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Time-Varying Competition

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Normative models typically suggest that prices rise in periods of high demand and cost. However, in many markets, prices fall when demand or costs rise. This inconsistency occurs because the normative models assume that competitive intensity does not change with demand and cost conditions over time. We therefore introduce the notion of *time-varying competition* by suggesting that it is important not only to account for the *direct effect* of demand and cost on prices (e.g., higher demand means higher prices), but also the *indirect effect* of demand and cost changes on competition (e.g., higher demand could cause more competition and, hence, lower prices).

We develop a general, unified framework to empirically model the direct and indirect effects of demand and cost shifts on pricing in differentiated product markets. Our approach allows us to measure the indirect effect of multiple demand and cost drivers on competitive intensity and test predictions from alternative theories of repeated games. The empirical application is to the U.S. photographic film industry, where there are two main players, Kodak and Fuji.

We find that the indirect effects are highly significant and comparable in magnitude to the direct effects. Competitive intensity is greater in periods of high demand and lower cost and is moderated by whether demand or costs are expected to grow or decline. Interestingly, we find asymmetries in the competitive responses of Kodak and Fuji. While Kodak is sensitive to demand factors, Fuji is sensitive to costs. Our results suggest that market characteristics such as observability of competitor prices can be an important determinant of how competitive intensity is affected by demand and cost conditions.

Key words: pricing research; competition; competitive strategy; game theory; estimation and other statistical techniques
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1. Introduction

Classical microeconomics suggests that when faced with a decline in demand or in their costs, firms in an industry cut prices. The conventional wisdom of low prices in the face of low demand or costs is, however, not always consistent with market reality. In many consumer markets, the holiday season tends to have the highest volumes; yet consumers expect low prices during this period. Further, high-volume periods need not necessarily translate to higher profits for firms. As an article about the highway construction market in the *Engineering News-Record* (June 26, 2000), tellingly titled "Margins Miss Out on Boom" indicates:

> The nation's bold investment in rehabilitating and expanding its highways promises to keep this one of the hottest construction markets for years to come.... Despite this bright picture, highway contractors are facing a major dilemma—recession-like margins in the face of record levels of volume. "The robust market hasn't produced more comfortable margins," says Mazey (president of Trumbull Corp, a Pittsburgh based company), "We're not seeing that yet, and I'm baffled as to why that's the case."

Similarly, cost declines do not always lead to price declines. In the well-documented case of Procter & Gamble's value pricing strategy, the firm lowered trade promotion incentives and was able to lower its manufacturing costs by smoothing out its production runs. At the same time, the net price paid by consumers in these categories *increased* by approximately 20% for P&G's products and by 8.4% for its competitors' products (Ailawadi et al. 2001).

In the last two examples, the predictions of classical microeconomic theories are violated empirically.

Clearly, the theory is missing an important element. Consider the following example from the *Wall Street Journal* (April 2, 2001) on the data storage systems industry:

> For years, providers of data storage systems enjoyed fat profit margins and seemingly insatiable demand.... But the reality of the economic slowdown is beginning to take its toll, just as competition among storage vendors has ratcheted up (p. B.4).

This example suggests the possibility that a decline in demand is accompanied by greater competition. Thus, prices fell due to two effects: (1) a *direct effect* of a decline in demand and (2) an *indirect effect* of the decline in demand due to greater competition. In this case, the direct and indirect effects reinforced each other, and both reduced prices and profitability. It is also possible that the direct and indirect effects counteract each other. For example, when aggregate demand increased in the highway construction market, it is possible that firms began to compete more for market share because shares are worth more in high-demand periods. While the direct effect of an increase in demand raises prices, the indirect effect of increased competition counteracts this effect, leading to "recession-like margins" in high-volume periods. Similarly, a decline in cost could cause an increase in prices, as in the P&G case, if the cost decline led to softer competition. Models typically used in marketing, based on static microeconomic models, only account for the direct effect, not the indirect effect, and hence are unable to account for the range of empirical realities illustrated in the examples above. Hence, a full understanding of, and an accurate forecast of how prices change in response to changes in demand and cost conditions is possible only if we model the indirect effect of *how competition varies over time as a function of demand and cost conditions*. We propose a unified model that measures both these direct and indirect effects.

The empirical economics literature has paid limited attention to indirect effects. Its attention has focused only on *homogeneous* product markets. Further, it looks only at the effect of *one variable* (demand level) on competition and assumes that competitive behavior is *symmetric* across firms. Our paper distinguishes itself from the extant economics literature in all these dimensions. (1) Our model of direct and indirect effects is for *differentiated* product markets, which are typically of interest to marketers. (2) Our model accounts for *multiple* drivers of the indirect effect simultaneously. There is a lively debate in the repeated-games literature about how current and future demand and cost affect price competition. By including all of these effects simultaneously, we are able to obtain a more comprehensive picture of time-varying competition than has been possible before. (3) Finally, our model allows each firm in an industry to respond differently to changes in demand and cost conditions, making our competitive model more realistic.

We provide an empirical analysis of the U.S. photographic film market, where Kodak and Fuji are the two major players. We find that indirect effects are significant and the magnitude of the indirect effect is as large as the direct effect in the film market. The large magnitude of the indirect effect can potentially explain the "baffling behavior" of recession-like margins in booms. We also find that incorporating time-varying competition through the indirect effects can help substantially in improving model fit, therefore providing a better model for pricing decision support systems. Our results suggest that institutional details such as the observability of competitor actions can be an important determinant of how competitive intensity is affected by demand and cost conditions.

2. Modeling the Indirect Effect: Choice of Variables

In this section, we discuss theories from the repeated-games literature that provide the motivation for modeling indirect effects in our model. The theoretical literature on repeated games offers predictions on how demand and cost variables affect competitive intensity. In repeated-game models, firms maintain tacit collusion by using threats of future price cuts to punish competitors who deviate from cooperative equilibrium prices. As demand and cost conditions change, gains from undercutting competitor prices and losses from future punishment change. Hence, observed prices change, creating a link between demand and cost conditions and competitive intensity. We discuss three sets of variables: (1) demand and cost levels, (2) demand and cost trends, and (3) asymmetric cost reduction.

Demand and Cost Levels

Green and Porter (1984) predict that competitive intensity will be higher in periods of low demand, while Rotemberg and Saloner (1986) make the opposite prediction. The key difference in the two papers is the assumption about the *observability* of aggregate demand and competitor actions. Green and Porter assume that aggregate demand and competitor actions are unobserved, so when a firm faces low demand, it cannot distinguish whether this is due to price-cutting by a competitor or due to low aggregate demand. Hence, whenever there is low demand (even if it might be due to low aggregate demand), all firms cut prices in equilibrium. The resulting low margin removes the incentives for firms to secretly cut prices when there is high demand in the hopes of stealing market share. In equilibrium, no firm cheats, but prices are lower and competitive intensity is greater in periods of low demand.

Rotemberg and Saloner assume that firms observe aggregate demand and competitor prices. Aggregate demand is assumed to be independent over time. When firms face high aggregate demand, they are tempted to cut prices to gain short-term profits. While firms know that this will lead to lower future prices from rivals, they also recognize that the aggregate demand in future will on average be less than the current high-demand period. Therefore, the threat of future punishments has less impact in a high-demand period. In equilibrium, firms charge lower prices in high-demand periods to eliminate the incentives for firms to undercut the cooperative equilibrium. This results in lower prices and greater competitive intensity in high-demand periods.

There are two interesting issues to note about these theories in the context of our empirical application. First, unlike the assumptions made in the above theoretical models, the film market that we analyze is not a homogeneous product market. The more differentiated firms in an industry are, the less likely it is that firms' demand outcomes are correlated with one another. In this case, should a firm observe a drop in its own demand, it is less likely to attribute this to a drop in the rival's price, and hence it may not retaliate by lowering its price. Therefore, it is unlikely that we will observe any systematic correlations between industry demand conditions and competitive intensity (Raith 1996). In the film market, universal compatibility of 35mm film reduces differentiation; however, color, sharpness, and contrast enhance differentiation. Hence, the extent of differentiation in the film market and its effect on competitive intensity is an empirical question.

Second, Rotemberg's and Saloner's (1986) theory assumes competitor prices and market shares are observed, while Green's and Porter's (1984) theory assumes that these are unobserved. In the film market, thanks to the widespread availability of competitive action data, managers are quickly able to assess the prices charged by competitors, and the market shares, so we expect support for the theory of Rotemberg, and Saloner in this market. This is in contrast to results in Porter (1983) and Ellison (1994), who found support for Green and Porter in their analysis of the railroad shipping market. However, unlike the film market, competitive prices and market shares are unobserved in the railroad shipping market.

Borenstein and Shepard (1996) point out that these theories can be modified for cost levels. Since an increase in cost reduces the profits to firms (opposite of the demand effect on profits), the effect of changes in cost levels will be the opposite of the effect of demand levels. We summarize the predictions from the three theories below:

Theory	Relationship between competition and demand level	Relationship between competition and cost level
Green and Porter (1984)	Negative	Positive
Rotemberg and Saloner (1986)	Positive	Negative
Raith (1996)	Zero	Zero

Demand and Cost Trends

Haltiwanger and Harrington (1991) relax Rotemberg's and Saloner's assumption that demand is independent over time by allowing for trends in demand. However, they maintain the assumption that competitor prices and market shares are observable. If firms value future profits sufficiently (long-term outlook), the threat of future punishments is a stronger deterrent to cheating if there is a growth trend rather than a decline. Hence, controlling for demand levels, firms can sustain higher prices and (lower competitive intensity) when the demand trend is positive. However, if firms discount future profits heavily (short-term outlook), the result is reversed. The predictions for cost trends are the opposite for demand trends. These predictions are summarized below:[1]

Inference about firm behavior	Relationship between competition and future demand growth	Relationship between competition and future cost growth
Short term	Positive	Negative
Long term	Negative	Positive

In their analysis of the gasoline market, Borenstein and Shepard (1996) dismiss the possibility that firms can be extremely short-term oriented and consider only Haltiwanger's and Harrington's (1991) prediction consistent with the long-term outlook. We also believe that firms are not so short term in their outlook to heavily discount the future. Hence, our expectation is that if firms behave consistently with the predictions of Haltiwanger and Harrington, it would be consistent with a long-term outlook.

Asymmetric Marginal Cost Reduction

Firms make investments in plants and technologies to reduce their marginal costs of production. The most visible examples of these investments are those by Japanese and European auto firms on plants in the United States. When a firm's costs fall, it cuts prices. In addition, it may use its relative cost advantage to price more aggressively, and therefore cooperation

[1] Kandori (1991) and Bagwell and Staiger (1997) make similar predictions with slightly different models.

between firms may break down. Besanko et al. (1996, p. 364) note that asymmetry among firms is a major reason for breakdown of cooperative behavior and increased competition. A reduction in the costs of one firm (in our case, Fuji) is likely to have a negative impact on the ability to cooperate among firms.

3. Methodological Positioning Relative to the Literature

In recent years, the empirical industrial organization (EIO)-based approach has been widely used by marketers to infer the competitive behavior of firms (see Kadiyali et al. 2001 for a review). In these models, price levels in the market depend upon demand and cost conditions and the nature of interfirm interactions in that market. By estimating a demand and a supply (price) function, this approach allows price levels to be decomposed into the effects of demand, cost, and competitive behavior. These models typically assume "steady-state" competitive behavior and *estimate an average measure of competition over the entire period of analysis*. In these models, firms interact in a Nash-Bertrand manner over the entire duration of the observed data. Such analyses have been done on both homogeneous (e.g., Genesove and Mullin 1998) and differentiated (e.g., Gasmi et al. 1992, Roy et al. 1994) product markets. By making the assumption of "steady-state" or time-invariant competition, these models account for the direct effects of demand and cost, but ignore the indirect effects.

Next we consider papers that model time-varying competition. Two papers by Porter (1983) and Ellison (1994) are similar in spirit to our model, in that they *structurally* separate out direct and indirect effects. However, both of these papers analyze the railroad shipping market, which is a market for homogeneous goods. They only model the impact of demand level in the indirect effect. They also do not allow for asymmetries in firm behavior. Both papers find support for Green and Porter (1984).

Borenstein and Shepard (1996) use a *reduced-form* approach to test the relationship between competition (price-cost margins) and demand and cost trends (not levels), using gasoline price data. They find support for the predictions in Haltiwanger's and Harrington's (1991) theory where firms take a long-term perspective. Because they use a reduced-form approach, they are not able to separate the direct effects from the indirect effects. They also do not allow for asymmetries in firm behavior.

In contrast, our proposed approach estimates demand and pricing equations at the *firm* level, accounting for product differentiation and asymmetry in firms' competitive strategies. Ours is the first paper to investigate demand and cost *levels* and *trends* simultaneously. This is important because predictions about trends are *conditional* on controlling for levels. We summarize the positioning of the current paper with respect to some select (but representative) papers.

	Market homogenous/ differentiated	Symmetric/ asymmetric strategies	Structural/ reduced form	Competition model	Variables modeling time-varying competition
Genesove and Mullin (1998)	Sugar refining (homogenous)	Symmetric	Structural	Time invariant	NA
Gasmi et al. (1992)	Cola (differentiated)	Asymmetric	Structural	Time invariant	NA
Roy et al. (1994)	Auto (differentiated)	Asymmetric	Structural	Time invariant	NA
Kadiyali (1996)	Film (differentiated)	Asymmetric	Structural	Time invariant	NA
Sudhir (2001)	Auto (differentiated)	Asymmetric	Structural	Time invariant	NA
Porter (1983)	Railroad shipping (homogenous)	Symmetric	Structural	Time varying	Demand level (supports Green and Porter 1984)
Ellison (1994)	Railroad shipping (homogenous)	Symmetric	Structural	Time varying	Demand level (supports Green and Porter 1984)
Borenstein and Shepard (1996)	Gasoline (homogenous)	Symmetric	Reduced form	Time varying	Demand, cost trends (supports long term behavior in Haltiwanger and Harrington 1991)
This paper	*Film (differentiated)*	*Asymmetric across firms*	*Structural*	*Time varying*	*Demand and Cost Levels* *Demand and Cost Trends* *Asymmetric Marginal Cost Reduction*

4. Model and Estimation

Our goal in this paper is to model both the direct and indirect effects (through changes in competitive intensity) of changes in demand and cost conditions on prices. We now describe our models of demand, cost, and competitive intensity.

Demand

Even though we use aggregate data, we model demand using a logit model with heterogeneity modeled across consumers (e.g., Sudhir 2001, Chintagunta 2001). For a more detailed discussion of the benefits of using the logit model with aggregate data, see Dubé et al. (2002). The probability P_{ijt} that consumer i chooses brand j ($j = 1, 2, \ldots, J$) in time t ($t = 1, 2, \ldots, T$) is:

$$P_{ijt} = \frac{\exp(\alpha_{ij} + \beta_i p_{jt} + \gamma_i X_{jt} + \mu_{jt})}{1 + \sum_{k=1}^{J} \exp(\alpha_{ik} + \beta_i p_{kt} + \gamma_i X_{kt} + \mu_{kt})}, \qquad (1)$$

where α_{ij} is consumer i's intrinsic brand preference for brand j, β_i is consumer i's price sensitivity parameter, p_{jt} is brand j's price at time t, γ_i is consumer i's sensitivity to other marketing activities in time t, X_{jt}. The term μ_{jt} in the above equation denotes brand and time-specific factors that are common across consumers that could influence consumer i's utility for brand j in period t. While these factors are important to the consumer (and consumers observe these levels), the researcher does not observe them. These factors are referred to as "demand shocks" or "unobserved attributes" of the brands. By their very nature, these factors could be correlated with the marketing activities of firms (prices, advertising levels, etc.) that are included in the utility function above. This has consequences for the estimation of the model parameters—an issue that we return to subsequently. Note that we allow for category expansion via the inclusion of an "outside good" alternative. This results in the "1" in the denominator of the expression in Equation (1).

We allow for consumer preferences to be heterogeneous. Define the household preference coefficients as a market-level mean and household-specific deviations: $\alpha_{ij} = \alpha_j + \Delta\alpha_{ij}$, $\beta_i = \beta + \Delta\beta_i$, $\gamma_i = \gamma + \Delta\gamma_i$, the utility of consumer i for brand j is decomposed into household-invariant means (Y_{jt}) and household-specific terms (ΔY_{ijt}).

$$\alpha_{ij} + \beta_i p_{jt} + \gamma_i X_{jt} + \mu_{jt} = \underbrace{\alpha_j + \beta p_{jt} + \gamma X_{jt} + \mu_{jt}}_{Y_{jt}} + \underbrace{\Delta\alpha_{ij} + \Delta\beta_i p_{jt} + \Delta\gamma_i X_{jt}}_{\Delta Y_{ijt}}.$$

Let the household-specific parameters be $\theta_i = \{\Delta\alpha_{ij}, j = 1, 2, \ldots, J, \Delta\beta_i, \Delta\gamma_i\}$, and let the distribution of θ across consumers be denoted as $F(\theta)$. $F(\cdot)$ has mean zero and unknown covariance matrix, Σ. For example, $F(\cdot)$ can denote the CDF of a $(J+2)$-variate normal distribution where X_{jt} has only one variable in it. The aggregate share S_{jt} of brand j at time t across all consumers is obtained by integrating the consumer-level probabilities in Equation (1) over the region of the support A_i of θ that yields brand choice j.

$$S_{jt} = \int_{A_i} \left[\exp(\alpha_j + \beta p_{jt} + \gamma X_{jt} + \mu_{jt} + \Delta\alpha_j + \Delta\beta p_{jt} + \Delta\gamma X_{jt})\right] \cdot \left(1 + \sum_{k=1}^{J} \exp(\alpha_k + \beta p_{kt} + \gamma X_{kt} + \mu_{kt} + \Delta\alpha_k + \Delta\beta p_{kt} + \Delta\gamma X_{kt})\, dF(\theta)\right)^{-1} \qquad (2)$$

or

$$S_{jt} = \int_{A_i} \frac{\exp(Y_{jt} + \Delta Y_{jt})}{1 + \sum_{k=1}^{J} \exp(Y_{kt} + \Delta Y_{kt})}\, dF(\theta).$$

An important feature of the share expression in (2) is that the elasticities are not subject to the IIA restriction of the homogeneous logit model.

Cost

We model costs as a function of factor inputs into the production process, such as material, labor, etc. Specifically, we parameterize the cost to manufacturer j at time t (c_{jt}) as follows:

$$c_{jt} = Z_{jt}\lambda_j + \varepsilon_{jt}. \qquad (3)$$

Z_{jt} is a matrix of factor inputs (including an intercept), λ_j is a vector of unknown parameters for brand j to be estimated, and ε_{jt} is the error in measuring costs using observed factor inputs.

Competitive Intensity

Intuitively, competitive intensity is lower when prices are higher, but prices can also rise due to low demand elasticity and high costs. To measure competitive intensity, we therefore need to control for demand and cost factors. Because the Bertrand price takes into account demand elasticity and costs, it serves as a useful benchmark. Thus, the extent of deviation from the Bertrand price can serve as a measure of competitive intensity (relative to the Bertrand price). This is also a useful benchmark because previous research has *imposed* the Bertrand assumption on the data (e.g., Berry et al. 1995, Besanko et al. 1998).

Consider the situation in which firm j prices according to the Bertrand equilibrium. In this case, brand j's objective function can be written as (given our empirical application, we assume single-product firms):[2]

$$\max_{p_{jt}} \Pi_{jt} = M_t(p_{jt} - c_{jt})S_{jt}. \qquad (4)$$

[2] Given that camera and film brands can be used interchangeably, and given the high level of competition in the camera market,

M_t is the potential size of the market at time t. Solving the first-order conditions for profit maximization under the assumption of the Nash-Bertrand equilibrium, we have:

$$p_{jt} = c_{jt} + \frac{-S_{jt}}{S_{jt}^j}, \quad \text{where } S_{jt}^j = \frac{\partial S_{jt}}{\partial p_{jt}}.$$

Hence, the Bertrand margin

$$m_{jt}^{\text{Bertrand}} = -S_{jt}/S_{jt}^j \tag{5}$$

or $p_{jt} = c_{jt} + m_{jt}^{\text{Bertrand}}$.

Because our interest is in measuring the indirect effect of changes in competitive intensity, we allow the margins to vary from the Bertrand margin. We thus capture the indirect effect by introducing a *multiplier* ω_{jt} on the Bertrand margin. The pricing equation can then be specified as follows:

$$p_{jt} = c_{jt} + \omega_{jt} m_{jt}^{\text{Bertrand}}. \tag{6}$$

Villas-Boas and Zhao (2005) use similar specifications, but with time-invariant multipliers, thus measuring average competition over the entire period of analysis. Because our objective is to understand how competitive intensity varies with demand and cost conditions, we parameterize ω_{jt} as follows:

$$\omega_{jt} = W_{jt}\vartheta_j. \tag{7}$$

W_{jt} is the matrix of *observed* predictor variables affecting the competitive behavior of firm j in period t, and ϑ_j is a vector of unknown parameters for brand j to be estimated. We discuss the predictor variables in greater detail in a subsequent section. The interpretation of ω_{jt} is as follows: When $\omega_{jt} > (<)1$, firm j is pricing cooperatively (competitively) relative to the Bertrand equilibrium. At $\omega_{jt} = 0$, firm j prices at marginal cost.[3] Combining Equations (3), (6), and (7),

$$p_{jt} = Z_{jt}\lambda_j + W_{jt}\vartheta_j m_{jt}^{\text{Bertrand}} + \varepsilon_{jt}. \tag{8}$$

In the above equation, ε_{jt} is independent of the factor inputs Z_{jt} and the competition predictor variables W_{jt}. As we do not a priori impose any restrictions on the ϑ_j parameters, our specification does not favor any particular behavioral outcome from the data. Depending upon the estimated values of parameters, we could find a wide range of competitive interactions—from the firms pricing at marginal cost to the firms behaving in a cooperative manner.

To see how Equation (8) captures the direct and indirect effects of demand and cost factors on prices, we note the following: (1) The direct effects of cost factors are reflected in the first term on the right-hand side of (8), $Z_{jt}\lambda_j$, which allows costs to vary over time. (2) The direct effects of demand factors are embodied in the term m_{jt}^{Bertrand}. From Equation (5), we know the factors that influence demand influence the markup term, m_{jt}^{Bertrand}. (3) The indirect effects of demand and cost factors, as well as the deviations from Nash-Bertrand pricing, are reflected in the multiplier term, ω_{jt}. The average value of ω_{jt} over the duration of analysis will represent the average deviation of pricing in the market from the benchmark Bertrand price level, whereas the variation in ω_{jt} over time captures the dynamics of competitive interactions. We note that because the price outcomes in the theoretical repeated-games model range from the Bertrand equilibrium prices to the collusive equilibrium prices, our empirical model nests all the theoretically possible price outcomes. Note that the indirect effects of demand and cost factors have been introduced in a reduced-form manner in our model. Our empirical approach of modeling indirect effects is similar to Parker's and Roller's (1997) approach of analyzing the effects of multimarket contact on competition.

The parameters of the demand model and the pricing equation are estimated simultaneously as in Berry et al. (1995) using a Generalized Method of Moments (GMM) estimation procedure. To identify the parameters of a model using GMM, we need at least as many identifying restrictions as the number of parameters in the model. As discussed earlier, we have exogenous variables for the intercepts in the demand and cost equations, the X variables (except for advertising which we treat as endogenous), the Z variables, and the W variables. Therefore, the coefficients associated with these variables will be identified. We need six additional identifying restrictions: two parameters associated with the endogenous variables (price and advertising) and four nonlinear parameters associated with individual-level heterogeneity. The four nonlinear heterogeneity parameters are three associated with the covariance matrix of the demand intercepts and one associated with the standard deviation in price.

For advertising, we use both quarterly and annually lagged advertising as instruments. We use cost variables as instruments for price. Because we have

two-part pricing strategies using either film or cameras as a loss leader cannot be sustained. Industry experts confirmed this intuition. Therefore, analyzing the film market separately is a reasonable assumption for our purpose.

[3] Corts (1999) suggests, using simulated data, that estimating competitive behavior using "conjectural variations" or conduct parameters of the type we are estimating may be problematic in some situations. In practice, this may not be a serious problem. Genesove and Mullin (1998), in their analysis of the sugar-refining industry, show that they get reasonable competitive conduct parameters consistent with the market structure of the industry. Further, Corts shows that bias is strong when there is strong negative autocorrelation in sales. In our empirical application, this is not an issue, as we find positive autocorrelation in sales.

three cost variables, we use them as instruments. We also interact them with the three quarter variables, thus obtaining another nine instruments. In all, we have fourteen additional restrictions compared to the six restrictions we need, and therefore our model is overidentified.[4]

5. Data

Our empirical illustration uses data from the U.S. photographic film market for the period 1981–1998. These data are on firm-level prices, units sold, advertising, and demand and cost variables. We obtained price data from *Popular Photography*, a monthly magazine where mail-order firms advertise photography-related products. Prices are for 35 mm 24-exposure 200 ASA color rolls—the most popular speed and size of film (see the *Wolfman Report on the Photographic and Imaging Industry in the U.S.* for further details). Quarterly advertising expenditures are from the *Class/Brand YTD Report of Leading National Advertisers*. We obtain quarterly market shares of firms (in terms of quantities) and industry-level sales from various sources, including *Study of Media and Markets* by Simmons Market Research Bureau, the Photo Marketing Association and *Product Data Series* by Media Mark Research. We obtain data on quarterly consumer incomes from *Survey of Current Business*.

The wage data for Kodak is obtained from *Monthly Labor Review* and *International Comparisons of Manufacturing Productivity and Labor Cost Trends*, both published by the Bureau of Labor Statistics. The price of capital (proxied by annual interest rates) is obtained from *International Financial Statistics.* For Kodak, the monthly price of silver is obtained from annual wholesale price indexes/producer price indexes issued by the Bureau of Labor Statistics. For Fuji, the price for corresponding materials (wages, capital, silver) is obtained by using monthly indexes from Bank of Japan's *Price Index Annual*. To standardize Japanese costs (for wages, capital, and silver) to U.S. prices, we use the monthly exchange data from *Annual Statistical Digest* (1980–1988) and *Survey of Current Business* (1989–1998). We use annual tariff numbers from the *Hamonized Tariff Schedule* to obtain effective U.S. costs. To convert the indices to real prices, we need at least the prices of silver and labor for one time period. For the United States, we obtain these data from the *Producer Price Indexes* and *Employment and Earnings* Report of the Bureau of Labor Statistics. For Japan, we obtain these numbers from the *Yearbook of Minerals and Nonferrous Metal Statistics*, published by MITI and the *Yearbook of Labor Statistics*, published by Japan's Ministry of Labor. We use the Consumer Price Index (base year 1990) for the United States for consumer prices of film and the Wholesale Price Index (base year 1990) for the United States for the United States and Japan for costs. These indices are obtained from *International Financial Statistics*.

Table 1. Descriptive Statistics—1981–1998

Variable	Mean	Std dev
Kodak quantity (no. of rolls)	112.6 M	19.7 M
Fuji quantity (no. of rolls)	18.8 M	8.3 M
Kodak price (1990 $/roll)	2.39	0.07
Fuji price (1990 $/roll)	2.04	0.05
Kodak advertising (1990 $)	11.1 M	0.7 M
Fuji advertising (1990 $)	1.5 M	2.1 M
Per-capita income (1990 $ quarterly)	1,275.47	16.55
Price of capital (U.S.)(interest rate %)	6.39	0.34
Price of labor (U.S.) (1990 $ per hr)	10.58	0.07
Price of silver (U.S.) (1990 $ per gram)	673.23	62.90
Price of capital (Japan) (interest rate %)	4.90	0.44
Price of labor (Japan) (1990 $ per hr)	8.70	0.14
Consumer confidence index (U.S.)	87.28	1.37

Operationalizing the Tests

We now discuss the predictor variables, W_{jt}, to be included in the indirect effect multiplier function ω_{jt}. For demand levels, we need some exogenous variables that are unambiguously related to the level of demand. From Table 2, we see that sales in the first quarter are substantially lower than in other quarters. Hence, we use quarter dummies to measure demand levels. A second variable we found useful to measure demand levels is the index of consumer confidence. A regression of sales against quarter dummies and consumer confidence showed that consumer confidence explained 22% of the variance and is positively related to sales.

For cost levels, there are three potential factor costs: labor, silver, and cost of capital. From Table 1, we see that variation in silver prices (both in absolute terms and relative to the mean) is substantially greater than for other cost factors. Also, because silver is an important input into the cost of producing film and it is an internationally traded commodity (so there is a

Table 2. Mean Quantities and Prices

	Kodak quantity	Fuji quantity	Kodak price	Fuji price
Quarter 1	89.5 M	15.1 M	$2.57	$2.08
Quarter 2	121.8 M	20.5 M	2.31	2.02
Quarter 3	117.6 M	19.2 M	2.36	2.04
Quarter 4	121.6 M	20.3 M	2.34	2.04

[4] We also estimated our models with instruments such as consumer confidence on the demand side and quarterly interactions with consumer confidence. Our results are robust to these other instruments. We recognize that lagged advertising is a problematic instrument for advertising due to serial correlation, but given the difficulty in finding other instruments for advertising, we use this in our analysis.

common price), Kodak and Fuji closely monitor their costs (Kadiyali 1996). To limit the number of variables (to conserve degrees of freedom), we use only the cost of silver to measure the effect of cost levels on competition.

Demand and cost trend variables are harder to observe. We tried several methods of classifying periods into growth or decline trend periods and used the following strategy. We fit a polynomial regression equation on consumer confidence and silver prices with time as the independent measure. Based on the fitted polynomial, upward-sloping periods are classified as growth periods and downward-sloping periods are classified as decline periods. We found that a fifth-order polynomial regression (with t, t^2, t^3, t^4, t^5 as variables), tracked both the index of consumer confidence and the silver prices well and gave us a smooth curve, which helps us to classify periods into the growth or decline phase. We also fitted higher-order polynomials, and the results we report are robust to classifications based on alternative fits. We discuss other methods of classifying quarters into growth and decline periods when discussing robustness checks.

Fuji started production in Greenwood, South Carolina in 1995, which lowered its cost to serve the U.S. market. Due to domestic production, Fuji no longer has to pay import duties of 3.7% that it had previously paid for film imported from the Netherlands and Japan. We allow the factory to affect marginal costs as well as competitive intensity by introducing dummy variables in the set of variables in the cost equation (U.S. Factory in Z_{jt}) and the indirect effects (Kodak and Fuji U.S. factory in W_{jt}) for the period 1995–1998.[5]

Control for Possible Correlation in Demand Elasticity and Demand Level

We have argued that a decline in prices in periods of high demand could be due to the indirect effect of greater competition. However, it is possible that this effect is due to consumers being more price elastic in high-demand periods (Bils 1989, Warner and Barsky 1995). For example, Wolfram (1999), in her analysis of the British electricity market, finds that price elasticities tend to be different during weekdays and weekends, summers and winters. Bils' model for durable goods may be inappropriate for the film market. Warner and Barsky suggest that consumers will search more for lower prices in periods of high demand due to economies of search leading to greater elasticity of demand. To test the indirect effect of demand and competition, we need to control for possible correlation in demand sensitivity and demand levels. In our empirical analysis, we include price-quarter interactions in the demand function to capture the differences in price sensitivity in different quarters.

6. Results

The results of the estimation are reported in Tables 3A–3C below. Table 3A contains the demand estimates, 3B the cost estimates, and 3C the estimates of competitive interactions.

Demand

To have a modest number of parameters, we allow for heterogeneity only in the intrinsic preferences and price sensitivities of consumers. Quarter 1 has a

Table 3. Model Estimates

A. Demand Parameters		
Kodak intercept	*n.s.*	
Fuji intercept	*n.s.*	
Quarter 1	2.37*	
Quarter 2	1.23**	
Quarter 3	*n.s.*	
Advertising (log)	*n.s.*	
Price-mean	−1.89**	
Price-SD	0.68*	
Price X Quarter 1	−1.28**	
Price X Quarter 2	−0.63*	
Price X Quarter 3	−0.39**	
Log income (Kodak)	−8.00*	
Log income (Fuji)	*n.s.*	
L11	*n.s.*	
L22	*n.s.*	
L21	*n.s.*	
B. Cost Parameters		
Kodak intercept	0.96***	
Fuji intercept	0.81***	
Labor	0.65**	
Capital	0.48*	
Silver	0.59**	
U.S. factory	−0.18**	
C. Competition Parameters		
	Kodak	Fuji
Intercept	*n.s.*	0.42*
Quarter 1	0.30*	*n.s.*
Consumer confidence	−0.59**	*n.s.*
Silver price	*n.s.*	0.80**
Consumer confidence growth	0.21**	*n.s.*
Silver price growth	*n.s.*	−0.20*
U.S. factory	−0.39**	−0.35**

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; *n.s.*: not significant.

[5] The effective marginal cost for Fuji could also appear to be lower due to excess capacity and the need for factory managers to exploit potential economies of scale. We thank a reviewer for suggesting this possibility.

higher coefficient than other quarters, but the price sensitivity in Quarter 1 is also higher than in other quarters. Adjusting for the greater price sensitivity and the fact that prices are higher in the first quarter, we find the net utility for consumers is lower in the first quarter than in other quarters. This is not surprising given the lower average sales in Quarter 1 relative to other quarters. The price sensitivity results run counter to the hypothesis of Warner and Barsky (1995) because consumers are more price sensitive in the low-volume first quarter than in other quarters. Also, consumers have higher price sensitivity in Quarters 1–3 compared to Quarter 4, as indicated by the negative price-quarter interactions. This could be because consumers who exclusively buy during the holiday season may not be as price sensitive as others who buy throughout the year. The mean price coefficient is −1.89 ($p < 0.05$). There is significant unobserved heterogeneity in price sensitivity ($p < 0.1$), but not in preferences for Kodak and Fuji film.

Income has a negative and significant effect on demand for Kodak. In the late 1980s and in the 1990s, higher-income households started substituting camcorders and digital cameras for film. We conjecture that the negative income effect for Kodak could be because higher-income people who otherwise purchase Kodak's more expensive film substituted out of the film category more than Fuji consumers.

Costs

The cost estimates in Table 3B indicate that labor, capital and silver prices are all significant.[6] As expected, the coefficient of U.S. Factory is significant, indicating that the introduction of a U.S. factory lowered costs for Fuji.

Competitive Interactions

Several predictors of competitive behavior are statistically significant (see Table 3C). The positive coefficient on Quarter 1 for Kodak ($p < 0.1$) supports the prediction of Rotemberg and Saloner (1986) that competition will be less in periods of low demand. However, this coefficient is positive, but not significant, for Fuji. We find support for this result in the trade press. Kodak typically raised prices for the first quarter and Fuji followed many times (though not always) with its own price increases (*USA Today* 1989). The Kodak coefficient on consumer confidence is negative and significant, indicating that Kodak prices more competitively in periods of high demand, supporting Rotemberg and Saloner. In contrast, Fuji does not respond to changes in consumer confidence. With respect to costs, Fuji prices more cooperatively when costs rise, but Kodak's behavior is not affected by changes in cost levels. In sum, we conclude that there is broad support for the prediction of Rotemberg and Saloner. Given the institutional reality of observable aggregate demand and competitive actions, the Rotemberg and Saloner model (1986) is more appropriate than the Green and Porter model (1984) for the film market. Our results also show that, contrary to Raith's (1996) argument, the Rotemberg and Saloner predictions are robust to modest levels of differentiation in the market.

With respect to demand and cost trends, we find that Kodak is more cooperative when there is a positive demand trend (the positive coefficient on consumer confidence growth variable). Thus, Kodak behaves in a manner consistent with the long-term outlook in the Haltiwanger and Harrington (1991) model. Similarly, Fuji behaves in a manner consistent with a long-term outlook in the Haltiwanger and Harrington model with respect to trends in silver prices. A consistent pattern across both level and trend variables is that Kodak responds to demand factors, while Fuji responds to cost factors.

The consistent support for both Rotemberg and Saloner (1986) and Haltiwanger and Harrington (1991) across the level and trend variables for demand and costs suggests the important role of observability of aggregate demand and competitor actions. By simultaneously testing their impact, we are able to obtain an integrative picture of how level and trend variables affect competitive intensity consistent with theories that assume observability. This would not have been possible with piecemeal approaches used in previous research that focused only on a subset of these variables.

As Fuji began production in its U.S. factory in 1995, it became more competitive as indicated by the negative coefficient on U.S. Factory. We evaluate this by computing the margins in the years around 1995. For Fuji, the average margin in 1995 went down to \$0.83 from \$1.11 in 1994. The Lerner Index (Margin/Price) fell from 0.65 to 0.51. The Kodak response was more aggressive. The average margins fell from \$1.27 in 1994 to \$0.83 in 1995, and the Lerner Index fell from 0.63 to 0.43. Thus, Fuji's cost reduction made both Kodak and Fuji aggressive in their pricing.

The estimated price-cost margins for Kodak from 1996–1998 are \$1.36, \$1.31, and \$1.11, while the estimated price-cost margins for Fuji were \$0.78, \$0.78, and \$0.77. Thus, Kodak did not change its competitive strategy much between 1996 and 1997, but aggressively responded in 1998 even when Fuji's price reduction was very marginal. Our findings about the difference in Kodak's margins between 1997 and 1998 appear to be consistent with a 1998 price war reported in the Hamilton (August 2, 1998):

[6] We also allowed separate coefficients on the factor inputs for Kodak and Fuji in the cost equation. Because the differences were not significant, we constrained them to be equal.

> In 1997, Kodak lost three to four percentage points of U.S. market share to Fuji, which waded into the market with an aggressive and almost unchallenged program of promotion and price cutting... "The big difference this year and last year is that they reacted slowly or didn't react at all to Fuji's moves" said analyst.... This year Kodak has undertaken major steps...including price promotions of its own (p. H.02).

Robustness Checks

We perform several robustness checks. We included a time trend in the multiplier function for both Kodak and Fuji in addition to the other variables, but these were not significant.[7] Directionally, the other variables continue to maintain the same pattern as in the main model.

We also estimated a benchmark model with no indirect effects (only a time-invariant multiplier is estimated for the competition parameters) as is the current standard practice in the literature. The demand and cost estimates are fairly close to the estimates in Table 3. This suggests that extant models that do not account for time-varying competition still obtain consistent demand and cost estimates. The average time-invariant multiplier on the Bertrand price for Kodak was 1.22 and that for Fuji was 1.61, indicating that both Kodak and Fuji were more cooperative than the Bertrand price-setting behavior. Thus, our results are consistent with Kadiyali (1996), who also finds that Kodak and Fuji were cooperative in their pricing behavior. The higher multiplier for Fuji, however, does not necessarily mean that Fuji was more cooperative than Kodak, because the difference between the Bertrand and cooperative prices may have been lower for Kodak than for Fuji. Given the large share of Kodak in the market, the difference between Bertrand pricing and cooperative pricing is possibly much lower. To check this, we compute the average ratio of cooperative margins to Bertrand margins for Kodak and Fuji. These ratios were 1.12 and 1.99, respectively. This implies that the cooperative margins are only 12% higher than the Bertrand margins for Kodak, while they are 99% higher for Fuji. Therefore, Kodak has much less leeway in terms of punishing Fuji by reverting to Bertrand pricing. This is consistent with the "fat cat" posture that has been adopted by Kodak in accommodating Fuji's entry, previously documented in the literature (Kadiyali 1996).

We checked the impact of our definition of growth and decline periods for the trend variables. As an alternative to the fitted curve obtained from a fifth-degree polynomial, we used higher-degree polynomials, and the results are robust. We also used a different smoothing procedure to test robustness, by maintaining the period to be in the same state (growth or decline) as in the previous period unless there was a change greater than a 10% threshold. So, if period $t-1$ was a growth period, period t was classified as a decline period only if the consumer confidence fell by over 10%. Similarly, if period $t-1$ was a decline period, period t was classified as a growth period only if the consumer confidence increased by over 10%. This allowed us to smooth out small changes in consumer confidence, which may not be perceived as growth periods by managers. We also did this for costs. We found no substantive changes in the results when we varied the threshold percentages from 8–15%.[8]

Managerial Implications

Our approach and results are useful to managers operating in turbulent markets in the face of fluctuating demand and cost conditions. Typical models used in decision support systems for setting prices assume that competitive intensity will not vary as demand and cost conditions change. We propose and document that the indirect effect of demand and cost on competitive intensity have significant impact on the prices observed in the marketplace. Firms can use this information about changes in competitive intensity to compute the optimal prices. We further assess the substantive usefulness of modeling indirect effects by (1) computing the relative improvement in the fit of prices and (2) the relative magnitude of the direct and indirect effects.

Table 4 shows the observed and fitted prices for the time-variant and time-invariant competition models in the different quarters and before and after the U.S. factory was introduced. Clearly, the fit is better for the time-variant model that models indirect effects. Further, we find that the Mean Absolute Percentage Error (MAPE) between fitted and actual prices for Kodak for the time-varying competition and time-invariant competition model are 8.3% and 21.8%. The corresponding numbers for Fuji are 5.6% and 11.9%, respectively. While it is not surprising that the sample fit improves (given the additional model parameters), the magnitude of the improvement in fit suggests that the indirect effect is substantively important

[7] We thank the area editor for suggesting this specification to check if the indirect effect could be explained by a simple downward trend in competitive intensity, given the systematic decline in prices over the period of analysis.

[8] We also tested the robustness of the estimates to demand functional form by estimating a linear model of demand (as in Kadiyali 1996). However, the number of parameters in the linear model increases at double the rate compared to the logit model, as we need two parameters for each variable to account for the differential effects of Kodak and Fuji. It was not possible to meaningfully estimate the price-quarter interaction effect with the linear model (the price coefficient became positive when we included this interaction effect). We therefore tested the model with all the variables we use in the logit model, but without the price-quarter interaction. For this model we found that the predictors of competition had identical effects (in terms of the signs) as the logit results.

Table 4. Comparison of Observed Prices and Fitted Prices

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Before factory	After factory
Kodak	Observed price	$2.54	$2.25	$2.30	$2.29	$2.53	$1.69
	Time varying Competition price	2.53	2.26	2.29	2.26	2.52	1.70
	Time invariant Competition price	1.84	2.53	2.55	2.85	2.55	2.07
Fuji	Observed price	2.04	1.97	1.99	1.99	2.14	1.49
	Time varying Competition price	2.05	1.95	1.99	2.02	2.15	1.49
	Time invariant Competition price	1.77	2.05	2.09	2.26	2.13	1.73

and should help decision support systems set more realistic prices that are in tune with market conditions.

Because Quarter 1 has the lowest demand and Quarter 4 has the highest demand, firms should charge a lower margin in Quarter 1 and higher margin in Quarter 4, if we only consider the direct effect, by holding competition constant. Accordingly, with time-invariant competition as the benchmark, the ratio of Kodak's Quarter 1 margins to Quarter 4 margins is 0.6; for Fuji it is 0.43. However, *after* we allow for the indirect effect, the same ratio becomes 1.14 and 0.97 for Kodak and Fuji, respectively. Thus, the margins in the high- and low-demand quarters become almost comparable (i.e., closer to 1), indicating that the direct effect of higher prices in high-demand periods has been effectively neutralized by the indirect effect. This result is striking in that it is similar to the highway contractors' example cited in the introduction where management complained about a "baffling" decrease in margins in boom times. Our analysis provides a rationale for such market outcomes that could otherwise be puzzling.

7. Conclusion

Contributions

Researchers typically assume that competitive intensity is invariant when the demand and cost conditions change. With this assumption, an increase in demand or cost will cause prices to increase. Examples from the business press suggest that this prediction is not always valid. We argue that changes in demand and cost conditions may influence the competitive intensity, thereby causing an "indirect effect" on prices. Only the "direct effect" is accounted for when competition is maintained invariant.

We develop a general approach to allow for both direct and indirect effects. We test a number of alternative predictions (developed based on the theoretical literature on repeated games) about how competitive behavior changes as a function of demand and cost variables. We test these predictions using data from the U.S. market for photographic film and demonstrate that our model with indirect effects does substantially better at predicting prices than a model that does not allow for such indirect effects. The key contributions of the paper are:

(1) It introduces the notion of time-varying competition to the marketing literature by modeling the indirect effects of demand and cost variables on prices through its impact on competition.

(2) It develops a unified framework to operationalize and measure direct and indirect effects in *differentiated* product markets—the kind of markets that are typically of interest to marketers. Our framework recognizes that firm strategies can be asymmetric, and helps us to obtain more general insights relative to previous research.

(3) The framework allows us to test several predictions from the literature on repeated games in differentiated product markets. These have previously only been tested in homogeneous product markets and only on a piecemeal basis. This is the first paper where the effects of multiple demand and cost drivers (trends and levels) are assessed simultaneously.

(4) Our results consistently support the predictions from theoretical models, in which competitive actions are assumed to be *observed*, an institutional characteristic of the market for photographic film. Previous research found support for alternative theories, applicable to markets where competitor actions are observed. This suggests that the institutional details such as the observability of competitor actions are important in understanding competitive behavior.[9]

(5) We show that there can be substantial gains in fit by allowing for time-varying competition through

[9] Domowitz et al. (1986) investigate the relationship between price-cost margins using *accounting costs* in a cross-category analysis across industries. They find that margins are greater in high demand periods (as in Green and Porter) for concentrated industries. Our study suggests that the cyclicality of margins may be different in markets depending on observability of competitor actions.

the indirect effects. In our empirical analysis, we find that the indirect effect is large enough to neutralize the direct effect. Thus, the indirect effect needs to be incorporated in pricing decision support systems.

Decision support systems in marketing typically calibrate demand and cost models, but *assume* the competitive equilibrium (Bertrand, Cournot, Stackelberg) in making predictions about the optimal prices. Decision support systems usually do not test whether the assumption made about the competitive equilibrium is appropriate, but this is required if we are to account for how competition will react to changes in a firm's marketing mix in response to a change in demand and cost conditions. By estimating how firms deviate from the prices predicted by the Bertrand equilibrium model and allowing firms to react asymmetrically to changes in market conditions, we are able to provide a precise quantification of the likely competitive response.

In constructing a decision support system, a question that arises is: Is the estimated competitive equilibrium optimal, or can firms improve upon this equilibrium? Firms need to perform simulations to identify whether they can increase profits by modifying their current reactions to changes in demand and cost conditions as well as to competitive reactions. For example, when P&G found that it would be profitable to move away from a prisoner's dilemma high-low pricing strategy to an EDLP pricing strategy, it signaled strongly to its competitors and the channels that this was a permanent move. While it took a temporary cut in profits, it was able to get its competitors to move to a higher profit equilibrium in the longer run. Most firms, however, may not be powerful enough to change the market equilibrium and have to act as per the inferred equilibrium in the market place. Given the inferred equilibrium, decision support systems can then automate the routine process of setting prices by using estimates of the calibrated model.

A related question is: If the current price setting by managers is optimal given the inferred equilibrium, what is the value of automating this decision? Russo and Shoemaker (1990, pp. 134–135) demonstrate that decisions made by a bootstrapped model fitted on ratings provided by an expert "outperforms" even the same expert in new situations. This is because the rule-based model performs more *consistently* than any (even expert) human being using the same set of rules. In that spirit, we believe price setting based on a model of firm behavior calibrated using observed market outcomes can lead to more consistently profitable price setting by firms.[10]

[10] We thank the area editor and the editors for encouraging us to address these questions.

Limitations and Future Research

While we have tested the robustness of our key results on a number of dimensions, we recognize that the results may still be sensitive to certain specification choices that we make in the paper. The significance of some of the coefficients is marginal, so it would be useful to check the robustness of our substantive claims with alternate datasets and in different markets. Our results suggest that the nature of time-varying competition is determined by the observability of competitor actions. It would be particularly useful to test the robustness of this finding by identifying markets that differ in observability and compare the support for the theory of Green and Porter versus that of Rotemberg and Saloner.

In this paper, we focused on price as the strategic variable of interest, but did not model other strategic variables such as advertising. By including advertising in the demand model and accounting for the endogeneity of advertising in the pricing equation, we obtain consistent inference about the effect of advertising on pricing. In future research, it also would be insightful to study how firms compete with strategic instruments such as advertising (e.g., Kadiyali 1996). However, specifying the equilibrium advertising levels over time is not a trivial task due to carryover effects of advertising (Dubé and Manchanda 2005).

We do not model time-varying competition in a structural manner. As discussed earlier, it is important to understand what structure should be imposed on the model before estimating a structural model. Because our analysis is an early step in empirically understanding competitive dynamics, the flexibility of our reduced-form approach enables us to gain exploratory insights. Nevertheless, it would be particularly useful to incorporate structural dynamics into competitive models using Markov perfect equilibrium methods (e.g., Pakes and Ericson 1998, Pakes and McGuire 2001). However, estimation of realistic dynamic structural models of firms is computationally prohibitive and restrictive at the present time. Such a structural model should be able to endogenously account for asymmetries in firm responsiveness to different demand and cost variables as well.

Chevalier et al. (2003) provide reduced-form evidence that retail prices (in contrast to our focus on manufacturer prices) do not rise in periods of high demand due to loss-leader pricing. We expect future work to address differences in the responses of manufacturers and retailers to demand and cost conditions in understanding variations in pass-through over time.

We have taken the first steps in addressing the issue that a change in demand or cost not only has a direct effect on the marketing mix, but also an indirect effect due to its impact on competitive intensity. As discussed above, much more remains to be learned. We expect our research to serve as a beginning for a fruitful stream of research investigating "time-varying competition."

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