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Collusion enforcement with private information and private monitoring ☆

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Abstract

This paper shows that a cartel that observes neither costs, prices, nor sales may still enforce a collusive agreement by tying each firm's continuation profit to the truncated current profits of the other firms. The mechanism applies to both price and quantity competition, and the main features are broadly consistent with common cartel practice identified by Harrington and Skrzypacz [24].

JEL classification: C73; D43; D82; L13; L40

Keywords: Collusion; Oligopoly; Repeated game; Private information; Private monitoring

1. Introduction

Despite an extensive literature on repeated games, there has been little work that seeks to provide a theoretical justification of observed cartel practice. In an important exception, Harrington and Skrzypacz [24] note that many cartels used transfer schemes to enforce collusion.

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Under these schemes, colluding firms agreed to a set of sales quotas, and firms that reported sales above quota compensated firms that reported sales below through inter-firm purchases. In one case, Haarmann & Reimer purchased 7000 tons of citric acid from Archer Daniel Midlands. Inspired by Harrington and Skrzypacz [24], we propose a new collusion enforcement scheme in a repeated game with both private monitoring and private information. We show that despite observing neither costs, prices, nor sales, a cartel can still enforce a collusive agreement that maximizes joint profit. When the firms are patient and the demand shocks small, the equilibrium cartel profit could be close to the monopoly level.

We call the static version of our scheme an output–target mechanism. Under this mechanism firms first agree to a set of output targets. At the end of each period the cartel can calculate the "reported" profit of each firm based on the reported output and cost of each firm. The cost reports and profit shortfalls—the difference between the profit targets (i.e., the firm's profit if it makes the output target) and the reported profits—jointly determine the side-payments between firms and the probability of switching to a non-collusive continuation path (i.e., having a price war) in the next period. A firm tends to pay less when it reports lower sales, but the gain is offset by a higher probability of a price war. Taking into account its payments to other firms and the loss in case of a price war, each firm's continuation profit in equilibrium is linear in the reported output shortfalls of the other firms.

One can view the mechanism as a *truncated* Clarke–Groves mechanism (Vickrey [38], Clarke [15] and Groves [23]). If the output targets were set higher than the maximum outputs, then the continuation profit of each firm (including side-payments) would be equal to the reported profits of the other firms (minus a constant), and our scheme would resemble a classic Clarke–Groves mechanism. But since our cartel problem involves hidden actions, we cannot balance the budget by transferring the penalty of one firm to another firm. Instead, all penalties are destroyed through a price war. If the output targets were set above the maximum outputs, the amount to be destroyed could be very large. The first contribution of this paper is to show that we can reduce the efficiency loss by lowering the output targets. When the demand shocks are small, the efficiency loss would be small when the output targets are set near the expected output levels. However, when output targets are set below the maximum outputs, the transfer scheme would no longer fully capture the external effects of the firms' actions. A firm that has secretly cut price may escape punishment when a positive demand shock masks the effect of the price cut. A second contribution of the paper is to show that despite this "truncation" problem, the mechanism can still enforce an efficient collusive agreement under a fairly weak condition.

The main feature of our mechanism—that a firm is punished when the reported outputs of the other firms fall below certain targets—is consistent with the transfer schemes described by Harrington and Skrzypacz [24]. Since these schemes are common, it is important to understand how they work. Harrington and Skrzypacz [24] show that the main features of these schemes are consistent with equilibrium behavior in a model of repeated Bertrand competition with private monitoring. Our model is more general in that it allows private information and applies to both Bertrand and Cournot competition. In Harrington and Skrzypacz [24], inter-firm transfers serve as a linear output tax. By choosing the right tax rate, a cartel can discourage the firms from over-production. However, since a firm is required to pay more when it reports higher sales, it has an incentive to under-report. Harrington and Skrzypacz [24] show that it is possible to induce truth-telling when the industry demand is completely inelastic. Under our mechanism, firms have no incentive to mis-report as the continuation profit of a firm does not depend on its own report.

The standard approach to enforce an efficient outcome in repeated games with private monitoring is to punish a player whenever he fails a statistical test (Kandori and Matsushima [28],