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Actions Speak Louder than Words: Econometric Evidence to Target Tacit Collusion in Oligopolistic Markets

Actions Speak Louder than Words: Econometric Evidence to Target Tacit Collusion in Oligopolistic Markets

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July 2013

Abstract

Tacit collusion reduces welfare comparably to explicit collusion but remains mostly unaddressed by antitrust enforcement which greatly depends on evidence of explicit communication. We propose to target specific elements of firms' behavior that facilitate tacit collusion by providing quantitative evidence that links these actions to an anticompetitive market outcome. We apply our approach to incidents on the Italian gasoline market where the market leader unilaterally announced its commitment to a policy of sticky pricing and large price changes which facilitated price alignment and coordination of price changes. Antitrust policy has to distinguish such active promotion of a collusive strategy from passive (best response) alignment. Our results imply the necessity of stronger legal instruments which target unilateral conduct that aims at bringing about collusion.

Keywords: antitrust law, tacit collusion, oligopolistic competition, gasoline market

JEL classification: K21, K42, L13, L41, L71

1 Introduction

In most markets firms quickly realize that they can earn supracompetitive profits by coordinating their market conduct. In response, antitrust policy seeks to foster "effective competition" by targeting collusive activities. The current legal framework to accomplish this goal has mainly evolved around communication as a means to reach a collusive agreement. In contrast, purely tacit collusion remains largely unaddressed by antitrust law though it may bring about the same negative welfare effects.

We argue that a crucial step forward in targeting tacit collusion could be taken through the forensic use of econometric evidence which may reveal collusive strategies. Theoretical and empirical findings on collusive behavior provide a basis for deriving clear test hypotheses to distinguish (lawful) oligopolistic interdependence from tacit collusion. Thus econometric analyses may provide quantitative evidence that firms strategically use specific elements of market conduct to (tacitly) collude. Antitrust remedies should in turn take up such instances of market behavior to tackle tacit collusion.

The paramount significance of evidence of explicit communication entails fundamental problems for the fight against cartels.[1] Communication is not a necessary condition to collude. At the heart of collusion lies the incentive of firms to cooperate rather than to compete.[2] In oligopolies firms can exercise their unilateral market power to facilitate anticompetitive coordination without engaging in communication. As firms weigh up the costs and benefits of explicit collusion, antitrust law's focus on communication incentivizes them to concentrate on tacit means of collusion. Legal instruments to counter collusion, the effectiveness of which depends on evidence of explicit communication, are least effective in concentrated industries,[3] i.e. precisely in those industries where the cartelization rate is presumably the highest and communication is least needed to sustain collusion.[4] Any economic approach to support the enforcement of antitrust law[5] is chal-

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[1] Throughout this paper we use the term "cartel" to describe any kind of welfare-decreasing form of collusion, be it an explicit or a tacit one, and irrespective of whether or not we consider it an infringement of antitrust law.

[2] Much of the theoretical discussion on tacit collusion is based on the supergame approach. The best known result describing firms' incentives to collude is the "Folk Theorem" which states that for sufficiently low discount rates almost any price may be sustained as the equilibrium outcome of a repeated game. While the "Folk Theorem" provides fairly general conditions under which tacit collusion may be sustained as an equilibrium, it says nothing about how firms behave in reality. The strategies used in the "Folk Theorem" are chosen because of their analytical ease and not because they describe firms' collusive behaviour. See Fudenberg and Tirole (1991) for a discussion of the "Folk Theorem".

[3] While economic theory shows that concentration facilitates collusion, and thus predicts a positive relation between cartelization rate and market concentration, empirical evidence seems to contradict this result (Levenstein and Suslow, 2006). This gap between the number of cartels predicted from a theoretical perspective and the number of cartels that appear in the empirical analysis may plausibly be explained by a sample-selection bias. Only cartels which, first, have been detected and which, secondly, were regarded as illegal by antitrust authorities or courts are contained in the sample.

[4] Fonseca and Normann (2012) use a laboratory experiment to investigate the role of communication in sustaining collusion. They show that highly concentrated industries collude irrespective of communication.

lenged by a legal significance of evidence of communication. Economists can use observable variables such as prices, and their knowledge of the strategies employed by firms to infer collusion[6] but have no instruments to prove whether firms collude with or without communication. From an incentive-based perspective, (illegal) communication appears to be of relative unimportance: While non-enforceable communication might facilitate coordination on a *particular* collusive equilibrium,[7] "talk is cheap" in the absence of effective enforcement mechanisms.[8]

It is, however, not out of economic naivety that antitrust law concentrates so much on evidence of communication in its struggle against collusion. Firstly, this reflects skepticism about whether instances of tacit collusion may be distinguished from oligopolistic competition with a degree of precision that suffices for forensic purposes. This concern may be associated with the so-called "indistinguishability problem" as put forward by Phlips (1996). He suggested that game theoretic arguments combined with the unavailability of some key data can make an economic based proof of collusion very difficult as something that looks like collusion might stem from a multiplicity of (indistinguishable) equilibria.[9] Hence, the application of any legal instrument that addresses tacit collusion faces the challenge to prevent an unacceptable high number of false positives. Secondly, for purposes of antitrust enforcement it does not suffice to show that an observable market outcome emerged as the result of a collusive strategy. Antitrust remedies may not straightforwardly tackle firms because they charge "collusive", i.e. supracompetitive, prices but must address specific elements of firms' market conduct which may be characterized as collusive. Without taking into account these issues, antitrust enforcement that tackles tacit collusion risks either unduly restricting market operators' leeway to compete or to ultimately amounting to an instrument of price control.

In the following, we outline an approach that addresses both these concerns, and hence provides the basis for an expansion of the law's ambition to tackle tacit collusion. Oligopolistic interdependence *as such* and oligopolistic collusion are conceptually distinct. Tacit collusion arises from

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[5] See for comprehensive analyses of the use of economics to support cartel enforcement Werden (2004) and Kaplow (2011a).

[6] One of the best known examples of economic detection of collusion is provided by the work of Christie and Schultz (1994). They detected collusion between Nasdaq market makers by comparing their bid-ask spread to the equivalent spread on the New York Stock Exchange. Christie and Schultz' (1994) work had an impressive impact as it led to regulatory investigations by the Securities and Exchange Commission (SEC) and class action lawsuits that were settled for over $1 billion.

[7] Genovese and Mullin (2001) provide narrative evidence of the role of communication for collusion in the Sugar Institute Case. They find that one key missing aspect in formal theories of collusion is the role for rich communication within the collusive agreement.

[8] To use the words of Thomas Hobbes (1651/1959, chap. 14, p. 71), author of the Leviathan, "[…] the bonds of words are too weak to bridle mens ambition, avarice, anger, and other Passions, without the fear of some coercive Power […]."

[9] For example, Peltzman (2000) confirms the long standing observation that prices respond faster to cost increases than to cost decreases in 77 consumer and 165 producer goods. This finding has been generally associated with collusion even though other reasons such as inventories and "menu costs" might lead to the same (indistinguishable) outcome.

decisions endogenous to the market by one or several firms which aim at reducing or eliminating competition. In contrast, oligopolistic interdependence stems from best response to market conditions (including other firms' behavior) which favor non-competitive performance. Thus, while the market outcome might appear to be "indistinguishable," the specific strategies that lead to the outcome differ significantly. The gist of our approach to identify collusive behavior lies in an identification of patterns of *behavior* used by firms to bring about or facilitate (tacit) collusion.[10] Yet antitrust law must not simply infer the existence of a punishable (tacit) agreement from the insight that a certain market outcome is the result of a collusive strategy. Rather, it is essential to distinguish the active promotion of a collusive strategy by one firm from the passive (best response) alignment of competing firms. Consequently, antitrust enforcement should not conceptualize such instances of collusive leader-follower behavior as an illegal *coordination* which would – with regard to the "followers" – result in punishing oligopolistic interdependence. Rather, antitrust law should capture such instances of "unilateral collusion" only through considering as illegal the *unilateral* conduct that actively promotes the implementation of a collusive strategy. To effectively fight tacit collusion it appears therefore to be necessary to strengthen legal instruments that target the unilateral conduct that firms strategically employ to promote collusion.

To illustrate our behavioral approach to tackling tacit collusion and to demonstrate the capacity of econometric evidence we refer to incidents on the Italian gasoline market. In Andreoli-Versbach and Franck (2013), hereafter AVF, we provide quantitative evidence of the means, i.e. specific pricing strategies, and the effects, i.e. higher prices, caused by the unilateral public announcement of ENI, the market leader. On 6th October 2004 ENI announced a new pricing policy which consisted of infrequent price variations (sticky pricing) and large price changes. Using daily firm level prices of gasoline in Italy and average weekly EU prices over the time period from January 2003 to May 2005, AVF show the effect of the new pricing policy. ENI increased the time lag between price changes from 6 to 16 days and increased the mean price change from 1% to 5.8%. After the policy change ENI did not change its price for 57 days irrespective of cost changes. Initially ENI's competitors kept their short-run cost-based pricing and thus increased their prices following (lagged) cost increases.[11] Once competitors started to align to ENI in mid-November 2004 a different pricing pattern emerged: sticky-leadership pricing. Each large price

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[10] In this respect, our approach is conceptually in line with Hay (2000, p. 128) who argues that "if there is to be a category of unlawful tacit collusion which is to be distinguished from classic oligopoly, the difference must lie […] on the specific elements of behavior that brought about that state of mind".

[11] Firms respond to cost shocks with some lags. While current costs decreased immediately after ENI's policy, lagged costs increased and thus competitors increased their prices. See **Figure I** for a plot of daily prices and costs, i.e. Platts Cif. Med., around ENI's new price policy announcement (first vertical line).

variation was matched by competitors and ENI endogenously emerged as the price leader in the market and coordinated price changes. While the first effect of the policy was to change the price interdependence in the Italian gasoline market this newly emerged tacit coordination had an additional effect: a significant price increase. Using several estimation techniques AVF show that Italian prices rose compared to EU prices after the new sticky leadership pricing emerged. Thus, the econometric analysis used to characterize pre and post policy pricing behavior and evaluate the effect of the new market conduct on the price level might provide solid "statistical" evidence that ENI's unilateral commitment to a policy of sticky pricing has to be characterized as collusive.

Against the background of these incidents on the Italian gasoline market we suggest that an implementation of sticky pricing along with large price changes should be prohibited under market conditions such as highly asymmetric market shares and high concentration where it may be expected that price leadership will emerge as a price coordination mechanism and, thus, where such a pricing strategy will bring about collusion. Such an expansion of the legal tools to counter cartels seems especially relevant for oligopolies where the structural market features favor collusion and at the same time communication might be less needed because of price and cost transparency.

The structure of the paper is as follows: Section 2 discusses the status quo of cartel enforcement which focuses on firms' communication and the law's difficulties with tackling tacit collusion. In section 3 we outline incidents on the Italian gasoline market as an illustration for how our approach might be applied for purposes of antitrust enforcement. Section 4 describes the way to integrate quantitative evidence of collusion with antitrust law. Section 5 concludes.

2   On Collusion as a Legal Concept, its Limits in the Absence of Evidence of Collusive Communication, and the Reasons therefor

Collusion allows competing firms to charge supra-competitive prices and entails negative welfare effects. Meta-studies on cartel overcharges show that the median cartel-price increase ranges between 20 and 30 percent (Bolotova, 2009, and Connor, 2007). This is why antitrust law aims at inhibiting collusion and why the horizontal coordination of prices and quantities is considered a per-se violation of Section 1 Sherman Act or Article 101 Treaty on the Functioning of the European Union (TFEU), respectively. Successful collusion requires *inter alia* an underlying – tacit or explicit – consensus on the terms of the cooperation. Thus, in order to counter collusion, it seems a logical step to regard such underlying understanding as illegal.

However, the economic conception of a collusive agreement diverges significantly from the corresponding legal concepts of "conspiracy" according to Section 1 Sherman Act or "agreement"

and "concerted practice" according to Article 101(1) TFEU.[12] While the former focuses on firms' incentives to engage in collusion and their strategies for sustaining a collusive equilibrium, the latter centers around the means to reach an understanding between firms. This divergent perspective on collusion becomes apparent with regard to instances of tacit collusion, i.e. under circumstances where no direct evidence of consensus between competing firms is available, such as written records or insider testimony. Though, as a matter of principle, both under the Sherman Act and the TFEU circumstantial evidence may suffice to demonstrate the existence of a "conspiracy"[13] or an "agreement"[14] respectively, there are doctrinal limits in this regard if it comes to (supposedly) tacit collusion between competitors.

In the words of the U.S. Supreme Court, "conspiracy" requires "that [the defendants] had a conscious commitment to a common scheme designed to achieve an unlawful objective."[15] Reasonably, this may not be inferred from conscious parallelism alone.[16] Rather a plaintiff has to produce additional evidence to prove that an observed parallel market conduct may not be considered the result of oligopolistic interdependence, but indeed forms part of a collusive strategy. Such so-called "plus factors" may encompass first, elements of industry structure that indicate that an industry is conducive to collaboration, second, conduct that appears irrational or inefficient absent collusion, and third, additional factors such as industry performance (e.g. stabile market shares over time, supra-competitive pricing) or facilitating practices (e.g. exchange of information).[17] While the U.S. Supreme Court has stated that plaintiffs can only survive summary judgment by presenting circumstantial evidence "that tends to exclude the possibility that the alleged conspirators acted independently,"[18] the case law so far does not provide a taxonomy of plus factors which would allow us to determine which elements of evidence are required to infer an agreement. Thus, Gavil et al. (2008) concluded that "[…] decisions analyzing plus factors generally have failed to establish a clear boundary between tacit agreements – to which Section 1

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[12] This conceptual divergence may also give rise to *terminological* misunderstandings between economists and lawyers. Throughout this paper we will indicate when we use terms such as "collusion" or "agreement" in their technical economic or legal meaning.

[13] *American Tobacco Co. v. United States,* 328 U.S. 781, 809 (1946) ("No formal agreement is necessary to constitute an unlawful conspiracy"); *Norfolk Monument Co. v. Woodlawn Memorial Gardens, Inc.,* 394 U.S. 700, 704 (1969) ("business behavior is admissible circumstantial evidence from which the fact finder may infer agreement").

[14] CFI, 26.10.2000, Case T-41/96 *Bayer v Commission* [2000] ECR II-3383 para. 69; confirmed on appeal by the ECJ, 6.1.2004, Joined Cases C-2/01 P and C-3/01 P *Bundesverband der Arzneimittel-Importeure and Commission v Bayer* [2004] ECR I-23, para. 97.

[15] *Monsanto Co. v. Spray-Rite Servs. Corp.,* 465 U.S. 752, 768 (1984). While *Monsanto* involved a vertical collaboration, the Court soon after adopted the same reasoning also in a horizontal case, see *Matsushita Electronics Industries Co. v. Zenith Radio Corp.,* 475 U.S. 574, 588 (1986).

[16] See e.g., *Theatre Enters., Inc. v. Paramount Film Distrib. Corp.,* 346 U.S. 537, 541 (1954).

[17] See for an overview Gavil et al. (2008), pp. 310-311.

[18] *Matsushita Electronics Industries Co. v. Zenith Radio Corp.,* 475 U.S. 574, 588 (1986) (quoting *Monsanto Co. v. Spray-Rite Servs. Corp.,* 465 U.S. 752, 764 (1984)).

applies – and parallel pricing stemming from oligopolistic interdependence […]. This condition makes judgments about future litigation outcomes unpredictable."[19]

While the European Court of Justice (ECJ) considers it generally conceivable that consent to an agreement may be inferred from circumstantial evidence,[20] the Court is reluctant to infer an "agreement" between competitors from their market conduct alone, notwithstanding the presence of certain "plus factors." Given the current state of the jurisprudence, it appears that in the absence of direct evidence of collusion the Court does not presume the existence of an "agreement" even if one has proved that observed parallel market conduct was an expression of (tacit) collusion rather than of oligopolistic interdependence as such. This has been reaffirmed by a decision on the doctrine of "collective dominance" under Article 102 TFEU where the ECJ implicitly approved that tacit collusion *per se* may not fall under Article 101(1) TFEU: "[u]nless they can form a shared tacit understanding of the terms of the coordination, competitors might resort to practices that are prohibited by Article [101 TFEU] in order to be able to adopt a common policy on the market."[21] However, where tacit collusion has been induced by facilitating practices such as, for example, an exchange of information, it may come under Article 101(1) TFEU as an illegal "concerted practice". In this regard, the ECJ drew a line: On the one hand, by assigning market operators the legal leeway to "adapt themselves intelligently to the […] conduct of their competitors" the Court signaled that mere *passive alignment* would not be treated as an illegal form of coordination. On the other hand, the Court submitted that a strategy that *actively aims at aligning* competitors' market conduct may fall under Article 101(1) TFEU.[22] Thus, to implement this standard it is essential to identify elements of behavior that promote (tacit) collusion.

This insight into legal concepts of coordination reveals ambiguities and restrictions with regard to tacit collusion. It raises the question why the law finds it so difficult to cope with this phenomenon, given that it seems uncontroversial in terms of competition policy that tacit collusion on prices and quantities should be prevented as rigorously as collusion based on explicit consensus. To begin with, the respective judicial definitions of "conspiracy" and "agreement" do not restrict

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[19] See also Kaplow (2011b), p. 816, who concludes after an extensive analysis of the concept of agreement in antitrust law: "[…] this Article does not come close to demonstrating that it would be good policy to proscribe and highly penalize all instances in which interdependent oligopolistic behavior appears to occur. The design of optimal policy is not dictated by definitions but rather by direct assessment of the consequences of different regulatory approaches."

[20] Accordingly, the Court infers a tacit approval of a collusive initiative from the attendance of a meeting where an anticompetitive agreement was concluded, see ECJ, 28.6.2005, Joined Cases C-189/02 P, C-202/02 P, C-205/02 P to C-208/02 P and C-213/02 P *Dansk Rørindustrie A/S and others v Commission* [2005] ECR I-5425 para. 143: "That complicity constitutes a passive mode of participation in the infringement which is therefore capable of rendering the undertaking liable in the context of a single agreement […]."

[21] ECJ, 10.7.2008, Case C-413/06 P *Bertelsmann and Sony Corporation of America v Impala* [2008] I-4951, para. 123.

[22] ECJ, 16.12.1975, Joined Cases 40 to 48, 50, 54 to 56, 111, 113 and 114/73, *Suiker Unie and others v Commission* [1975] ECR 1663 paras. 173-174; ECJ, 14.7.1981, Case 172/80 *Züchner v Bayerische Vereinsbank* [1981] ECR 2021, paras. 12-14.

these concepts in a way that would exclude collusion which has been sustained tacitly. Whatever the rhetoric of the courts might be when they characterize the requirements of an agreement – typically they refer to a need to show a "meeting of minds,"[23] a "joint intention"[24] or a "concurrence of wills"[25] –, the respective antitrust law concepts have to be defined strictly instrumentally. Hence it is, first, the underlying policy to contain as far as possible any kind of welfare-reducing collusion and, second, the role a legal intervention and, in particular, a prohibition of agreements between competitors may feasibly play in this regard, that determine which behavior should be regarded as illegal.

Part of the law's problem in coping with tacit collusion lies with the difficulty to distinguish collusion from oligopolistic interdependence as the latter may also result in suspiciously parallel market conduct and supra-competitive prices. This problem is addressed by the requirement of "plus factors" which – in addition to parallel pricing – are meant to indicate collusion, such as market conduct which may reasonably only be explained as part of a collusive strategy.[26] From this perspective, the problem of distinguishing oligopolistic collusion from oligopolistic competition comes essentially down to a question of error costs: by defining the "critical mass" of plus factors required to infer an illegal coordination, courts strike a balance between the ambition to contain (tacit) collusion and the risk of producing false positives.[27]

However, in particular the ECJ's categorical reluctance to infer an agreement in cases of mere tacit collusion suggests that there is more to the law's difficulties to cope with tacit collusion than the problem of multiple (indistinguishable) equilibria and the issue of reaching an acceptable degree of error costs in this regard. Legal standards and remedies that are supposed to influence market conduct in order to guarantee effective competition may not simply prohibit an undesired economic condition such as a collusive equilibrium and punish firms because they charge "collusive" prices. Such a policy effectively meant nothing other than price control. This unwelcome consequence is prevented as antitrust standards and remedies relate to individual behavior and define which acts or omissions are required or prohibited. When authorities or private plaintiffs order a firm to bring an infringement to an end or seek to obtain injunctions before a court, it is

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[23] *American Tobacco Co. v. United States,* 328 U.S. 781, 810 (1946); *Copperweld Corp. v. Independence Tube Corp.,* 467 U.S. 752, 771 (1984).

[24] ECJ, 15.7.1970, Case 41/69 *ACF Chemiefarma* [1970] ECR 661 para. 112.

[25] CFI, 8.7.2008 *AC-Treuhand* [2008] ECR II-1501, para. 118.

[26] This is presumed if, for example, a certain conduct "is so perilous when not imitated and imitation so uncertain that no reasonable actor would so act, then parallel action does imply some exchange of commitments or at least some comforting assurances connoting a traditional conspiracy", Areeda and Hovenkamp (2010), §1415c, p. 107 with reference to *Blomkest Fertilizer v. Potash Corp.,* 203 F.3d 1028, 1037 (8th Cir. 2000).

[27] See Posner (2001), p. 99: "[…] a damages judgment in a tacit collusion case would promote competition at a tolerable cost in legal uncertainty and judicial supervision."

already the remedy's behavioral nature that requires a specification of elements of conduct that violate antitrust law. The intended deterrent effect of concurring remedies such as imposing fines or damages likewise depends on whether market operators are in a position to foresee what conduct they may be sanctioned for, and how they are expected to behave to avoid sanctions. This appears particularly challenging where an undesired economic effect or market condition is the consequence of the interdependent behavior of several market actors.[28] But once again: if the elements of behavior that bring about a collusive equilibrium remain unclear, any legal intervention may ultimately amount to a price control by antitrust authorities or courts. Furthermore, with regard to criminal and quasi-criminal sanctions it is required by the principle of culpability[29] and the need to prove intent[30] or negligence,[31] respectively, that antitrust enforcement ensures that market operators may anticipate their legal leeway and addresses certain modes of behavior rather than an economic effect or condition.

Thus, the key to overcoming the law's difficulties to counter tacit collusion lies in an approach which identifies specific elements of behavior whose object or effect it is to bring about or facilitate collusion. Such an approach has a chance for success as market operators that seek to implement a collusive strategy need to adjust their market conduct to reach an optimal and stable collusive equilibrium. Even in oligopolistic markets that are characterized by features that facilitate tacit collusion, prices and other parameters have to be adjusted according to an underlying (tacit) agreement, and the need for such adjustments may lead firms to resort to a certain behavior that may be identified as serving a collusive strategy. Empirical and theoretical research[32] on how cartels behave provides solid test hypotheses to identify such elements of collusive behavior.

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[28] Cf., e.g., *E.I. Du Pont De Nemours & Co. v. FTC (Ethyl),* 729 F.2d 128, 139 (2d Cir. 1984): "In view of this patent uncertainty the [Federal Trade] Commission owes a duty to define the conditions under which conduct claimed to facilitate price uniformity would be unfair so that businesses will have an inkling as to what they can lawfully do […]. The Commission's decision in the present case does not provide any guidelines; it would require each producer not only to assess the general conduct of the anti-knock business but also that of each of its competitors and the reaction of each to the other, which would be virtually impossible."

[29] Under European law, Article 7(1) ECHR enshrines the principle that offences und punishments are to be strictly defined by law, see on the relevance of this norm as to fines in EU Competition Law ECJ, 28.6.2005, Joined Cases C-189/02 P, C-202/02 P, C-205/02 P to C-208/02 P and C-213/02 P *Dansk Rørindustrie A/S and others v Commission* [2005] ECR I-5425 para. 202.

[30] Cf. 438 U.S. 422, 435 (1978): "We agree with the Court of Appeals that an effect on prices, without more, will not support a criminal conviction under the Sherman Act […]. [A] defendant's state of mind or intent is an element of a criminal antitrust offense which must be established by evidence and inferences drawn therefrom, and cannot be taken from the trier of fact through reliance on a legal presumption of wrongful intent from proof of an effect on prices." As to the required standard of intent the Court concluded id., at 444, "that action undertaken with knowledge of its probable consequences and having the requisite anti-competitive effects can be a sufficient predicate for a finding of criminal liability under the antitrust laws."

[31] See Article 23(2)(a) Council Regulation (EC) No 1/2003 of 16 December 2002 on the implementation of the rules on competition laid down in Articles 81 and 82 of the Treaty, Official Journal L 1, 04.01.2003, p. 1-25.

[32] For a meta-study on cartels' features see Harrington (2006) and Levenstein and Suslow (2006). For a survey on price fixing in particular see Hay and Kelley (1974). For an analysis of the determinants of cartel duration see Levenstein and Suslow (2011).

Precisely these elements of behavior are the focus of our approach to provide evidence of anti-competitive behavior.

3   Empirical Evidence

Academic forensic economics and finance[33] has long applied its tools in a number of areas to reveal conduct that agents strive to conceal. Some of the most prominent examples include teachers cheating in exams (Jacob and Levitt, 2003), violations of U.N. sanctions (DellaVigna and La Ferrara, 2010), and racial biases in employment decisions (Bertrand et al., 2005). This research is methodologically related to our topic of empirical cartel detection as econometrics is employed to provide evidence of hidden wrongdoings. In academic forensic economics and finance researchers use their knowledge about incentive schemes on observable variables, e.g. prices, in order to derive statistical tests to compare distinct hypotheses, e.g. collusion versus competition.

While a test hypothesis for teachers to raise students' test scores or employment discrimination on the basis of race can be clearly defined, what should constitute an appropriate test for collusion? In line with the literature on economic screens (see Abrantes-Metz and Bajari, 2009) we believe that the answer lies in economic theory and empirical evidence on cartel behavior.[34]

Since the foundational work by Stigler (1964) who highlighted firms' incentive to cheat as the preeminent challenge faced by cartels, much research has been carried out on "pricing structures" which can sustain a collusive outcome.[35] The two key strategic aspects that are relevant for our analysis are the use of sticky and leadership pricing as a facilitating device to sustain collusion. With respect to price leadership we base our analysis on the models developed by Rotemberg and Saloner (1990) and Mouraviev and Rey (2011). With respect to price stickiness we rely on theoretical findings by Athey and Bagwell (2001, 2008), Athey et al. (2004), Hanazono and Yang (2007) and Garrod (2012), and empirical insights by Abrantes-Metz et al. (2006), Blanckenburg et al. (2012) and Connor (2005) who show that price stickiness is associated with collusive behavior.

3.1 The Facts of the Case

On 6th October 2004, ENI, the market leader in the Italian gasoline market, publicly announced the adoption of a new pricing policy. ENI declared that the purpose of this policy was to lower

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[33] For a review of forensic economics and finance see Zitzewitz (2012) and Ritter (2008), respectively.

[34] See for example Bajari and Ye (2003) who develop an approach to identify and test for bid rigging in procurement auctions. For a general discussion of methods to detect collusion see Porter (2005), Harrington (2008b) and Rey (2007).

[35] See, for example, Green and Porter (1984), Rotemberg and Saloner (1986) and Maskin and Tirole (1988).

the short-term price-cost relation and to stabilize retail prices.[36] As the volatility of crude oil was increasing, ENI claimed that the policy aimed at lowering the retail price variability and would benefit customers. The new policy consisted in a reduction of the number of price changes (i.e. sticky pricing), and increased the magnitude of each variation. ENI increased the average time lag between price changes from 6 to 16 days and increased the mean price change from 1% to 5.8%. The result of this declaration can be seen in **Figure I**, which shows the daily price per company over time before and after the new pricing policy was introduced. Before the policy firms' price changes were frequent. On average, firms changed their prices every five days. The average price change was .8% before the policy change. After the new pricing policy was introduced, price changes occurred infrequently, on average every 9 days, but their amount became larger, namely 2.9% on average.

As a result, all but one competitor, ERG,[37] followed ENI's new pricing strategy. About five months later in March 2005, the Italian Truckers' Association, FITA, complained to the Italian antitrust authority about high and aligned prices.[38] This eventually led to an investigation by the antitrust authority for price fixing under Article 14 of Law 287/90 of 10 October 1990, the Italian legislation which restates Article 101 TFEU. The Italian antitrust authority claimed that the petrol firms' conduct of adapting their prices to the leader's price had to be considered a collusion to stabilize prices and to coordinate price changes.[39] The high transparency in the market facilitated an exchange of price information. Firms may easily observe their competitors' prices at each gas station and Italian law required weekly price communications to the Ministry of Industry which subsequently published the data. In addition and more importantly, companies communicated future price changes to a specialist Italian magazine, "Staffetta Quotidiana," which published all price change announcements on its website. Cost transparency also facilitated coordination. The major source of cost is the Platts Cif Med,[40] the wholesale price refineries charge in the Mediterranean area for gasoline. This price can be thought of as the opportunity cost of companies to sell their gasoline on the Mediterranean wholesale market rather than to gas stations. It thus con-

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[36] Autorità Garante della Concorrenza e del Mercato, 18.1.2007, Case I681 – *Prezzi dei carburanti in rete,* Provvedimento no. 16370, Section VI, para. 42, available at http://www.agcm.it.

[37] ERG publicly declared that it would not follow ENI's new pricing and stick to their own method which it did not further specify, see Autorità Garante della Concorrenza e del Mercato, 18.1.2007, Case I681 – *Prezzi dei carburanti in rete,* Provvedimento no. 16370, Section VI, para. 41.4, available at http://www.agcm.it.

[38] Autorità Garante della Concorrenza e del Mercato, 18.1.2007, Case I681 – *Prezzi dei carburanti in rete,* Provvedimento no. 16370, Section I, para. 1, available at http://www.agcm.it.

[39] Autorità Garante della Concorrenza e del Mercato, 18.1.2007, Case I681 – *Prezzi dei carburanti in rete,* Provvedimento no. 16370, Section VIII, paras. 58 and 59, available at http://www.agcm.it.

[40] The Platts company is a leading global provider of energy information that collects and publishes on a daily basis details on the prices of bids and offers for specialized oil products and regions from traders and exchange platforms.

stitutes industry practice[41] to compute firms' margins as the difference between their (suggested) consumer price and the Platts Cif Med.

It is important to note that the antitrust authority had no proof of direct communication between the firms, other than the price changes the firms communicated via the aforementioned online magazines. The authority claimed that ENI's policy created a focal price used to facilitate coordination. ENI's sticky pricing lowered competitors' uncertainty about the future pricing while the large price variations helped to coordinate price changes.[42]

3.2 Sticky Pricing

Sticky pricing constitutes an important element in a strategy to sustain collusion. An advantage of rigid pricing is that it is straightforward to implement and that deviations can be easily detected and punished. A series of studies (Athey and Bagwell, 2001, 2008, Athey et al., 2004, Hanazono and Yang, 2007, and Garrod, 2012) analyze the profit maximizing scheme of cartels under different settings and find a direct relation between optimal collusive schemes and rigid pricing.[43] For example, Athey and Bagwell (2008) show that when firms are moderately patient the equilibrium that maximizes ex-ante profits is relatively simple: all firms adopt a sticky pricing scheme and charge the consumers' reserve.[44] In this equilibrium colluding firms adjust their prices infrequently, and thus sacrifice productive efficiency to sustain a higher price level in the market.

In fact most empirical studies conclude that prices are more rigid when the industry is in a collusive phase (Abrantes-Metz et al., 2006, Blanckenburg et al., 2012, and Connor, 2005). A key example is the study by Abrantes-Metz et al. (2006) on the frozen perch market. Using ex-post evidence of collusion the authors find that the price variance during collusion was indeed distinctly lower than the price variance in the period after the end of the cartel. In a meta-study Blanckenburg et al. (2012) compare the distribution of price changes between competition and collusion for 11 cartels. They find that the price variance decreased significantly in 8 out of 11 examined cartels.

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[41] See, for example, the definition of the gross margin by the Italian Petrol Union who defines it as the difference between the retail price net of taxes and the Platts Cif Med, available at
http://www.unionepetrolifera.it/it/show/34/La%20struttura%20del%20prezzo.

[42] Autorità Garante della Concorrenza e del Mercato, 18.1.2007, Case I681 – *Prezzi dei carburanti in rete,* Provvedimento no. 16370, Section VIII paras. 60-63; available at http://www.agcm.it.

[43] Rigid pricing is defined as firms pricing independently of their current cost position.

[44] With other parameter configuration other (more complex) type of equilibria are possible.

A shortcoming of sticky pricing models is that they do not address *how* colluding firms react and coordinate to exogenous cost and demand changes. In section 3.3 we will describe how firms in our case used the leader's price as the focal price.

3.3   Leadership Pricing

Price leadership is "one of the most important institutions facilitating tacitly collusive pricing behavior" (Scherer and Ross, 1990, p. 346). Theoretical evidence has been presented by Rotemberg and Saloner (1990) who demonstrate that price leadership facilitates collusion under asymmetric information and that it increases price rigidity. The authors conclude that such a pricing scheme has many positive attributes: First, it is easy to implement, second, it doesn't require communication and third, it is very easy to detect (and punish) deviations.

In line with these findings Mouraviev and Rey (2011) study the role of price or quantity leadership under circumstances where firms can act either simultaneously or sequentially in an infinitely repeated setting for both Bertrand and Cournot competition. They highlight that leadership facilitates collusion. Firms competing on prices a la Bertrand can use price leadership to sustain (perfect) collusion for any value of the discount factor while leadership is less effective with quantity competition a la Cournot.

Both papers convey an important implication for antitrust policy: if firms are able to tacitly collude using price or quantity leadership, the negative effects on welfare are essentially the same compared with cases of explicit collusion. The way firms collude is not decisive for the negative effect collusion has on consumers' welfare. In addition, both papers show how leadership pricing can be used to implement an anticompetitive strategy in the market as it facilitates coordination and makes deviation more visible.

3.4   Key empirical findings

Based on the previous finding of the role of sticky and leadership pricing to sustain collusion and on the effects of collusive agreements on prices, we show that ENI's pricing behavior facilitated price coordination and led to a price increase.

Table 1 shows the different pricing conduct firms adopted after ENI's price commitment. In Panel A we summarize the frequency and magnitude of price changes. Columns 3 and 5 show the differences in the pre and post mean of these variables and thus test whether the pricing behavior significantly changed after ENI's policy. ENI significantly increased the time lag between price changes from one every 6 days to one every 16 days. This difference is significant at the 1% level and shows that ENI did hold its price commitment as publicly announced on 4th October 2004.

In addition, the leader increased the absolute mean price change from 1% to 5.8%. This 4.8% increase is statistically significant at the 1% level. Similar results hold true for all firms. The average time lag between price changes increased from five to nine days, while absolute price changes increased from .8% to 2.9%, both significant at the 1% level. Theoretical literature discussed above suggests that large price changes might have been used to coordinate price changes on the leader's focal price. Panel B tests this hypothesis and shows whether the average number of perfectly aligned competitors (i.e. up to three digits) to the leader and the average price difference of competitors to ENI significantly changed after ENI's new pricing policy. In line with the collusive hypothesis the number of aligned competitors significantly increased and the average price difference to the leader significantly decreased after the policy.

In addition to the price coordination adopted by firms we report the key coefficients on the causal effect of the policy on prices and margins from AVF in **Table 2**. Specification 1 shows the result of the dif-in-dif model with standard errors clustered at the country level. In this regression weekly prices of eight EU countries[45] were used as a control group.[46] The estimate on the dif-in-dif effect of the policy on Italian prices is positive and highly significant. As one might question the subjective selection and the sufficient similarity of the control group, in specification 2 AVF first construct an "optimal" data-driven benchmark (i.e. a synthetic control group) and then take the weekly difference between the Italian price and the "optimal benchmark" as the (stationary) dependent variable. The synthetic control group estimation was developed by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) and is constructed using a data-driven weight of European prices that minimizes the pre-treatment differences between the Italian price and the resulting synthetic control group. Consistent with specification 1 we find a positive and significant effect of the policy on prices. Finally, specification 3 shows the within market regression of firm-level margins (i.e. without benchmark) which also points to a positive and significant effect of the new policy on firms' profits.[47]

The results of the econometric analysis show that ENI's policy had two effects: first, it facilitated price coordination and second, it increased average prices.

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[45] EU countries differ with respect to Italy, e.g., in the number of gas stations owned by hypermarkets that compete aggressively to attract customers to their stores. Using state-level data of U.S. gasoline prices, Zimmerman (2012) shows the positive competitive impact of hypermarket retailers. The dif-in-dif analysis as carried out in AVF assumes that "market trends" would be the same in the treatment and control group while structural country specific market differences are captured by the fixed effects.

[46] For a plot of average weekly prices in Italy and the EU and the Brent see **Figure II**.

[47] Both specification (2) and (3) were performed using robust standard errors.

3.5 Discussion and Robustness of the Empirical Results

In oligopolistic markets the way firms interact with their competitors determines their profits. Our empirical analysis shows that the *ex-post* effect of the leader's (credible) commitment to sticky pricing was an equilibrium with higher prices.

ENI's success in the implementation of a collusive scheme depended on the individual incentives for its competitors to adhere. The first issue that arises, therefore, is whether it is reasonable to think that the leader could expect *ex ante* that its competitors would adopt its pricing and that this would cause an increase in prices.

Firms' behavior is a key element of managerial choice. Spagnolo (2005) shows that typical compensation schemes for CEOs are designed to incentivize tacit collusion at the cost of "income smoothing".[48] In addition, managers are aware of or are at least well-advised of strategic behavior that favours collusion.[49] Since the seminal work by Schelling (1960) it is common knowledge that commitment lies at the heart of strategic behavior.[50] If competing firms could write enforceable contracts on prices, most industries would collude. However, as explicit collusion is illegal and the decision to communicate is endogenous, firms may opt for tacit collusion instead. Yet any collusive strategy must be incentive compatible, irrespective of whether it is implemented explicitly or tacitly. After its announcement on 6th October 2004, ENI kept prices fixed until 3rd December 2004 (57 days), see **Figure I**. This means that ENI kept sticky prices for almost 10 times the usual price-change interval (6 days) irrespective of cost changes. Just after ENI's announcement costs increased and its competitors kept cost-based pricing. As costs fell again competitors started to align to ENI at the beginning of November, i.e. about a month after ENI's change in pricing policy. We can only speculate about what would have happened if costs *had risen* after ENI's announcement. However, it clearly emerges both from **Figure I** and from the price-interdependence analysis that ENI strongly committed itself to sticky pricing. As can be inferred from Table 2, specification (3), ENI's competitors' behaved in their best interest as industry margins increased. ENI emerged *endogenously* as the price leader through its use of market power and

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[48] Spagnolo (2005) focuses on the role of observable CEO compensation schemes with regard to tacit collusion. He concludes that "a strong pro-collusive effect may well outweigh agency costs and transform apparently puzzling compensation practices into profitable 'governance' instruments."

[49] One of the standard textbooks used in MBA courses that deal with competitive strategy is "Economics of Strategy" by Besanko et al. (2010). Chapters 9 and 10 extensively deal with the issues of "Strategic Commitment" and "The Dynamics of Pricing Rivalry", respectively, which are key elements to sustain collusion. Under the heading "The golden age of micro", the journal "The Economist" discussed in its issue of 19th October 2012 why leading academic microeconomists are top advisers at firms such as Microsoft and Amazon.

[50] Maskin and Tirole (1988) build commitment in a dynamic Bertrand model through exogenous costs such as menu costs. They show that sticky prices can serve as a commitment device to sustain higher prices than under static Bertrand. Recently, Wang (2009) studied firms' pricing strategies in a gasoline market before and after the introduction of a law which regulated firms' timing of price changes. As a result, he highlighted the importance of short-run price commitment in tacit collusion.

then used its position to coordinate the price changes of its competitors, which ultimately caused a price increase. While each market has its traits and results from an individual market cannot be easily generalized, leadership pricing has been consistently associated with collusion. The empirical results of AVF provide large evidence that ENI's strategy aimed at coordinating and increasing prices at the expense of consumers.

A second concern which arises is where to set the boundaries between a firm's freedom to set its profit-maximizing price on the one hand, and antitrust authorities' power to prevent certain behaviour that results in supra-competitive pricing on the other. To address this issue we need to distinguish the "source" of market power which made that market outcome possible. In this respect it is helpful to compare our empirical results with Borenstein et al. (2002) who analyse inefficiencies in the restructured Californian electricity market. They find that wholesale electricity expenditures increased in the summer of 2000 with respect to the summer of 1999 from $2.04 billion to $8.98 billion and that about 59% of this increase was caused by the exercise of unilateral market power.

Both the Italian gasoline market and the Californian electricity market suffered from higher prices. However, there is a key difference: in California market power stemmed from exogenous shocks. Electricity prices were relatively low compared to a benchmark in 1998 and 1999 but dramatically increased in the summer of 2000. While there are many structural factors that make it easy for electricity firms to exercise market power, such as binding constraints at peak times or difficulties to forecast demand and high storage costs, firms did not actively implement a new strategy to coordinate and increase their prices but rather *individually* best-responded to shocks which favored the exercise of market power. Among many factors Borenstein (2002) identifies that 2000 was a very dry year which reduced hydroelectric production, economic growth throughout the western United States increased demand for energy, and the price of nitrogen oxide pollution permits increased from about $1 per pound to over $30 per pound which increased the price of gas.

In the Californian electricity market regulation should address the structural problems which have been revealed by the incidents in the summer of 2000. However, insofar as the firms only best-responded to exogenous shocks, their conduct should not be addressed by cartel enforcement. In contrast, our analysis reveals the active implementation of a collusive strategy by one firm which resulted in an anticompetitive market outcome and thus, should be targeted by antitrust enforcement.

4   Integrating Economic Insights on Collusive Strategies into the Legal Framework

As any collusion between competitors may result in welfare losses, it is essential to strive to contain collusive behavior irrespective of direct evidence of a "meeting of minds" or explicit communication between firms. It remains, however, an outstanding question how economics may be integrated with the legal framework and how antitrust law should be developed to counter tacit collusion.

There are several reasons to believe that this challenge deserves more attention than ever. First of all, prevalence of tacit collusion may increase in times of globalization. Information on competitors' actions as capacity choices, prices and transactions are widely reported by international media and thus, transparency increases. Firms interact on many markets which increases their scope to collude. Secondly, market players must not be regarded as naïve, but as professionally advised and capable of employing economic know-how strategically to avoid price wars, and to reach collusive equilibria instead. Thirdly, the introduction of leniency or other types of immunity programs increased the capability of antitrust authorities to produce direct evidence of collusion such as documents or insider testimony, and thus has significantly strengthened the effectiveness of the law to counter collusive behavior that occurs via explicit communication.[51] As the decision to communicate is endogenous to market players, leniency programs have increased firms' cost of following such a strategy. This is likely to cause or to have already caused a shift from explicit to tacit collusion.

These are grounds to expect that social welfare damage caused by tacit collusion will increase. Legal instruments that are supposed to work preventively against collusion such as merger control or (quasi-)regulatory mechanisms which address the unwanted effects of collusion will hardly suffice to counter tacit collusion effectively. It appears to be crucial, therefore, that antitrust law finds a way to target those elements of behavior that are employed by firms to implement a collusive strategy and whose collusive character may be demonstrated by the kind of analysis as suggested in this article. Inasmuch as it appears inadequate to regard such behavior as an illegal *coordination*, this calls for a development of the law against *unilateral* anticompetitive conduct.

4.1 "Unilateral Collusion" and Unlawful Coordination

Price leadership may serve as a mechanism to find a consensus about the collusive price, a challenge any cartel faces. However, since leader-follower behavior may equally be the result of oligopolistic competition, its mere observation must not suffice to infer a collusive agreement. This

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[51] For a theoretical discussion of leniency see Motta and Polo (2003) and Harrington (2008a). Empirical evidence on the effects of leniency is provided by Miller (2009).

raises the question of whether under circumstances such as those in the present case, i.e. where it may be demonstrated that leader-follower behavior sustained a collusive equilibrium, such conduct should be considered illegal. In other words, should the kind of evidence presented herein be regarded a "super plus factor"[52] that allows courts to infer an illegal (tacit) agreement?

If certain conduct of two or more firms is conceptualized as an unlawful *coordination*, i.e. a violation of, for example, Section 1 Sherman Act or Article 101(1) TFEU, this implies that the law regards the behavior of these firms as a wrongdoing which may be punished. In other words, where a certain collusive equilibrium has been brought about by the unilateral collusive conduct of one firm, one should only infer a punishable agreement if one also considered the competitors' reactions as inappropriate behavior. Turning again to the general regulatory and legal requirements we formulated above with regard to antitrust enforcement,[53] we may recall that antitrust standards and remedies should address specific elements of behavior and that market operators should be provided with an idea of which conduct may be regarded as acceptable or not acceptable under defined market conditions. Such standards of conduct must be in line with the general purpose of antitrust law to foster effective competition. Thus, if tacit price alignment in response to unilateral collusive conduct ought to be prohibited, the law has to define how firms should behave once a competitor's conduct may be interpreted as a (tacit) invitation to engage in (tacit) collusion. When ENI held prices constant despite of cost increases and thereby signaled its commitment to a policy of sticky pricing, this might be viewed as a "suggestion" to its competitors to align their pricing policy and as an "offer" to take on the role as price leader. Should ENI's competitors have been legally obliged to refrain from any market conduct that ultimately could have been regarded as having brought about a collusive equilibrium and thus proof of an underlying illegal agreement?

It seems not feasible to define any meaningful and administrable legal standard of conduct in this respect. Should it have been forbidden for ENI's competitors to tacitly align their prices to ENI's policy of sticky pricing? Should they have been obliged to stick to their higher prices and with open eyes to put up with losing market share? And even if an alignment of pricing to the strategy of a price leader such as ENI was prohibited, the question would remain *how closely* and *how quickly* a competitor would be allowed to adjust its market parameters. In the absence of any clear standard of behavior, a legal intervention in situations of (supposedly) collusive pricing may ultimately

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[52] Kovacic et al. (2011), p. 435, offer a list of "super plus factors" which includes *inter alia* "[a] reliable predictive econometric model that accounts for all material noncollusive effects on price, estimated using benchmark data where conduct was presumed noncollusive, produces predictions of prices that do not explain the path of actual prices in the period or region of potential collusion, at a specified high confidence level."

[53] See supra section 2.

amount to judicial price regulation. In addition, under such a legal regime a market player could strategically restrict the competitive room for manœuvre of its competitors: if it was prohibited for ENI's competitors to align its pricing to ENI's strategy because such an alignment would be regarded an illegal coordination, ENI could have restricted the price-setting freedom of its competitors by implementing its strategy of sticky pricing.

These considerations point to the heart of the regulatory problem with regard to "unilateral collusion." The reaction of ENI's competitors to ENI's pricing policy must be regarded as mere best response. Their behavior is an expression of mere oligopolistic interdependence, even though they benefitted from the higher price level in the market. Consequently, a passive adaptation to collusive market conduct should not be considered illegal but part of functioning oligopolistic competition. Thus, collusive leader-follower behavior must not be conceptualized as a form of unlawful *coordination,* and thus illegal according to Section 1 Sherman Act or Article 101(1) TFEU. Antitrust law should instead target *unilateral* collusive behavior that facilitates "best response" which leads ultimately to collusion.

This appraisal of collusive leader-follower behavior appears to be in line with the treatment of non-conspiring firms that adjust their prices in reaction to a price increase by cartelizing competitors. Such a constellation is generally referred to as "umbrella pricing" since the nonparticipant benefits from the "price umbrella" spread by its cartelizing rivals.[54] This metaphor somewhat obscures the interdependence between the optimal cartel price and the behavior of the firms outside the circle of cartel participants. Nevertheless, even if the conduct of a non-cartelist is in fact in accordance with the collusive strategy of the cartel, "umbrella pricing" is generally regarded as being innocent per se, and the legal discussion circles only around the question of whether customers of nonparticipants may recover damages from the cartelists.[55] Thus, notwithstanding that "umbrella pricing" contributes to sustain collusive equilibria, antitrust law does not require market operators to abstain from a best-response strategy in reaction to their competitors' pricing. The law refrains from imposing on non-cartelists a duty to keep prices constant (or at least at a lower level than the cartel price) which would effectively amount to a duty to increase output to offset the cutback of conspiring competitors.

If we accept therefore that there are valid economic and regulatory reasons why collusive leader-follower behavior such as the pricing alignment by ENI's competitors should not be considered

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[54] Areeda and Hovenkamp (2007), §347, p. 198.

[55] Several courts have recognized such claims for "umbrella damages," see, for example, *Loeb Indus., Inc. v. Sumitomo Corp.,* 306 F.3d 469 (7th Cir. 2002); *In re Beef Indus. Antitrust Litig.,* 600 F.2d 1148 (5th Cir. 1979).

as participation in an illegal coordination, it seems consequent that the law should instead target ENI's decision to implement a collusive strategy.

4.2 Developing the Legal Framework: Targeting Unilateral Conduct with Collusive Impetus

Unilateral conduct that has as its object or effect to promote (tacit) collusion ought to be prevented. Based on findings of the collusive potential of sticky pricing we have proved empirically that ENI employed such a pricing policy successfully to bring about a collusive equilibrium in the Italian gasoline market. But is there a feasible way of legal intervention? Should we ban a firm from implementing a policy of sticky pricing because it may facilitate collusion and punish the firm in case of an infringement?

There would be nothing inherently new in prohibiting a certain pricing behavior. Market dominant firms are not allowed to engage in predatory pricing. And just as it has to be defined with regard to a specific industry whether a certain pricing policy has to be considered "predatory," courts would also have to define "sticky pricing" industry-specifically as infrequent price changes in response to changes of input costs or demand patterns. Thus, we propose to adopt a doctrine according to which *inter alia* the implementation of sticky pricing along with large price changes would be prohibited under market conditions where it may be expected that price leadership will emerge as a price coordinating mechanism and thus, such a pricing strategy will bring about collusion. This is particularly relevant for oligopolies with price and cost transparency where structural market features favor collusion and at the same time communication might be less needed.

These requirements would have been fulfilled in ENI's case. The Italian gasoline market[56] was characterized by features that indicate its conduciveness to tacit collusion, such as its concentrated oligopolistic market structure, a high price transparency and entry barriers etc. More specifically, due to its market share of about 35 percent and the asymmetric distribution of market shares in the Italian petrol industry, ENI clearly held the position as market leader. Thus, its commitment to a strategy of sticky pricing resulted in a credible signal to its competitors and entailed a strong potential to encourage them to align their pricing in order to bring about a collusive equilibrium.

In suggesting that a certain market practice should be prohibited depending on its *potential* to restrict competition *under particular market conditions* we propose nothing revolutionary. An exchange of information between competitors, for example, does not necessarily restrict competition and

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[56] See supra section 3.1 and 3.2.

may even be regarded as procompetitive. However, under particular market conditions it may seriously endanger the competitive process as it allows firms to coordinate their behavior and thus, may be considered an illegal facilitative practice.[57] A corresponding regulatory response should be conceivable in cases of unilateral practices which entail an equal potential to facilitate collusion. Turning to antitrust provisions which address firms' unilateral behavior, we need to recognize, however, that the law appears to be fragmented – to say the least – when it comes to conduct whose object or effect it is to promote collusion. Neither Section 1 Sherman Act nor Article 101 TFEU embodies an offense of *attempted* coordination. Section 2 Sherman Act and Article 102 TFEU, the essential provisions on unilateral conduct, apply generally[58] only to firms with monopoly power or to firms that dominate a market, respectively, and thus based on criteria which typically exclude single oligopolists.

In line with the approach suggested in this article, the Federal Trade Commission (FTC) strove already to tackle unilaterally adopted (supposedly) facilitating practices under Section 5 FTC Act.[59] This ambition received a decisive blow from the decision of the Court of Appeals for the Second Circuit in the *Du Pont (Ethyl)* case.[60] In *Ethyl* the FTC blamed four producers of gasoline antiknock compounds of having unilaterally adopted practices that were aimed at facilitating parallel pricing at a supra-competitive level. These practices included 30-day advance announcements of price changes, "most favored nations" clauses in sales contracts, and uniform delivered prices.[61] The Court, however, held that the evidence presented by the FTC did not sufficiently support the view that these practices did indeed have an anticompetitive purpose or effect.[62] Econometric evidence as suggested in this article could fill such gaps by relating a specific practice with a certain market outcome. With adequate firm level data and a benchmark an antitrust

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[57] See, for example, ECJ, 23.11.2006, Case C-238/05 *Asnef-Equifax,* [2006] ECR I-11125, para. 54: "[…] the compatibility of an information exchange system […] with the [EU] competition rules cannot be assessed in the abstract. It depends on the economic conditions on the relevant markets […] as well as the type of information exchanged […] and its importance for the fixing of prices, volumes or conditions of service."

[58] Unilateral use of facilitative practices to sustain collusion by a firm that is not individually market dominant could be regarded as an abuse of collective dominance under Article 102 TFEU. But there is no established doctrine to that effect. Under Section 2 Sherman Act it is the prohibition of any "attempt to monopolize" which broadens the scope and which may allow catching unilateral conduct of firms that individually do not hold a monopoly position. Thus, in *United States v. American Airlines, Inc.,* 743 F.2d 1114 (5th Cir. 1984), an explicit invitation to collude was considered an infringement of Section 2 Sherman Act as the court considered the aggregate market share of offeror and offeree. Besides, explicit attempts to initiate collusion have been charged as violation of the wire fraud or mail fraud statutes, see, e.g., *United States v. Ames Sintering Co.,* 927 F.2d 232 (6th Cir. 1990).

[59] The U.S. Supreme Court had recognized that this provision may comprise anticompetitive conduct beyond the Sherman Act, see, e.g., *FTC v. Indiana Federation of Dentists,* 476 U.S. 447, 454 (1986); *FTC v. Sperry & Hutchinson,* 405 U.S. 233, 244 (1972); FTC v. Brown Shoe Co., 384 U.S. 316, 320-321 (1966).

[60] *E.I. Du Pont De Nemours & Co. v. FTC (Ethyl),* 729 F.2d 128 (2d Cir. 1984).

[61] Id. at 133.

[62] Id. at 139-140.

authority or a court may test whether or not (supposedly) facilitative practices contributed to a supra-competitive price level.

This shows on the one hand that advanced economic methods may support an effective use of available legal instruments to counter unilateral behavior which has as its object or effect to promote collusion. On the other hand, the analysis reveals a significant gap in the arsenal of antitrust enforcement when it comes to targeting unilateral conduct that serves a collusive strategy. Thus, under the current legal framework the potential of advanced economics to identify the collusive character of specific elements of behavior may not be fully realized. It seems therefore essential to strengthen legal instruments that frustrate unilateral conduct through which firms strive to promote or sustain collusion.

5   Conclusion

Collusion in oligopolistic markets has been a perennial topic both for economics and antitrust law. Antitrust law rests on economic welfare analysis which shows that collusion inflicts substantial negative welfare effects. However, antitrust authorities and private plaintiffs are substantially restricted in their fight against collusion as they much depend on evidence of explicit communication between competitors. The mild reaction of the Italian antitrust authority to the incidents on the Italian gasoline market illustrates the limits of antitrust enforcement in the absence of such evidence.

The crucial role attributed to explicit communication in the practice of antitrust enforcement hinders the detection and punishment of cartels precisely in those industries where the collusion rate is expected to be relatively high and communication appears to be less needed. Theoretical and empirical findings on cartel behavior provide a basis to derive clear test hypotheses to distinguish (lawful) oligopolistic interdependence from (tacit) collusion. On that basis, econometric evidence may step in and reveal collusive strategies behind firms' actions. Thus, it entails the potential to decisively increase the effectiveness of cartel enforcement in oligopolistic markets.

Analyzing the incidents on the Italian gasoline market where the market leader announced it was changing its pricing strategy reveals how firms might use their market power to facilitate price alignment and coordinate price changes. To be more specific, the econometric analysis by Andreoli-Versbach and Franck (2013) reveals just *how* the leader's sticky pricing policy coordinated prices, and its *effect* on the price levels with respect to a benchmark. After the new policy was implemented, all competitors adjusted their prices following the leader's price changes. In addition the new pricing behavior resulted in a significant price increase. Combined, this price coordina-

tion mechanism and its effect show that it was the object and effect of the introduced pricing policy to collude through facilitating price coordination and to raise prices.

Whilst antitrust enforcement may certainly benefit from an enhanced economic methodology to identify tacit collusion, antitrust law cannot straightforwardly prohibit the participation in tacit collusion as a form of illegal coordination. The active promotion of collusive pricing by ENI and the passive (best response) alignment of its competitors must not be normatively equated. Thus, antitrust law should not infer a punishable (tacit) agreement between ENI and its competitors from the collusive market outcome, but should instead consider conduct such as ENI's pricing strategy as being a unilateral anti-competitive practice. To effectively fight tacit collusion it appears therefore to be necessary to strengthen legal instruments that target unilateral conduct which firms strategically employ to promote or sustain collusion.

References

Abadie, Alberto, and Javier Gardeazabal (2003). The Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review* 93(1), 113–132.

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller (2010). Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association* 105(490), 493–505.

Abrantes-Metz, Rosa M., and Patrick Bajari (2009). Screens for Conspiracies and Their Multiple Applications. *Antitrust Magazine* 24(1), 66–71.

Abrantes-Metz, Rosa M., Luke M. Froeb, John F. Geweke, and Christopher T. Taylor (2006). A Variance Screen for Collusion. *International Journal of Industrial Organization* 24(3), 467–486.

Andreoli-Versbach, Patrick, and Jens-Uwe Franck (2013). Endogenous Price Commitment, Sticky and Leadership Pricing: Evidence from the Italian Petrol Market. *Working Paper*.

Areeda, Phillip E., Roger D. Blair, Herbert Hovenkamp, and Christine Piette Durrance (2007). *Antitrust Law*. Vol. IIA, 3rd ed., Wolters Kluwer.

Areeda, Phillip E., and Herbert Hovenkamp (2010). *Antitrust Law*. Vol. VI, 3rd ed., Wolters Kluwer.

Athey, Susan, and Kyle Bagwell (2001). Optimal Collusion with Private Information. *RAND Journal of Economics* 32(3), 428–465.

Athey, Susan, Kyle Bagwell, and Chris Sanchirico (2004). Collusion and Price Rigidity. *Review of Economic Studies* 71(2), 317–349.

Athey, Susan, and Kyle Bagwell (2008). Collusion with Persistent Cost Shocks. *Econometrica* 76(3), 493–540.

Bajari, Patrick, and Lixin Ye (2003). Deciding between Competition and Collusion. *Review of Economics and Statistics* 85(4), 971–989.

Bertrand, Marianne, Dolly Chugh, and Sendhil Mullainathan (2005). Implicit Discrimination. *American Economic Review* 95(2), 94–98.

Besanko, David, David Dranove, Mark Shanley, and Scott Schaefer (2010), *Economics of Strategy*. 5th ed., Wiley.

Blanckenburg, Korbinian von, Alexander Geist, and Konstantin Kholodilin (2012), The Influence of Collusion on Price Changes: New Evidence from Major Cartel Cases. *German Economic Review* 13(3), 245–256.

Bolotova, Yuliya V. (2009). Cartel overcharges: An empirical analysis. *Journal of Economic Behavior & Organization* 70(1-2), 321–341.

Borenstein, Severin (2002). The Trouble with Electricity Markets: Understanding California's Restructuring Disaster. *Journal of Economic Perspectives* 16(1), 191–211.

Borenstein, Severin, James B. Bushnell, and Frank A. Wolak (2002). Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market. *American Economic Review* 92(5), 1376–1405.

Christie, William G., and Paul H. Schultz (1994). Why Do Nasdaq Market Makers Avoid Odd-Eighth Quotes? *Journal of Finance* 49(5), 1813–1840.

Connor, John M. (2005). Collusion and Price Dispersion. *Applied Economics Letters* 12(6), 335–338.

Connor, John M. (2007). Price-fixing overcharges: Legal and economic evidence. In Richard O. Zerbe and John B. Kirkwood (eds.), *Research in Law and Economics* 22, 59–153.

DellaVigna, Stefano, and Eliana La Ferrara (2010). Detecting Illegal Arms Trade. *American Economic Journal: Economic Policy* 2(4), 26–57.

Duso, Tomaso, Lars-Hendrik Röller and Jo Seldeslachts (2012). Collusion through Joint R&D: An Empirical Assessment. *Review of Economics and Statistics*, forthcoming.

Fonseca, Miguel A., and Hans-Theo Normann (2012). Explicit vs. Tacit Collusion – The Impact of Communication in Oligopoly Experiments. *European Economic Review*, forthcoming.

Fudenberg, Drew, and Jean Tirole (1991). *Game theory*. MIT Press.

Gavil, Andrew I., William E. Kovacic, and Jonathan B. Baker (2008). *Antitrust Law in Perspective*. 2nd ed., Thomson West.

Garrod, Luke (2012). Collusive Price Rigidity under Price-Matching Punishments. *International Journal of Industrial Organization* 30(5), 471–482.

Genovese, David, and Wallace P. Mullin (2001). Rules, Communication, and Collusion: Narrative Evidence from the Sugar Institute Case. *American Economic Review* 91(3), 379–398.

Green, Edward J., and Robert H. Porter (1984). Noncooperative Collusion under Imperfect Price Information. *Econometrica* 52(1), 87–100.

Hanazono, Makato, and Huanxing Yang (2007). Collusion, Fluctuating Demand, and Price Rigidity, *International Economic Review* 48(2), 483–515.

Harrington, Joseph E., Jr. (2006). How Do Cartels Operate? *Foundations and Trends in Microeconomics* 2(1), 1–105.

Harrington, Joseph E., Jr. (2008a). Optimal Corporate Leniency Programs. *Journal of Industrial Economics* 56(2), 215–246.

Harrington, Joseph E., Jr. (2008b). Detecting Cartels. In Paolo Buccirossi (ed.), *Handbook in Antitrust Economics*, MIT Press, 213–258.

Hay, George A. (2000). The Meaning of "Agreement" Under the Sherman Act: Thoughts from the "Facilitating Practices" Experience. *Review of Industrial Organization* 16(2), 113–129.

Hay, George A., and Daniel Kelley (1974). An Empirical Survey of Price-Fixing Conspiracies. *Journal of Law and Economics* 17(1), 13–38.

Hobbes, Thomas (1651/1959). *Leviathan*. J.M. Dent & Sons.

Jacob, Brian A., and Steven D. Levitt (2003). Rotten Apples: An Investigation of the Prevalence and Predictors of Teachers Cheating. *Quarterly Journal of Economics* 118(3), 843–877.

Kovacic, William E., Robert C. Marshall, Leslie M. Marx, and Halbert L. White (2011). Plus Factors and Agreement in Antitrust Law. *Michigan Law Review* 110(3), 393–436.

Kaplow, Louis (2011a). An Economic Approach to Price Fixing. *Antitrust Law Journal* 77(2), 343–449.

Kaplow, Louis (2011b). On the Meaning of Horizontal Agreements in Competition Law. *California Law Review* 99(3), 683–818.

Levenstein, Margaret C., and Valerie Y. Suslow (2006). What Determines Cartel Success? *Journal of Economic Literature* 44(1), 43–95.

Levenstein, Margaret C., and Valerie Y. Suslow (2011). Breaking up is hard to do: Determinants of cartel duration. *Journal of Law and Economics* 54(2), 455–492.

Maskin, Eric, and Jean Tirole (1988). A Theory of Dynamic Oligopoly, II: Price Competition, Kinked Demand Curves, and Edgeworth Cycles. *Econometrica* 56(3), 571–599.

Miller, Nathan H. (2009). Strategic Leniency and Cartel Enforcement. *American Economic Review* 99(3), 750–768.

Mouraviev, Igor, and Patrick Rey (2011). Collusion and Leadership. *International Journal of Industrial Organization* 29(6), 705–717.

Motta, Massimo, and Michele Polo (2003). Leniency Programs and Cartel Prosecution. *International Journal of Industrial Organization* 21(3), 347–379.

Peltzman, Sam (2000). Prices Rise Faster than they Fall. *Journal of Political Economy* 108(3), 466-502.

Phlips, Louis (1996). On the Detection of Collusion and Predation. *European Economic Review* 40(3-5), 495–510.

Porter, Robert H. (2005). Detecting Collusion. *Review of Industrial Organization* 26(2), 147–167.

Posner, Richard A. (2001). *Antitrust Law.* 2nd ed., University of Chicago Press.

Rey, Patrick (2007). On the Use of Economic Analysis in Cartel Detection. In Claus-Dieter Ehlermann and Isabela Atanasiu (eds.), *European Competition Law Annual 2006*, Enforcement of Prohibition of Cartels, Hart Publishing, 69–82.

Ritter, Jay R. (2008). Forensic finance. The Journal of Economic Perspectives 22.3, 127-148.

Rotemberg, Julio J., and Garth Saloner (1986). A Supergame-Theoretic Model of Price Wars during Booms. *American Economic Review* 76(3), 390–407.

Rotemberg, Julio J., and Garth Saloner (1990). Collusive Price Leadership. *Journal of Industrial Economics* 39(1), 93–111.

Schelling, Thomas C. (1960). *The Strategy of Conflict.* Harvard University Press.

Scherer, Frederic M., and David Ross (1990). *Industrial Market Structure and Economic Performance.* 3rd ed., Houghton Mifflin.

Spagnolo, Giancarlo (2005). Managerial Incentives and Collusive Behaviour. *European Economic Review* 49(6), 1501–1523.

Stigler, George J. (1964). A Theory of Oligopoly. *Journal of Political Economy* 72(1), 44–61.

Wang, Zhongmin (2009). (Mixed) Strategy in Oligopoly Pricing: Evidence from Gasoline Pricing Cycles Before and Under a Timing Regulation. *Journal of Political Economy* 117(6), 987–1030.

Werden, Gregory J. (2004). Economic Evidence on the Existence of Collusion: Reconciling Antitrust Law with Oligopoly Theory. *Antitrust Law Journal* 71(3), 719–800.

Zimmerman, Paul R. (2012). The Competitive Impact of Hypermarket Retailers on Gasoline Prices. *Journal of Law and Economics* 55(1), 27–41.

Zitzewitz, Eric (2012). Forensic economics. *Journal of Economic Literature* 50(3), 731–769.

Appendix: Tables and Figures

Table 1: Pre and post policy pricing						
Panel A: Frequency and Magnitude of Price Changes	(1)	(2)	(3)	(4)	(5)	(5)
Time period	Pre	Post		Pre	Post	
	Mean	Mean	*Difference*	Mean	Mean	*Difference*
	(St. Dev.)	(St. Dev.)	**t-stat**	(St. Dev.)	(St. Dev.)	**t-stat**
	[Obs.]	[Obs.]	[Obs.]	[Obs.]	[Obs.]	[Obs.]
	Abs. % Price Change			Days between price changes		
All Firms	0.0088	0.0293	*0.0205****	5.3	9.47	*4.16****
	(0.0065)	(0.0319)	**19.27**	(5.43)	(7.67)	**8.81**
	[1143]	[172]	[1315]	[1143]	[172]	[1315]
ENI	0.0103	0.0586	*0.0483****	6.63	16.4	*9.76****
	(0.0071)	(0.0377)	**11.45**	(7.81)	(10.95)	**3.64**
	[104]	[10]	[114]	[104]	[10]	[114]
Panel B: Average Alignment to the Market Leader	(1)	(2)	(3)	(4)	(5)	(5)
	Sum of aligned firms			Price difference to ENI		
ENI's Competitors	1.74	2.98	*-1.24****	.00527	.00115	*.00439****
	(2.07)	(2.06)	**-7.23**	(.00656)	(.01986)	**12.94**
	[681]	[185]	[866]	[5448]	[1480]	[6928]

Table 1 summarizes the pre and post policy pricing behaviour of the nine firms acting in the Italian wholesale gasoline market. Panel A shows the frequency and magnitude of price changes. ENI increased the mean price change from 1% to 5.8%, while the average price change increased from .8% to 2.9%. Similarly, ENI increased the average time lag between price changes from one every six days to one every 16 days. The same time lag increase holds across firms, where the time lag between changes increased from five to nine days. Panel B shows the sum of aligned firms to ENI (specification 1 and 2) and the average price difference to the leader (specification 4 and 5). The number of aligned competitors significantly increased after the policy, while the average price difference to the leader significantly decreased after the policy. All changes in the pricing behaviour are significant at the 1% level.

Table 2: Effect of the policy on prices

	(1)	(2)	(3)
Dependent Variable	Price EU Country j at week t	Price Difference Italy-Synthetic Control week t	Margin firm i day t
Type of Data	Panel Data	Time Series	Panel Data
Regression Model	Dif-in-Dif	OLS	Firm Fixed Effect
Policy*Itlay	9.863***		
	(2.117)		
Policy		12.551***	22.95***
		(4.224)	(2.036)
Controls	Crude oil (4 Lags), Year and Month FE	Crude oil (4 Lags), Time trend	Time trend
Observations	891	94	7,794
R-squared	0.66	.486	0.115

Table 2 reports the coefficients on the full specification regression models which capture the effect of the new pricing policy. For the details of the regression analysis we refer to Andreoli-Versbach and Frank (2013). *Policy*Italy* is the intersection between two dummies (Italian price after the policy), while *Policy* is a dummy being one after the 12th of November 2004 when most competitors adopted ENI's pricing behaviour. FE stands for fixed effects. Prices and margins are expressed in € per 1000 liters. In specification (1) standard errors are clustered at country level, while in specification (2) and (3) robust standard errors are reported. In all specifications prices/margins significantly increased after the competitors adopted the same pricing behaviour as the market leader.
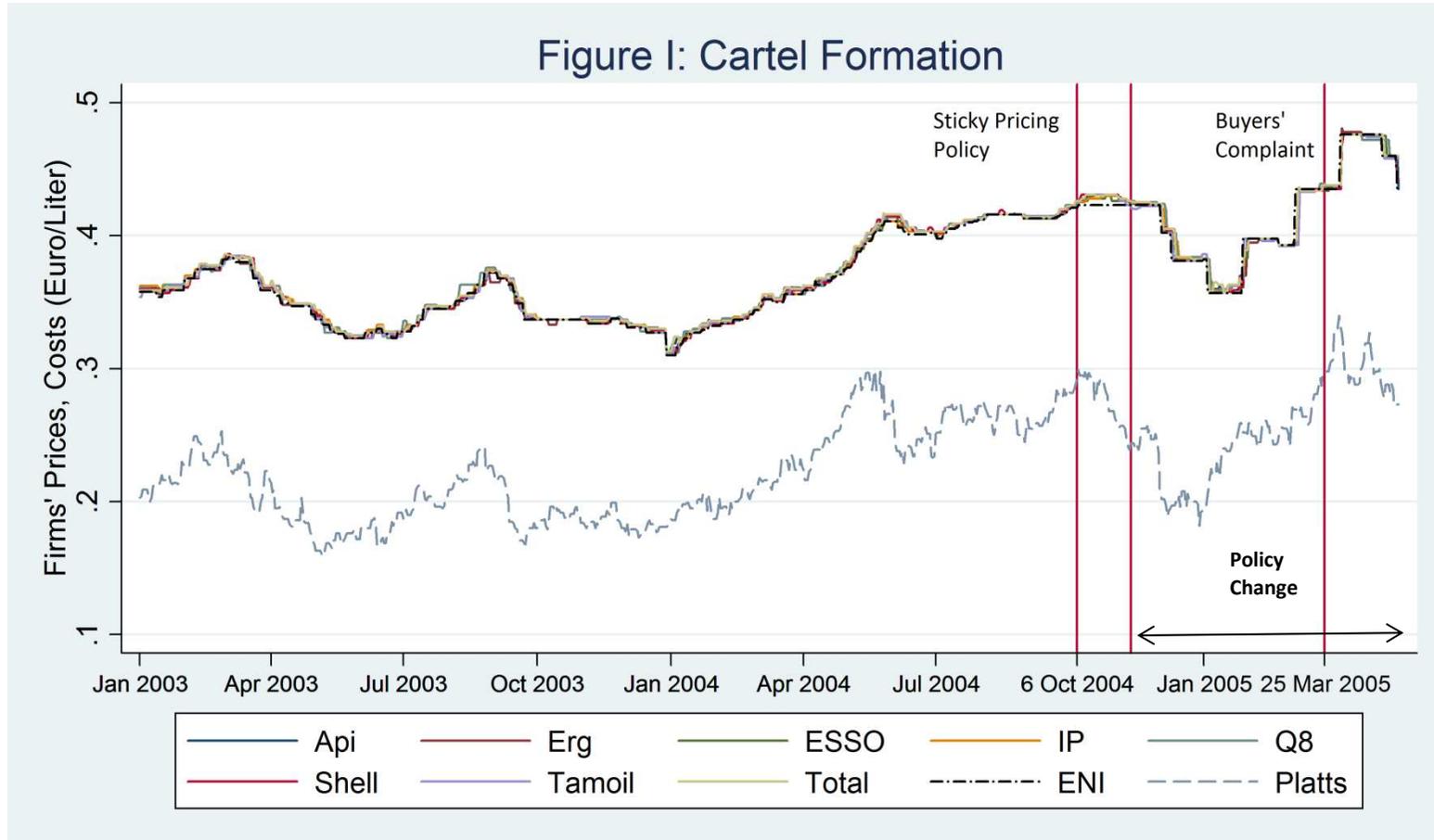
Figure I: Cartel Formation

Figure I shows the daily "suggested" firm-level prices in the Italian gasoline market from January 2003 to 15th May 2005. These prices represent a very good approximation of final retail prices paid by consumers, see section 3.2. The dashed line represents the Platts Cif Med, the major source of cost for firms. The first vertical line denotes 6th October 2004, the date on which ENI, the market leader, announced that it would adopt a new pricing policy consisting of sticky prices (i.e. infrequent price changes). The time span between the first two vertical lines constitutes the "commitment" time period. As prices respond to costs with about a month time lag costs were *increasing* just after the announcement by ENI contrary to what might seem from Figure I. Competitors kept increasing their prices following short-run cost changes until the beginning of November when costs decreased and they started to align and follow the leader's price. The second vertical line is placed on 12th November, the date when most competitors aligned to the leader. Note that we will take this date as the starting date of the new equilibrium in the empirical analysis. The third vertical line shows the date when the Italian Trucker Association (FITA) formally complained about "high and aligned prices" to the Italian antitrust authority.
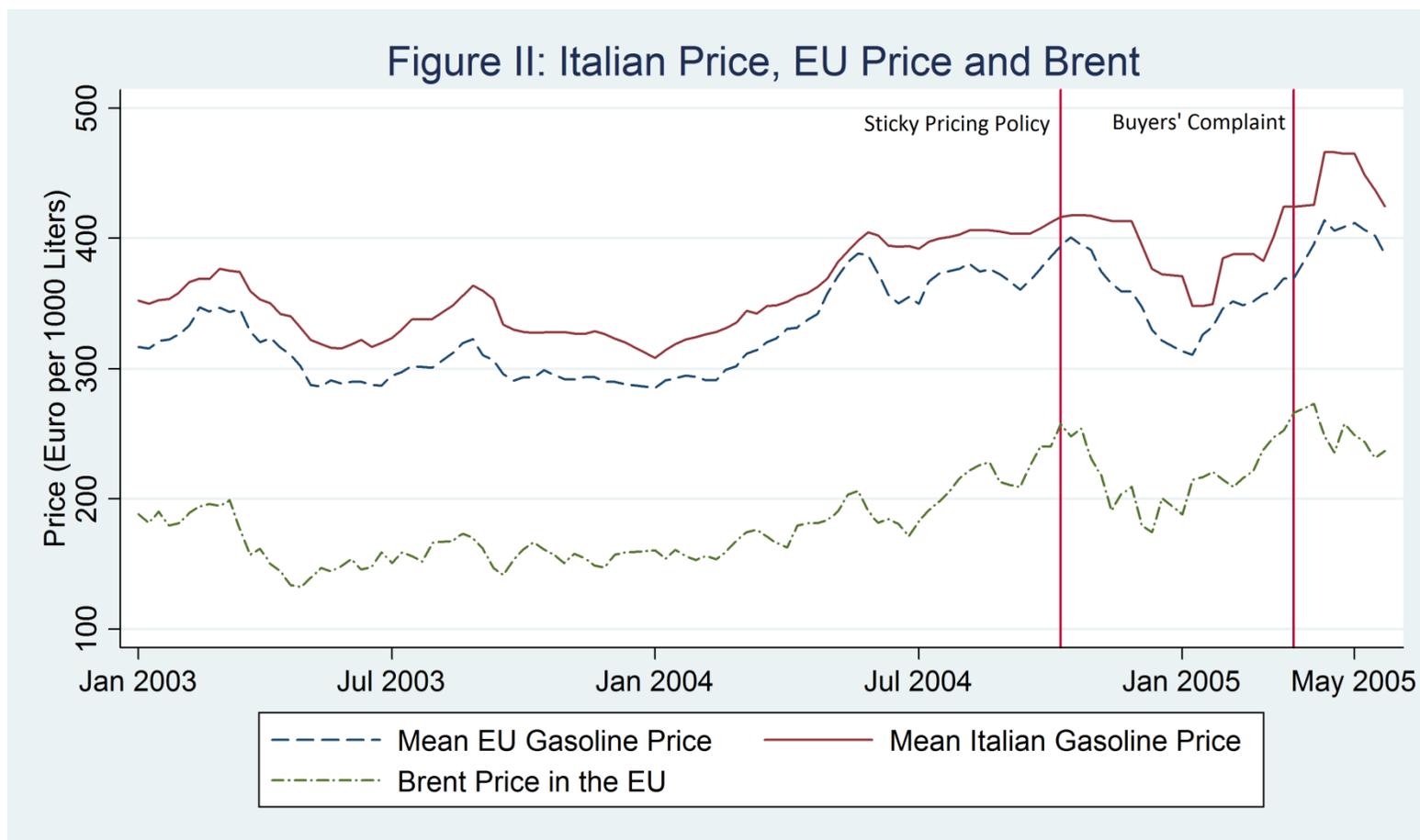
Figure II shows the average weekly Italian and EU price of gasoline and the European price of the Brent, i.e. crude oil. The continuous line represents the Italian price, while the dashed (dashed-dotted) line represents the EU price (Brent). The first vertical line denotes the date where the market leader announced that it would adopt a new pricing policy consisting of sticky pricing (i.e. infrequent price changes). The second vertical line shows the date on which the Italian Truckers' Association (FITA) formally complained about "high and aligned prices" to the Italian Antitrust Authority on 25th March 2005.