Empirical analysis of cartels

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1 Introduction

Empirical analysis of collusion and cartels is mostly about

1. Detecting cartels and

2. Estimating cartel damages

Sometimes also testing collusion theory

The purpose of collusion is to increase firms' profits by restricting competition in some manner

Firm profits when markets are competitive are lower than when in oligopoly (e.g. Cournot) which are lower than in monopoly

Increase in all active firms' profits due to collusion is smaller than decrease in consumer welfare (and the welfare of potential entrants and their employees)

This deadweight loss is the case for regulation

Collusion may or may not be an equilibrium (Prisoner's dilemma type situation)

Cartels can coordinate actions on

market entry (extensive margin)

prices or bids (intensive margin, most of of literature)

quotas and other types of consumer allocation

Sustainable cartel must be able to detect deviation and punish from deviation. Cartel must also manage to increase profits at low cost and low risk of getting detected

e.g. "We will meet any price out there" -strategies will help to detect deviation

Theoretical and empirical analysis of sustainability useful when trying to fight cartels

Empirical tools may be preventive simply because they increase risks and because avoiding some cartel tests may reduce cartel profits. Note FCCA new policy of statistical screening for public procurement cartels

1.1 Factors that make cartels more sustainable

Stable (inelastic) demand, steady growth

Homogeneous product

Small number of firms in the market

Barriers to entry

Simple market definion

Simple cartel operations (e.g. agree only on price or entry)

Public price information (e.g. public procurement)

Natural places to communicate

Cross-ownership (meetings, reduce incentives to cheat)

Simple ways to share the profits (subcontracting, cross firm purchases)

Sequential actions as opposed to simultaneous actions (in auctions). Or regular purchases

Multi-market contact

Weak buyer power (may be good have the labour union if also firms decide on salaries together)

Symmetric firms

Example: De Beers diamond cartel

Owns many mines. Controls diamond trade through CSO (80% of world trade)

CSO provides expertise, price stability (stocks), advertizing

1981 Zaire announced started to sell diamonds directly without CSO

CSO (probably) retaliates by flooding the market (prices drop 40%)

1983 Zaire renews contract on worse terms

2 Law

Cartels are or have been either legal or illegal over time and countries

In Finland, legal until late 80s

Currently in EU and US:

Implicit (tacit) collusion is legal, because involves no explicit arrangement. "We all opened the umbrellas because it rained"

Explicit collusion (cartel) is illegal, because involves a criminal conspiracy and deliberate action

Some cartels are agreed to be legal. e.g. labour unions and industry associations, US export

Cartels have a long history and likely to be many out there. e.g. Hyytinen, Steen Toivanen (2012) show that 90% of Finnish manufacturing was cartellized at end of the legal period

Frequency likely to vary across countries and depend on current and past institutions. Hard to study because we only observe cartels that got caught

Lots of examples of court cases: Vitamin and elevator cartels in EU (790 and 830 million euro fines), Finnish asphalt cartel case (fines 83 me), Trucks in EU (3.8 billion)

Penalties

Cartel fines (administrative court). These should fine the deadweight loss and be harsh enough to be preventive. Beckerian view: Fine at least extra profits*probability of discovery. Newer results: Too large fines may increase existing cartel stability

Cartel damages ("normal" court). Comes on top of fines. Direct damage to customers (consumers or other firms)

Jail sentences etc. (in US)

2.1 How to prevent cartels ex-ante

Optimal fines (and perhaps prison sentences) and strict enough laws

Resources for competition authority and more efficient targeting of resources with help of statistics

Prohibit price or auction target announcements and other forms of information exchange

Auction and market design

Leniency programs

2.2 How to prevent cartels ex-post?

Competition authority, surprise raids

Resources for competition authority and more efficient targeting of resources with help of statistics

Leniency programs. Cartel member who confesses will not pay fines. However, may have to pay damages!

Leniency may deter cartels from forming and help to detect some existing ones

Success hard to evaluate on current field data (may see more convictions because larger share detected from same pool or same share from larger pool)

Lack of theory so far of on how damage claims interacts with leniency

3 Statistical detection of cartels

1. Detective work i.e. hard evidence (phone taps, meeting notes, stamps, hand writing...)

2. Leniency

3. Market data and statistical analysis:

a) Find markets suspect to cartel based on market characteristics

b) Find behavioral evidence of cartel

3. can be used to guide efforts at 1.

Suspicion and evidence may arise because of buyer complaints, current or former firm employees confessions or suspicions, competitor complaints, mergers and acquisitions

As in crime in general, perhaps the best criminals do not get caught, this is an issue also for statistical tools

Unclear whether frequency of cartels is low or high. Discovered cartels only a small share of activity

3 a) may be useful if high frequency of cartels, but not if most market with suspect characteristics do not have a cartel

Harrington (2006) surveys earlier statistical tools to detect cartel (mostly in auctions) based on its behavior. We discuss mainly examples using structural auction analysis. This excludes many interesting reduced form approaches, such as recent great developments by Kei Kawai et al.

Screening tools to identify markets where collusion is suspected

Verification tools that try to provide evidence of collusive behavior

Prosecution tools that try to convince court

Typically courts need something else than regressions as evidence

Usage of tools in prosecution is limited by the econometric knowledge of judges

Typically difficult to separate tacit and explicit collusion. Objective would be to detect cartels

Some classification (use Harrington's here) of different approaches are possible:

1. Is behavior consistent with competition?

2. Is there structural break in behavior?

3. Does behavior of suspected colluding firms differ from that of competitors? (and is firms' behavior consistent with collusion/competition)

4. Does collusive model fit data better than competitive?

3.1 Is behavior consistent with competition?

Bajari and Ye (2003)

FPSB procurement auctions

Homogenous goods (they have highway maintenance)

Conditional IPV setting

Conditionally independent costs $F(c_i|z_i, \theta)$, c between 0 and 1.

Conditional on characteristics z, cost are iid

Normal FPSB AIPV equilibrium

Bids may be correlated but not after controlling for z

After controlling for z, bid are

independent and **exchangeable** due to iid

Test of independency:

Are residuals from regression of bids on observables correlated

Test of exchangeability:

Are parameters the same?

This test can screen which firms may be colluding. This is complementary to approaches that require info on what firms to suspect

Problems of the test:

Not robust to unobserved heterogeneity

May fail to detect cartel even if all is observed. This happens if firms proportionally scale their competitive bids

3.2 Structural breaks

Look for formation or demise of a cartel

Discrete change in pricing

Price-costs, variance in price, relative prices, average prices

Need data also on a competitive period

Screening device

Need prior information on what could be the time of the structural break

Meetings, leniency info, out-of-sample statistical evidence

Problem: Are there confounding simultaneous treatments (e.g. entry, exit or merger dissolves the cartel). This has effect on the competitive benchmark as well. However, some measures may not be affected by the confounding treatment, e.g. competition effect parameter

3.3 Does behavior of suspected colluding firms differ from that of competitors?

If a cartel group and a competitive control is available, may get more power to tests

Some of these tests can be used without prior info

Control group: Prior info on identitities, e.g. Prosecuted firms vs. not-prosecuted firms. Also spatially or temporally different group can be used as the control

Porter and Zona 1993

FPSB

Reduced form $log(b_{it}) = \alpha_t + \beta X_{it} + \epsilon_{it}$

Five asphalt firms form the candidate cartel based on prior sentences

Other firms compete

Minor test: Estimate model separately for these groups and show that different

Main test

Likelihood of observed ranking of bids is multinomial logit

$$\mathsf{Pr}(b_{r_1 t} < ... < b_{r_{n_i} t}) = \Pi_{i=1}^{n_t} \frac{e^{\beta Z_{r_i t}}}{\sum_{j=i}^{n_t} e^{\beta Z_{r_j t}}}$$

Model can be estimated for any subset of bids. Likelihood ratio test if coefficients are the same for different subsamples

low rank: $\prod_t^T \frac{e^{\beta Z_{r_1} t}}{\sum_{j=i}^{n_t} e^{\beta Z_{r_j} t}}$

other ranks: $\prod_t^T \prod_{i=2}^{n_t} \frac{e^{\beta Z_{r_i} t}}{\sum_{j=i}^{n_t} e^{\beta Z_{r_j} t}}$

H_0: Competition: Estimated coefficients are the same for all subsets (low rank, high rank, all ranks)

H_0 rejected for the cartel group but not for the control group

Consistent with collusion where designated winner bids based on costs, but others submit phony bids that only have to be higher. Then low rank and high rank bids differ

Can be conducted also without the competitive benchmark but has more persuasive power when use prior info

Main gain from prior info: robust to most unobserved heterogeneity

Porter and Zona 1999

Prior info used but not necessary

School milk cartel. Detailed data

Reduced form regression on entry and bidding

Test 1: Estimate model assuming they are the same for all firms and assuming they differ between 1 cartel member and the rest. Should not differ if compete

Find: Cartel members' bids are defined by a different process which is consistent with collusion and other firms bid are consistent with competition

Test 2: Entry model. Are error terms correlated?

Test 3: Are bid residuals also correlated

3.4 Does collusive model fit data better than competitive?

Horserace for fit in the data

Porter (1983) estimates a model following a Green and Porter (1984) logic

Regime switching demand and supply model for railroad grain transit

$$\log Q_t = \alpha_0 + \alpha_1 \log P_t + \alpha_2 \text{LAKES}_t + \epsilon_1$$

$$\log P_t = \beta_0 + \beta_1 \log Q_t + \beta_2 S_t + \beta_3 I_t + \epsilon_2$$

S is entry, exit and mergers in the cartel. I is regime shifter that is estimated.
I is iid over time and estimated as probability of collusive phase

Ellison (1994) estimates as I Markov process that may depend on observables

Finds persistence in I

Support for Green and Porter (1984) model, because find regime switches

Baldwin, Marshall, Richard (1997)

Collusion with side payments

Timber auctions

Ascending auctions, CIPV

They allow for multi-unit setting, here we look at single object case

Most efficient cartel member submits a bid

If cartel members do not contain 2 highest valuations, price is second-order statistic

If cartel members contains k highest valuations, price is k+1 -order statistic

Under collusion, price is mixture of these order statistics, under competition 2-order

Estimate these two models using ML and compare fit

Problem: collusion may not be only reason why 2-order has worse fit

Banerji and Meenakshi 2004

Ascending asymmetric IPV auctions for wheat

Prior info on three bidders

Allow them to draw valuations from different F than competitive firms

Compare collusive and competitive structural models in terms of fit

Competitive model: Winning bid is the second-order statistic of all bidders

Collusive model: Winning bid is the second-order statistic of 1 collusive bidder and all competitive bidders

BM find collusive models fit data better in various dimensions

Note that collusive estimation requires assumption of particular form of collusion, here bid rotation. This is often the case with the structural approach

Bajari and Ye (2003), the structural part

Their reduced form test found firms 2 and 4 and firms 2 and 5 suspect of colluding

Compare cartel 24, cartel 25 and no-cartel cases

Bayesian method

Step 1: Estimate actual mark-ups

Step 2: Specify (arbitrary) prior distribution over competing models

Step 3: Estimate likelihood of observing actual mark-ups given model

Step 4: Use Bayes rule derive posterior distributions

Estimate actual mark-ups separately for each compared model

Assume each cartel maximises joint profits

Structural auction estimation then gives the mark-ups

asymmetric IPV

Estimate likelihood by comparing actual estimated mark-ups to engineer estimates

Take engineer estimate of mark-up distribution

Take random draw from this for each bidder and auction and infer the individual costs

Regress cost on observables

Use this and the model to calculate likelihood of set of costs

Compare to expected likelihood from actual mark-ups

Relying on engineer estimates both useful and problematic

Experts much have useful info

But their opinions may be also biased by the cartel. Moreover may be bad at predicting extremes

4 Estimating cartel damages

Damages can be divided into three parts (see e.g. Verboeven 2009)

Price overcharge

Pass-on effect

Output effect

Typically focus on first, but recent court examples on latter two

Pass-on decreases damages, other two increase

4.1 Price overcharge

Many approaches to get the "but for" price:

Financial analysis, rules-of-thumb (typically bad ideas)

Dummy variable approach

Yardstick approach

Prediction model approach

Structural estimation

From welfare perspective, important to include also non-cartel members overcharge

4.1.1 Dummy variable approach

Before-during-after comparison

Use regression to make markets (e.g. different auctions) comparable on observables

The coefficient for the cartel period dummy will tell the damage (counterfactual)

Potential problem both with over- or underfitting because cartel dummy not randomized

Underfitting leads to omitted variable bias but with overfitting the effect can be hidden to control variables

4.1.2 Yardstick approach

Compare the cartel to similar markets where no cartel during the same period

Can combine with dummy variable approach (time series) to get DID

Often not easy to find valid cross-sectional control group

4.1.3 Prediction model approach

Run regression only on the competitive period

Then predict the competitive price for the cartel period (covariates may vary between periods)

Calculate the damage as difference

Can use statistical model selection criteria in the competitive period to avoid cherry-picking, but

Needs more data than the dummy variable approach. In practice, often more unstable analysis

4.1.4 Structural estimation, Asker 2010

Detailed data on cartel operations

Stamp dealer cartel

Cartel had an own knock-out auction that determined winner and side-payments

Asymmetric bidders (some in the cartel only for side payments)

Knock-out stage leads to inefficiences and also losses for the non-cartel firms (in addition to seller)

Estimate structural auction model using GPV logic (but different mechanism)

Ring members have incentive to bid higher in knock-out than their true valuation (side payments increase in bids)

Contol for unobservables (as in Krasnokutskaya 2011)

With valuation estimates, can calculate damages, efficiency costs and returns to cartel

Knock-out incentives lead to seller sometimes benefitting from the cartel even after accounting for competition effect.

This reduces total damages by 50% compared to naive estimate where true valuations revealed in knock-out

4.2 Pass-on effect

Cartel produces intermeadiate goods

Purchasers can potentially pass-on some of the increase in price to their customer

This reduces cartel damages suffered by the typical plaintiff

Depends on the competition in the market where plaintiff in the seller

With monopoly or firm-specific cost increase and high competition, no pass-on

With high competition and industry level cost shock, high pass-on

With market concentration and industry level shock, medium pass-on

4.3 Output effect

Sales that are lost due to pass-on

These are damages

Even with high pass-on, may still suffer high damages

Depends on the price-elasticity of demand