KONKURRENSVERKET
Swedish Competition Authority

Datum
2014-01-30

Ansökan om forskningsmedel

Observera att ansökan med bilagor endast ska skickas elektroniskt till konkurrensverket@kkv.se

1 Sökande (huvudansvarig för projektet)

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3 Projektbeskrivning

Projekttitel *För att radbryta texten, använd Alt + Enter*
Measuring the effect of cartels on price

Projektet avses starta, datum
2014-09-01

Projektet beräknas vara slutfört, datum
2017-08-31

Sammanfattning av projektets syfte, betydelse och genomförande (högst 1400 tecken).
För att radbryta texten, använd Alt + Enter

Establishing the existence of a suspected cartel is important in competition work. Moreover, knowing the impact of a cartel is the basis for determining the magnitude of the damage caused by the cartel. The most commonly used approach for these purposes is to use field data and to estimate a reduced form price equation, with cost and demand shifters and a cartel dummy as explanatory variables.

While this modelling strategy is simple and intuitive, market data including a cartel has been claimed to have non-constant variance, be persistent and non-stationary. In addition, the literature has suggested that cartels are not well represented by a simple level shifts. Rather, transition periods where prices slowly move to new stationary levels/equilibriums, have been identified. This suggests that the price path is subject to (multiple) structural breaks that need to be identified from data. Moreover, it has been suggested that the cartel effect is 'unstable'.

Taken together, these specific features of cartel pricing impose very particular econometric challenges that the existing literature has not dealt with in a systematic way. The purpose of this project is to identify the effect of a cartel when data have these common characteristics. Our modelling approach will be based on a new class of models called Generalized Autoregressive Score (GAS) models that have recently been developed. In contrast to existing models, GAS has the benefit of being able to handling time varying price volatility and unstable price level(s). The project contributes to the economic literature in two ways: (i) a methodological development in that GAS models are extended to also allow for structural breaks, and (ii) the application of our new estimation procedure on simulated data and a real case.

Bifoga en utförligare projektbeskrivning (max 10 A4–sidor).

4 Kostnadsredovisning

Fyll i de ofärgade cellerna med för projektet gällande information, så uppdateras de färgade automatiskt. Ge akt på de felmeddelanden i rött som visas vid överträdelse av Konkurrensverkets riktlinjer för anslag till forskningsprojekt.

Projektår 1 Personalnamn, akademisk titel **(bifoga CV)**	Månadslön enligt KKV:s riktlinjer	Anställningstid i projektet, månader	Arbetstid i procent av heltid	Lönekostnad inkl. sociala avg.
Magnus Soderberg, Assistant Professor	34000	12	20%	120 768
Asger Lunde, Professor	55000	12	20%	195 360

Summa övriga kostnader (hämtas från tabell 4a)	50 000
Total kostnad inklusive sociala-, och förvaltningsavgifter	494 273

Projektår 2 Personalnamn, akademisk titel **(bifoga CV)**	Månadslön enligt KKV:s riktlinjer	Anställningstid i projektet, månader	Arbetstid i procent av heltid	Lönekostnad inkl. sociala avg.
Magnus Soderberg, Assistant Professor	34000	12	20%	120 768
Asger Lunde, Professor	55000	12	20%	195 360

Summa övriga kostnader (hämtas från tabell 4a)	50 000
Total kostnad inklusive sociala-, och förvaltningsavgifter	494 273

Projektår 3 Personalnamn, akademisk titel **(bifoga CV)**	Månadslön enligt KKV:s riktlinjer	Anställningstid i projektet, månader	Arbetstid i procent av heltid	Lönekostnad inkl. sociala avg.
Magnus Soderberg, Assistant Professor	34000	12	20%	120 768
Asger Lunde, Professor	55000	12	20%	195 360

Summa övriga kostnader (hämtas från tabell 4a)	50 000
Total kostnad inklusive sociala-, och förvaltningsavgifter	494 273

4a Redovisning övriga kostnader

	År 1	År 2	År 3
Material och utrustning	10 000	10 000	10 000
Resor	40 000	40 000	40 000
Övriga kostnader			
Summa	50 000	50 000	50 000

5 Kostnadssammanfattning (anges i kronor) för nu sökt anslag

Total projektkostnad

1 482 818

Därav söks från		Tidigare erhållna anslag från	
Konkurrensverket	Annan anslagsgivare *	Konkurrensverket	Annan anslagsgivare **
1 482 818 kr	None.	This is a new project	

*Anslagsgivarens namn	Ansökan inlämnad, datum	Sökt belopp

**Anslagsgivarens namn	Ansökan beviljad, datum	Beviljat belopp

6 Övriga projekt som samtidigt kommer att ledas av huvudansvarig

Projekttitel *För att radbryta texten, använd Alt + Enter*

The principal investigator is not planning to be the principal investigator of any other project during the designated time period.

Namn och institution på personer som beviljas forskningsbidrag kommer att publiceras på Konkurrensverkets webbplats.

Project title: Measuring the effect of cartels on price

Introduction

In their work to detect cartels, Competition Authorities have a natural interest in determining whether suspected colluding firms differ from competitive firms and, given that the presence of a cartel has been established, both the Authority and the court have an interest in determining the magnitude of the damage so that appropriate fines can be established. The most commonly used measurement approach to address these tasks is to rely on field data and to estimate a reduced form price equation by regressing price on cost and demand shifters and a dummy variable that takes the value 1 for the firms and time periods when the (suspected) cartel was active. If the coefficient associated with the cartel dummy is significant, then the result is consistent with the existence of a cartel and the value of the coefficient indicates the size of the damage and thus, provides a benchmark for the appropriate fine.

While this modelling strategy is simple and intuitive, there is ample evidence that it may generate misleading results. First, both economic theory and empirical studies based on field data have shown that price variability is lower during cartel periods compared to competitive periods. This suggests that standard errors will be heteroskedastic, leading to results that may suggest that a cartel was operational when in fact it was not, or vice visa. Second, price series are often subject to persistence. If persistence (or 'autocorrelation' to use the econometric terminology) is not incorporated into the model, it may also lead to wrong conclusions about the existence of the cartel. Third, price series are often non-stationary, which opens the risk of running spurious regressions that may lead to coincidental conclusions. While being a well know and well understood problem in time series econometrics it is rarely seriously accounted for in empirical work. Bolotova et al. (2008), for example, estimate a price model that includes the lagged price as an explanatory variable. The coefficient on the lagged price is 0.96. In such a situation one should not perform tests on the cartel dummy using a standard t-test approach. The approach depends on whether the autoregressive parameter is less than one, which also requires a special test. (We return to Bolotova et al., 2008, in the section where we review the literature).

In addition to these 'standard' econometric problems, the literature has suggested that cartels are not well represented by a dichotomous level shift where the price immediately jumps to a different level at the beginning and at the end of the cartel. Rather, transitions periods where prices slowly move to new stationary levels/equilibriums, have been identified in both theoretical and empirical studies. This suggests that the price path is subject to (multiple) structural breaks that need to be identified from data. The figure below shows a simple price path with start and end dates for a cartel that includes transition periods following both the start and end periods. These transitions create two structural breaks at uncertain points in time, indicated by red circles. Moreover, even when prices can be considered stationary, it has been suggested that the cartel effect is 'unstable' because of unobserved cost factors and partially delayed cost past-through.

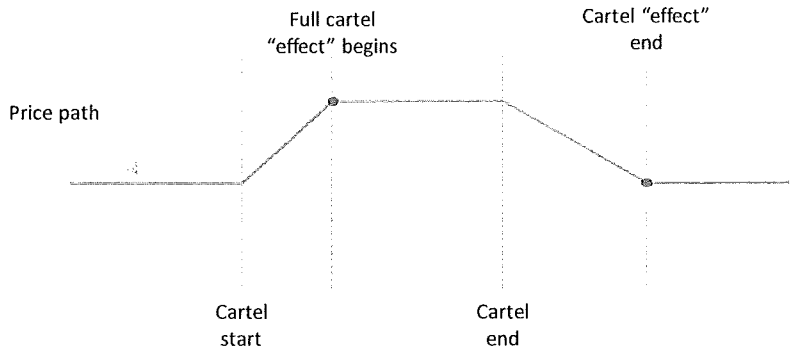

Figure. Conceptual illustration of transition periods at the beginning and at the end of a cartel that creates two structural breaks that needs to be determined from data.

Taken together, all these specific features of cartel pricing impose very particular econometric challenges that the existing literature has not dealt with in a systematic way. The over-arching research question in this project is how to identify the effect of a cartel when data have these common characteristics, i.e. when several of the standard econometric assumptions are simultaneously violated. We will consider situations when field data is available during cartel and non-cartel periods for multiple units/firms and periods (i.e. panel data). This is a common situation in many real-world situations and it is imperative that econometric estimations can provide credible results in this situation.

Our modelling approach will be based on a new class of models called Generalized Autoregressive Score (GAS) models that have recently been developed by Creal, Koopman and Lucas (2013). In contrast to existing models, GAS has the benefit of being able to handling situations with time varying price volatility and when the price level is unstable.

The project contributes to the economic literature in two ways:

(i) A distinct methodological development in that GAS models are extended to also allow for (multiple) structural breaks.
(ii) The application of our new estimation procedure on simulated data and a real case. This will show the practical value of our model over more standard models.

Next we review the relevant literature.

Literature Review

The econometric literature on the measurement of cartels, and the determination of their magnitude, is based on the idea to compare the colluding price (or when there is a suspicion of collusion) with a competitive benchmark (Harrington, 2005). In addition to the dummy variable approach described in the introduction above, this can also involve the interaction of the cartel dummy variable with the other

explanatory variables and to test if the intercept and slope parameters are jointly different during collusion and non-collusion.

The fact the standard errors in the above specification might be both heteroskedastic and autocorrelated is suggested in a number of studies. In their theoretical model Harrington and Chen (2006) assume that customers complain to Authorities when prices move in suspicious ways, i.e. when prices make relatively large jumps. This makes cartels reduce price variability relative to both competitive and monopoly markets. The implication is that cartels gradually pass cost changes to price in order to reduce anomalous price patterns that will attract the attention from customers. Athey et al (2004) argue that another reason for colluding prices being more stable is that firms are generally patient. The more patient firms are the more stable the prices will be. In bid rigging, price variability has also been claimed to be lower than in competitive markets (LaCasse, 1995). The argument is that participating firms choose losing bids randomly from a distribution of bids subject to bids not being higher than the winning collusive bid. Effectively, the cartel truncates the bidding distribution resulting in a lower variance compared to the competitive situation.

The empirical evidence generally supports this theory prediction. For example, the price variance was almost 100% lower during the Sugar cartel period in the U.S. during the 1920s-1930s (Genesove and Mullin, 2001). Abrantes-Metz el at. (2006) find that the mean price reduced by 16% and the standard deviation increased by more than 200% when the cartel collapsed.

Next, we turn to price persistence. Prices have been found to be subject to persistence in a number of contexts. In the literature, this often goes under the names 'price stickiness' and 'price rigidity'. One justification for price persistence is that of an "implicit contract" between the service provider and its customers. Okun (1981) proposed the "invisible handshake" notion that firms have "...implicit agreements with their customers not to take advantage of tight market conditions by raising their price in exchange for stable prices in weak markets" (Nakamura and Steinsson, 2011, p. 6). Blinder et al (1998) report that 64.5% of firms say they have implicit contracts with their consumers and 79% of these firms indicate that these contracts are an important source of price rigidity. The possible reasons for these implicit contracts include various forms of relationship-specific sunk investment, such as consumer switching costs (Klemperer, 1995; Eber, 1999; Kleshchelski and Vincent, 2009), good-specific habit-formation (Ravn et al., 2006; Nakamura and Steinsson, 2011), and consumer learning in the case of experience goods (Bils, 1989; Renner and Tyran, 2004; Villas-Boas, 2004). It should be emphasised that price persistence is a general phenomenon that has not been directly related to cartels. Though, it could be that the cost of changing a coordinated price is higher than a competitive price – making the price persistence higher during cartels. In either case, the autocorrelation that is likely to exist in price series must be dealt with in the econometric investigation.

Bolotova et al. (2008) is the only study we are aware that explicitly controls for both price persistence and different price variations in cartel and non-cartel periods. They use GARCH models to simultaneously estimate the effects of the cartel on the mean price and the price variance. They generally find that the cartel affects both the mean and the variance of the price, but results are not

always consistent with the expectation that the price variance is lower when the cartel was active. The authors attribute their results to limited amount of pre- and post-cartel data and a lack of control variables describing the market characteristics. However, as noted in the introductory section, Bolotova et al. (2008) do not test that some of the crucial assumptions they make are valid.

Finally, we also stress the transition periods that have been claimed to exist at the beginning and at the end of a cartel. Harrington (2004, 2006) point out that those periods are difficult to capture in empirical models and no empirical study has so far claimed to control for them.

Method

Our motivation for using GAS models have already been discussed in the introductory section. We will use both Monte Carlo experiments and real market data to evaluate our modelling approach. The GAS model(s) will be compared with existing modelling approached, such as the Smooth Transition Autoregressive (STAR) model (e.g. Tersäsvirta, 1994). In a STAR model the transition periods are modelled by a smooth flexible function that is determined by the observational data. Other natural benchmarks will be the standard GARCH and OLS.

A point worth mentioning at this stage is that while data used when evaluating cartels often has a panel structure, it is typically characterized by nonstandard panel dimensions. While most developments on the estimation of models using panel data have been made for large N (i.e. the number of units/firms in the data set) small T (i.e. number of time periods in the data set) or small N large T, the common situation in cartel cases is that we have small N and medium sized T. So inference in such cases is difficult because most developments are asymptotic approximations that are likely to be dubious when using samples with common characteristics. This needs to be further explored and that will be done as part of the Monte Carlo experiments.

Time and Personnel

The project will extend over three years and both project participants will spend 20% of their time on the project during the three years. Magnus Soderberg will be acting as project leader. Magnus is Assistant Professor of Economics at Mines ParisTech in France. Asger Lunde is the other project participant. Asger is Professor of Economics at Aarhus University in Denmark.

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