Measuring the Effectiveness of Anti-Cartel Interventions: A Conceptual Framework

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Our Contribution

• Provide a conceptual framework (a model of birth and death of cartels) which captures the effects that various dimensions of CA enforcement actions against cartels have on:
  – Disrupting cartel activity in those industries where cartels form
    \( \rightarrow \) Direct Effect
  – Deterring cartels from forming in certain industries
    \( \rightarrow \) Indirect Deterrence Effect
  – Price set by cartels that do form
    \( \rightarrow \) Indirect Price Effect

• Show how to measure both Total and Marginal effects on welfare
  (presentation concentrates on total effects)

• Show how to decompose both Effects into 3 components: Direct Effect + 2 Indirect Effects

• Calibrate model and provide illustrative calculations
Key Insights

• Strong Complementarities at work:
  – between different intervention activities
  – between Direct Effect and Indirect Deterrence Effect

• The Total Effect (TE) of CA interventions can be very substantial

• The TE is substantial relative to the direct effect that CAs measure

• The direct effect that CAs measure – which we call Observable Direct Effect – may mis-measure (sometimes significantly) the true Direct Effect

• When penalties are based on revenue the Indirect Price Effect MAY be negative.
Related Literature

• Harrington and Chang (2009, 2015):
  – Use models of birth and death of cartels to examine cartel behavior (pricing / stability) and the impact of leniency
  – But do not provide a framework that integrates Direct and two Indirect Effects. Smaller range of policy interventions.

  – Similar objectives (general framework integrating direct and indirect effects and estimation of cartel harm, applicable to wide range of interventions)
  – Very different approach – Monte Carlo methods
  – NO model of cartel behavior: No Indirect price effects, No Marginal effects

• Katsoulacos, Motchenkova, Ulph (2015-IJIO)
  – Extend repeated oligopoly framework to allow for simultaneous analysis of cartel stability and pricing. Compare the impact of different penalty regimes
  – Here we extend this model to allow death and (re)birth of cartels and for CA actions that may disrupt (block) cartel activities
The Framework: intervention parameters

Three intervention parameters:

– $\beta$, $0 \leq \beta < 1$: probability of detection and prosecution in any period
  • Resources put into detection and prosecution (inspections, evidence collection)

– $\gamma$, $0 \leq \gamma \leq 1$: probability that, in period after prosecution, industry will be competitive
  • Preventing re-emergence of cartels following the successful prosecutions (imprisonments, closer monitoring after detection, behavioral remedies)

– $\chi$, $0 \leq \chi < 1$: probability that if industry is competitive at start of a period it is competitive at start of next period.
  • Long-term interventions (sustained monitoring in previously prosecuted industries)

– Note: because of these disruptive activities of CA, industries in which cartels occur will oscillate between periods of cartelization and periods of competition

Fourth parameter:

– $\rho$: penalty rate (define $\tau = \beta \rho$ as toughness of penalty regime)
Empirical Evidence on Re-emerging Cartels

– Connor (2010, 2015) claims recidivism is rampant and has grown to around 20%;

– Werden et. al. (2011) say that no evidence that it is a serious problem in USA, and cartels come to an end after prosecution.

– Ormosi (2014) shows that in the year after prosecution, 75% of prosecuted firms are no longer likely to be caught in collusive activity, but that this figure drops to 10% in the long run.
Basic Set Up of Model

• Infinitely repeated oligopoly game with antitrust enforcement (grim-trigger strategies):
  – CA sets the penalty regime: the penalty base $B(p)$, the penalty rate $\rho$, and resources devoted to pursuing and monitoring cartels (i.e. $\beta, \gamma$, and $\chi$)
  – Knowing all of this firms decide whether or not they can successfully form a stable cartel (i.e. one that is immune to defections) and what price, $p$, the cartel will set. Cartel price $p$ is a strategic variable that maximizes cartel’s profit given the CA actions.

• Range of industries, which differ in number of firms, $n$

• In each industry $n$ symmetric firms compete in prices

• Homogeneous product, demand $Q(p)$; firms within industry have identical constant MC, $c$; Repeated Bertrand Competition.

• Per-period industry/cartel profits: $\pi(p) = (p - c)Q(p)$

• Discount rate: $\delta$, $0 < \delta < 1$
Implications of Disruptive CA Activities

Expected profits from being in cartel:

\[ V^{CART} = \sigma \left[ \frac{\pi(p) - \tau B(p)}{1 - \delta} \right] \]

\[ \sigma = \frac{1}{1 + \frac{\beta \gamma \delta}{1 - \delta \chi}}, \quad 0 < \sigma \leq 1 \]

Expected cartel profits if cartels live for ever

Fraction of cartel profits that remains despite of disruptive CA activities.

Implications:

• The smaller is \( \sigma \) the stronger is the *Direct Effect* of interventions

• If \( \beta = 0 \) (i.e. there is no CA) or if \( \gamma = 0 \) (i.e. CA interventions did not stop cartel activity (at least temporarily)), then \( \sigma = 1 \)

• If \( \sigma < 1 \), then \( \sigma \) is a strictly decreasing function of all 3 intervention parameters \( \beta, \gamma, \chi \).

  Note also that \( \sigma \) is not affected by \( \rho, B(p) \).

• Strong Complementarity: The more you undertake two of the intervention activities the greater is the percentage reduction in \( \sigma \) brought about by increasing the third.
Cartel behaviour: pricing and stability

1. Cartel Price:
   \[ p^C(\tau) = \arg \max_{p \geq c} V^{CART}(p) = \arg \max_{p \geq c} \left[ \pi(p) - \tau B(p) \right] \]
   • Key Result: \( p^C(\tau) \) is a decreasing function of \( \tau = \beta \rho \), if \( p^C(\tau) \)
     is below monopoly price \( p^M = p^C(0) \).
     \( p^C(\tau) \) is an increasing function of \( \tau = \beta \rho \), if \( p^C(\tau) \)
     is above monopoly price \( p^M = p^C(0) \).
   • Note: cartel price is unaffected by intervention parameters \( \gamma \) and \( \chi \).

2. Cartel Stability / Deterrence:
   • Stable cartels exist if intrinsic difficulty of holding cartel together (derived from ICC - cartel stability condition) is smaller than certain threshold, \( \underline{\Delta} \leq \bar{\Delta} \)
     \[
     \bar{\Delta} = \sigma \cdot \Delta^0(\tau) \quad \text{and} \quad \Delta^0(\tau) = \frac{\pi(p^C) - \tau B(p^C)}{\pi^D(p^C)}
     \]
   • So \( \bar{\Delta} \) is fraction of industries in which cartels are still stable in the presence of CA
     (i.e. undeterred cartels).
     Hence, \( 1 - \bar{\Delta} \) gives the magnitude of Indirect Deterrence Effect
   • Note: strong complementarity with Direct Effect
   • All 4 intervention parameters affect \( \bar{\Delta} \) (reduce \( \bar{\Delta} \)) and, hence, improve deterrence.
Welfare/Consumer Surplus

- Harm = Extent to which consumer surplus below that under competition $CS(c)$
- Loss of consumer surplus when a cartel exists is:
  \[ CS(c) - CS(p^c) > 0 \]

- Harm only arises:
  - (i) In those industries where cartels have not been deterred;
  - (ii) For these industries, in those periods for which cartel activity has not been impeded (blocked).

- So the harm actually suffered in the economy is
  \[ H = \sigma \Delta \left[ CS(c) - CS(p^c) \right] \]

- Potential Harm – harm that would have existed had there been no CA is
  \[ H^0 = \left[ CS(c) - CS(p^M) \right] \]
Harm Actually Suffered, $H$

Loss of Consumer Surplus

$CS(c) - CS(p^c)$

Deterred Harm

Impeded Harm

Suffered Harm $H$

Fraction of Benchmark Industries
Potential Harm, $H^0$

Loss of Consumer Surplus

$CS(c) - CS\left( p^M \right)$

Fraction of Benchmark Industries
Total Effect, \( TE = H^0 - H \)

Potential Harm - \( H^0 \), Harm Actually Suffered - \( H \), Total Effect = \( H^0 - H \)

\[
TE = \left\{ \Delta(1-\sigma) \left[ CS(c) - CS\left( p^C \right) \right] \right\} + \left\{ (1-\Delta) \left[ CS(c) - CS\left( p^C \right) \right] \right\} + \left\{ CS\left( p^C \right) - CS\left( p^M \right) \right\}
\]

- Direct Effect (DE)
- Indirect Deterrence Effect (IDE)
- Indirect Price Effect (IPE)
Two Performance Measures

1. One measure of performance is 
   how much of the Potential Harm a CA removes: \( \frac{TE}{H^0} \)

2. But CAs also interested in:
   by how much can they scale up their measured Direct Effect – i.e. their \( ODE \) – to get a measure of the Total impact of CA activity relative to \( ODE \):

   \[
   \frac{TE}{ODE} = \frac{DE}{ODE} \left(1 + R_{IDE} + R_{IPE}\right)
   \]

   Ratios of Indirect Effects to Direct Effect

   • Direct Effect (\( DE \)) depends on \( \sigma \) – very hard for CAs to measure
   • What they can/do measure is \( ODE \) (i.e. number of cartels they shut down multiplied by resulting gain in surplus).
   • So Observable Direct Effect (\( ODE \)) is \( ODE = \beta \gamma \Lambda \left[ CS(c) - CS\left(p^C\right) \right] \)
Calibration

• Assume penalties based on Revenue and penalty rate 10% i.e. $\rho = 0.1$
• Discount Factor: $\delta = 0.9$
• Demand Function: $Q(p) = 1 + \varepsilon - p$; $R(p) = p(1 + \varepsilon - p)$
• Inverse price elasticity: $\varepsilon = 0.6, 0.8, 1.0$
• Probability of
  – detection: $\beta = 0.1, 0.2, 0.3$
  – CA closes cartels down: $\gamma = 1.0, 0.8$
  – CA maintaining competition: $\chi = 0.1, 0.5, 0.9$
How much of the Potential Harm a CA removes? $\frac{TE}{H^0}$

<table>
<thead>
<tr>
<th>$\chi$</th>
<th>$\gamma$</th>
<th>1</th>
<th>0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>0.9</td>
<td></td>
<td>0.551</td>
<td>0.750</td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td>0.282</td>
<td>0.464</td>
</tr>
<tr>
<td>0.1</td>
<td></td>
<td>0.194</td>
<td>0.341</td>
</tr>
</tbody>
</table>

Relates to Davies and Ormosi (2014), who also show (using Monte Carlo methods) that a CA can remove between 55 and 87% of all potential harm depending on the efforts devoted to detection and prosecution.
Measure of the Total impact of CA activity relative to Observable Direct Effect: \( TE/ODE \)

<table>
<thead>
<tr>
<th>( \chi )</th>
<th>( \gamma )</th>
<th>1</th>
<th>0.8</th>
<th>0.9</th>
<th>0.5</th>
<th>0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \beta )</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>0.9</td>
<td>8.345</td>
<td>7.717</td>
<td>7.417</td>
<td>8.656</td>
<td>8.059</td>
<td>7.751</td>
</tr>
<tr>
<td>0.5</td>
<td>3.374</td>
<td>3.357</td>
<td>3.176</td>
<td>3.482</td>
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</tr>
<tr>
<td>0.1</td>
<td>2.193</td>
<td>2.157</td>
<td>2.141</td>
<td>2.270</td>
<td>2.265</td>
<td>2.252</td>
</tr>
</tbody>
</table>

The \( TE \) is substantial relative to the direct effect that CAs measure
Ratio of the Deterrence Effect to the Direct Effect: 
\[ RIDE = \frac{IDE}{DE} \]

<table>
<thead>
<tr>
<th>( \chi )</th>
<th>( \gamma )</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
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</tr>
<tr>
<td>0.9</td>
<td>1.638</td>
<td>2.244</td>
<td>2.898</td>
<td>1.560</td>
<td>2.061</td>
<td>2.601</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>1.462</td>
<td>1.729</td>
<td>2.014</td>
<td>1.483</td>
<td>1.715</td>
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<tr>
<td>0.1</td>
<td>1.540</td>
<td>1.739</td>
<td>1.951</td>
<td>1.612</td>
<td>1.789</td>
<td>1.982</td>
<td></td>
</tr>
</tbody>
</table>

Relates to Dierx and Ilzkovitz (2016):
- provide an overview of different methods to measure the deterrence effect
- provide an estimate of the ratio of the Deterred Harm to the Detected Harm (which can be appr. by \( IDE/DE \) (range 1.5-3) or by \( IDE/ODE \) (range 1.5-6) in our model)
  - However, their estimate is substantially higher than ours.

On the other hand, Dierx and Ilzkovitz (2016) also confirm that
- deterrence effect cannot be a simple multiple of the direct effect
  It is in line with the implications of our table above: deterrence effect is indeed bigger than direct effect, but the difference depends on the size of intervention parameters and is non-linear in those parameters
Ratio of the Deterrence Effect to the Observable Direct Effect: *IDE/ODE*
Equivalent to Deterred Harm/Detected Harm in Dierx et al. (2016)

<table>
<thead>
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<th>( \gamma )</th>
<th>1</th>
<th>0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>0.9</td>
<td>5,258</td>
<td>5,453</td>
<td>5,671</td>
</tr>
<tr>
<td>0.5</td>
<td>2,061</td>
<td>2,135</td>
<td>2,209</td>
</tr>
<tr>
<td>0.1</td>
<td>1,386</td>
<td>1,435</td>
<td>1,489</td>
</tr>
</tbody>
</table>
Ratio of the Indirect Price Effect to the Direct Effect: \( RIPE = IPE/DE \)

<table>
<thead>
<tr>
<th>( \chi )</th>
<th>( \gamma )</th>
<th>( \beta )</th>
<th>( 1 )</th>
<th>( 0.8 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>-0.039</td>
<td>-0.068</td>
<td>-0.107</td>
<td>-0.042</td>
</tr>
<tr>
<td>0.5</td>
<td>-0.070</td>
<td>-0.092</td>
<td>-0.118</td>
<td>-0.082</td>
</tr>
<tr>
<td>0.1</td>
<td>-0.103</td>
<td>-0.124</td>
<td>-0.147</td>
<td>-0.125</td>
</tr>
</tbody>
</table>

When penalties are based on revenue the *Indirect Price Effect* MAY be negative.
The direct effect that CAs measure – which we call *Observable Direct Effect* – may mis-measure (sometimes significantly) the true *Direct Effect*.
Conclusions

• Important for academics and CAs to recognise
  – there are different effects of anti-cartel interventions
    • Direct effects - relatively easy to measure
    • Indirect (Deterrence / Price) effects – measuring is problematic
  – there are different dimensions of interventions:
    • More than just detection and prosecution
    • Post-prosecution efforts to keep industries competitive can be the most powerful form of intervention

• Need more research into identifying and quantifying these different dimensions and effects, in particular (Indirect) *Deterrence Effect*. 