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Cartel pricing dynamics with reference-dependent preferences☆

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HIGHLIGHTS

- Cartel pricing dynamics when consumers have reference-dependent preferences.
- Consumers are unsure whether a high price is due to collusion or high cost.
- High prices increase consumers' belief that firms collude.
- Collusive prices rise over time alongside consumers' price expectations.
- Collusive prices reach a steady-state when consumers are sure that firms collude.

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ABSTRACT

This paper characterizes cartel pricing dynamics when consumers have reference-dependent preferences. Firms have a common discount factor unknown to consumers and a common cost i.i.d. over time. Consumers observe prices over time and update their expectations about firms' ability to collude, which affects consumers' price expectations. Reference-dependent preferences make consumers lose utility when the actual price is higher than the expected one, which forces colluding firms to raise prices alongside consumers' price expectations. This increasing price path is capped by the price arising when consumers are sure that firms collude.

1. Introduction

The cartels discovered in the last decades have shown that prices have a transitory phase during which they gradually rise and eventually become constant. Harrington (2006) reports several examples, among which the citric acid and lysine cases (Connor, 2001), several of the vitamins cases (Levenstein and Suslow, 2001), and graphite electrodes cases (Harrington, 2004b). Harrington (2006) also provides examples of future planned gradual price increases, for the choline chloride and the carbonless paper cartels. These examples are for intermediate products, but there are also examples for final products, like the French mobile cartel,[1] the Italian pasta cartel,[2] the German coffee cartel[3] and the German supermarkets cartel.[4]

Theories addressing this issue must show both that prices rise gradually and then that they eventually become stable. In Harrington (2004a, 2005) and Chen and Harrington (2006) the probability of detection by an Antitrust Authority is assumed to positively depend on the price increases. Colluding firms balance off increasing profits with increasing the probability of detection, which makes prices gradually rise up to a steady-state.

My paper, instead, proposes an explanation based on rational consumers with reference-dependent preferences (RDPs), i.e. con-

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[1] http://www.autoritedelaconcurrence.fr/pdf/avis/05d65.pdf.

[2] http://www.agcm.it/stampa/news/8-notizie/comunicati-stampa/4120-i694-listino-prezzi-della-pasta.html.

[3] http://www.bundeskartellamt.de/wEnglisch/download/pdf/Fallberichte/B11-019-08-ENGLISH.pdf. This cartel served both final clients and bulk customers, like hotels and vending machine operators.

[4] http://www.bbc.com/news/business-36245023. Several supermarket chains participated in this cartel, which involved confectionery, coffee, pet food, beer and body care products.

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sumers' utility depends on the comparison between the outcome and a reference point. Evidence of RDPs is widespread. Thaler (1980) proposes this concept to explain why consumers' behavior often depart from consumer theory. Kahneman et al. (1991) enumerate biases that are not explainable by traditional economic theory, among which loss aversion (a particular case of RDPs), providing a series of experiments. Tversky and Kahneman (1991) discuss other experimental evidence and propose a model based on loss aversion that explains these biases by a deformation of the indifference curves about the reference point. Kőszegi and Rabin (2006) analyze consumer behavior with loss aversion and an endogenous reference point and show that, when the outcome is uncertain, the willingness to pay increases in the expected price, conditional on purchase. Heidhues and Kőszegi (2008) use loss aversion to explain the existence of focal prices in a static game.

I assume that consumers have RDPs in the price dimension. The higher the difference between the actual and the expected price, the higher the utility loss. I develop an infinite-horizon game with an endogenous reference point where the basic ingredients are (i) reference-dependent preferences and (ii) the uncertainty, on the consumers' side, of whether firms are colluding or not.[5]

Consumers update their reference point through the prices firms have set up to that period. The reference point is based on the probability that firms, whose common cost and ability to collude are unknown to consumers, set a high or low price. Firms' common cost is i.i.d. over time. Consumers see the prices firms set in every period and update their beliefs over firms being colluding. If the price in the current period is high, consumers' belief that firms are colluding increases. Thus, the larger the number of periods in which firms set the high price, the more consumers become pessimistic about the competitiveness of the market and (rationally) expect a higher price. This makes the reference point rise, which reduces the effect of RDPs and makes consumers accept to pay a higher price, which in turn allows firms to actually raise prices. The cap is the price that would take place if consumers were sure that firms are colluding.

2. The model

Demand in period t is given by $D_t(\mathbf{p}_t, E[\mathbf{p}_t])$, where $\mathbf{p}_t$ is the vector of prices and $E[\mathbf{p}_t]$ is the expected vector of prices in t, given the information available up to the beginning of period t. Assume that demand is decreasing in $\mathbf{p}$ and in the difference $\mathbf{p} - E[\mathbf{p}]$. The latter represents the impact of RDPs.

Firms have a common marginal cost equal to the constants $\underline{c}$ or $\bar{c}$ which is drawn in every period. The current cost c_t is firms' private information and it is $\underline{c}$ with probability μ and $\bar{c} > \underline{c}$ with probability $(1-\mu)$.

In each period t, firms choose prices. Each firm i faces a demand equal to $d_{i,t}(\mathbf{p}_t, E[\mathbf{p}_t])$ and earn profits equal to $\pi_{i,t} = (p_{i,t} - c) * d_{i,t}(\mathbf{p}_t, E[\mathbf{p}_t])$. Timing is as follows:

In $t = 0$:

1. Firms' discount factor is drawn and revealed only to firms.
2. Consumers form price expectation $E[\mathbf{p}_0]$.
3. Marginal cost c_0 is drawn and revealed to firms. It is $\underline{c}$ with probability μ and $\bar{c}$ with probability $(1-\mu)$.
4. Firms choose prices.
5. Demand and stage game payoffs are realized.

In $t \geq 1$ all the steps are the same, except step 1 that disappears (the discount factor is drawn only at the beginning of the game). In every period consumers update their beliefs over ρ by observing the prices firms set. Denote $\hat{\rho}_{t,\tau,\hat{t}}$ consumers' belief that market is collusive at the beginning of period t, after τ periods of "low" prices and $\hat{t}$ periods of "high" prices. "Low" and "high" prices are explained in the following subsection.

2.1. Price evolution

Denote the vector of low (high) prices by $\underline{\mathbf{p}}_t(\hat{\rho}_{t,\tau,\hat{t}})$ ($\bar{\mathbf{p}}_t(\hat{\rho}_{t,\tau,\hat{t}})$): it is the set of prices that competitive firms set in period t when the current cost draw is $\underline{c}$ ($\bar{c}$) and the updated belief is $\hat{\rho}_{t,\tau,\hat{t}}$. Both prices therefore depend both on the current belief $\hat{\rho}_{t,\tau,\hat{t}}$ that the market is collusive (which impacts the expected price) and the current cost draw. Though I let demand and competition among firms be as general as possible, I impose the following assumptions.

A1 For any belief $\hat{\rho}_{t,\tau,\hat{t}}$, competitive prices are higher when cost is higher: $\bar{\mathbf{p}}_t(\hat{\rho}_{t,\tau,\hat{t}}) > \underline{\mathbf{p}}_t(\hat{\rho}_{t,\tau,\hat{t}})$.

A2 For any cost draw, competitive prices are higher when the demand is higher.

I also assume $\bar{\mathbf{p}}_t(0) \geq \bar{c}$ in order to ensure the existence of the market for any cost realization and belief.

Many standard demand functions and types of competition fulfill these assumptions. **A1** encompasses almost all standard types of demand and competition among firms, except completely elastic demand. **A2** encompasses many different models of differentiated products. The only standard type of competition that these assumptions rule out is the homogeneous Bertrand case.[6]

Firms may be able to collude or not, depending on their common discount factor. At the beginning of the first period their discount factor is drawn and it is firms' private information. Consumers do not know whether firms' discount factor makes collusion sustainable or not, but they can imperfectly infer it from the prices firms set over time. The ex-ante probability that the discount factor allows firms to collude is denoted by ρ.[7,8]

Assume also that, when firms collude, they pretend to compete and have the high cost, instead of clearly stating that they collude. Clearly stating that they collude would have the obvious advantage of making $\hat{\rho}_{t,\tau,\hat{t}}$ instantaneously equal to 1, making the utility loss for consumers due to RDPs smaller and therefore allowing colluding firms to increase prices immediately. However, there are several good reasons under which this is not a reasonable strategy. The most obvious one is when there exists an Antitrust Authority that can impose fines. Moreover, even without an Antitrust Authority, firms are unwilling to show that they are colluding when this may induce entry into the market – as entrants expect supra-competitive profits – or make consumers search

[5] Consumers may be both final consumers or intermediate (industrial) buyers. In the case of intermediate buyers, reference-dependent preferences may be seen as a reduced-form approach of intertemporal substitution for durable goods or search costs. In the former case, industrial buyers may prefer to buy less when price is higher than they expected if they can store the good, as they expect the price to go back to the (lower) expected value. Intertemporal substitution would yield the same qualitative outcome as reference-dependent preferences, i.e. lower demand when price is above the expected price. In the case of search costs, an intermediate buyer who has to incur a cost to discover the price (or the existence) of an alternative input may decide to incur it if the price of the known input is above a threshold depending on the expected price. In other words, if the price of the known input is too high compared to its expected price, the intermediate buyer may expect to find another input sufficiently cheaper so as to justify the cost of searching for it. With some probability the search will be successful, which reduces the demand for the known input and, therefore, yields the same qualitative result as reference-dependent preferences.

[6] In the Appendix I solve the model with differentiated goods Bertrand competition and linear demand and show that these assumptions are fulfilled.

[7] Assume that when the discount factor allows firms to collude, firms actually collude.

[8] This can be seen as a reduced form of the decision of whether to collude or not in a Markov Perfect Bayesian equilibrium, where $\hat{\rho}_{t,\tau,\hat{t}}$ is the state variable. Thanks to the Folk Theorem we know that a discount factor high enough to sustain collusion, for example through a grim trigger strategy, exists. I discuss this in more detail in the additional material.