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Assessing Methods for the Quantification of Antitrust Damages. An Application to the Pasta Cartel in Italy

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ASSESSING METHODS FOR THE QUANTIFICATION OF ANTITRUST DAMAGES. AN APPLICATION TO THE PASTA CARTEL IN ITALY*

GIOVANNI NOTARO†

Abstract

This paper contributes to the on-going debate on the quantification of the damages caused by anticompetitive conduct by applying a number of empirical methods to the pasta cartel, discovered by the Italian Competition Authority in 2007. These methods include the dummy variable approach, the Dynamic Treatment Effects (DTE) method and the so-called straight line methods. The key results show that both the dummy variable and the DTE methods perform better than the straight line methods. Moreover, the latter should not be used when the underlying cost and demand drivers over the cartel period are substantially different from those prevailing before or after. The dummy variable approach and the DTE provide very similar estimates of the cartel overcharge, though there is no reason to expect that this would always be the case. Finally, this paper contributes to the on-going debate on "optimal fines" and on the benefits to society of having a proper antitrust enforcement by showing that that the fines levied by the ICA in this particular case were below "optimal" levels and that the benefits from this intervention of the ICA are roughly 7 times its annual budget.

Questo lavoro vuole contribuire al dibattito sulla quantificazione dei danni causati da comportamenti anticoncorrenziali, applicando una serie di metodi empirici al cartello dei produttori di pasta scoperto dall'Autorità Garante della Concorrenza e del Mercato nel 2007. Il contributo suggerisce che la metodologia basata sull'introduzione di una variabile dummy per il periodo del cartello e il metodo Dynamic Treatment Effects (DTE) pervengono a risultati più attendibili rispetto alla famiglia dei cosiddetti metodi "straight line". Inoltre, questi ultimi non dovrebbero essere utilizzati quando i driver di costo e la domanda nel periodo dell'intesa sono sostanzialmente diversi da quelli prevalenti prima e/o dopo. Nel caso in esame, la metodologia basata sulla variabile dummy e il metodo DTE forniscono una stima molto simile del sovrapprezzo determinato dal cartello, anche se non c'è ragione di attendersi che ciò valga nella generalità dei casi. Infine, questo lavoro contribuisce al dibattito sul livello "ottimale" delle sanzioni e sull'importanza per la collettività di avere una efficace applicazione delle norme antitrust, rilevando come, in questo caso particolare, le sanzioni comminate dall'Autorità in questo caso non sembrano in linea con la teoria "dell'optimal sanction" e come i benefici di questo (singolo) intervento dell'AGCM siano quantificabili in un ammontare pari a circa 7 volte il budget annuale dell'Autorità.

Key words: Cartel; damages; Dynamic Treatment Effects (DTE) method.

Classification JEL: L41 - Monopolization; Horizontal Anticompetitive Practices; K21 – Antitrust Law

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TABLE OF CONTENTS

1. Introduction

An increasingly topical issue in antitrust enforcement concerns the estimation of damages from anticompetitive conduct. There are several (but wholly different) reasons why this happens to be the case. First of all, the renewed efforts in the promotion of private enforcement. In Europe nowadays private enforcement is widely recognized as an important complement to public enforcement of competition laws. Clearly it requires the proper quantification of damages from infringements of antitrust laws as, for example, argued by the European Commission[1]. This consideration raises the need to «*offer assistance to courts and parties involved in actions for damages by making more widely available information relevant for quantifying harm caused by infringements of the EU antitrust rules. The Guidance Paper therefore provides insights into the harm caused by infringements of these rules to different categories of injured parties and, in particular, presents the main methods and techniques currently available to quantify such harm*»[2].

Secondly, damages' estimation is increasingly undertaken by competition authorities around the world for different reasons[3]. On the one hand, in some jurisdictions and for specific types of conduct competition authorities are required to quantify the potential or actual harm in order to prove the conduct, to calculate administrative fines, or for advocacy reasons. On the other, antitrust bodies are increasingly called, for accountability purposes, to demonstrate the benefits of their work in order to justify their costs[4]. This involves estimating the consumer savings from interventions; the damages avoided due to intervention in a given timeframe is the basis for measuring such savings. All these factors raise the issue of how, and under what circumstances, robust estimates of the damages from anticompetitive conduct can be obtained.

The economics literature provides a wide array of methods, models and techniques that can be used for the quantification of damages. These can be both theoretical and empirical. They come from diverse fields within economics and finance, in particular industrial organisation, corporate finance, and econometrics. These models and methods differ especially in terms of the key assumptions, the data requirements and the inference that can be drawn from the outputs. Methodologically, the key issue to be faced in order to properly measure the damages from anticompetitive conduct it to identify the proper counterfactual or "but-for" scenario, i.e., what would have happened to the variable(s) of interest had the anticompetitive activity not taken place. The counterfactual sets the baseline against which the effects of the actual anticompetitive conduct have to be measured. Different methods make different assumptions about the counterfactual and

[1] EUROPEAN COMMISSION, DG COMPETITION, *Draft Guidance Paper - Quantifying harm in actions for damages based on breaches of Article 101 or 102 of the Treaty*, Brussels, June 2011.

[2] According to the European Commission, «*the full effectiveness of the EU antitrust rules (Articles 101 and 102 TFEU) requires that any individual can effectively claim compensation for the harm caused by an infringement of these rules. Damages actions based on an infringement of these rules complement public enforcement by allowing those who have been harmed to receive compensation for their harm*». See p.2 of the *Draft Guidance Paper.*

[3] See OECD, *The quantification of harm to competition by national courts and competition agencies – Background Note*, Policy Roundtable, October, 2011.

[4] For instance, the UK Office of Fair Trading has a performance target agreed with HM Treasury (HMT) of delivering direct financial benefits to consumers of at least five times its cost to the taxpayer and thus systematically estimates the impact of its work. Along these lines, the Bundeskartellamt estimates that its cartel prosecution activities have over the last years brought benefits to the German consumer of € 500 to 750 million a year. See BUNDESKARTELLAMT, *Effective cartel prosecution. Benefits for the economy and consumers*, 2010.

some are more plausible than others. As it will be shown in the paper such choice is not an obvious one, and selecting a particular technique (and the related assumpions underpinning it) influences the ultimate quantification of the damages. This implies that the choice of a particular approach should be made on a sound basis, making sure that the assumptions underlying the chosen approach are justified in the case at hand.

The methods to undertake damages' estimation are usefully summarized in a number of surveys, which have been published in the last few years, such as the study done by Oxera[5] for the European Commission or that undertaken by the Bundeskartellamt[6]. What these studies generally do is to describe the types of harm caused by different types of infringements, who has been harmed by the anticompetitive conduct as well as a wide array of methods and models developed by the economics and finance literature, which could be used for the quantification of damages. For example, the Oxera report describes 15 different techniques, which can be used to undertake damage estimation, their advantages and disadvantages, the data requirements to implement them, the assumptions made (about the counterfactual) and the instances in which it would be more appropriate to use a technique instead of another.

These reports essentially survey methods and provide some form of useful handbooks for damage estimation as they describe and compare many different approaches. However, what these types of studies most often fail to convey are the consequences of choosing a technique over another and the consequences of a given choice. Instead, the advantages and shortcomings of the different methods can only be appreciated when looking in detail at a specific case. This is precisely what this paper does. More specifically, by making reference to a recent cartel in the Italian market for pasta, discovered by the Italian Competition Authority ("ICA") in 2007, this paper compares different methodologies to quantify the effects of the cartel, including the dummy variable approach, the Dynamic Treatment Effects ("DTE") and the so-called straight line methods.

In essence, we will use all the available techniques that can be applied by using publicly available information, that do not require cross-sectional comparators and that do not rely on market structure-based approaches. The first condition rules out cost based or financial approaches as we do not have access to company data to perform such calculations. Cost data are in general very difficult to obtain and even when there are disclosure powers they are subject to a high level of information asymmetry. As for the comparators' based approaches, the difficulty of identifying suitable comparators is the reason for not using methods that require cross-sectional control groups such as "Difference-in-difference". While econometrics methods can to some extent provide for controlling for some of the spuriousness on yardstick comparisons they would be in any case best placed if the chosen comparators are not too heterogeneous and provide for a good qualitative benchmark. Finally, we do not consider market structure-based approaches for the very well known difficulties in identifying models that fit the data convincingly as well as the difficulties encountered in the calibration process. Moreover, the latter methods require making a number of assumptions on the nature of competition within the market (i.e., Bertrand, Cournot, dynamic models of competition and others), the extent of the relevant market and the structure of costs; these methods can also be extremely demanding in terms of data requirements to be used to estimate the necessary parameters and to calibrate the models.

The key indication of the paper is that there are significant effects from the choice of a particular method on the scale of estimated damages and, therefore, particular care must be exerted in choosing the method to be used. This implies, as a corollary, that any choice of a particular

[5] OXERA, KOMNINOS et al, *Quantifying Antitrust Damages. Towards Non-binding Guidance for Courts*, study prepared for the European Commission, 2009.

[6] BUNDESKARTELLAMT, *Private Kartellrechtsdurchsetzung: Stand, Probleme, Perspektiven*, Discussion Paper, 2005.

technique should be made in the most possible objective way and with the aim of selecting the technique that can expected to perform best in the specific case at hand. One way of achieving this involves the following steps: i) identifying the techniques which are in principle applicable to the case at hand also assessing the available data and their quality; and ii) making explicit the reasons underlying the choice of the preferred approach. Such an approach rules out undertaking damages' estimation in specific cases by simply using historical averages on cartels' effects[7], as the degree of heterogeneity across cartels is too high for these methods to produce meaningful outcomes.

The structure of the paper is as follows. Section 2 contains a brief description of the working of the pasta cartel. Section 3 describes the data that are used in the paper. Section 4 contains the econometric specifications underlying each technique, the estimation methods and the estimates of the key parameters of interest. Section 5 compares the results obtained by using different techniques and section 6 concludes.

2. The pasta cartel in Italy

In 2007, the ICA found a cartel among the major Italian pasta producers[8]. The undertakings involved had about 76% of the Italian market for pasta. According to the ICA, the producers had coordinated their behaviour in order to increase the (list) price of pasta following a steep increase of the price of durum flour, which is a key input. Such coordination was centred on a number of meetings held by pasta producers in which attendees discussed future pricing strategies of pasta. The firms attending these meetings reached a 'broad' agreement to increase the (list) prices of pasta; on this basis, they then individually decided their pricing for pasta.

Durum flour, energy, labour and transportation costs are the key inputs necessary to produce pasta. Indeed, they accounted for 73% of the total direct costs in 2006 (54% of total costs) and for 77% (60% of total costs) in 2007. This higher cost share in 2007 was due to a significant increase in the cost share of durum flour (from 47% to 55% of total direct costs and from 54% to 60% of total costs), whose price increased substantially even before the years of the cartel as a result of higher global demand and lower supply due to adverse climatic factors, higher production of biofuel and of other cereals to feed cattle, coupled with speculative factors[9].

According to the ICA, the cartel run from October 2006 to March 2008. Over this timeframe, the price at which pasta producers sold to supermarkets increased by almost 45% (see Figure 1). Given the increase in production input prices, one would have expected prices of pasta to rise even in a perfectly competitive market[10]. It is important to remember therefore that not all the price

[7] See, among others, J. CONNOR, R. LANDE, "How High Do Cartels Raise Prices? Implications for Reform of the Antitrust Sentencing Guidelines", *American Antitrust Institute Working Paper Series*, WP No. 01-04, 2001; J. CONNOR, R. LANDE, "Cartel Overcharges and Optimal Cartel Fines", in *3 Issues in Competition Law and Policy*, ch. 88, 2203 (edited by Spencer Weber Waller, A.B.A. Section of Antitrust Law 2008); G. J. WERDEN, "The Effect of Antitrust Policy on Consumer Welfare: What Crandall and Winston Overlook", *U.S. Department of Justice Antitrust Division Discussion Papers*, Discussion Paper No. EAG 03-2, February 2003, and R. A. POSNER, *Antitrust Law*, 2nd edition, The University of Chicago Press, 2001.

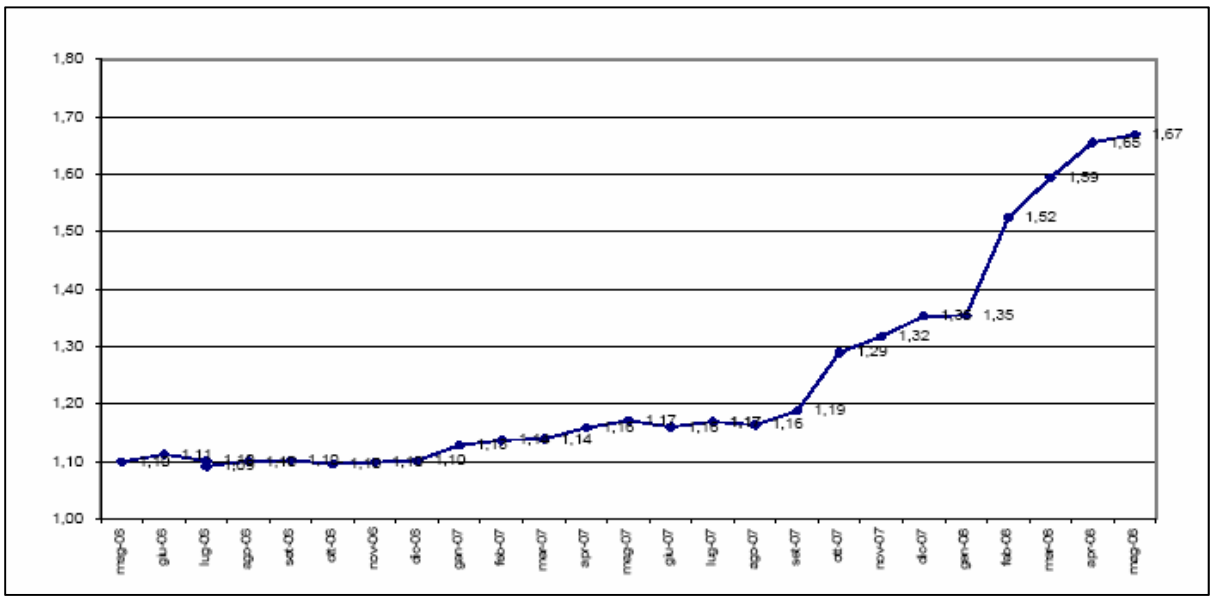
[8] See Agcm, *I694 – Listino prezzi della pasta*, provv. n. 19562, 16 March 2009, in Boll. n.8, 2009 (hereafter "ICA decision").

[9] See Agcm, *I694 – Listino prezzi della pasta*, cit., p. 17.

[10] See D. GIANGIULIO , "Meccanismi di trasmissione dei prezzi lungo la catena agro-alimentare: un esercizio di analisi sulla filiera della pasta alimentare secca", *Studi e ricerche dell'Autorità Garante della Concorrenza e del Mercato*, N.4, 2011. The author studies the value chain of pasta (wheat farmers-producers-

increase may be attributable to the cartel, but at most 'some' of it. In order to estimate the effects of the cartel, it is then necessary to disentangle the impact of the cartel on prices from that of the (increasing) production costs. The analysis carried out in Section IV does so by mean of several methods. Some of these methods are also able to take into account the fact the production costs were on the rise before and during the cartel.

FIGURE 1. The average price of pasta paid by supermarkets over the period May 2006 – May 2008



Source: Graph reproduced from ICA's decision

As background to the overprice estimation, the pasta producers were fined for €12,5m in total. The pasta decision was challenged before the Italian Administrative Court of first instance (Tribunale Amministrativo del Lazio or TAR), which upheld ICA's decision. The pasta producers further filed appeals to the Administrative Court of second Instance (Consiglio di Stato) against the ruling of the court of first instance, who upheld the ruling of the Court of first instance in its entirety.

3. The data

The data used for the analysis is drawn from several sources. The first is ISTAT's ConIstat databank[11], which provides information on producer prices for pasta and energy sold in the domestic market as well as on a number of indicators of labour costs by industry/sector[12]. We use the producer price of pasta, since this is the variable on which firms colluded. This is because the cartel was among the pasta producers and concerned the list price of pasta, i.e. the price at which pasta producers sell to retailers. The data provided by ISTAT is complemented by external data from the Datima databank, which provides information on the domestic producer price of durum wheat (frumento buono mercantile), and from the USDA, which provides information on the price of

retailers) over the period 2007-2009, finding that the gap between production costs and retail price of pasta has indeed widened over the cartel period.

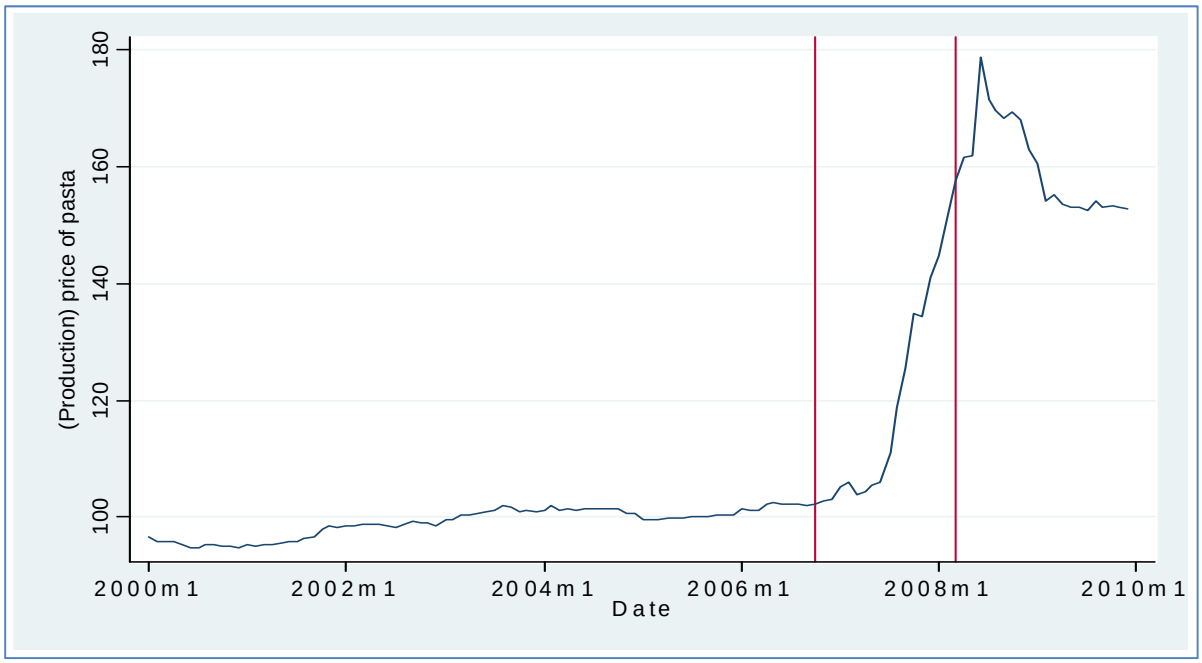
[11] ISTAT is the Italian central statistics agency.

[12] This databank is available on ISTAT's website (www.istat.it).

durum received by U.S. farmers. The latter is taken as a proxy of the international price for durum wheat. It is a well known fact that Italian pasta producers now rely quite extensively on imported durum wheat as well as on wheat harvested in Italy. This data is consistently available on a monthly basis over the period 2000-2009.

Figure 2 plots the (producer) price of pasta over the period 2000-2009. The vertical (red) lines denote the cartel period, which, according to ICA's decision, ran for eighteen months, from October 2006 to March 2008. The average price for pasta over the cartel period is 19% above the average price prevailing in the 18 months immediately before the cartel. Interestingly, the price of pasta after the cartel does not seem to revert to the pre-cartel levels, even though, as it is shown in the charts that follow, the price of inputs tend to a large extent to reach pre-cartel values. This confirms that the effects of cartels tend to be long-lasting, even after the intervention of competition authorities, as, once cartel participants have managed to set the terms of coordination, it is rational (and becomes relatively easy) for them to keep colluding, though tacitly.

FIGURE 2. Producer price index for pasta, January 2000 to December 2009



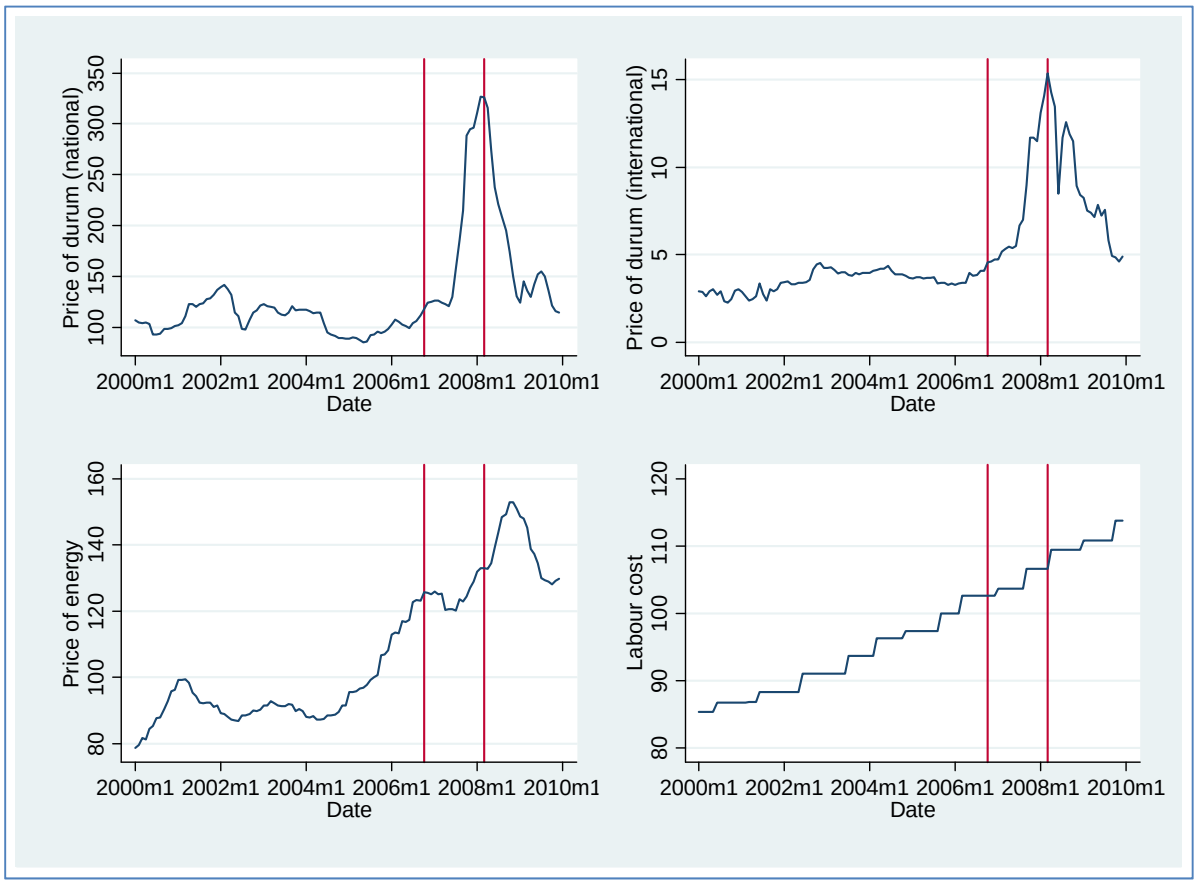
Source: Graph reproduced from ICA's decision.

Figure 3 displays the evolution over time of the price of durum (both domestic and international), of energy and of the labour cost. The price of durum over the cartel period is more than double than that prevailing in the period of time immediately before; after such a spike, the price of both domestic and international durum revert to levels not substantially different from pre-cartel values. It is worth noting that both the price of domestic and international durum begin to increase in the first months of 2006 and thus before the inception of the cartel. The price of energy is also increasing over the cartel period relatively to previous periods, though not steadily. Finally, labour costs increase during the cartel period at rate which appears in line with the pre-cartel period.

The below statistics show that the production costs of pasta have unequivocally increased during the cartel period due to higher prices of durum, energy and higher labour costs. This, in the absence of changes in the competitive regime in the market, would have led to an increase of the

price of pasta. We know, however, that the competitive conditions in the market also changed due to the cartel among pasta producers. In the next section, we will quantify the extent to which the price of pasta has increased due to higher costs and that due to the cartel activity.

FIGURE 3. Domestic durum, international durum, energy price and labour costs, January 2000 to December 2009



Source: Graph reproduced from ICA's decision.

4. Estimating the damages of the pasta cartel

This section outlines three alternative approaches to estimate the damages caused by the pasta cartel in Italy: the dummy variable approach, the Dynamic Treatment Effects (or DTE) approach and the so-called straight line methods. For each of these methods, this section also provides a suitable specification of the model, discusses the key underlying assumptions and the model estimation issues.

4.1 The dummy variable approach

Under this approach, the impact of the cartel can be recovered through a simple OLS regression of the price of the cartelized good on the key cost and demand covariates of price,

augmented for a shift of the intercept term during the period of operation of the cartel[13]. The counterfactual of the cartel can simply be obtained by predicting the price of the good over the cartel period with the cartel dummy switched off. Equivalently, the coefficient of the cartel dummy capture the ceteris paribus effect of the cartel on price. According to standard literature, the "true" effect of the cartel can only be identified if: i) both the observable and unobservable causes of prices (in addition to the cartel) are not endogenous nor caused by the cartel; ii) the model is correctly specified; and iii) the unobservable causes of prices are strictly exogeneous w.r.t. other observable factors affecting prices and the cartel itself[14]. Should one of these conditions not hold, the coefficient of the cartel dummy does not capture the ceteris paribus effect of the cartel on price; the direction of this difference is generally unpredictable, which means that the impact of the cartel can be over-estimated or under-estimated.

In order to apply this method to the pasta cartel, a simple model for the price of pasta can be constructed by considering that pasta is produced out of durum semolina, labour and energy. According to ICA's decision, such inputs account for about 71% of the direct costs to make pasta and 56%% of the total costs. Accordingly, denoting time by t = 1, ..., T, a dummy variable model for the (producer) price of pasta can be written as follows:

$$\begin{aligned} PP\_pasta_t &= \beta_0 + \beta_1 P\_durum\_national_t + \beta_2 P\_durum\_international_t + \\ &+ \beta_3 P\_energy_t + \beta_4 labour\_cost_t + \alpha D_t + \sum_{i=1}^{11} h_i M_i + \lambda_t + \varepsilon_t \end{aligned} \quad (1)$$

Where PP_pasta_t is the (log) production price of pasta, $P\_durum\_national_t$ and $P\_durum\_international_t$ are respectively the (log) domestic and the (log) international prices of durum, a key ingredient for the production of semolina, P_energy_t is the (log) price of energy, $labour\_cost_t$ is the (log) labour cost for the food industries, $M_2 - M_{12}$ is a full set of monthly dummies, λ_t is a time (annual) effect and ε_t an error term. D_t, the cartel dummy, is a dummy variable taking value 1 over the cartel period and 0 otherwise. α, the coefficient of the cartel dummy, measures the ceteris paribus effect of the cartel on the price of pasta.

Equation (1) assumes that the explanatory variables have the same impact on the price of pasta before and during the cartel regime. This assumption may be unrealistic since during the cartel period firms may have found it easier to pass-trough cost increases relatively to previous periods, where such coordination was absent. In other words, one of the consequences of the fact that a firm coordinates its behaviour with its competitors is that such a firm faces less uncertainty in relation to the their behaviour and this may make easier to pass through a costs' increase. This is especially the case if firms have asymmetric cost structures as was indeed the case for pasta producers[15]. Conversely, in noncooperative regimes other than perfect competition, firms are wary of increasing their prices as a result of higher costs since, if this is not followed by their competitors, it will result in a loss of market share. Should this be the case, the demand and cost shifters will have different impacts on price in different competitive regimes, which if not properly taken into account, gives raise to bias in the parameters' estimates and thus in the estimated impact of the cartel. In order to

[13] In essence, the price equation is one of the two reduced form equations of a standard demand and supply system, where each endogenous variable is expressed as a function of the exogenous variables included in the demand and supply equations.

[14] Halbert White shows that if the joint distribution of the observable causes of prices does not differ between regimes, condition ii) is no longer required. See H. WHITE, "Time Series Estimation of the Effects of Natural Experiments", *Journal of Econometrics* 135, 527-566, 2006.

[15] See Agcm, *I694 – Listino prezzi della pasta*, cit., § 171.

control for this, we also estimate a version of Equation 1 where all the r.h.s. variables are interacted with the cartel dummy.

Table 1 displays the OLS estimates of Equation 1. Model (1) is equation (1). Most of the variables included in the equation are rightly signed and statistically significant at conventional levels; the cartel dummy is negatively signed (the cartel has reduced prices!). The limitations of the (basic) dummy approach can be mitigated by introducing a more flexible specification, whereby the parameters capturing the sensitivity of prices to costs are allowed to vary across competitive regimes. This can easily be done by interacting all the r.h.s. variables in equation (1) with the cartel dummy. If the interaction terms are (statistically significant and) take a positive sign, the sensitivity of prices to costs is higher during the cartel than in the pre-cartel period. Model (2) is a version of Equation 1 where all the cost drivers are interacted with the cartel dummy. It is interesting to note that all interaction terms (with the exception of labour) are positively signed, which means that the firms increased indeed the pass-through of costs in the cartel period. If we value these interactions at the (average) value taken by each variable over the cartel period, the cartel overcharge (interactions coupled with dummy effect) is positive and can be estimated at 11% of the observed price.

TABLE 1. Dummy variable models for the price of pasta, 2000.2-2008.03.

Variable	Model (1)	Model (2)
$P\_durum\_national_t$	0.1673	0.0206
	(0.0298)	*(0.0100)*
$P\_durum\_national_t * D_t$	-	0.0661
	-	*(0.1380)*
$P\_durum\_international_t$	0.0987	0.0114
	(0.0246)	*(0.0083)*
$P\_durum\_international_t * D_t$	-	0.2142
	-	*(0.1629)*
P_energy_t	0.0412	-0.0903
	(0.0553)	*(0.0273)*
$P\_energy_t * D_t$	-	0.7177
	-	*(0.4143)*
$labour\_cost_t$	0.7593	0.1243
	(0.2866)	*(0.0918)*
$labour\_cost_t * D_t$	-	-0.5580
	-	*(0.9099)*
Cartel dummy	-0.040	-1.5270
	(0.0108)	*(3.1152)*
Constant	0.1222	4.298
	(0.14287)	*(0.4833)*
Number of observations	99	99
R-squared	0.977	0.995
Adjusted R-squared	0.970	0.993
S.E. of regression	0.017	0.008
Monthly dummies	Yes	Yes
Year dummies	Yes	Yes

Notes: Newey-West standard errors in parenthesis below coefficients

Thus, according to the standard application of the dummy variable approach, the impact of the cartel on the (producer) price of pasta would be negative. However, if we consider a more general model, that allows the parameters to differ across competitive regimes, the cartel overcharge can be

estimated at 11% of the actual price. It is worth to note that the magnitude of the latter is well within the distribution of cartel overcharges reported in different studies, such as Oxera[16] and Connor and Lande[17].

4.2 Dynamic treatment effects (DTE)

To put it simply, this approach involves estimating a (dynamic) price equation for the cartelized good using only the pre-cartel observations and using it to forecast prices over the cartel period as the counterfactual of the cartel. Such forecast price, the so-called "but-for price", can be interpreted as the price which would have prevailed in the market had the cartel not operated. The dummy approach also estimates a but for price, but it does it differently. The main condition for a meaningful application of the DTE method is that the variables included in the model are "conditionally independent given predictive proxies" [18] , in which case Rubin's "unconfoundedness" condition is satisfied[19].

All the input prices included in Equation 1 are likely to satisfy the CIPP condition as they are not determined by the cartel neither by the dependent variable for several reasons. Some of them are not specifically related to the pasta industry as they concern many food industries (such as the labour cost) or economy-wide (as it is the case for the price of energy). The international price of durum is set on the global commodity markets and thus it is unlikely related to the pasta cartel in Italy. As for domestic durum, its price is primarily affected by the actual domestic production. This is in turn driven by the weather conditions prevailing during the year (most of the production takes place in the southern part of the country, where harvests can be severely curtailed by drought), and from the subsidies received by farmers under the common agricultural policy[20]. Moreover, as the price of domestic durum starts to increase before the cartel period (see Figure 2 and Figure 3), it appears difficult to relate it to the cartel.

Before proceeding with the forecasting exercise and the in-sample estimation of our models, non-stationarity of the key variables included in Equation 1 is checked by computing a robust univariate unit root test for the integration of the series. This is done by using the Augmented

[16] See *supra* note 5.

[17] See *supra* note 7.

[18] In formal terms, conditional independence given predictive proxies (CIPP) can be expressed as $\ddot{X}_t \perp D_t \mid \widetilde{X}_t, \widetilde{Z}_t$, which means that, given $\widetilde{X}_t$ and $\widetilde{Z}_t$ there is no information in D_t useful for predicting $\ddot{X}_t$, where $\ddot{X}_t$ are unobservable causes of the dependent variable, D_t is the treatment, $\widetilde{X}_t$ are observable causes of the dependent variable and $\widetilde{Z}_t$ are predictive proxies of $\ddot{X}_t$ not causally related to the dependent variable (see H. WHITE, cit., *supra* note 14). In essence, CIPP holds if $\widetilde{Z}_t$ are able to capture variation in the $\ddot{X}_t$ and are not determined by the natural experiment or the dependent variable. Such variables must have a compelling economic relationship with $\ddot{X}_t$, can even be measured with error and it is also possible to have multiple proxies for a single unobservable.

[19] D. B. RUBIN, "Estimating causal effects of treatments in randomized and nonrandomized studies", *Journal of Educational Psychology*, 66, 688-701, 1974.

[20] It should also be noted that domestic durum has to be mixed with (higher protein) imported durum in order to be used in industrial processes, Italy imports durum even when the domestic production is above the domestic demand; this implies that the demand of durum does not only depends on the domestic price but also on its international price, which is certainly unrelated to the cartel. See A. FRASCARELLI, F. OLIVERIO, "I Prezzi dei Cereali in Italia. Un'analisi delle serie storiche 1993-2008", *Gruppo 2013 Working Paper*, N. 12, 2008.

Dickey-Fuller test with GLS de-trending (ADF-GLS) suggested by Graham Elliott and others[21]. This test is similar to the more standard Dickey-Fuller t test but it applies GLS de-trending before the series is tested with the ADF test. Compared with the standard ADF test, the ADF-GLS test has the best overall performance in terms of small sample size and power.

Table 2 shows the unit root test results for the variables included in Equation 1, both considering a constant (superscript μ) and a constant and trend (superscript τ) as exogenous regressors. Such tests are run for the pre-cartel sample, i.e., February 2000 – September 2006. Both the $DF-GLS^{\mu}$ and the $DF-GLS^{\tau}$ tests fail to reject the null of a unit root for PP_pasta_t, $P\_durum\_national_t$ $P\_durum\_international_t$, P_energy_t and $labour\_cost_t$. With reference to $P\_durum\_national_t$, the null of a unit root cannot be rejected only by the $DF-GLS^{\tau}$. We can then conclude that all the variables included in Equation 1 are non stationary over the pre-cartel period.

TABLE 2. Unit Root tests for the price of pasta, durum and labour cost

Variable	$DF-GLS^{\mu}$	$DF-GLS^{\tau}$
PP_pasta_t	0.050	-1.587
$P\_durum\_national_t$	-2.211**	-2.282
$P\_durum\_international_t$	-1.507	-2.555
P_energy_t	-0.103	-2.059
$labour\_cost_t$	1.563	-3.249

Notes: The $DF-GLS^{\mu}$ test indicates the test where a constant is included as the exogenous regressor, while $DF-GLS^{\tau}$ is the test with a constant and trend included. The critical values at 1, 5, and 10% for the $DF-GLS^{\mu}$ ($DF-GLS^{\tau}$) test are -2.594 (-3.656), -1.945 (-3.094) and -1.614 (-2.800). The lag-length has been chosen on the basis of the Akaike Information Criterion. ***, ** and * indicate rejection at 1, 5 and 10%, respectively.

Given that all the variables included in Equation (1) are nonstationary, least squares estimates are not consistent and the customary tests of statistical inference do not hold. Granger and Newbold call such outcome "spurious regression" [22]. If, however, there exists a combination of the variables included in Equation (1) that is stationary, such variables are cointegrated. The principal feature of cointegrated variables is that their paths are influenced by the extent of any deviation from long-run equilibrium. We then investigate whether there is a cointegration relationship between the price of pasta and that of its inputs (durum, energy and labour) and, if this is the case, we will construct an error correction model (ECM) for the price of pasta.

Applying the Engle-Granger methodology to PP_pasta_t, $P\_durum\_national_t$ $P\_durum\_international_t$, P_energy_t and $labour\_cost_t$ over the pre cartel sample (February 2000 – September 2006), the null of no cointegration among these variables can be rejected at the 5% confidence level (the Engle-Granger t-statistic is -4,920). Thus, it is possible to argue that there is a long run relationship between the price of pasta and the included variables. Given that there exists a cointegration relationship between the above specified variables, an ECM model for the production of pasta can be specified as

[21] G. ELLIOTT, T. J. ROTHENBERG, J. H. STOCK, "Efficient Tests for an Autoregressive Unit Root", *Econometrica*, 64 813-836, 1996.

[22] C. W. J. GRANGER, P. NEWBOLD, "Spurious Regressions in Econometrics", *Journal of Econometrics*, 2, 111-20, 1974.

$$\Delta PP\_pasta_t = \beta_0 + \beta_1 \Delta P\_durum\_national_t + \beta_2 \Delta P\_durum\_international_t + \beta_3 \Delta P\_energy_t + \beta_4 \Delta labour\_cost_t + \beta_5 \left(PP\_pasta_{t-1} - \gamma \mathbf{X}_{t-1}\right) + \sum_{i=1}^{11} h_i D_i + \varepsilon_t \quad (2)$$

Where $\left(PP\_pasta_{t-1} - \gamma \mathbf{X}_{t-1}\right)$ is the cointegration relationship between the price of pasta, the price of durum (national and international), the price of energy and the labour costs. Obviously, all the variables included in Equation (2) are stationary.

Table 3 reports the OLS estimates of two ECM models of the price of pasta over the pre-cartel period. Model (1) is exactly Equation (2), whereas model (2) is a more parsimonious version of Model (1), which includes only the statistically significant variables at conventional levels. All the variables included in the equation show a pattern of signs consistent with our expectations. The long term relationship is negatively signed, reflecting the fact that deviations of the price of pasta from its long run equilibrium are temporary. The absence of serial correlation suggests that the dynamic specification is appropriate.

TABLE 3. ECM models for the price of pasta, 2000.2-2006.9.

Variable	Model (1)	Model (2)
Constant	0.0015	0.0012
	(0.0009)	*(0.0005)*
$\Delta P\_durum\_national_t$	0.0152	0.0191
	(0.0133)	*(0.0108)*
$\Delta P\_durum\_international_t$	0.0095	-
	(0.0071)	
ΔP_energy_t	-0.0266	-
	(0.0293)	
$\Delta labour\_cost_t$	-0.0530	-
	(0.0715)	
$\left(PP\_pasta_{t-1} - \gamma \mathbf{X}_{t-1}\right)$	-0.2151	-0.229
	(0.0735)	*(0.0642)*
Number of observations	80	80
R-squared	0.978	0.976
Adjusted R-squared	0.973	0.975
S.E. of regression	0.004	0.004
Monthly dummies	Yes	February and December only
Serial correlation	1.768	1.523
p-value	0.179	0.225
Heteroskedasticity	0.989	0.731
p-value	0.482	0.602

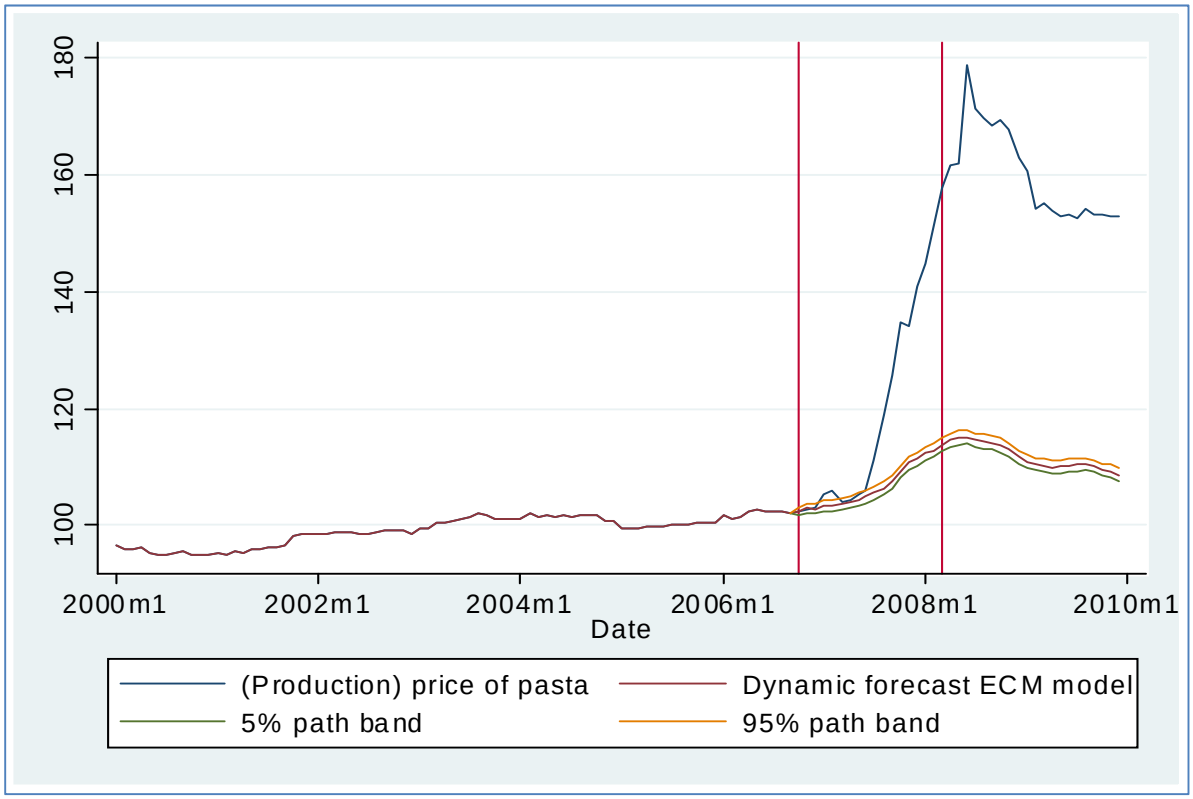
Notes: Standard errors in parenthesis below coefficients; Serial correlation is a Breusch-Godfrey LM Test; Heteroskedasticity is a Breusch-Pagan-Godfrey test.

We then use the models displayed in TABLE 3 to simulate the but-for price of pasta over the cartel period. In essence, the but-for price for pasta in each month of the cartel period is obtained by

using dynamic updating (i.e. the but-for price generated for the previous period) and the contemporaneous values of the other variables included in such models[23].

Figure 4 displays a 90% confidence interval for the (production) price of pasta for each month in which the cartel operated, i.e., from October 2006 to March 2008. This interval represents a band of possible but-for prices for a particular month having a 90% probability of containing the true but-for price. The but-for price increases over the cartel period until June 2008 and declines afterwards, but it is always below the actual price of pasta. Such evolution reflects the growing pasta production costs observed in the period (see section 3) and assumes that the competitive conditions in the market are those prevailing immediately before the cartel is formed. This means that, as a result of the cartel activity, the price for pasta has increased more than what would have implied by higher production costs.

FIGURE 4. Forecast of the (counterfactual) price of pasta over the cartel period, October 2006 to March 2008



The average cartel overcharge is estimated at 11% of the observed price of pasta. If we consider the upper bound of the 90% price band, the cartel overcharge is on average 10,2%. As before, the magnitude of the estimated effect of the cartel falls within the distribution of cartel overcharges displayed in the Oxera report for the Commission[24].

[23] All the results reported in this section are based on Model 2. The results obtained using Model 1 (available on request) are remarkably close to those reported in this paper.

[24] *See* OXERA, cit., *supra* note 5.

4.3 Straight line methods

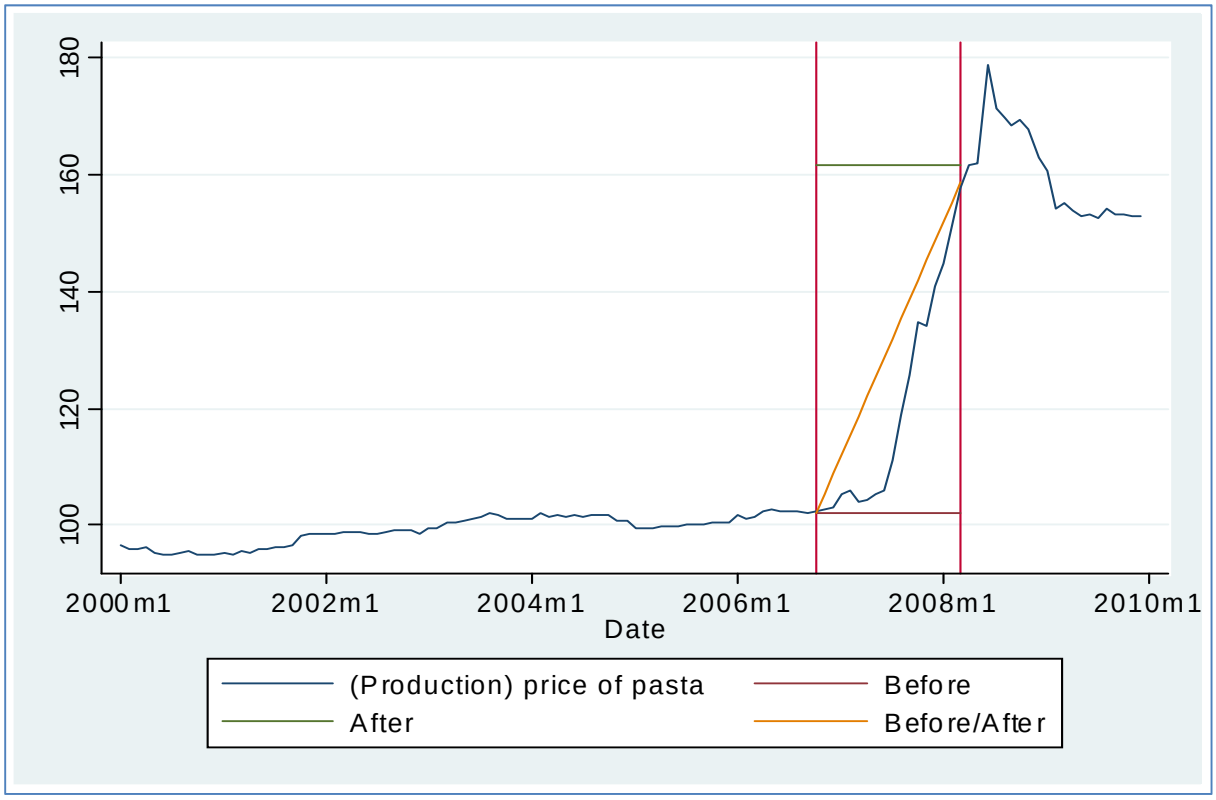
The so-called straight line methods are simpler methods for establishing the counterfactual of a cartel that do not involve econometric analysis. In this section we will focus on three straight-line methods: the "Before", the "After" and the "Before/After". The "Before" method assumes that but-for price is simply the actual price of pasta one instant before the cartel begins to operate. The underlying assumption is that the price of the cartelized good would have stayed unchanged had the cartel not taken place. Thus, the cartel overcharge is simply given by the difference between the average pasta price during the infringement period and that immediately before the infringement. Applying this technique to the pasta cartel, the average overcharge can be estimated at 15% of the actual price. That is the result on overcharges is inflated by 50%.

A variant of the "Before" method involves comparing the average pasta price over the cartel period with that "After" the infringement. One of the advantages of using post-infringement data is that it may be easier to identify a reasonably precise date at which the infringement ended, for example, dates cited in the competition authority's infringement decision. However, as it may take some time for the cartel behaviour to unwind fully and for the market to return to non-infringement-based pricing, using the after infringement data may underestimate the 'true' cartel overcharge. In this particular case, such method would provide a negative estimate of the cartel overcharge!

The "Before/After" method builds on a comparison of the prices from both the pre and the post-infringement periods to estimate the counterfactual price. The idea is to take into account increases (or decreases) in prices that might occur over time, irrespective of the infringement. In its simplest form, such but-for price may be obtained by joining the price points before and after the infringement period. Applying this technique to the pasta cartel, it would provide a negative estimate of the cartel overcharge, just as in the plain vanilla dummy model.

Figure 5 illustrates the actual price of pasta and counterfactuals over the cartel period that would be estimated by using the straight line methods. It is immediate to realize that both the "After" and the "Before/After" methods would yield a negative estimate of the cartel overcharge. Conversely, the "Before" counterfactual provides a positive estimate of the overcharge but at the pre-cartel production costs. This means that if the production costs change over the cartel period, as in the case at hand, the overcharge can easily over (if production costs increase over the cartel period) or under (if production costs decrease over the cartel period) estimate the "true" cartel overcharge. These methods are also very sensitive to start and end period.

FIGURE 5. Straight line estimates of the (counterfactual) price of pasta over the cartel period, October 2006 to March 2008



5. A comparison of the three approaches

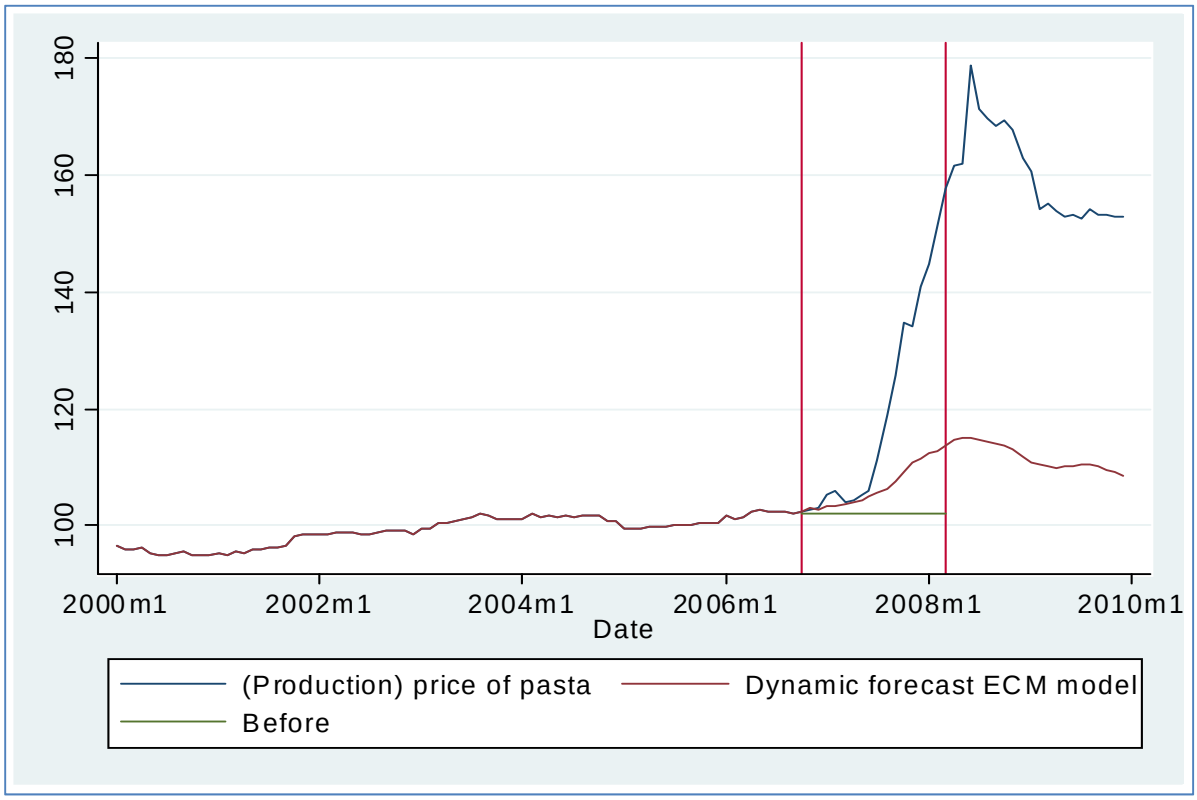
In this section, we compare the estimates of the overcharge due to the pasta cartel obtained by using the three approaches sketched and applied in the previous section. Beginning with the econometric methods, both the (fully interacted) dummy variable approach and the DTE (mean value) yield an estimate of the average cartel overcharge of 11% of the observed price of pasta. Given that the "true" counterfactual is not observable, there is no way to know with certainty which method performs best at estimating the "true" average effect of treatment on the treated, i.e. the "true" impact of the cartel. However, it is important to note that the DTE is able to estimate the "true" average effect of treatment on the treated under much milder conditions than those required by the dummy variable approach, i.e. unconfoundedness vs. correct specification of the model and strict exogeneity of the unobservable causes of prices w.r.t. other observable factors affecting prices and/or the cartel itself. For example, in the labour econometrics literature 'unconfoundedness' is typically simply assumed[25]. For these reasons, DTE should be preferred to the dummy variable

[25] We note in passing that if we are willing to assume the covariates included in the model satisfy the unconfoundedness condition, estimating the dummy variable model of the cartel by using the OLS estimator is not a valid approach, but the estimators proposed by Hahn, Hirano, Imbens and Ridder should instead be used. See: J. HAHN, "On the role of the propensity score in efficient semiparametric estimation of average treatment effects", *Econometrica* 66, 315-331, 1998; K. HIRANO, G. W. IMBENS, "Estimation of causal effects using propensity score weighting: An application to data on right heart catheterization", *Health*

approach. In addition, it should also be noted that the estimates of the cartel overcharges obtained by using the dummy variable approach can be easily manipulated by a 'proper' choice of the regressors to be included in the regression.

We now turn our attention to the so-called straight-line methods. The "Before" variant of these methods is the only one that gives a positive estimate of the overcharge for the pasta cartel (Figure 5). It is thus interesting to compare the price sequence over the cartel period obtained by using the "Before" method with that generated by using DTE (Figure 6). The Figure shows that the "Before" approach would lead to a much lower counterfactual and therefore to a higher estimate of the cartel overcharge than the DTE. This is due to the fact that the "Before" method is unable to take into account of the fact that the production costs of pasta increased over the cartel period, as also noted by the ICA in its decision. This implies that the "Before" method, and in general, all straight line methods maintain their validity only if we are willing to make excessively strong assumptions on the underlying drivers of the price of the cartelized good, such as that the cost and demand determinants of prices stay unchanged over the cartel period. This exercise illustrates the consequences of the fact that these assumptions are likely to be violated in reality.

FIGURE 6. DTE vs. straight line forecasts over the cartel period, October 2006 to March 2008



Finally, we can use the econometric estimates obtained in this paper to assess the consistency of the sanctions levied by the ICA with the so-called "optimal" level of deterrence as well as to quantify the net benefits to society arising from the ICA's intervention.

Services & Outcomes Research 2, 259-278, 2001; K. HIRANO, G. W. IMBENS, G. RIDDER, "Efficient estimation of average treatment effects using the estimated propensity score", *Econometrica* 71, 1161-1189, 2003.

In principle, the 'optimal' fine should be such that the expected gain from participating in the cartel, given by the increase in profits minus the expected fine, is zero[26]. According to our estimates, in the case of the pasta cartel, the benefits (overcharge) for the participating firms may reach EUR 147 Million. As it happens in most jurisdictions, the gains for the participating firms are well above the (total) sanctions levied by the ICA[27]. This implies that, in the absence of any private enforcement action, if the pasta producers had known (ex ante) that they would have been caught with certainty, they would have found still profitable to engage in the cartel. If we consider that the probability of detection is lower than 1 (say 20-30%) in order to be an "optimal" deterrent, the (total) fine should have been even higher. But we also have to consider the likelihood of private enforcement actions and/or of collective redress, which may reduce the "optimal" fines at a level below the gains from participating to the cartel (normalized on the probability of detection).

The benefits of antitrust intervention can be estimated by noting that the counterfactual of not intervening is that the cartel would have lasted for a longer period. Connor and Zimmerman estimate that the average cartel duration is about 6.3 years[28]. In the OFT's study it is assumed that a cartel would last for 6 years from inception. Using such estimate of the total duration of a cartel, it can be assumed that pasta cartel would have lasted for 4.5 years more since the instant of detection. Discounting the consumer savings and the deadweight loss over this period at a social discount rate of 3.5%[29], the benefits to society of detecting the pasta cartel can be estimated at EUR 420 Million, or, equivalently, about 7 times the annual budget of the Italian Competition Authority[30]. It is important to realize that this figure is a lower bound for the benefits to society (from this intervention) as it does not consider the deterrence effects of the enforcement action.

6. Conclusions

This paper has applied different methodologies to estimate the damages from anticompetitive conduct. Differently from a number of surveys of several methods to undertake damage estimation, this paper provides an assessment on how different techniques perform when applied to a real life case, i.e. the pasta cartel in Italy.

The results obtained in this paper show that, in general, econometric methods perform better than commonly used methods such as the straight line methods; moreover, the latter methods should not be used when the underlying cost and demand drivers over the cartel period are substantially different from those prevailing before or after the cartel.

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[26] See, for example, W. M. LANDES, *Optimal Sanctions for Antitrust Violations*, University of Chicago Law Press 50, 652-678, 1983.

[27] This finding is in line with the results of Buccirossi and Spagnolo, which show that the sanctions actually imposed in most jurisdictions are well below optimal levels. See P. BUCCIROSSI, G. SPAGNOLO, *Optimal Fines in the Era of Whistleblowers. Should Price Fixers still Go to Prison?*, in *The Political Economy of Antitrust*, edited by Vivek Ghosal and Johan Stenneck, 2007.

[28] Connor, J. M., and Zimmerman, J. E., Determinants of Cartel Duration: a Cross-Sectional Study of Modern Private international Cartels", *Purdue University Working Paper*, April, 2005.

[29] We use the same social discount rate used in the OFT's study: see Office of Fair Trading, *A Guide to OFT's Impact Estimation methods*, 2010, available from www.oft.gov.uk.

[30] The formula to compute the avoided loss of consumer surplus due to antitrust intervention is $f = \sum_{s=1}^{c} (cs) / (1+d)^{s}$, where cs is the consumer surplus (cartel overcharge plus deadweight loss), c is the number of years the cartel would have been operational but-for the antitrust intervention and d is the social discount rate. The deadweight loss due to the cartel is estimated assuming that the elasticity of the demand for pasta is equal to 1.

Within the domain of econometric methods applied in this paper, in this particular case, the (fully interacted) dummy variable approach and the DTE provide very similar estimates of the overcharge due to the cartel. This can be rationalised as both methods allow for changing market dynamics before and after the cartel, including reaction to input cost changes. A theoretical argument suggests, however, that DTE may be preferable as this method is able to recover "the average effect of treatment on the treated" under much less restrictive conditions than those required by the dummy variable approach.

Finally, this paper contributes to the on-going debate on "optimal fines" as well as on the benefits to society of having a proper antitrust enforcement. The results obtained in this paper show that the fines levied by the ICA in this particular case were only a fraction of those that would have been implied by the literature on "optimal" deterrence. If we consider that the effects of the cartel tend to last beyond the 'official' end of the infringement, optimal deterrence implies that sanctions should be even higher than those based on the 'official' duration of the cartel. Moreover, the estimates provided in this paper suggest that the benefits (in terms of consumer surplus which, in absence of the intervention of the competition authority, would have been lost) of this antitrust intervention is roughly 7 times the annual budget of the Italian Competition Authority.

References

AGCM, *I694 – Listino prezzi della pasta*, provv. n. 19562, 16 March 2009, in Boll. n.8, 2009, available from www.agcm.it.

BUCCIROSSI, P., SPAGNOLO, G., *Optimal Fines in the Era of Whistleblowers. Should Price Fixers still Go to Prison?*, in *The Political Economy of Antitrust*, edited by Vivek Ghosal and Johan Stenneck, Elsevier, 2007.

BUNDESKARTELLAMT, *Effective cartel prosecution. Benefits for the economy and consumers*, 2010, available from www.bundeskartellamt.de.

BUNDESKARTELLAMT, *Private Kartellrechtsdurchsetzung: Stand, Probleme, Perspektiven*, Discussion Paper, September, 2005.

CONNOR, J. M., ZIMMERMAN, J. E., "Determinants of Cartel Duration: a Cross-Sectional Study of Modern Private international Cartels", *Purdue University Working Paper*, April 2005.

CONNOR, J., LANDE, R., "Cartel Overcharges and Optimal Cartel Fines", in *Issues in Competition Law and Policy*, Vol. 3, chapter 88, 2203, edited by Spencer Weber Waller, A.B.A. Section of Antitrust Law 2008.

CONNOR, J., LANDE, R., "How High Do Cartels Raise Prices? Implications for Reform of the Antitrust Sentencing Guidelines", *American Antitrust Institute Working Paper Series*, WP No. 01-04, 2001.

ELLIOTT, G., ROTHENBERG, T. J., STOCK, J. H., "Efficient Tests for an Autoregressive Unit Root", *Econometrica*, 64 813-836, 1996.

EUROPEAN COMMISSION, DG COMPETITION, *Draft Guidance Paper - Quantifying harm in actions for damages based on breaches of Article 101 or 102 of the Treaty*, Brussels, June 2011.

FRASCARELLI, A., OLIVERIO, F., "I Prezzi dei Cereali in Italia. Un'analisi delle serie storiche 1993-2008", *Gruppo 2013 Working Paper,* N. 12, 2008.

GIANGIULIO, D., "Meccanismi di trasmissione dei prezzi lungo la catena agro-alimentare: un esercizio di analisi sulla filiera della pasta alimentare secca", *Studi e ricerche dell'Autorità Garante della Concorrenza e del Mercato*, N.4, 2011.

GRANGER, C. W. J., NEWBOLD, P., "Spurious Regressions in Econometrics", *Journal of Econometrics*, 2, 111-20, 1974.

HAHN, J., "On the role of the propensity score in efficient semiparametric estimation of average treatment effects", *Econometrica* 66, 315-331, 1998.

HIRANO, K., IMBENS, G. W., "Estimation of causal effects using propensity score weighting: An application to data on right heart catheterization", *Health Services & Outcomes Research* 2, 259-278, 2001.

HIRANO, K., IMBENS, G. W., RIDDER, G., "Efficient estimation of average treatment effects using the estimated propensity score", *Econometrica* 71, 1161-1189, 2003.

LANDES, W. M., *Optimal Sanctions for Antitrust Violations*, University of Chicago Law Press 50, 652-678, 1983.

OECD, *The quantification of harm to competition by national courts and competition agencies –Background Note*, Policy Roundtable, October, 2011.

OFFICE of FAIR TRADING, *A Guide to OFT's Impact Estimation methods*, 2010, available from www.oft.gov.uk.

OXERA, KOMNINOS et al, *Quantifying Antitrust Damages. Towards Non-binding Guidance for Courts*, study prepared for the European Commission, 2009.

POSNER, R. A., *Antitrust Law*, 2nd edition, The University of Chicago Press, 2001.

RUBIN, D. B., "Estimating causal effects of treatments in randomized and nonrandomized studies", *Journal of Educational Psychology*, 66, 688-701, 1974.

WERDEN, G. J., "The Effect of Antitrust Policy on Consumer Welfare: What Crandall and Winston Overlook", *U.S. Department of Justice Antitrust Division Discussion Papers*, Discussion Paper No. EAG 03-2, February 2003.

WHITE, H., "Time Series Estimation of the Effects of Natural Experiments", *Journal of Econometrics* 135, 527-566, 2006.