Oxera

Agenda

Advancing economics in business

Hide and seek: the effective use of cartel screens

Hardcore cartels seek to increase profits at the expense of their consumers by deviating from competitive behaviour, while avoiding detection and punishment. Econometric screens, if designed well, can be a useful tool in detecting such deviations from competitive patterns, and can thereby help to improve cartel enforcement. Moreover, they can reduce the extent to which cartels are able to covertly restrict competition

Hardcore cartels seem to have become more sophisticated in recent decades and no longer exhibit their coordination as openly as perhaps they once did. For example, nowadays competition authorities and savvy purchasing managers are quick to catch firms that attempt collusion by submitting several identical sealed bids, a practice that often went unnoticed in the 1940s and 1950s.[1]

Hardcore cartel behaviour may have become more difficult to detect because colluding firms have started to imitate competitive patterns. However, cartels want to deviate from fully competitive behaviour, and competition authorities may need to undertake more sophisticated analysis to identify collusive activity. To complicate matters further, not all cases of information exchange, price manipulation and unlawful agreements really constitute what might be considered a hardcore cartel, as they may have little impact on prices and other market outcomes. Econometric cartel screens can provide a useful tool to help competition authorities and private practitioners concentrate their resources effectively on those behaviours that are likely to have affected market outcomes.

One example of a case where screening detected a form of price manipulation (although not cartel price-fixing behaviour) is the case of the London Interbank Offered Rate (LIBOR). It was found that the LIBOR may have been subject to coordination between banks for many years, potentially going back to the 1990s. The *Wall Street Journal* reported in 2008[2] that the banks involved had been keeping the LIBOR at an artificially low level. These claims were followed by studies in the same year, which used various techniques to examine the pattern of LIBOR formation. They found that the volatility of the rate was suspiciously low over some periods, and that bids were surprisingly uniform.[3] Furthermore, the distribution of second digits of the LIBOR over time was inconsistent with what is known as Benford's law.[4] This law predicts that, for many datasets from real-life sources, the second digits will be almost uniformly distributed, which was found not to be the case for either the LIBOR or individual bank quotes.[5]

The use of screens

Econometric screens can be used for a wide range of purposes and by different parties. In particular, competition authorities can use screens to filter candidates for further investigation (for example, in cases of a suspected breach of Article 101 TfEU) or to support the initial steps of proceedings. Once a sector has been found to be a potential candidate, screens may be used to identify possible participants in collusive agreements, and to estimate the starting point of the infringement. Screens can also help firms to improve their corporate governance and find out about potentially infringing behaviour. Firms which suspect that they are affected by anti-competitive behaviour may also use screens to collate evidence and potentially file a complaint.

If screens are implemented effectively, hardcore cartels should find it difficult to remain undetected, especially if the firms involved do not want, or are unable, to adapt. Assuming that firms make a rational decision about cartel participation based on profits, the probability of detection and potential fines, cartel participation should become less attractive from the outset. Cartels would thus be less likely to form, or to remain stable if already in operation. If firms are willing to adapt, they would have to try harder to be less openly anti-competitive. This, in turn, means that firms would have less discretion when setting parameters such as price,

quantity and market shares. Since they have to follow competitive patterns more closely, it is plausible that the outcome would be closer to a competitive one than in a world without screening. Effectively, more widespread use of screens may reduce both the number of hardcore cartels and the harm that they can cause when they do exist.

However, none of the screens currently applied will be able to determine precisely whether a cartel is present in an industry. Similarly, a negative test cannot be taken as unambiguous evidence that there is no cartel present. Econometric screening provides only an indication of where the most obvious patterns occur, and further analysis may therefore be required—screens cannot replace a more detailed understanding of the industry-specific dynamics that may explain why a market appears collusive or coordinated in the absence of actual anti-competitive behaviour, or vice versa. Such reasons might include technology shifts or market exits. Tacit collusion, although not illegal per se, may also lead to similar patterns to explicit collusion.

Screen types

Econometric screens can be used to search for collusive patterns, often called 'markers', in market data, such as prices, quantities, market shares or costs. These screens can take various forms. One is to test for structural breaks in prices, price–cost margins or other variables over time. However, this assumes that an industry has already been identified as suspicious and that a break is likely to occur within a certain period. When taking a broader view, current data across firms and industries may provide the best starting point. Many collusive markers have emerged in the literature that may distinguish a collusive industry from a competitive one—for example, higher correlation of prices (including bids), higher stability of market shares, and lower price–cost correlation under collusion. Many markers rely on hypotheses on prices.

Price screens

Used both in academic research and by competition authorities, there are two reasons why price screens are a suitable area of investigation. First, if a cartel is effective, it is likely to have an effect on price in some way—either as the direct target variable of the firms or as the means to another objective (such as stabilising market share). Second, national price data is often readily available, sometimes even at a more disaggregated level—for example, by firm or by region. It can therefore serve as a good basis for more complex tests. Even if only an aggregated time series is available, various hypotheses can be tested by exploiting different properties based on, for example, different statistical moments[6] of the data.

First-moment collusive marker: high prices

The most straightforward marker of collusive behaviour is a higher average price. If the colluding firms want to increase prices above the competitive price in order to raise profits, they would ideally set the monopoly price and share the monopoly profits. Many other factors also have a considerable influence on price levels, including input costs and demand. This makes it difficult to isolate a potential cartel effect from these factors without knowing whether and when a cartel arrangement was in place. Overcharge analyses in investigations or litigation cases are often able to estimate such an effect only on the basis of specific dates and a variety of industry-specific information about the influence of other relevant factors such as costs. Hence, despite being theoretically well-founded, it may not be an effective approach to screen average prices in different periods.

Second-moment collusive marker: stable prices

Another characteristic of price data is its volatility over time. Common measures are variance (the sum of the squared distance of each data point from the mean), the standard deviation (the square root of the variance), and the coefficient of variation (obtained by dividing the standard deviation by the mean).[7]

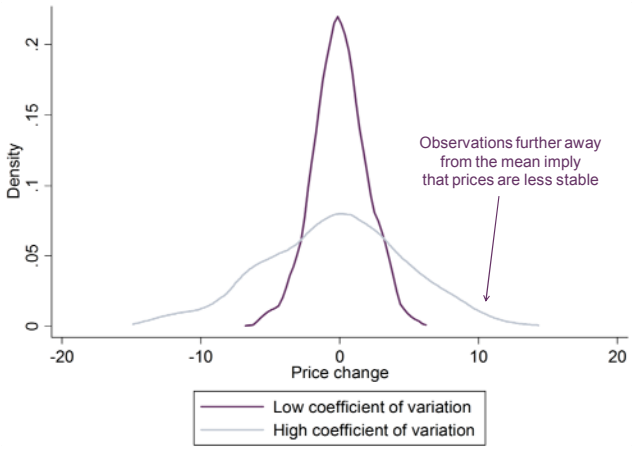
Volatility is likely to be lower in the presence of a cartel, as firms seek to coordinate prices. Doing so frequently is costly, since they have to communicate and avoid price moves that attract the attention of authorities. Various theoretical models underpin the result that there will be lower variance in a collusive equilibrium, and empirical studies have found various cartels to be characterised by low price variance.[8] Consequently, prices that are unusually stable may help to identify industries with anti-competitive behaviour and therefore provide a suitable foundation for econometric screening. Other potential explanations for low price volatility might be a drop in the variance of input costs, or reduced volatility of demand.

The coefficient of variation of a time series can also be visualised using price change distribution, which serves as the base of the following markers. Figure 1 overleaf shows two price change distributions that may be associated with the same average price, but which have different coefficients of variation.

Third-moment collusive marker: price rises

It is also possible to look at the distribution of price changes to screen for potential cartel behaviour. Skewness indicates which tail of a distribution is longer or fatter—a more pronounced tail (ie, more 'extreme' values on the right-hand side) is positive skewness; while skewness of zero indicates symmetry. For example, the number of minutes by which a plane arrives before/after its scheduled time is likely to be

Figure 1 Price change distributions with different coefficients of variation



Source: Oxera.

positively skewed, since planes can be (and sometimes are) very late, but are not often very early.

The reasoning for a difference in skewness between competitive and collusive markets is that cartels prefer positive price changes, as these allow them to adjust to positive demand shocks and raise their expected profit. Adjusting to negative demand shocks may be misunderstood as cheating (eg, lowering prices to steal market shares) and has more adverse effects, so cartels may avoid it.[9] Accordingly, a screen can test whether the right-hand tail of the distribution is fatter and/or longer, meaning that price rises are more likely than price cuts, and hence skewness is higher than expected. As with the variance screen, very specific underlying cost or demand functions could also affect the price change distribution; however, by looking at the third moment, levels and changes in levels are not reflected.

Figure 2 below shows a price change distribution with high positive skewness, in comparison with a less skewed distribution that has an identical mean and coefficient of variation.

Fourth-moment collusive marker: zero or large, but not medium

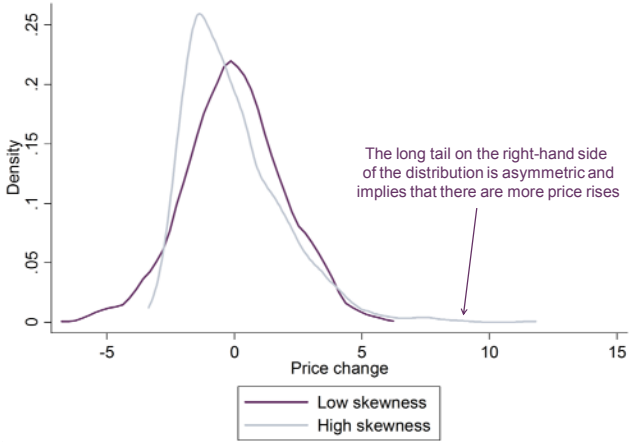
Another measure of the shape of the price change distribution is its kurtosis—ie, the 'peakedness' and the 'heaviness' of the tails. This measure provides an indication of where in the distribution the variance is coming from: the 'peak' (near the mean), the 'tails' (far from the mean), or somewhere in between. The more pronounced the peak, and the higher the number of observations further away from the median, the higher the kurtosis.

Collusive price change distributions are likely to have a higher kurtosis because non-zero price changes occur with a lower frequency—but where they do occur, the changes are in larger steps than the many small price adjustments under competition. This means that a screen for the kurtosis of price change distributions may help to detect patterns that are not expected in a competitive market.

Two price change distributions with the same mean, coefficient of variation and skewness, but different kurtosis, are plotted in Figure 3.

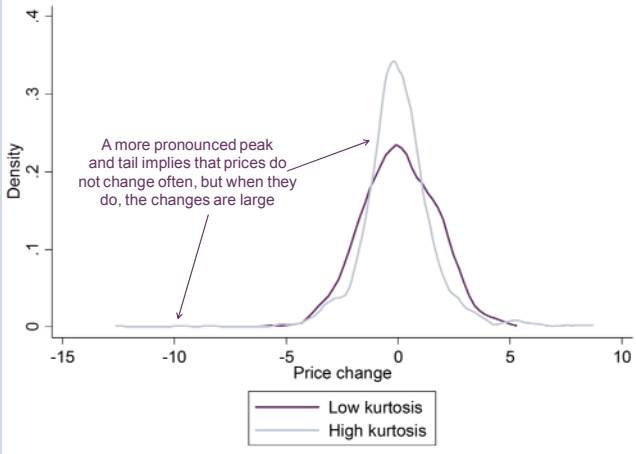
If a price series has some or all of these collusive markers, it may warrant greater attention from an authority. Looking back, many known cartels fit the markers well. One example is the cartel in synthetic rubbers that was active between May 1996 and November 2002.[10] Figure 4 overleaf plots the price change distribution for both the cartel period and the adjacent non-cartel period (January–April 1995 and December 2002–July 2009). The coefficient of variation

Figure 2 Price change distributions with different skewness



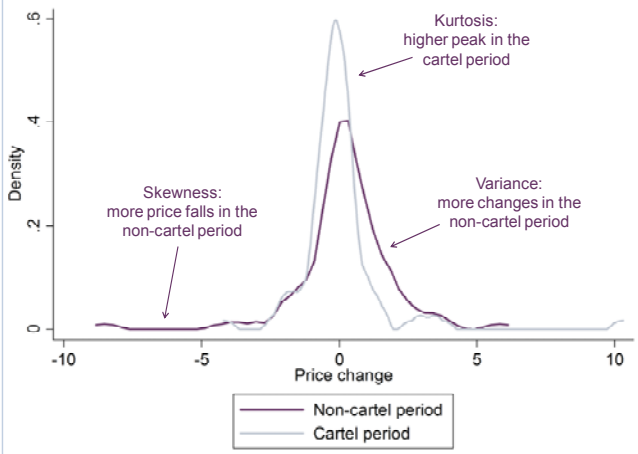
Source: Oxera.

Figure 3 Price change distributions with different kurtosis



Source: Oxera.

Figure 4 Price change distributions of the synthetic rubbers cartel



Source: Oxera replication of analysis by Blanckenburg et al. (2012), op. cit., based on German Federal Statistical Office data.

is almost twice as high in the non-cartel period, while skewness and kurtosis are lower. This is confirmed by both the statistics and visual examination: the cartel price change distribution has a higher peak and takes on values that are not far to the left, but much more to the right than the non-cartel price change distribution.

Benchmarking

The effectiveness of a screen depends on the extent to which it distinguishes between collusive and competitive patterns. This is not as easy as in the case of the synthetic rubbers cartel, where the start and end points are known. A screen thus requires benchmarks for either collusive or competitive patterns in order to test whether the time series in question looks 'more' competitive or collusive than a benchmark series.

This means that obtaining values for the markers of the relevant time series is just the first step. The markers then require an appropriate reference point of collusive or competitive behaviour to enable their results to be interpreted. No absolute reference point can be used because the dynamics differs between industries and produces different patterns.

This implies that screening needs to involve a certain case-specific benchmark in order to determine whether the result obtained is significantly above or below another one. The benchmark could be obtained as follows.

- **Before and during**—price data for the same market but from an earlier time can serve as a reference point, assuming that data is available from an earlier period that is believed to be non-collusive.
- **Other locations**—data can be used from other geographic areas that are likely to constitute a separate market but may share general dynamics. For example, heavy commodities that are rarely transported long distances, such as ready-mixed concrete, can be analysed in this way. See the box below for an application in practice.
- **Other products**—a price series and its properties can be compared with those of other products that are in a similar industry, but are not under investigation for possible cartelisation. Alternatively, a price series from one specific industry can be compared against a large number of other industries at the same time, on the basis that it is unlikely that all the benchmark industries are subject to cartelisation.

Statistical tests, such as the Kolmogorov–Smirnov and Epps–Singleton tests,[11] can be applied to investigate whether distributions are significantly different, for example. These tests evaluate how likely it is that the difference between the distribution in question and the benchmark has not been caused by random variation—ie, is statistically significant. Such use of statistical tests may help to make screening results more objective and comparable.

Concluding remarks

Econometric screens may be useful for identifying markets that warrant greater attention, especially when only a fraction of the available data can be analysed in detail. However, they cannot replace the detailed

Example: using other locations as a benchmark

An investigation into the Dutch gasoline market used various geographic locations.[1] First, the study identified the petrol stations with the lowest price variance on the basis of firm-level price data. Then the spatial data was used to test whether the petrol stations in question formed clusters and, if so, where these clusters were located. Thus, assuming that not all regions were affected, or at least not to the same extent, a comparison was made with the same industry in the same country at the same time, which would be likely to rule out major differences in costs or demand across the price series. One cluster was found to have an especially high concentration of stations with very low variance, and the researchers concluded that further investigation might be warranted.

Note: [1] Heijnen, P., Haan, M.A. and Soetevent, A.R. (2012), 'Screening for Collusion: A Spatial Statistics Approach', *Tinbergen Institute Discussion Papers*, 12-058/1.

analysis necessary to determine, with certainty, whether a cartel is present in a particular industry. Firms involved in collusive activity, in turn, are confronted with choosing between a higher probability of detection and greater discretion in their deviation from competitive outcomes, both of which are desirable from an authority's point of view.

[1] For example, the Tennessee Valley Authority detected cartels retrospectively in 1960. See Monks, R.A.G. and Minow, N. (2011), *Corporate Governance*, John Wiley & Sons, p. 88.
[2] Mollenkamp, C. and Norman, L. (2008), 'British Bankers Group Steps Up Review of Widely Used Libor', *Wall Street Journal*, April 17th, p. C7; Mollenkamp, C. and Whitehouse, M. (2008), 'Study Casts Doubt on Key Rate', *Wall Street Journal*, May 29th, p. A1.
[3] Abrantes-Metz, R.M., Kraten, M., Metz, A.D. and Seow, G. (2012), 'LIBOR Manipulation?', *Journal of Banking and Finance*, **36**, pp. 136–50; first draft dated August 4th 2008, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1201389.
[4] Many insights are summarised under Benford's law. The most well-known is that first digits are generally not uniformly distributed; however, the following digits approach a uniform distribution very quickly. See Benford, F. (1938), 'The Law of Anomalous Numbers', *Proceedings of the American Philosophy Society,* **78**, pp. 551–72.
[5] Abrantes-Metz, R.M., Judge, G.G. and Villas-Boas, S.B. (2011), 'Tracking the Libor Rate', *Applied Economics Letters*, **18**, pp. 893–9.
[6] Statistical moments capture different properties of a distribution—ie, the mean (first moment), the variance (second moment), the skewness (third moment) and kurtosis (fourth moment).
[7] The variance reflects the levels of the price series most directly, so that a price series with prices that are double those of another will also have a variance that is twice as high. The coefficient of variation may be more suitable for comparing different time series, since it is less sensitive to price levels.
[8] Abrantes-Metz, R.M., Froeb, L.M., Geweke, J.F. and Taylor, C.T. (2006), 'A Variance Screen for Collusion', *International Journal of Industrial Organisation*, **24**, pp. 467–86.
[9] Blanckenburg, K., Geist, A. and Kholodilin, K.A. (2012), 'The Influence of Collusion on Price Changes: New Evidence from Major Cartel Cases', *German Economic Review*, **13**:3, pp. 245–56.
[10] Ibid.
[11] These tests differ in the assumptions they make about the distributions they compare. Which is the more appropriate test will therefore depend on the characteristics of the distributions.