1. Introduction

A problem which is often studied in the context of repeated economic relationships between a principal and many agents is the possibility of the agents uniting themselves in order to form collusion scheme, attempting to increase their share of the total payoff in the situation.

Even though maintaining collusion is often not optimal individually on the short run, cartels can be sustained in the long run through the use of threats against participants who deviate from the action that is suggested by the collusion ring. As explained in Abreu (1986 and 1988), participants who are punished for their deviations can, in fact, be led to cooperate in their own punishments, which is an interesting alternative to symmetric punishments, such as the end of the cartel (in which all participants, even those who did not deviate, are punished). These punishments are formulated in order to turn the collusion scheme into a Nash Equilibrium: conditional on the other agents following the cartel suggested strategy, it is optimal for each agent to follow it too. On the other hand, in the absence of such punishments, the only stable strategies are composed by myopic Nash Equilibria in which, for each period, agents ignore the effects of their actions in the future periods (more specifically, on the actions adopted by the other agents in the future). In this situation, they simply choose the action which will result in the highest expected benefit in the current time period, conditional to actions (in the current period) of the other agents.

This problem is present in auction settings, in which there is a Principal (denominated the "auctioneer"), which is interested in buying or selling a good or service and one or more agents (denominated the "participants" or "potential bidders" of the auction), each looking to increase his utility by realizing a transaction with the auctioneer. With no loss of generality, we herein will assume the auction of study is a supply auction. In traditional supply auctions, the participants will offer bids to the auctioneer, which will choose the highest bid and exchange the good or service of interest with the participant who offered such bid. Myerson (1981) has established that, in all traditional auction s, the expected revenue for the auctioneer is the same (on the absence of collusion between the participants).

The objective of cartels in an auction setting is to reduce this revenue (which is also the value paid by the highest bidder), so as to increase the total payoff of the auction participants. An example of such a collusion is the Bid Rotation Scheme, as described by McAfee & McMillan (1992) and Aoyagi (2003), in which a random mechanism determines, at each period (or at each auction), which participant will offer the minimum bid, while the other participants will abstain from offering their own bids. In such a scheme, the increase in the welfare of the participants is obtained by reducing the value paid by the winner. It is, however, inefficient, as it is highly likely that the good will end up with a participant that does not value it the most.

In this context, the articles by McAfee & McMillan (1992) and Aoyagi (2003) propose some changes in this scheme to make it more efficient. The first one uses cash transfers between the bidders, in effect arranging for a side auction, and the second, working with two-bidder auctions, arranges for a phase in the scheme in which the loser from the preceding phase has a higher expected payoff.

Skrzypacz & Hopenhayn (2004a, b) describe an asymptotically efficient collusion scheme which requires neither transfers nor communication between the participants of the ring, except for the existence of a public random mechanism. This scheme reduces expected payment, at the same time that it guarantees that the winner's valuation and the highest valuation are relatively close.

However, all of these cartel mechanisms require that the auctioneer announces, at the very least, the identity of the winners of the past auctions. Such an announcement may not always be made, such as in military procurement, art sales or even at the Brazilian Central Bank foreign exchange currency auctions. The question that arises, therefore, is: Is it possible to construct a collusion scheme on the absence of any information?

Harrington & Skrzypacz (2010) will also be useful in this work, as they look into cartels in oligopolies in which each company's sales are not observable (which is an idea similar to the auctioneer not announcing the winner in an auction). With some restrictions on the distribution function that determines the size of the market, they find a sustainable collusion scheme with the firms doing

likelihood tests on the sum of the firms' announced sales. For this scheme to work, the authors make use of monetary transfers between the firms.

The objective of this work is to demonstrate the sustainability and the asymptotic efficiency of a cartel on the absence of public information. For this purpose, we allow for participants to communicate (and establish a communication equilibrium, as found in Myerson (1986)), even though it is not necessary that their messages be truthful (which is assumed when the auctioneer makes an announcement).