Post-Cartel Pricing during Litigation

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Abstract

This paper is a non-technical summary of Harrington (2004). Standard methods for calculating antitrust damages in price-fixing cases are shown to create a strategic incentive for firms to price excessively high during the post-cartel phase which causes an overestimate of the but for price and an underestimate of the level of damages. The extent to which damages are underestimated is greater, the longer the cartel was in place and the more concentrated is the industry.

1   Some Methods for Estimating the But For Price

Consider a cartel that has been caught colluding. According to standard U.S. antitrust practice, the damages associated with firms colluding in period t are calculated according to the following formula:

$$Q^c(t) \times (P^c(t) - P^{bf}(t)), \tag{1}$$

where $P^c(t)$ is the observed (collusive) price, $Q^c(t)$ is the number of units sold (at the collusive price), and $P^{bf}(t)$ is the "but for" price; that is, the price that would have been charged *but for collusion*. The difference between the factual price and the counterfactual price, $P^c(t) - P^{bf}(t)$, is the "overcharge" attributed to the cartel. Two crucial elements to the calculation of damages are identifying the periods during which firms were colluding and obtaining an estimate of the but for price. This paper will consider the latter challenge by describing a previously unrecognized bias associated with standard methods for estimating the but for price.

One set of methods for estimating the but for price is based on using data from a time or market for which competition, not collusion, was prevailing:

> [A class of approaches] use data from sources that are external to the infringement to estimate the counterfactual. Broadly, this can be done in three different ways: by cross-sectional comparisons (comparing different geographic or product markets, also referred to as the yardstick or benchmark approach); time-series comparisons (analysing prices before, during, and/or after an infringement); and combining the above two in difference-in-differences models (e.g., analysing the change in price for a cartelised market over time, and comparing that against the change in price in a non-cartelised market over the same time period).[1]

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[1] Oxera (2009) , p.44.

Our focus here is on the use of time-series data for estimating the counterfactual price, which is used with both the time-series and difference-in-differences approaches. With these methods, firms' prices during the conspiracy period ...

> ... can be compared with (1) a competitive period prior to the beginning of such activity; (2) a period within the collusive period [during which collusion broke down]; or (3) a period after the termination of the conspiracy. ... More commonly used is the post conspiracy period, since the ending of the conspiracy is usually a fairly dramatic event.[2]

As just mentioned, using data from the post-cartel phase is partly due to the greater difficulty associated with identifying the birth of a cartel than its death. Most cartels desist meeting and communicating once an investigation has been announced. (Though there is the concern of explicit collusion being replaced with tacit collusion.) Another reason is that, when the cartel had been in effect for many years, it may be difficult to obtain reliable and relevant data from the pre-cartel phase.

The simplest time-series approach to estimating the but for price is to calculate the average price charged outside of the conspiracy, using data from the pre- and post-cartel phases. The overcharge is then the difference between the actual price charged during the cartel phase and the average price outside of the cartel phase:

> [In *Ohio Valley Electric Corp v. General Electric Co.*, plaintiffs who purchased steam turbine generators] proposed to measure damages by the difference between the average 11% discount [off of list price] during the conspiracy period and the average 25.33% discount that prevailed after the conspiracy had been terminated.[3]

> [For an Austrian driving school cartel, the] Bundesarbeitskammer argued that the loss suffered by customers could be quantified as the 22% difference between the price charged by the driving schools during the two months of

[2] Finkelstein and Levenbach (1983), pp. 161-2.
[3] Finkelstein and Levenbach (1983), p. 145.

the cartel's duration ... and the lower price once the cartel had ended (based
on an average price calculated at that time).[4]

The use of averages implicitly attributes all differences in price - between the cartel phase
and the pre- and post-cartel phases - to collusion. As other factors that influence price -
such as cost and demand shifters - could have changed between these phases, a more
common approach to estimating the but for price is to use regression analysis.[5] A
regression model specifies a set of factors that are believed to determine price and a
relationship between those factors and price. A common specification is a linear
relationship:

$$P(t) = \delta + \beta_1 X_1(t) + \cdots + \beta_m X_m(t) + \varepsilon(t) \tag{2}$$

where $P(t)$ is price, $X_1(t)$, ..., $X_m(t)$ are the factors that influence price, $\varepsilon(t)$ is the
residual which measures that part of observed price which is not explained by the factors
in the regression, and δ, β_1, ..., β_m are unknown parameters which are to be estimated. For
example, factors taken account of to explain vitamins prices included the prices of raw
materials (such as ammonia, hydrochloric acid, methanol, sugar, etc.), a wage index for
chemical industry workers, and U.S. dollar exchange rates, as companies manufactured
outside of the U.S. and then sold in the U.S. (Bernheim, 2002).

With data on factors $X_1(t)$, ..., $X_m(t)$ and price $P(t)$, (2) is estimated using data from
outside of the cartel phase. Estimates for the unknown parameter values δ, β_1, ..., β_m are
derived which results in the estimated equation that best explains the observed prices. Let
the estimated equation be denoted

$$\hat{\delta} + \hat{\beta}_1 X_1(t) + \cdots + \hat{\beta}_m X_m(t) \tag{3}$$

where $\hat{\delta}$, $\hat{\beta}_1$, ..., $\hat{\beta}_m$ are the parameter estimates. By inserting values for $X_1(t)$, ..., $X_m(t)$
for period t from the cartel phase, an estimate of the but for price for period t is derived.
The estimated overcharge for period t is then

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[4] Oxera (2009), p. 53.

[5] See, for example, Fisher (1980), Finkelstein and Levenbach (1983), and Page (1996)

$$P(t) - (\hat{\delta} + \hat{\beta}_1 X_1(t) + \cdots + \hat{\beta}_m X_m(t)); \tag{4}$$

that is, the difference between the observed price and the predicted competitive price based on the observed factors.[6]

In implementing this approach for the vitamins case, Bernheim (2002) used pre-cartel data and, depending on the vitamins market, post-cartel data as well. In markets with three or more suppliers, post-cartel data were used after excluding the first 12 months on the grounds that there may be a transition from collusion to competition. However, recognizing the pragmatism that must be exercised as a result of data availability, only the first three months of post-cartel data were excluded for choline chloride due to the lack of much data outside of the cartel phase. For markets with two suppliers, post-cartel data were not used because of concerns that firms may have still been colluding through tacit means.

A related regression approach estimates the but for price using data over the entire time period, including the cartel phase as well as the pre- and/or post-cartel phases. The equation to be estimated is now

$$P(t) = \delta + \beta_1 X_1(t) + \cdots + \beta_m X_m(t) + \gamma D(t) + \varepsilon(t) \tag{5}$$

which differs from (2) only by the indicator or dummy variable $D(t)$. $D(t)$ equals one for cartel periods and zero for non-cartel periods. The appeal to including data from the cartel phase and estimating (5) is that the additional data allows for more precise estimates of how the m factors determine price. The variable $D(t)$ seeks to take account of the price equation being different during the cartel. With this specification, the implicit assumption is that collusion causes price to be higher by some fixed amount γ in each period, and how much higher is unrelated to these other factors. The estimated but for price for period t

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[6] An alternative, though not often-used, approach is to estimate (2) using only data *during* the cartel period. The estimates are then used to project what prices would have been during the pre-cartel and/or post-cartel phases if collusion had continued. The difference between those projected prices and the actual prices are then used as an estimate of the overcharge during the cartel period. Thus, the counterfactual is not competition during the cartel phase but rather collusion during the competition phase. This method was deployed by an expert witness for the plaintiffs in the corrugated container industry; see Breit and Elzinga (1986).

during the cartel phase is of the form in (3), though the estimated parameter values would be different due to the inclusion of additional data. The overcharge could be measured by (4) or, alternatively, the estimated value for γ since it measures how much higher price is during the cartel phase, after controlling for the other factors thought to determine price.

The preceding approach was used to estimate the but for price for a Canadian petrol station cartel in Sherbrooke, Quebec, though it deploys the difference-in-differences method rather than the time-series approach (Erutku and Hildebrand, 2010). In explaining the Sherbrooke retail petrol price, the empirical model controlled for lagged wholesale petrol prices (the primary cost component), seasonal factors (e.g., demand is stronger during the summer), and other factors by taking account of the retail petrol price in Montreal (where there was no evidence of collusion); any cost or demand factor that impacts both the Sherbrooke and Montreal markets will then be taken account of by including the Montreal price. Data was available during the cartel phase and the post-cartel phase, with the demarcation between the two phases being defined by the date at which the Competition Bureau announced its investigation. The authors found that the post-cartel price in Sherbrooke was lower by 1.75 cents per litre compared to the retail price in Montreal. That is, controlling for cost and other relevant factors, the Sherbrooke price was lower by 1.75 cents per litre in the post-cartel phase compared to the cartel phase, relative to the price change in the Montreal market. This provided an estimate of the overcharge.

The preceding examples all estimated the but for price using price data from the post-cartel phase. As is well-recognized, this approach runs a risk of overestimating the but for price if, in fact, firms continue to collude tacitly after the cartel has been dismantled. However, in some cases, that concern can be dispensed with some confidence, perhaps because there are too many firms for tacit collusion to be credible or that monitoring of compliance required direct communication or that an observed drop in price or an increase in price dispersion across firms is inconsistent with tacit collusion. For those cases, an expert economist will probably be inclined to use post-cartel price data since it will allow for a more precisely estimated but for price.

This paper presents, in non-technical terms, the formal theoretical argument in Harrington (2004) which shows that, even if firms are legitimately competing in the post-cartel phase,

the estimated but for price may still be biased and that damages will be underestimated when post-cartel price data is being used in the estimation.

2   Bias in the Estimated But For Price

The analysis begins with having identified three regimes: pre-cartel, cartel, and post-cartel. The accuracy with which cartel birth and death has been determined is unimportant for the argument to be made. The post-cartel phase is the period between the presumed dissolution of the cartel (for example, the public announcement of an investigation into price-fixing) and the conclusion of litigation. While the main result will hold if the but for price is estimated using regression analysis, it will be easier to express if instead it is assumed the estimated but for price is a weighted average of prices during the pre-cartel and post-cartel phases. All that matters for our conclusion is that the but for price is estimated using a data set that includes post-cartel price data.

If P^{pre} is the average pre-cartel price, P^{post} is the average post-cartel price, and α is the weight given to the pre-cartel prices (where $0 \leq \alpha \leq 1$), the estimated but for price, P^{bf}, is

$$P^{bf} = \alpha \times P^{pre} + (1 - \alpha) \times P^{post} \qquad (6)$$

α is a choice variable of the expert economist, though the choice is constrained by the circumstances. If the post-cartel phase is shorter in length then α will tend to be closer to one, as more weight will be given to pre-cartel prices because there are more pre-cartel than post-cartel observations. If the cartel phase is longer - so that pre-cartel data is older and thus less available, reliable, or relevant - then α will tend to be closer to zero, as more weight is given to more recent (post-cartel) observations. Given (6), estimated damages in period t of the cartel phase are equal to:

$$Q^c(t) \times (P^c(t) - \alpha \times P^{pre} - (1 - \alpha) \times P^{post}) \qquad (7)$$

where $P^c(t)$ is the observed price and $Q^c(t)$ is the number of units sold at $P^c(t)$. Summing these damages over the periods during the cartel phase, total estimated damages can be represented as

$$Q^c \times (P^c - \alpha \times P^{pre} - (1 - \alpha) \times P^{post}) \tag{8}$$

where Q^c is the total number of units sold during the cartel phase and P^c is the weighted average price during the cartel phase (where the weight attached to $P^c(t)$ is $Q^c(t)/Q^c$, that is, the share of Q^c sold in period t).[7]

Suppose firms believe that damages will be calculated according to (8). Given that firms are assumed to not be colluding, let us initially suppose that, during the post-cartel phase, each firm chooses a price to maximize its current profit. If all firms do that - and each correctly anticipates what the other firms will charge - the resulting price observed in the post-cartel phase will be the competitive price, which is the true but for price. Such a situation is depicted in Figure 1, with the post-cartel prices represented by the series of *'s (the +'s can be ignored for the moment). Note that post-cartel prices are generated by the same process as prevailed prior to the formation of the cartel. The estimated but for price is P_1^{bf} which is the average of the pre-cartel and post-cartel prices.[8] In this scenario, the resulting estimate of the overcharge is $P^c - P_1^{bf}$ and damages are calculated to be $Q^c \times (P^c - P_1^{bf})$. The penalty to a firm would then be $\lambda \times Q^c \times (P^c - P_1^{bf})$ where λ is the damage multiple. In the United States, $\lambda = 3$ (treble damages) by law but that applies only if the case is settled in court. A very high fraction of cases are settled out of court and it appears that single damages are common (Lande, 1993). In "White Paper on Damages Actions for Breach of the EC Antitrust Rules" (April 2008), the European Commission recommended single damages with the intent of damages being compensatory but not

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[7] Assume the cartel phase is composed of periods t', $t' + 1$, ..., $t'' - 1$, t'' and $Q^c = \sum_{\tau=t'}^{t''} Q^c(\tau)$ denotes total volume during the cartel phase. Estimated damages are

$$\sum_{t=t'}^{t''} Q^c(t) \times (P^c(t) - P^{bf}) = \sum_{t=t'}^{t''} Q^c \left(\frac{Q^c(t)}{Q^c}\right) \times P^c(t) - \sum_{t=t'}^{t''} Q^c(t) \times P^{bf}$$
$$= Q^c \times \sum_{t=t'}^{t''} \left(\frac{Q^c(t)}{Q^c}\right) \times P^c(t) - Q^c \times P^{bf}$$
$$= Q^c \times P^c - Q^c \times P^{bf} = Q^c \times (P^c - P^{bf})$$

[8] In Figure 1, it is assumed α equals the ratio of the number of pre-cartel observations to the sum of pre-cartel and post-cartel observations. However, all that is important is that $\alpha < 1$ so that P_1^{bf} depends on the post-cartel price observations. Those observations could be given more or less weight than the pre-cartel observations, or some of those observations could be given zero weight (such as the post-cartel prices immediately after the demise of the cartel).

punitive.

The preceding calculation of damages was predicated on former cartel members not colluding and choosing the competitive price. Now consider a firm setting a price in excess of the competitive price during the post-cartel phase. In Figure 1, this is represented by the post-cartel price series denoted by +'s. As these prices exceed that which maximizes profit coming from the product market, there is a cost in terms of foregone profit which comes from selling fewer units (e.g., losing demand to rival firms). However, because the average post-cartel price is higher, the estimated but for price is higher as well and now equals P_2^{bf}. As a result, the overcharge is reduced from $P^c - P_1^{bf}$ to $P^c - P_2^{bf}$ and damages have declined to $Q^c \times (P^c - P_2^{bf})$. While these higher post-cartel prices produce fewer sales and lower profit, the firm is benefitted by the reduction in damages it can expect to pay. All firms will have an incentive to price above the competitive price in order to bias upwards the estimate of the but for price. This also means that the foregone profit from an individual firm raising price is reduced - as its rivals have also raised prices in which case fewer sales are lost - which makes a firm yet more inclined to raise price.

> *Result: If post-cartel prices are part of the data set used to estimate the but for price then firms will price above the competitive price in the post-cartel phase. As a result, the but for price is overestimated and damages are underestimated.*

The logic behind this result is simple. A firm's prices during the post-cartel regime form part of the data set that is used to estimate the but for price. By pricing above the competitive level, a firm introduces an upward bias into the estimation of the but for price which serves to reduce the estimated overcharge and lower estimated damages. Of critical importance is that this strategic pricing effect does not require firms to still be colluding. Competition when litigation is on-going results in prices that exceed true competitive prices.

The preceding analysis implicitly assumed that the weight given to pre-cartel prices, α, was fixed. In practice, it could well depend on post-cartel prices. If those prices are high

then an expert economist may be less inclined to include them under the presumption that firms might still be colluding, which is the approach taken in Bernheim (2002) for the vitamins case. If the use of post-cartel price data is endogenous to post-cartel prices then there will still be bias in the estimate of the but for price but the effect will be a bit more complex. A firm that prices higher in the post-cartel phase will raise the estimated but for price by raising the average post-cartel price but will lower the estimated but for price by reducing the weight placed on post-cartel price data (assuming that the average post-cartel price exceeds the average pre-cartel price, which would be expected if firms were competing prior to cartel formation). While the magnitude of the price distortion is changed, it remains present. Thus, the but for price will still be overestimated.

Having identified a post-cartel pricing distortion that biases estimated damages, it is important to understand when this distortion - and the resulting bias - can be expected to be of greater concern. To address that issue, one needs to examine the calculus determining a firm's price in the post-cartel phase. Recall that pricing higher in the post-cartel phase benefits a firm by raising the estimated but for price and lowering damages, but it harms a firm by lowering its current profit through a reduction in its sales. Thus, how much a firm is willing to raise price depends on how much damages decline and how much current profit falls. The latter is standard and well-understood so our discussion will focus on the former.

Consider setting a higher average post-cartel price of P_2^{post} rather than P_1^{post} so that the but for price is higher at

$$\alpha \times P^{pre} + (1 - \alpha) \times P_2^{post}$$

compared to

$$\alpha \times P^{pre} + (1 - \alpha) \times P_1^{post}$$

Damages are lower by an amount

$$Q^c \times (P^c - P_1^{bf}) - Q^c \times (P^c - P_2^{bf})$$

$$= Q^c \times (P_2^{bf} - P_1^{bf})$$

$$= Q^c \times (\alpha \times P^{pre} + (1-\alpha) \times P_2^{post} - \alpha \times P^{pre} - (1-\alpha) \times P_1^{post})$$

$$= Q^c \times (1-\alpha) \times (P_2^{post} - P_1^{post})$$

$Q^c \times (1-\alpha) \times (P_2^{post} - P_1^{post})$ is then the gain - in terms of reduced damages - from pricing higher in the post-cartel phase by an amount $P_2^{post} - P_1^{post}$. The bigger is this gain, the more attractive it is to distort price upward so as to bias the estimated but for price. This gain is bigger when the total supply during the cartel phase, Q^c, is bigger. For example, longer cartel duration will increase Q^c and thus result in a larger upward distortion in post-cartel price (and thus generate greater underestimation of damages) because more is at stake in terms of damages. That is, a firm is willing to suffer from lower current profit (due to a high price) in order to reduce the estimated overcharge. If more weight is given to post-cartel prices, $1 - \alpha$, then damages will be more underestimated because a firm's post-cartel price is having more influence in determining the estimated but for price. Again, longer cartel duration will result in post-cartel data being more important because pre-cartel data is older and thus less likely to be available.

> Result: The longer is cartel duration, the more biased is the estimate of the
> but for price and the more that damages are underestimated.

Another relevant factor is market structure. When there are more firms, an individual firm's price during the litigation phase has less of an effect on the estimated but for price since it depends on the post-cartel prices of all firms. In other words, the pricing data collected from one firm is less influential in the estimation of the but for price. The gain that an individual firm experiences from raising its post-cartel profit is then smaller - since it has less of an impact on the estimated but for price - which means it will not raise the post-cartel price as much.

> Result: The fewer firms there are in the industry, the more biased is the
> estimate of the but for price and the more that damages are underestimated.

3 Considerations in the Choice of the Data Set

Since the bias in the estimated but for price is due to using price data from the post-cartel phase, an obvious solution is to exclude such data and rely exclusively on pre-cartel data. While pre-cartel data is not subject to strategic manipulation, it does suffer from several weaknesses compared to post-cartel data. First, pre-cartel data is older and thus is less likely to yield accurate estimates of damages in the later years of the cartel. Compounding this problem is that older data is more likely to be incomplete. Studies of cartels find that average cartel duration is in the range of 4-8 years and that 12-37% of cartels (depending on the study) had a duration in excess of ten years (Levenstein and Suslow, 2006). Thus, in some instances, the age of the pre-cartel data can be a serious problem if one is forced to rely exclusively on it. A second problem is that it is more difficult to identify when the cartel started than when it ended. If one presumes that the beginning of an investigation caused collusion to stop then the beginning of the post-cartel period may be relatively easy to identify. However, the end of the pre-cartel period is typically not so straightforward. For suppose that evidence of meetings (memos, testimony, etc.) is used to date the start of the cartel. If there is such evidence in a given year then the firms almost certainly colluded in that year while the absence of such evidence may be due to firms not colluding but could also be due to such evidence being lost or destroyed. There is then a tendency to include some cartel periods as part of the pre-cartel regime and this results in an overestimate of the but for price.

Another potential bias from using pre-cartel data is that cartel formation may have been preceded by an *abnormally* intense bout of competition. Consider, by way of example, the citric acid cartel (Connor, 2001). Prices fell from about 80 cents per pound to 60 cents in the 18 months prior to the beginning of the conspiracy and then increased back up to 80 cents in the ensuing 18 months. This pricing pattern suggests that firms cartelized in response to unusually aggressive pricing. This, of course, raises the question of the source of this intensification of competition which is pertinent for assessing whether it is, in some sense, atypical and thus inappropriate for calculating the but for price. One possibility is that some dynamic forces are causing price competition to be more intense in the short-run. For example, a permanent downward shift in demand may require exit by a firm which then induces a war of attrition as each firm waits for one of the other firms to exit.

In the short-run, there are too many firms which means that the observed price is below its normal competitive level given the current state of demand. Furthermore, some firms may price low with the explicit intent to induce another firm to exit. Another possibility is that, prior to cartel formation, the industry was characterized by tacit collusion which was then destabilized due to, for example, a shift in demand with a subsequent price war. In these cases, using pre-cartel price data would then provide an underestimate of the but for price. While it is natural to presume that the absence of a cartel would have led to a continued period of low prices, if these prices were due to abnormally intense competition then one would expect, on average, for the intensity of competition to subside and return to normal levels. This suggests that the pre-cartel prices might be below average competitive prices.

Rather than simply discard post-cartel price data, an alternative approach is to establish a set of criteria for determining whether to use them. It is critical, however, that the criteria be well-accepted by the economics community. The primary concern is that a plaintiff's expert will tend to dismiss post-cartel price data as being unrepresentative of the but for world when post-cartel prices are not much lower than cartel prices. But such an approach would lead to an underestimate of the but for price because, systematically, low price data are being included and high price data are being excluded. One statistical approach that would justify the exclusion of post-cartel price data is to test whether there is a structural break in the price-generating process at the time of the purported death of the cartel; that is, there is evidence that firms are pricing differently after, say, the announcement of an investigation compared to before it. If there is no such break found - which is evidence supportive of firms pricing in the post-cartel phase as they did in the cartel phase - this is consistent with collusion continuing, either explicitly or tacitly. The post-cartel data should not be used in that case. However, evidence in support of a break does not imply that post-cartel price data should be used. If firms are not colluding but are strategically propping up price for the reasons expressed in this paper then there would be a structural break but prices would still exceed the competitive level. How exactly to judge whether that data should be used is a topic requiring investigation.

4 Concluding Remarks

The time-series or "before and after" approach for estimating the but for price is potentially biased when it uses post-cartel price data. Even if firms are no longer colluding, post-cartel price data is distorted above the competitive level by the machinations of the price-fixing defendants during the litigation phase. Their intent is to cause an upward bias of the estimated but for price which then results in an underestimate of the overcharge and estimated damages below the true level of damages. The degree to which damages are underestimated is likely to be greater when the cartel was in place for a longer period of time and the industry is more concentrated.

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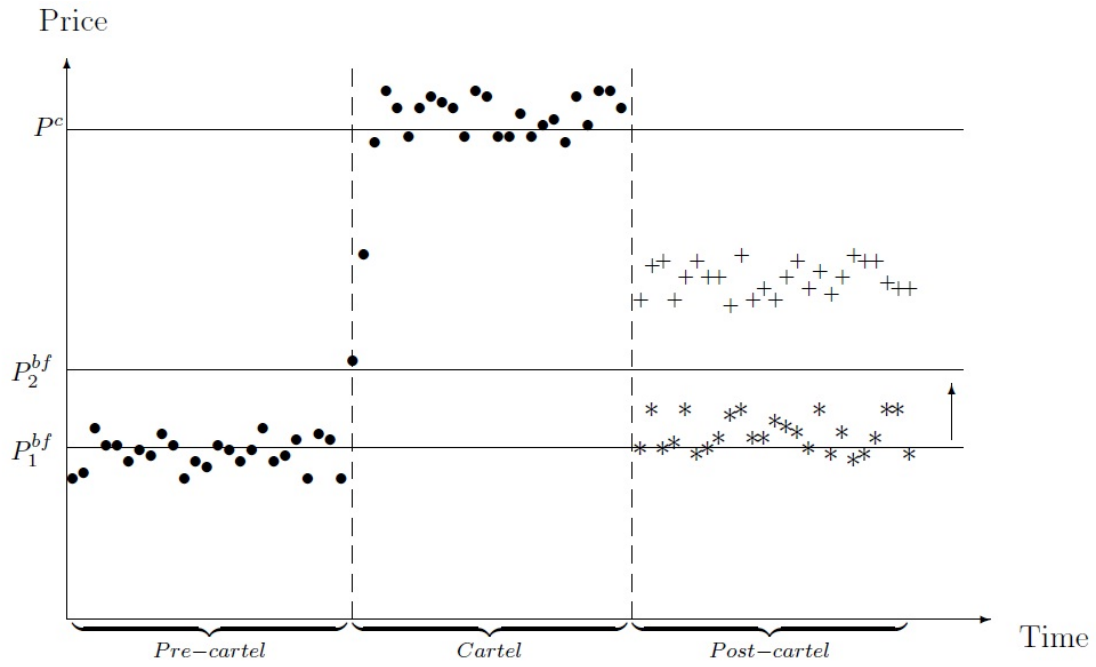[11] Page, W. H. (ed.), *Proving Antitrust Damages*, Chicago: American Bar Association, 1996.

Figure 1