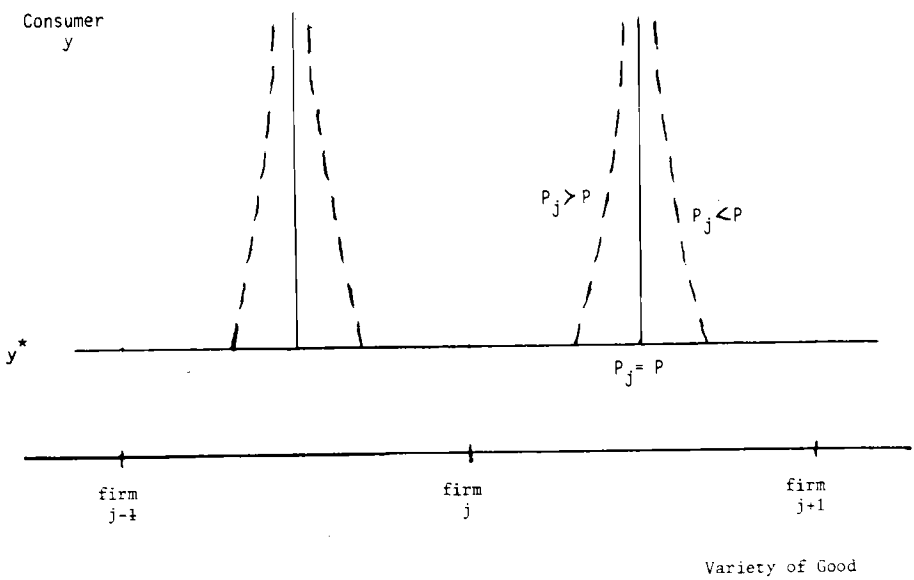

Figure 3: y_s^*, y_b^*, and Market Demand

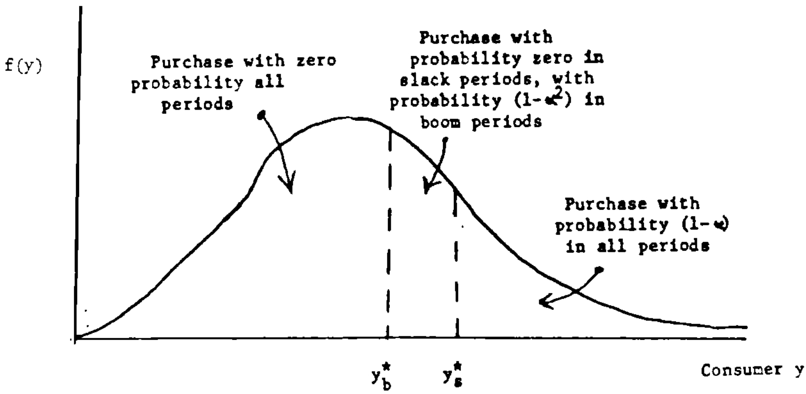

Figure 4: Condition for Price to Rise or Fall with Booms

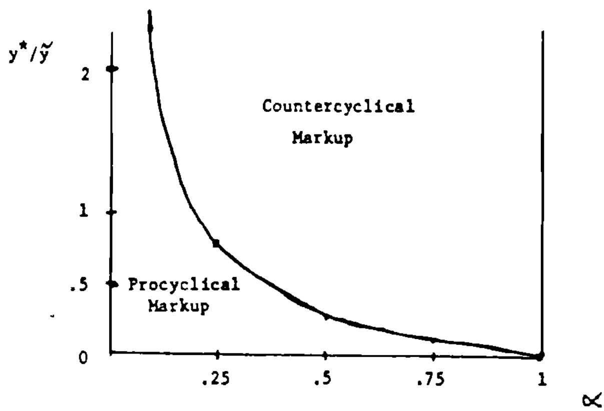

Figure 5: Condition for Price to Rise or Fall with Booms With and Without Short-run Entry/Exit

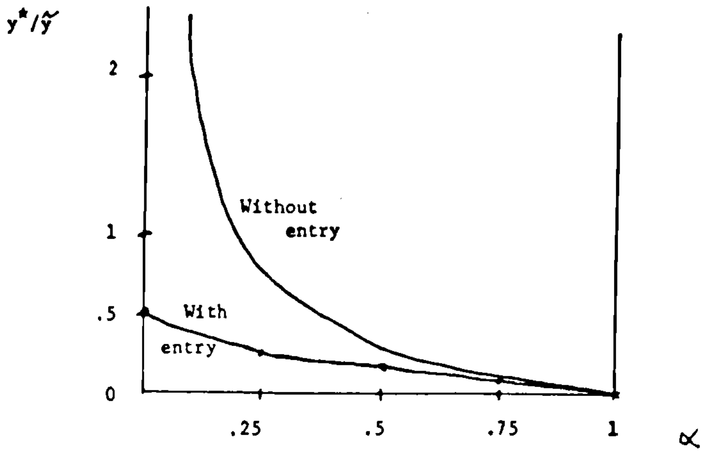

Figure 6: Condition for Price to Rise or Fall with Booms With and Without Long-run Market Growth

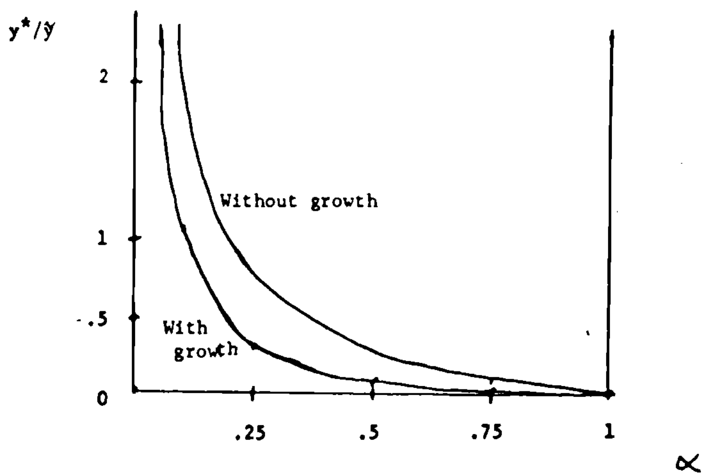

Table 1: Cyclical Markups Without Short-run Entry or Long-run Growth

% of consumers who consume	$\frac{y^*}{\bar{y}}$	α = 0	.25	.5	.75	.9
100	0	1	1	1	1	1
74	.5	1/2	1/6	-1/2	-5/2	-17/2
56	.75	2/5	0	-4/5	-16/5	-52/5
41	1	1/3	-1/9	-1	-11/3	-35/3
9	2	1/5	-1/3	-7/5	-23/5	-71/5

Table 2: Cyclical Markups With Short-run Entry
(but no long-run growth)

% of consumers who consume	$\frac{y^*}{\hat{y}}$	α				
		0	.25	.5	.75	.9
100	0	1/2	1/2	1/2	1/2	1/2
74	.5	0	-1/3	-1	-3	-9
56	.75	-1/4	-3/4	-7/4	-19/4	-55/4
41	1	-1/2	-7/6	-5/2	-13/2	-37/2
9	2	-3/2	-5/2	-11/2	-27/2	-75/2

Table 3: Cyclical Markups With Long-run Growth
(but no short-run entry)

% of consumers who consume	$\frac{y^*}{\hat{y}}$	α = 0	.25	.5	.75	.9
100	0	1	1	1	1	1
74	.5	1/2	-7/18	-7/2	-47/2	-359/9
56	.75	2/5	-2/3	-22/5	-142/5	-1078/5
41	1	1/3	-23/27	-5	-95/3	-719/3
9	2	1/5	-11/9	-31/5	-191/5	-1439/5