

UMBRELLA EFFECTS

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ABSTRACT

We analyze the key determinants of umbrella effects, which arise when a cartel causes a price increase or quantity reduction that diverts demand to substitute products. Umbrella effects arise irrespective of whether non-cartelists act as price takers (“competitive fringe”) or respond strategically to the increased demand. Sizable umbrella effects can also arise when non-cartelists are outside the relevant market, as defined by the hypothetical monopolist test (HMT), provided that the cartel’s price increase is substantial. Further, a shift of demand to non-cartelists can also occur when firms that purchase products or inputs from the cartelists pass on the price increase to their rivals that purchase from non-cartelists, who may benefit from higher demand. To identify the actual damage of umbrella effects, it is thus key to take into account the overall adjustments among cartel members and outsiders, as well as among their respective, potentially competing purchasers. We also discuss how future analysis of the endogenous formation of cartels with partial market coverage should inform theories of the determinants of umbrella effects.

JEL: K21; L13; L41

I. INTRODUCTION

The importance of private enforcement as a complement to public enforcement of competition law has rapidly increased in the European Union in the last few years due to the efforts of the European Commission. Those efforts have culminated in the recent publication of a draft guidance paper on the quantification of harm and a proposal for a *Directive of the European Parliament and the Council on certain rules governing actions for damages under national law*.¹

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¹ See EUROPEAN COMMISSION, DRAFT GUIDANCE PAPER ON QUANTIFYING HARM IN ACTIONS FOR DAMAGES BASED ON BREACHES OF ARTICLE 101 OR 102 OF THE TREATY ON THE FUNCTIONING OF THE EUROPEAN UNION (June 2011), available at http://ec.europa.eu/competition/consultations/2011_actions_damages/draft_guidance_paper_en.pdf; *European*

The quantification of damage is an essential element in damage claims resulting from breaches of Articles 101 and 102 of the Treaty on the Functioning of the European Union (TFEU). It is generally accepted, at least since *Courage v. Crehan*² and *Manfredi*,³ that any individual can claim compensation for harm suffered from an infringement of EU competition rules.⁴ This viewpoint would at least seemingly imply that victims that have suffered harm due to the so-called “umbrella effects” of cartels should be entitled to claim compensatory damages.

Umbrella effects typically arise when price increases lead to a diversion of demand to substitute products. Because successful cartels typically reduce quantities and increase prices, this diversion leads to a substitution away from the cartels’ products toward substitute products produced by cartel outsiders. As we discuss in this article, the increased demand for substitutes typically leads to higher prices for the substitute products.⁵ Such price increases are called umbrella effects and may arise either in the same relevant market—for example, in cases where a cartel covers less than 100 percent of the firms in that market—or in neighboring markets. We also discuss to what extent this holds true, both when the producers of these substitutes act merely as price takers and when they strategically react to the increase in demand for their substitute products.

Commission Proposal for a Directive of the European Parliament and of the Council on Certain Rules Governing Actions for Damages under National Law for Infringements of the Competition Law Provisions of the Member States and of the European Union, COM (2013) 404 final (June 11, 2013); see also *European Commission Green Paper on Damages Actions for Breach of EC Antitrust Rules*, COM (2005) 672 final (Dec. 19, 2005); *European Commission White Paper on Damages Actions for Breach of the EC Antitrust Rules*, COM (2008) 165 final (Apr. 2, 2008); Joshua P. Davis & Robert H. Lande, *Toward an Empirical and Theoretical Assessment of Private Antitrust Enforcement*, 36 SEATTLE U. L. REV. 1269 (2013) (concerning the complementary nature of public and private competition law enforcement).

² See Case C-453/99, *Courage Ltd. v. Bernard Crehan*, 2001 E.C.R. I-06297.

³ See *Joined Cases C-295/04 to C-298/04, Vincenzo Manfredi v. Lloyd Adriatico Assicurazioni SpA*, 2006 E.C.R. I-06619.

⁴ See DAVID ASHTON & DAVID HENRY, *COMPETITION DAMAGES ACTIONS IN THE EU: LAW AND PRACTICE* (Edward Elgar 2013) (providing a legal introduction and overview of the topic); Frank Maier-Rigaud & Ulrich Schwalbe, *Quantification of Antitrust Damages*, in *COMPETITION DAMAGES ACTIONS IN THE EU: LAW AND PRACTICE* ch. 8 (David Ashton & David Henry eds., Edward Elgar 2013) (emphasizing the economic aspects of damage actions and quantification); Roman Inderst, Frank Maier-Rigaud & Ulrich Schwalbe, *Quantifizierung von Schäden durch Wettbewerbsverstöße*, in *HANDBUCH DER PRIVATEN KARTELLRECHTSDURCHSETZUNG* (Andreas Fuchs & Andreas Weitbrecht eds., C.H. Beck, München forthcoming 2015) (emphasizing the economic aspects of damage actions and quantification).

⁵ While less relevant in a damages context, it is clear that umbrella effects also arise in the context of mergers—for example, if two firms merge, any direct unilateral price effect due to the merger typically entails umbrella effects, which in turn also increases the magnitude of the optimal price increase of the merged entity. This phenomenon will be briefly discussed below in the context of the SSNIP test.

Understanding (and quantifying) umbrella effects is of particular importance in the context of private enforcement in the European Union because they are—economically speaking—directly caused by the cartel and no convincing argument has been presented explaining why umbrella effects should not be legitimate, actionable claims for damages. As the proposed Directive does not address causality (foreseeability and remoteness),⁶ thereby delegating the question to the legal systems of EU Member States, a harmonized and economically coherent treatment of such claims is not ensured. However, as Member States continue to be bound by the principles of *equivalence* and *effectiveness*,⁷ so a harmonized and economically coherent treatment remains feasible.

The pressing need for a coherent legal interpretation of umbrella effects was further emphasized by a recent request to the Court of Justice of the European Union from the Oberster Gerichtshof, the highest court in Austria. The Oberster Gerichtshof requested a preliminary ruling on the question of whether EU competition law has to be:

[I]nterpreted as meaning that any person may claim from members of a cartel damages also for the loss which he has been caused by a person not party to the cartel who, benefiting from the protection of the increased market prices, raises his own prices for his products more than he would have done without the cartel (umbrella pricing).⁸

In order to gauge the legal repercussion of this question, it is important to understand the underlying economics of such effects.

This question is also of central importance to the overall coherence of competition law, particularly in light of a more economic approach. The consideration of umbrella effects is important for the proper assessment of effects in the context of the merger review process. It would seem inconsistent to consider such effects too remote in private enforcement when the concept is part of the accepted effects analysis in public enforcement.⁹

⁶ See Frank Maier-Rigaud, *Umbrella Effects and the Ubiquity of Damage Resulting from Competition Law Violations*, 5 J. EUR. COMPETITION L. & PRACT. 247 (2014) and Frank Maier-Rigaud, *Toward a European Directive on Damages Actions*, 10 J. COMPETITION L. & ECON. 341 (2014) (discussing the proposed directive).

⁷ See Joined Cases C-295/04 to C-298/04, *Manfredi*, 2006 E.C.R. at 98.

⁸ See Request for a preliminary ruling from the Oberster Gerichtshof (Austria) lodged on 3 Dec. 2012, Case C-557/12, *KONE AG, Otis GmbH, Schindler Aufzüge und Fahrtreppen GmbH, Schindler Liegenschaftsverwaltung GmbH, ThyssenKrupp Aufzüge GmbH v ÖBB-Infrastruktur AG*, 2013 O.J. (C 71) 9 (Sept. 3, 2013), available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:071:0005:0006:EN:PDF>. See also Opinion of Advocate General Kokott, delivered on 30 Jan. 2014 in Case C-557/12 *KONE AG and Others*, available at: <http://curia.europa.eu/juris/document/document.jsf?text=&docid=147064&pageIndex=0&doclang=EN&mode=lst&dir=&occ=first&part=1&cid=185155>.

⁹ In the merger between Hutchison 3G Austria and Orange Austria the Commission argued:

generally accepted and robust economic theory demonstrates that the profit-maximising response of competitors to a price increase would be to increase prices themselves. . . . The rationale behind this expectation is the following: if the merged entity were to raise prices, some customers would consider switching to one of the other two providers who would not

From a legal point of view, it may be noteworthy to point out that cartel outsiders' reactions, whether in the same relevant market or not, cannot be considered free-riding in the sense of being willfully exploitative (and thus subject to sanction by competition law). Instead, they should rather be seen as economically optimal reactions to changes in demand. In fact, when cartel outsiders are price-takers (constituting a "competitive fringe"), higher prices may simply reflect higher marginal costs of production at higher output (given the demand diverted away from cartel members). When cartel outsiders strategically react to an increase in demand caused by cartel members' higher prices or lower output, it may sometimes even mitigate the negative effects of the cartel, depending on the nature of strategic interaction in the market. That being said, the price for the cartel outsider's own output does increase relative to the counterfactual case without a cartel.

A deeper economic analysis also shows that umbrella effects may arise even when those who buy from cartel members could not be expected to switch to other suppliers—for example, when markets for the considered product or input are local. When firms affected by a price increase of cartel members pass on some of the increase, dependence on local firms will lead to higher demand for firms competing with the indirect purchasers and unaffected by the cartel. An umbrella effect will then still be likely because an increase of the rival firms' derived demand will cause their respective suppliers to increase prices. In this case, however, firms purchasing from these suppliers may *not* suffer damages from the cartel's actions, as they benefit from the increase in their rivals' costs. Our analysis explores the relationship between pass-on (passing-on) of price increases and umbrella effects.

In order to formulate the economics of umbrella effects, we proceed as follows. As noted above, one of our objectives in this article is to show that if the market is not fully covered, one can typically expect cartel outsiders to increase prices, at least when the cartel operates for a sufficient length of time and when its price increase is substantial. We also describe specific circumstances when

have done so in the absence of the merger. The merged entity will make its calculation balancing this loss of revenue against the higher revenue on the customers who remain. These newly available customers then increase the demand faced by the other competitors, as a result of which they have an incentive also to increase prices themselves. If [the competitors] have incentives to respond to a price increase of their rivals by themselves increasing price, then prices are called "strategic complements." . . . [T]he Commission notes that in standard models of oligopolistic price competition, strategic complementarity of pricing decisions always arises unless very extreme assumptions apply. . . . Therefore, and because strategic complementar[ity] of prices is rather robustly observed in oligopolistic models, the Commission considers that [there is] no reason in this case to depart from the robust conclusion that competitors would be very likely to respond to a price increase by a competitor by increasing prices themselves.

Commission Decision, Case M.6497, *Hutchison 3G Austria/Orange Austria*, ¶ 367, 369, 371–72.

such a price increase may be subdued. It is shown that umbrella effects will occur irrespective of whether the non-cartelized firms act as price takers or whether they set their prices or quantities strategically, taking into account the behavior of the cartelized firms. We also demonstrate that further determinants such as the type of competition (price or quantity), market coverage of the cartel, the degree of product differentiation, the elasticity of demand, and supply have an impact on the size of the umbrella effects. Further, we demonstrate that umbrella effects and market definition are conceptually related. Because cartelization in general leads to higher prices, products that would not be considered substitutes under effective competition may become substitutes at the inflated cartel prices. Finally, we discuss some problems that are related to the economic theory of the formation of partial cartels.

This article deals mainly with the theory of umbrella effects, but the presence of such effects also has implications for the quantification of damage caused by umbrella effects. Although, in principle, the same econometric tools that are employed to quantify damage to direct purchasers of goods from cartel members can be employed here, we note in Parts IV and V that, in the case of damage caused by umbrella effects, the calculation of a simple cartel-induced price overcharge may be grossly misleading. As these techniques have been treated in detail elsewhere,¹⁰ we do not discuss them in detail. Umbrella effects should, however, also be taken into account when assessing the cartel-induced damage to direct purchasers, provided that the prices set by cartel outsiders are used as counterfactuals or as comparators (for example, in a cost-price margin yardstick analysis). Otherwise, there may be an underestimation of damage to purchasers from cartel members.

II. PRINCIPLES

In this part, we discuss the economic foundations of umbrella effects caused by cartels. Depending on the conditions in the respective markets, different scenarios must be considered. For example, the magnitude of the umbrella effects might depend on whether the market is characterized by price (Bertrand) or quantity (Cournot) competition, whether the goods that are traded in the market are homogeneous or differentiated, or whether the non-cartelized firms behave strategically or (non-strategically) as price takers. Finally, umbrella effects might also depend on whether firms sell to final consumers or to firms that do not compete with each other and if there is downstream competition.

We consider in this part a scenario where (1) the non-cartelized firms behave competitively and (2) the parties that are affected by the price increase

¹⁰ See, e.g., DRAFT GUIDANCE PAPER ON QUANTIFYING HARM IN ACTIONS FOR DAMAGES BASED ON BREACHES OF ARTICLE 101 OR 102 OF THE TREATY ON THE FUNCTIONING OF THE EUROPEAN UNION, *supra* note 1; Maier-Rigaud & Schwalbe, *supra* note 4.

are final consumers or firms that do not compete with each other. The lack of competition on the direct purchaser level will, as we show further below, take away a channel that may either increase or decrease an umbrella effect. Still, our subsequent observations will also apply when firms compete downstream, but are equally affected by a quantity reduction or a price increase by cartel members and the reaction of cartel outsiders. If there is competition and firms are affected differently, however, there are additional effects at play, which we discuss in Part IV.

A. Umbrella Effects with Non-Strategic Cartel Outsiders

1. Price Competition

Consider a market where firms compete in prices and produce differentiated goods. We assume that there are two groups of firms. Firms in the first group set the prices of their products strategically, taking into account the effects of their behavior on other firms. Firms in group two, the suppliers of a substitute good, are price takers given their small size, which is to say we assume a “competitive fringe.” We further assume that all firms produce with increasing marginal cost. If we instead were to assume constant marginal cost without capacity constraints, any increase in price by the cartel would be fully compensated by an increase in the quantity produced by the competitive fringe. Stated differently, the competitive fringe will always set a price according to the condition “price equals marginal cost” and produce a quantity such that the price is driven down to the then constant marginal cost.

When the firms in the first group form a cartel, they increase the prices of their products. As the cartel operates for a sufficiently long time, this price change will increase the demand for viable, non-cartelized substitutes, assuming those substitutes exist and the markup is substantial.¹¹ Graphically speaking, the price increase induced by the cartel has the immediate effect of shifting the competitive fringe’s demand curve—that is, the demand that is not satisfied by the cartelized firms—outward. Notice that our assumption of increasing marginal cost implies that the competitive fringe’s supply function is not perfectly elastic. Otherwise, as noted above, any attempt by a cartel to increase the market price is canceled out by an increase in the quantity supplied by the competitive fringe.

The cartel may experience a profitable price increase when the competitive fringe’s supply curve is strictly increasing and the outsiders’ products are relatively close (or perfect) substitutes. The umbrella effect in the case of

¹¹ This model is equivalent to models of collusive price leadership, which have been analyzed. See, e.g., Claude d’Aspremont, Alexis Jacquemin, Jean Jaskold Gabszewicz & John A. Weymark, *On the Stability of Collusive Price Leadership*, 16 CANADIAN J. ECON. 17 (1983); Marie-Paule Donsimoni, *Stable Heterogeneous Cartels*, 3 INT’L J. INDUS. ORG. 451 (1986).

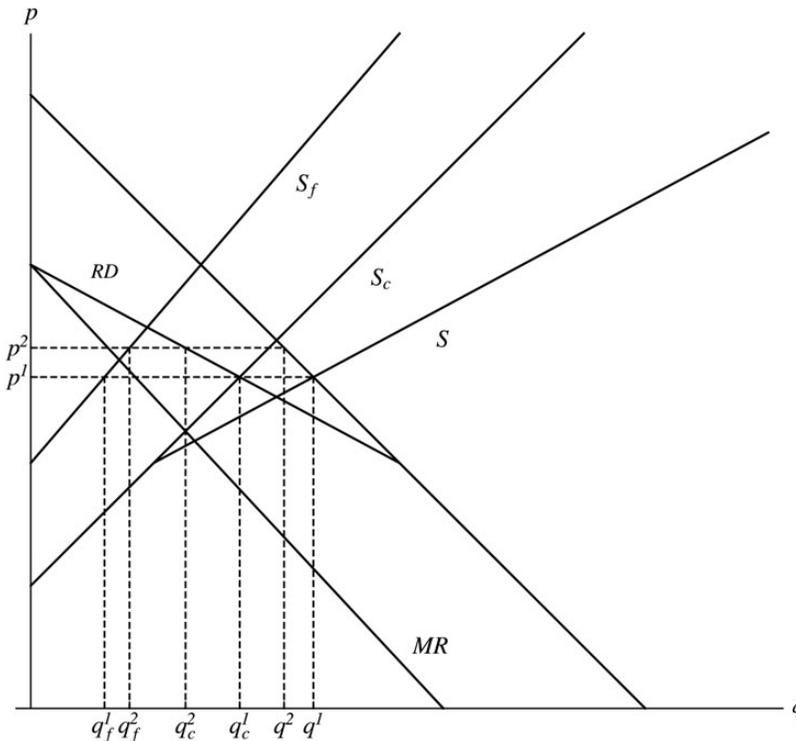


Figure 1. Umbrella effect with price-taking cartel outsiders

Source: Roger D. Blair & Virginia G. Maurer, *Umbrella Pricing and Antitrust Standing: An Economic Analysis*, 1982 UTAH L. REV. 763, 782 fig.2.

homogeneous products and price competition with a competitive fringe is illustrated in Figure 1.

Here, D denotes the market demand, and S is the total supply, with S_c being the supply (or marginal cost) curve of the possibly colluding firms and S_f the supply (or marginal cost) curve of the competitive fringe. RD denotes the residual demand for the firms in group one, and MR is the marginal revenue for the firms in group one. When all firms act as price takers, the equilibrium is found at the intersection of the market demand function and the total supply function, at a quantity of q^1 and a price p^1 . When the firms in the first group form a cartel, they maximize their profits given the residual demand function—that is, they equate the corresponding marginal revenue with marginal cost. Formation of a cartel reduces the quantity supplied by the firms in the first group from q_c^1 to q_c^2 resulting in a price of p^2 . The increased price, however, implies an expansion of the quantity supplied by the competitive fringe from q_f^1 to q_f^2 . Total quantity supplied decreases from q^1 to q^2 . The umbrella effect is the increase in price from p^1 to p^2 . In the case of a

homogeneous product, the price increase is the same for cartelized and non-cartelized firms.

When we examine a given reduction in the quantity of the cartelized firms, the umbrella effect is, *ceteris paribus*, higher when the price elasticity of the supply of the competitive fringe is lower—that is, when the residual supply curve is steeper in the relevant range. In turn, the firms' supply elasticity should be steeper when their capacity is small or when their average costs of production increase steeply as quantity increases.¹² The price increase resulting from the outward shift in residual demand also remains higher in the long run if there is less scope for entry.

Consider now the case where the firms in the two groups produce differentiated goods. Here, the degree of substitutability between the products of the cartelized and non-cartelized firms has to be considered. For a given price increase induced by the cartel, the higher the degree of substitutability between the cartelized and non-cartelized product, the more pronounced the increase in residual demand. This is the case when more of the displaced demand is indeed diverted to the substitute good.¹³ Keeping the cartel's price increase as given, the umbrella effect should also be more subdued when the market for the non-cartelized substitutes is large—that is, when the market coverage of

¹² Although a positive umbrella effect arises under typical circumstances, in principle, one could also conceive of situations where a negative effect may arise. Consider for example a situation where, due to the increased residual demand, firms in the competitive fringe may now employ a technology that allows them to produce this larger quantity with lower marginal and average cost. However, note that if the fringe firms' technology remained constant, this would not occur. A profit-maximizing firm does not produce in a region of decreasing average cost.

¹³ There is obviously a close relationship to the diversion ratio that is used in merger analysis. In a nutshell, the diversion ratio answers the following question: If the price of some good *A* rises, to what extent will customers switch from *A* to another good *B*? The diversion ratio from *A* to *B* is then, at least as a local approximation, equal to the cross-price elasticity of demand from *A* to *B* divided by the own-price elasticity of demand for *A*. See, e.g., Carl Shapiro, *Mergers with Differentiated Products*, 96 ANTITRUST MAG. 23 (1996); OECD, MARKET DEFINITION: OECD BEST PRACTICE ROUNDTABLES IN COMPETITION POLICY (June 2012), available at www.oecd.org/daf/competition/Marketdefinition2012.pdf [hereinafter OECD, MARKET DEFINITION] (including an analytical note by Ulrich Schwalbe & Frank Maier-Rigaud); Simon Bishop & Mike Walker, *THE ECONOMICS OF EC COMPETITION LAW: CONCEPTS, APPLICATION AND MEASUREMENT* (Sweet & Maxwell/Thomson Reuters 3d ed. 2010). Consider the following example taken from Shapiro: Assume *A* has an own-price elasticity of demand of 2.0, so that a 1-percent increase in the price of *A* results in a reduction of the marginal sales by 2 percent. Assume further that the cross-price elasticity of demand from *A* to *B* is 0.5 and that both firms produce the same quantities. The diversion ratio from *A* to *B* is then 0.5 divided by 2.0—that is, 25 percent. This means that one-quarter of the lost marginal sales of good *A*, following a (small) price increase, will be captured by the producers of product *B*. While for the present discussion there is clearly no need to fully calculate the diversion ratio, as we are not directly interested in the demand that is lost for the cartel, this shows the close relationship between the umbrella effect and the quantity reduction for the cartelized goods. Shapiro, *supra*, at 25. We return to this in Part III.

the cartel is small.¹⁴ In this case, the residual supply curve should be more elastic.¹⁵

For the present discussion, it is not essential that cartel outsiders directly observe the price increase of cartel insiders, let alone the reasons for such a price increase. Instead, their own price increase is a best response to how their (residual) demand changes with respect to the price increase of cartel members. Hence, to make their own price increase optimal it is only necessary for cartel outsiders to perceive a change in the demand they face.

2. Quantity Competition

Another workhorse model in market analysis is that of competition in quantities (so-called Cournot competition), which attempts to capture firms' choice of capacity. The Cournot model is usually employed in cases where quantities (or capacities) cannot be easily adjusted and also in cases where firms first choose a capacity and then charge a price such that this capacity is fully employed. Consider first a market where firms compete in quantities and produce a homogeneous product. Again, assume that there are two groups of firms, one that behaves strategically—that is, one that chooses quantities taking into account the effect on the market price—and one that behaves non-strategically.¹⁶ Firms in the second group are price takers and supply a quantity such that price equals marginal cost.

Prior to cartel formation, the strategic firms set their respective quantities non-cooperatively, taking into consideration that the non-strategic firms will choose quantities according to the “price equals marginal cost” rule. If the firms in group one form a cartel, they will reduce their quantities supplied, which in turn leads to an increase in market price. The higher market price induces the firms in group two to increase their quantities. This increase in quantity partially alleviates the cartel-induced price increase, but the total quantity supplied remains reduced. Thus, the resulting market price is higher in a cartelized market than when firms in group one behave non-cooperatively.

Similar results arise in models with competition in quantities and differentiated products—for example, where the product of the firms in group one

¹⁴ In the case of differentiated products, depending on the magnitude of the price increase caused by the cartel-induced quantity reduction, products could become attractive substitutes even if they were not part of the relevant market under competitive prices. If market coverage is large but the amount of new substitutes not part of the relevant market is large as well, the same effect may arise as does under small market coverage. See Part IV, *infra*.

¹⁵ As already noted, however, both closer substitutes and more incomplete market coverage should make a significant price increase infeasible, or at least unprofitable, as is further discussed in Part III, *infra*.

¹⁶ See A. M. Ulph & G. M. Folie, *Economic Implications of Stackelberg and Nash-Cournot Equilibria*, 40 ZEITSCHRIFT FÜR NATIONALÖKONOMIE 343 (1980); Koji Okuguchi, *Equilibria in an Industry with a Cartel and a Competitive Fringe*, 34 ECON. STUD. Q. 38 (1983); Koji Okuguchi, *Nash-Cournot Equilibrium for an Industry with Oligopoly and a Competitive Fringe*, 22 KEIO ECON. STUD. 51 (1985) (all analyzing Cournot oligopolies with a competitive fringe). See also STEPHEN MARTIN, *ADVANCED INDUSTRIAL ECONOMICS* (Wiley-Blackwell 2d ed. 2002).

differs from the product of the fringe firms. In such cases, the competitive fringe's quantity expansion induced by the cartel is less pronounced when the products are more differentiated, because increased product differentiation decreases demand diversion. Thus, the prices of both groups' products increase, but the price of the cartelized product increases by more than the price of the non-cartelized product—that is, the price difference between the two groups' products changes. The degree of differentiation can be captured by a measure similar to the diversion ratio used in the case of price competition. Although, in the case of price competition, the diversion ratio is defined in terms of quantities diverted from one product to the other, in the case of quantity competition, a “price diversion ratio” could be employed.¹⁷

The previous discussion showed that under quantity competition, despite the fact that the non-cartelized firms produce a larger quantity (of substitutes), the total quantity produced declines because the additional quantity supplied by the fringe firms is not sufficient to compensate for the cartel-induced quantity reduction. Summing up, market prices increase and umbrella effects occur in quantity competition, with both homogeneous products and differentiated products. This implies that the customers of the fringe firms pay higher prices in situations with a cartel than they do in those without. Note, however, that the question of the magnitude of the umbrella effect only arises when the substitute good and the cartelized good are differentiated such that at least some customers cannot easily switch. If the firms produce a homogeneous product, customers of the non-cartelized firms pay the same price as the customers of the cartelized firms, and the umbrella effect is identical to the cartel's price increase.

The preceding observations have demonstrated that umbrella effects may arise in cases where the firms not participating in the cartel behave non-strategically as mere price takers. In fact, the reaction of cartel outsiders was represented by their respective supply curve, as derived from their profit-maximizing behavior. The increase in residual demand induced by the diversion of demand away from cartel members, as well as the imperfectly elastic supply of the substitute, cause umbrella effects. In the following discussion we will focus on the case where the non-cartelized competitors react strategically to the changes in prices and quantities induced by a cartel.

B. Umbrella Effect with Strategic Cartel Outsiders

1. Price Competition

We now suppose that the cartel outsiders producing the substitute good possess some market power. Each of the cartel outsiders no longer acts as a price taker

¹⁷ See Serge Moresi, *The Use of Upward Price Pressure Indices in Merger Analysis*, ANTITRUST SOURCE (Feb. 2010), http://www.americanbar.org/content/dam/aba/publishing/antitrust_source/Feb10_Moresi2_25f.authcheckdam.pdf.

when it faces an increase in its residual demand. Firms with market power do not simply accommodate the higher demand, but rather, adjust prices optimally.

If firms are identical, produce a homogeneous product with constant marginal cost, and compete in prices, conditions describe the standard Bertrand model, where the market outcome is the same as that in a market where all firms are price takers. Forming a noninclusive cartel to increase the market price is pointless because capacity unconstrained competition of the non-cartelized firms will drive the price down to the competitive level. Thus, in this case, a cartel triggers neither price effects nor umbrella effects.

Consider therefore a situation where firms produce differentiated products and compete in prices. The optimal response of a non-cartelized firm to a given price increase by the cartelized firms will depend on how the cartel outsider trades off an increase in the price of its own product, resulting in a higher margin, with an increase in the quantity produced. In most of the standard demand systems, prices are strategic complements: as one or several competing firms increase their respective prices, it is optimal for any other firm to also increase its price.¹⁸ When cartelization leads to a price increase in the affected products, the best reply of the cartel outsiders is to increase the prices of their products as well. Formally, the increase in the price of the non-cartelized firm's products is given by the slope of the best reply function of those firms.

To illustrate this, consider the case of a linear demand function and constant marginal cost. Given linear demand, an incremental increase in price always has the same incremental effect on demand, irrespective of the prevailing price and quantity level. In this case, intuitively, the best-reply functions of firms are linear as well. That is, when a firm anticipates that the price of a rival is incrementally larger, its best reply prescribes a fixed incremental increase in its own price, irrespective of the prevailing price level. For Figure 2, we now assume that there are three firms in a market. In addition, we assume a linear demand function, equal and constant marginal cost, and equally differentiated products.

Consider the situation before a cartel forms. In Figure 2, the best-reply functions are drawn for two representative firms. Equilibrium prices are given by the intersection of the best-reply functions. In this so-called Nash equilibrium, the respective equilibrium prices are mutually best replies. Given that each firm anticipates that other firms will choose their respective prices, it is also optimal for the considered firm to choose its respective price. Next we consider a cartel of two firms. We suppose that the cartel jointly behaves optimally. Again, for ease of exposition we only consider two firms: one firm that is part of the cartel and the single outsider. The "representative" firm that is part of the cartel optimally chooses a best reply to the anticipated price of the outsider. Importantly, the best-reply function of the representative cartel member shifts upward and the new equilibrium prices are now given by the intersection

¹⁸ This holds if the demand function is log-concave. See, e.g., XAVIER VIVES, *OLIGOPOLY PRICING: OLD IDEAS AND NEW TOOLS* 94 (MIT Press 1999).

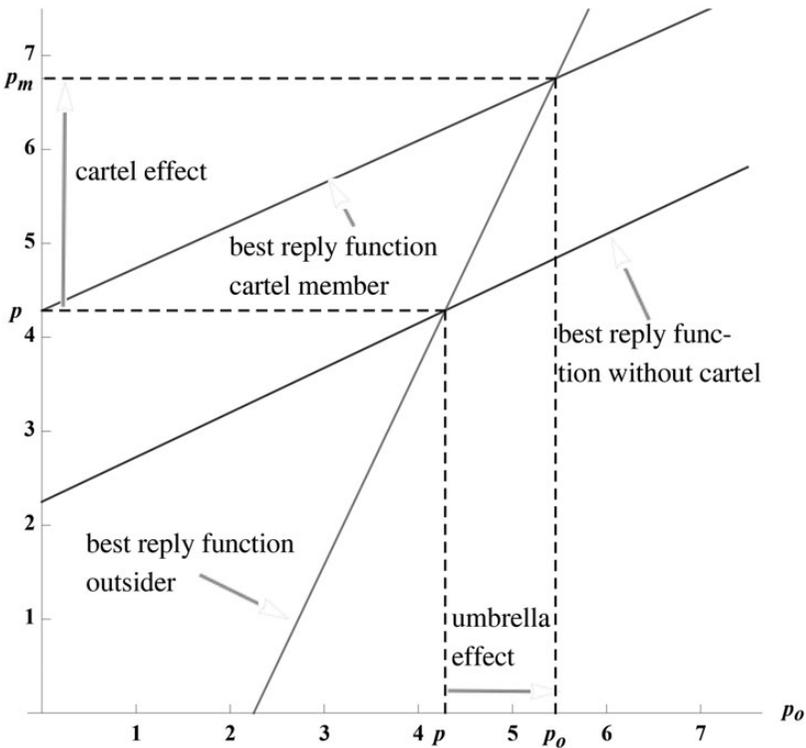


Figure 2. Umbrella effects with price competition and strategic outsiders

of the best-reply functions of the cartel member and the outsider. Note that the outsider may not be aware of the cartel formation, in which case the respective equilibrium prices may only be obtained over time. Once the new prices are obtained, the cartel’s direct effect on the price of the cartelized products is given by the increase from p^* to p_m^* and the umbrella effect is the price increase from p^* to p_o^* .¹⁹

As in the case where the substitute good is supplied competitively by price-taking firms, the umbrella effect should be more pronounced when firms produce with increasing marginal costs or when they are subject to capacity constraints because under these circumstances the reaction functions are characterized by an increasing slope. Also, the degree of substitutability, as measured by the diversion ratio, has an important impact on the magnitude of the umbrella effect. The higher the degree of substitutability, the higher the umbrella effects will be. This is due to the fact that the demand spillover from the cartel to the non-cartelized outsiders is more pronounced when the products are closer substitutes. Likewise, the magnitude depends positively on the size

¹⁹ This example is based on a linear model with profit functions given by $\pi_i = p_i(a - b p_i + d \sum_{j \neq i} p_j) - c_i p_i$ and with values of $a = 10$, $b = 2$, $c = 1$, and $d = 0.1$.

of the cartel. Intuitively, if the cartel has small market coverage, only a small part of the demand is diverted to each cartel outsider. Therefore, each outsider will increase the price of its product only slightly. If the cartel is larger, however, more demand is diverted to the few remaining outsiders who will increase their prices by a larger amount.²⁰

We illustrate this with the previously introduced case of linear demand and constant marginal cost. We take a market with ten identical firms that produce differentiated products with a low degree of substitutability. We then calculate the price charged by a cartel member, the outsider's price, and the umbrella effect for cartels with different degrees of market coverage. We vary cartel size from two to nine. For example, if the cartel size is nine, all firms except one form a cartel.²¹ As previously, we do not assume a fixed cartel price as the market coverage of the cartel varies. Instead, we suppose that the cartel jointly behaves optimally, akin to a merged firm, and then we determine the equilibrium as the intersection of the respective best-reply functions of the cartel and the outsiders. As noted above, even when outsiders may not be directly aware of the operation of a cartel, under the chosen specifications, notably that the cartel behaves like a merged firm, the outsiders' prices will adjust to changing demand.

Note that the price increase is calculated with reference to the symmetric non-cartel price (of 2.903). Depending on the size of the cartel, the value of the umbrella effect here ranges between 7 percent and 23 percent of the cartel price, even though we have chosen a low degree of substitutability between the products.²²

2. Quantity Competition

If firms compete in quantities or in capacities installed, quantities or capacities are strategic substitutes in most cases.²³ As one or several competing firms decrease their respective quantities, it is optimal for any other firm to increase its own. In other words, the decrease in the supply by the cartelized firms will lead to an increase in the market price, making it attractive for the outsiders to profit from a larger quantity sold at a higher price.²⁴ The price increase induced by the cartel will typically exceed the price decrease caused by the

²⁰ Of course this effect is driven by the fact that small (large) market coverage induces moderate (more pronounced) price increases, which in turn affects demand diversion.

²¹ The values are generated with the demand function $10 - 2p_i + 0.1 \sum_{j \neq i} p_j$ for all $j \neq i$ and constant marginal cost $c = 1$. Notice that we made the preceding analysis taking a cartel's size as given. However, not all considered cartels would satisfy the conditions of internal and external stability. This problem is discussed in Part V, *infra*.

²² In fact, the diversion ratio is only 5 percent.

²³ Under strategic substitutes, best reply functions are downward sloping, which means the demand function is not too convex—that is, if a firm's marginal revenue decreases when any competitor increases its output. See, e.g., VIVES, *supra* note 18, at 94.

²⁴ A stable cartel with a Cournot-fringe exists if demand is linear, firms are producing with constant marginal cost, and the cartel is not too large—that is, the number of fringe firms is sufficiently large. See, e.g., Sherrill Shaffer, *Stable Cartels with a Cournot Fringe*, 61 S. ECON. J. 744 (1995).

Table 1. Umbrella effects and cartel size

Cartel size	2	3	4	5	6	7	8	9
Price cartel	2.980	3.067	3.164	3.274	3.398	3.538	3.697	3.880
Price outsider	2.908	2.918	2.933	2.954	2.983	3.020	3.066	3.123
Cartel effect	0.077	0.164	0.261	0.370	0.494	0.634	0.794	0.977
Umbrella effect	0.005	0.0145	0.023	0.052	0.080	0.117	0.163	0.220

Source: Authors' calculations.

non-cartelized firms' increased quantity. Therefore, the total quantity produced decreases, and the market price increases. Similar results occur in the case where the cartelized and non-cartelized firms produce differentiated products. With respect to the umbrella effects, the main difference between the competitive fringe and strategic fringe models is that in the latter case the quantity responses of the fringe firms are less pronounced, because they take into consideration how their quantity choices affect the market price.²⁵

The preceding discussion has shown that umbrella effects arise in a variety of circumstances, for example, with price or quantity competition, with homogeneous or differentiated products, and with the non-cartelized firms acting as price takers or behaving strategically.²⁶ The magnitude of the umbrella effect is inversely related to the degree of substitutability between the cartelized and non-cartelized products. If products are homogeneous, there is no difference between the cartel-induced price increase and the umbrella effect. If products are highly differentiated, a price increase or a quantity reduction by the cartel leads to a limited diversion of demand from the cartelized to the non-cartelized firms, and thus to a limited price or quantity increase. Also, as demonstrated for the case of price competition, the magnitude of the umbrella effect depends positively on the market coverage and size of the cartel.

III. UMBRELLA EFFECTS, CARTEL STABILITY, AND MARKET DELINEATION

A. Umbrella Effects with Partial Coverage of the Relevant Market

Before considering umbrella effects under a partial cartel—that is, a situation where a cartel only partially covers the relevant market—one must determine

²⁵ It is interesting to note that when firms compete in quantities that are strategic substitutes, the price increase for a given cartel output, both of the cartelized good and the substitute good, is more pronounced when cartel outsiders do not learn (sufficiently quickly) about the changed market conditions. This effect occurs when cartel outsiders do not increase their output in response to higher demand. This is one of the instances where an active response by cartel outsiders to the changes induced by a cartel mitigates the total damages of the cartel.

²⁶ The only exception is the case where firms compete in prices, produce a homogeneous product, face constant marginal cost, and are not subject to capacity constraints. In this case, only an all-inclusive cartel has any effect on the market outcome.

the relevant market. In many jurisdictions, a key tool in defining the relevant market is the hypothetical monopolist test (HMT).²⁷ This test asks whether a hypothetical, profit-maximizing monopolist would cause a small but significant and nontransitory increase in the price (SSNIP) of its products. Here, “small but significant” is usually taken to be about 5 percent to 10 percent and “nontransitory” a time period of about one year. If this SSNIP condition is not satisfied, a profit-maximizing monopolist would not engage in such a price increase as this would lead to considerable demand substitution. Therefore, the candidate market is enlarged by adding substitutes and carrying out the HMT for the enlarged set of products. The relevant market is defined as the smallest set of products that satisfies the SSNIP condition—that is, the smallest set that would allow a profitable price increase by a hypothetical monopolist. The boundary of the market is drawn where such a price increase is profit-maximizing for the hypothetical monopolist because products not in the relevant market do not attract enough demand to render the monopolist’s price increase unprofitable.

In merger control, the analysis usually starts at the prevailing price level. In the context of abuse of dominance, however, the analysis starts at the hypothetical price level that would prevail under effective competition. The analysis at this hypothetical level is conceptually necessary, albeit difficult to accomplish in practice, as an analysis of the prevailing prices could fall foul of the so-called “cellophane fallacy.” Because a firm with significant market power may have already raised the prices of its products to the monopoly level, a further increase could be unprofitable, as a large number of consumers would switch to other products. As a result, the market would expand, leading to a relevant market. The new market definition would be too large because it comprises products that were substitutes at the monopoly price but were not substitutes at a price that would prevail under effective competition. As a result, the market share and market power of the dominant firm would be underestimated.²⁸

If a cartel in a properly defined relevant market does not cover the market fully, it risks free-riding from cartel outsiders. This is depicted in Figure 3 where firms *A* to *C* are cartelized and firm *D*, which is in the relevant market, is a cartel

²⁷ See European Commission Notice on the Definition of the Relevant Market for the Purposes of Community Competition Law, 1997 O.J. (C 372) 5; U.S. DEP’T OF JUSTICE & FED. TRADE COMM’N, HORIZONTAL MERGER GUIDELINES (2010), available at <http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf>; Commission Notice: Guidelines on the Application of Article 101 to Technology Transfer Agreements, 2004 O.J. (C 101) 2 ¶¶ 19–25; Communication from the Commission: Guidelines on the Applicability of Article 101 of the Treaty on the Functioning of the European Union to Horizontal Co-operation Agreements, 2011 O.J. (C 11) 1 ¶¶ 112–26; European Commission: Guidelines on Vertical Restraints, 2010 O.J. (C 130) 1 ¶¶ 86–95. See also OECD, MARKET DEFINITION, *supra* note 13 (discussing the role of market definition in competition law and regulation throughout the world and the recent US debate on market definition and alternative tools).

²⁸ See OECD, MARKET DEFINITION, *supra* note 13, at 40 Box 4.

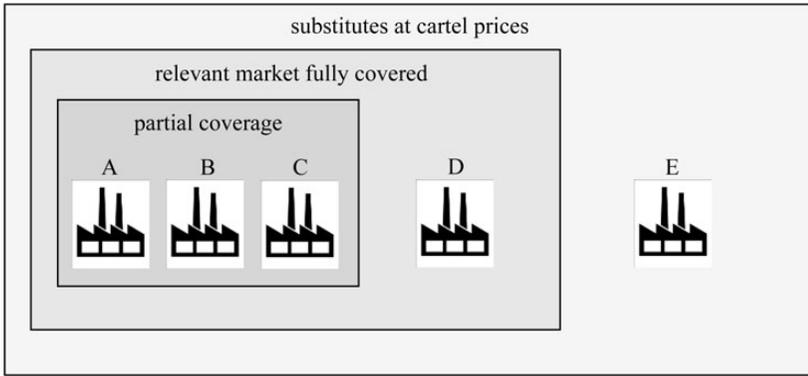


Figure 3. Umbrella effects within and outside the relevant market

outsider. In the shadow of the cartel, outsiders may be able to enjoy increased demand, and are also able to raise their prices. Demand replacement is, arguably, lower when the umbrella effect is stronger—that is, when cartel outsiders increase their price in response to a higher cartelized price. Put differently, a cartel's stability is less endangered when there is a stronger umbrella effect.²⁹

Due to the central focus on demand substitution in the absence of price reactions by outsider firms, umbrella effects are closely linked to the HMT. If the conditions of the HMT are not satisfied for a particular candidate market and competitive prices, it is not only clear that the relevant market is larger, but also that even a cartel completely covering this candidate market is unlikely to be profitable in the absence of umbrella effects. This cartel would only become profitable if those firms whose products are in the relevant market but excluded from the candidate market were also to increase their prices. As the SSNIP analysis excludes responses for products that are not part of the candidate market, the analysis does not take into account umbrella effects.³⁰ Adding substitutes gradually to expand the candidate market enlarges the set of market products by those that are most central to the cartel, up to the point where a candidate market is found in which a hypothetical monopolist (or a cartel behaving in exactly this way) would find it profitable to raise the price. Cartels, however, do not necessarily require that all firms in the relevant market defined in this fashion be part of the cartel, as cartelists can count on umbrella effects that are not part of the SSNIP analysis.

Suppose that the HMT indicates that the products of cartelists (firms *A*, *B*, and *C* in Figure 3) and the products of an outsider firm (firm *D*) belong to the same relevant market. Suppose also that, absent the cartel, it could be

²⁹ A relatively large umbrella effect could, for instance, also arise when the cartel's price is used as a focal price for implicit coordination between and with cartel outsiders.

³⁰ The SSNIP foresees neither a strategic response triggering the largest umbrella effect nor changes in price taking behavior.

demonstrated that highly competitive prices would prevail, for example, in the case of sufficiently homogeneous products. By definition of the relevant market, a price increase above the competitive level of 5 to 10 percent would not be profitable for cartel members (*A*, *B*, and *C*). Hence, if the cartel imposes a high markup, it could only be profitable if the cartel outsider (firm *D*) increases its price as well. While this discussion does not suggest a particular level for the umbrella effect *per se*—for example, in relation to the cartel's markup—it emphasizes that an umbrella effect is very likely when cartel outsiders belong to the same market.

As demonstrated in the preceding discussion, there is a clear relationship between market definition and umbrella effects. If a cartel outsider is within the relevant market (firm *D*), an umbrella effect will be likely and large if diversion between products (substitutes) within a relevant market is large. In fact, as we discussed, a partial cartel can be (substantially) profitable if outsider firms increase prices sufficiently.³¹ That is, for the cartel to profit in this case, either the cartel markup must be very small so that diversion is limited even in the absence of umbrella effects or the umbrella effect must be sufficiently large.

The next part explains how umbrella effects arise not only within a properly defined relevant market, but outside the relevant market as well.

B. Umbrella Effects When the Products of Outsiders Are Not in the Relevant Market

Suppose now that the market coverage of the cartelists is complete—that is, that all firms in a properly defined relevant market participate in the cartel (firms *A* to *D* in Figure 3). By definition of the SSNIP test, a small price increase of the cartelists starting from *competitive prices* would not lead to a large diversion of demand to the products of outsiders (firm *E*). This is likely, however, to be different when one considers cartel prices, rather than competitive prices. In particular, if the cartel markup over the competitive price is substantial, products that are not part of the relevant market become substitutes. As a result, if cartel prices are substantially above competitive prices, consumers will divert demand to the outsiders' products, even if they are not sufficiently close substitutes to be in the same relevant market. As these products, however, remain more remote substitutes than those in the relevant market, the size of the umbrella effect will be driven mainly by the size of the markup.

³¹ This is particularly salient with homogenous products and in the absence of capacity constraints. The cartel will not be profitable and therefore will not form if a cartel outsider in the same relevant market does not adjust prices. In the extreme case of Bertrand competition, this firm would simply undercut the cartel and thereby capture all demand.

This is intuitive if one considers the cellophane fallacy already mentioned previously. If cartel prices were used in the market definition,³² the relevant market would be defined too widely (comprising the products of firms *A* to *E*) as products that are only substitutes at these higher prices would be treated as substitutes. If, however, a complete cartel is formed with full coverage of a properly defined relevant market (the products of firms *A* to *D*), then umbrella effects may occur outside that relevant market (firm *E*'s product) as they are linked to relevant substitutes. If that was not the case, there would be no cellophane fallacy.

In order to see this, consider a simple example of three firms offering differentiated products.³³ Firms 1 and 2 produce close substitutes, and firm 3 produces a more distant substitute. If these firms maximize profits independently, one can derive a set of equilibrium prices. Applying the SSNIP test by increasing the price of the products of firms 1 and 2 by 10 percent above their competitive equilibrium price reveals that such a price increase is profitable.³⁴ As a result, the product of firm 3 does not belong to the relevant market as it does not exert a sufficient constraint. Consider now the case of a cartel fully covering the relevant market—that is, a cartel composed of firms 1 and 2, but not of firm 3, whose product is a substitute but not in the relevant market. If firms 1 and 2 form a cartel, they will maximize their joint profit. As a result, not only will the prices of the products of firms 1 and 2 increase but the price of the product of firm 3 will also increase. If a SSNIP test of 10 percent is performed based on the cartel price of firms 1 and 2, the additional price increase would not be profitable, wrongfully suggesting that firm 3 should be included in the relevant market. This will also hold for an increase of only 5 percent. In this case, we assume that firm 3 does not adjust its price in response to the price increases from firms 1 and 2. If, however, firm 3 were to adjust the price of its product optimally to the 10 percent increase in prices for the products of firms 1 and 2, it would render the cartel's 10-percent increase profitable. This would also hold for a 5-percent SSNIP with optimal adjustment of the price of firm 3's product.

While the above exercise is nothing more than an example of the cellophane fallacy (if one were to base market definition on this test), it demonstrates that products outside the relevant market under conditions of effective competition may become important substitutes under cartel prices. As a result, even when the cartelization of a market is complete, the firms that are not in the relevant market (as defined under competitive prices) may generate umbrella effects as

³² Prevailing prices are used in market definition in a merger context whereas hypothetical competitive prices are used in a monopolization or dominance context.

³³ The example is derived from the following profit functions for the three firms: $\pi_1 = p_1(a_1 - b p_1 + d p_2 + e p_3) - c_1 p_1$, $\pi_2 = p_2(a_2 - b p_2 + d p_1 + e p_3) - c_2 p_2$, $\pi_3 = p_3(a_3 - b p_3 + e p_1 + e p_2) - c_3 p_3$, where $a_1 = a_2 < a_3$, $b > d > e$, and $c_1 = c_2 = c_3$.

³⁴ Such a price increase may even remain profitable if, in contrast to usual practice under the SSNIP, firm 3 is assumed to respond optimally to this price increase.

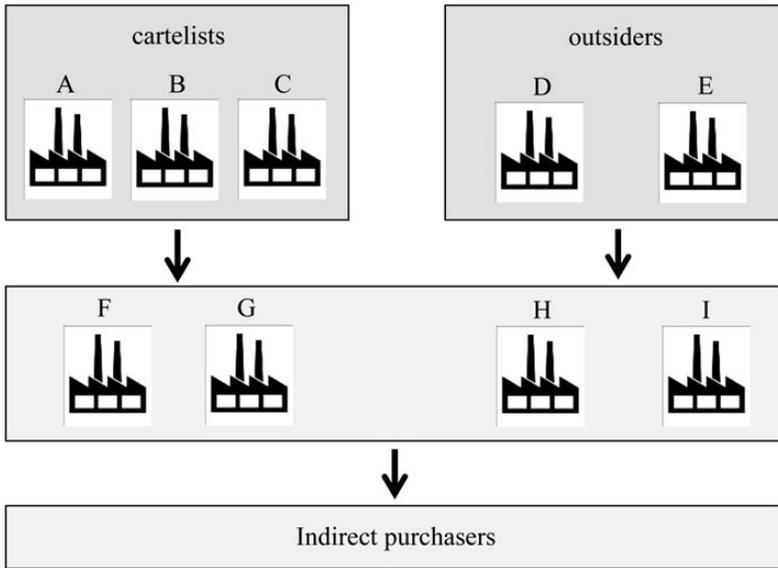


Figure 4. Umbrella effects with downstream competition

their products become relevant substitutes under cartel prices and divert demand away from the cartelists.

IV. DOWNSTREAM COMPETITION

In the preceding discussion, we did not address the question of whether the downstream firms that procure from the cartel are in direct competition with those that procure from cartel outsiders. In this part, it is shown that this distinction has important consequences. Depending on whether direct purchasers (firms *F* and *G* in Figure 4) are in direct downstream competition with purchasers of non-cartelized suppliers (*H* and *I*) or not, the latter may be harmed by the presence of a cartel even when non-cartelized producers of substitutes (firm *D* and *E*) increase their prices.

Recall first that if suppliers offer perfect substitutes and if there are no capacity constraints or firm-specific preferences (such as geographic distance) for one product over the other, then the question of whether an umbrella effect arises is pretty much superfluous. Under these assumptions all products should command the same price.³⁵ Consider now the opposite scenario, namely that, from the viewpoint of the direct purchasers, there is no direct substitution between the cartel's products and the non-cartelists' products (that is,

³⁵ In the case of price competition, when there are outsiders to the cartel and goods are homogeneous, the cartel will not be in a position to raise the price above the competitive level in the first place.

firms *F* and *G* can only purchase from *A* to *C*, and firms *H* and *I* only from *D* and *E*). As an example, consider the case where the input, given its cost of transportation, is procured only locally, but the final product is offered on a national or global market (that is, firms *F* through *I* operate on a common market). While this scenario should indeed preclude direct substitution between the cartel's product and the product offered by other suppliers, a price increase for one product will still drive up demand for the others and possibly lead to a price increase. However, we will show that the implications of such a price increase triggered by the cartel will be markedly different from previous examples. We then consider again the case where the cartel's product and the outsiders' products are substitutes.

Given a price increase by a cartel that direct purchasers *F* and *G* (partially) pass on to the indirect purchasers, the larger this pass-on, the less competitive the direct purchasers will become vis-à-vis *H* and *I*. Consequently, demand will shift to rival firms *H* and *I*. In order to serve this increased demand, rival firms *H* and *I* will demand more of the respective input provided by their non-cartel suppliers (firms *D* and *E*). Following the arguments presented previously, these actions should typically induce a price increase for these inputs. Moreover, as the size of the expected price increase depends on how far demand has shifted outward, this effect is closely related to the pass-on of direct purchasers to indirect purchasers and, thereby, to the cartel markup. Typically, the competitive advantage of rivals *H* and *I* vis-à-vis the direct purchasers *F* and *G* will remain (albeit reduced), despite the fact that the rivals' own input prices increase as well. After all, it is the expansion of the rivals' own demand, following a reduction in the competitiveness of direct cartel purchasers (*F* and *G*), that subsequently leads to an expansion of the rivals' demand for inputs, which then triggers a price increase for the respective input. Put differently, the benefits obtained from an increase in output, as the direct purchasers of the cartel become less competitive, will typically outweigh the higher induced input price that *H* and *I* face.

As previously noted, the extreme case where firms procuring their inputs from the cartel cannot switch the source of supply has been presented for illustrative purposes only. Suppose now that there is some degree of substitution, but those procuring from the cartel (*F* and *G*) and those procuring from cartel outsiders (*H* and *I*) remain rivals on the downstream market. There are then two reasons why the price of cartel outsiders (*D* and *E*) would increase. As the cartel's price increases, demand shifts away from the cartel (*A*, *B*, and *C*) to firms outside the cartel (*D* and *E*), which was the primary trigger for the umbrella effect, as discussed above. In addition, when the firms that are more affected by the cartel's price increase (*F* and *G*) pass on the increased input costs leading to higher output prices, downstream market demand increases for rivals *H* and *I*, who prefer the good supplied by cartel outsiders. The resulting increase in the demand faced by cartel outsiders, which now works through downstream firms' competition, also triggers

a price increase. These two effects should, however, not be considered complementary or mutually reinforcing. Instead, when competition in the downstream market is more intense, as there are a relatively higher number of firms that remain unaffected by the direct effects of the cartel markup, the direct purchasers of the cartel will respond to the more intense competition by not passing-on as much of the cartel markup to indirect purchasers as they would otherwise do. It is intuitive that in this case the cartel would also have reduced incentives to raise prices, as doing so would trigger a larger reduction in demand.

The essential point is that the two reasons why the demand for the product of cartel outsiders increases and why cartel outsiders face increased demand and increase prices in response have somewhat orthogonal implications for firms purchasing their products. In fact, as discussed above, when the demand expansion works through the increased competitiveness of the respective direct purchasers (H and I) on the downstream market, those purchasers benefit from the operation of the cartel. A simple empirical analysis that would merely determine the price increase of cartel outsiders (D and E), as opposed to examining a counterfactual market, would fail to uncover this difference. On the other hand, a full analysis of damages, which includes changes in quantity and pass-on, would not face this pitfall.³⁶ Even when such a full-fledged analysis is not feasible, however, it should be clear from the preceding discussion that the determination of an overcharge—that is, a markup multiplied by the actual quantity—may provide a very poor reflection of the damages emanating from umbrella effects.

As a final remark, note that even when the firms that face higher input prices from non-cartel suppliers (firms H and I) actually benefit from the operation of the cartel, their purchasers—that is, consumers or firms operating at the next level of the vertical value chain (not depicted in Figure 4)—will still be harmed. Even when these indirect purchasers buy from firms that are not purchasers of the cartel and, at least in our extreme example, could not even claim that the cartel's price increase had deprived them of a cheaper supply, they may still face a price increase ultimately initiated by the cartel.

V. UMBRELLA EFFECTS AND ENDOGENOUS CARTEL FORMATION

So far, it has been assumed that cartels exhibit only partial market coverage, instead of their partial coverage being derived as an equilibrium within a theoretical model. This assumption could be justified in the case where, besides the firms that constitute the cartel, all other firms in the market are each insignificantly small with respect to the market and therefore behave non-strategically as price takers. However, in many instances, cartels are observed with relatively

³⁶ See Maier-Rigaud & Schwalbe, *supra* note 4; Inderst, Maier-Rigaud & Schwalbe, *supra* note 4 (discussing quantification of antitrust damages).

low market coverage,³⁷ or where firms with significant market share do not participate in the cartel.³⁸ In such cases, the assumption of non-strategic behavior is unconvincing, and economic theory must explain the conditions under which incomplete cartels may arise in equilibrium. From a theoretical perspective, a consistent and convincing theory of umbrella effects can only be derived if cartels with partial market coverage can be theoretically explained.³⁹

³⁷ See Commission Decision, COMP/39.396—Calcium Carbide and Magnesium Based Reagents for the Steel and Gas Industries, 2009 (C 2009) 5791 final, Recital 37 (July 22, 2009) (noting that in addition to the cartellists there were seven other producers and suppliers with an estimated combined market share of 15 percent for calcium carbide powder and 31 percent for calcium carbide granulates); Commission Decision, Case COMP/38543—International Removal Services, 2008 (C 2008) 926 final, Recital 89 (Mar. 11, 2008) (identifying a 50 percent market share of the cartel). See also Commission Decision, Case COMP/38.628—Nitrile Butadiene Rubber (also known as synthetic rubber), 2008 (C 2008) 282 final, Recital 15 (Jan. 23, 2008) (the cartellists Bayer and Zeon have respective market shares of 36 percent and 19 percent, leaving 45 percent to competitors whose names and shares were considered confidential information). Note that Commission decisions will identify as cartellists only those cartel members for which an infringement could be proven. This implies that using the market coverage identified in decisions will tend to underestimate cartel coverage at least on average.

³⁸ See Commission Decision, Case COMP/39482—Exotic Fruit (Bananas), 2011 (C 2011) 7273 final (Oct. 12, 2011) (identifying a cartel between two of the four big multinational companies active on the market, namely Chiquita and Pacific, who had combined market shares of 30 percent and 40 percent for the two relevant years in Portugal—the only country with a 25 percent market share of fringe players in addition to the big four). The market shares of the cartel were 50 percent in Italy in both years, 65 to 70 percent in Greece in 2004, and 60 percent in Greece in 2005. *Id.* Recital 22 & 326. See Commission Decision, Case COMP/39188—Bananas, 2008 (C 2008) 5955 final, Recital 457 (Oct. 15, 2008) (estimating that the combined market share of the undertakings for which an infringement could be established is at least around 40 to 45 percent). See also James M. Griffin, *Previous Cartel Experience: Any Lesson for OPEC?*, in *ECONOMICS IN THEORY AND PRACTICE: AN ECLECTIC APPROACH* 179 (Lawrence R. Klein & Jaime Marquez eds., Kluwer Academic 1989) (reporting the cartel's market share for a sample of 54 international cartels: 35 percent of the cartels in his sample have market shares of at least 75 percent, whereas 17 percent (9 cartels) have market shares of at least 90 percent); Valerie Y. Suslow, *Cartel Contract Duration: Empirical Evidence from Inter-War International Cartels*, 14 *INDUS. & CORP. CHANGE* 705 (2005) (reporting that, for 39 of the 71 cartels in the sample market share data, the average cartel had at least 50 percent of the market); George A. Hay & Daniel Kelley, *An Empirical Survey of Price Fixing Conspiracies*, 17 *J.L. & ECON.* 13, 22–23 (1974) (providing estimates of industry concentration that are roughly comparable to what we find: “In thirty-eight of fifty cases for which estimates could be made the concentration ratio was greater than 50 percent.”).

³⁹ In this context, it has been shown that the incentives to form cartels depend on the type of competition in the market and on the related question of whether the strategies employed by the firms are strategic complements or substitutes. With price competition, prices are strategic complements, and cartel outsiders always have an incentive to join the cartel. See Raymond Deneckere & Carl Davidson, *Incentives to Form Coalitions with Bertrand Competition*, 16 *RAND J. ECON.* 473 (1985). With quantity competition, however, quantities are strategic substitutes, and, provided the cartel is not very large relative to the overall market, partial cartels are unstable because outsiders are better off free riding on the higher prices induced by the cartel's quantity reduction. See Stephen W. Salant, Sheldon Switzer & Robert J. Reynolds, *Losses from Horizontal Merger: The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium*, 98 *Q.J. ECON.* 185 (1983) (demonstrating the linear case of this effect).

The basic theoretical approach to analyzing cartels is a repeated interaction model in which a cartel is considered stable if the short-run gains from a deviation from the cartel agreement are smaller than the long-run gains of remaining in the cartel.⁴⁰ This model implicitly assumes that the cartel breaks down as soon as at least one member deviates from the cartel.⁴¹ To thoroughly analyze umbrella effects of cartels, economic theory must explain why it is in the interest of some firms not to participate in the cartel or, stated otherwise, why the cartelists would not prefer to include the other firms. The central questions addressed relate to the internal and external stability of a cartel. Here, internal stability refers to the question of whether or not a member of the cartel faces sufficient incentive to adhere to the cartel. Internal stability exists if the profit gained by an additional outsider is lower than that of a cartel member. External stability refers to the incentives to join the cartel in the first place—that is, a cartel will be externally stable if no outsider has an incentive to participate in the cartel. The external stability condition is satisfied if the increase in price due to joining the cartel does not increase a cartel member's profit beyond what an outsider currently receives. A cartel is stable if it is internally and externally stable.

An important factor with respect to umbrella effects is the size of the cartel. The smaller the cartel with respect to the market, the less effective it will be at raising prices. In the case of a small cartel, the market outcome is not substantially different from that of a competitive market. In line with the comparison made above with the HMT, this relationship not only applies to the size of the cartel relative to its market coverage, but also to the types of products supplied by these firms in the market. While coverage is important, it will also be important to evaluate the firms producing the closest substitutes. The products of those firms that would have already been included in early candidate markets are more relevant than those included just before the relevant market is found, *ceteris paribus*.⁴²

A recent strand of literature on partial cartels has analyzed several aspects of partial cartels in a homogenous good framework, including cartel formation, cartel behavior, and industry structures that make partial cartels particularly likely.⁴³ If firms differ with respect to their capacities and if cartel formation is

⁴⁰ There is, however, an older strand of the literature, based on a static, one-shot game analysis, which goes back to the contributions of Reinhard Selten, *A Simple Model of Imperfect Competition, Where 4 Are Few and 6 Are Many*, 2 INT'L J. GAME THEORY 141 (1973) and d'Aspremont, Jacquemin, Gabszewicz & Weymark, *supra* note 11.

⁴¹ This does not imply that the cartel breaks down forever—a deviation might lead to a finite punishment phase and a return to the cartel arrangement. See, e.g., Martin K. Perry & Robert H. Porter, *Oligopoly and the Incentive for Horizontal Merger*, 75 AM. ECON. REV. 219 (1985). However, the assumption that all firms in a market participate in the cartel is maintained.

⁴² This issue does not, however, arise in models where only homogenous product Cournot competition is considered.

⁴³ See A.M. Bos, *Incomplete Cartels and Antitrust Policy: Incidence and Detection* (Nov. 20, 2009) (unpublished thesis, Tinbergen Institute) (on file with authors); Iwan Bos & Joseph E. Harrington, *Endogenous Cartel Formation with Heterogeneous Firms*, 41 RAND J. ECON. 92

costly, a cartel will not include all firms in the industry, provided that the costs of cartelization increase with the number of cartel members. The actual size of the partial cartel depends on the cost of cartelization—the larger the cost, the smaller the number of firms in the cartel. The market price is shown to be an increasing function of the cartel's joint capacity. This implies that umbrella effects increase with the degree of market coverage. The literature also demonstrates that larger firms have a stronger incentive to join a cartel. Thus, an equilibrium consists of a partial cartel that contains the largest firms in an industry. In addition, it is shown that partial cartels are more likely in industries where the size distribution of firms is asymmetric than in markets where firm size is more evenly distributed.⁴⁴

Thus, the literature that analyzes homogenous product cartels with partial market coverage as an equilibrium outcome seems to be, by and large, in accordance with the results derived above—that is, the degree of market coverage and the magnitude of the umbrella effects are positively correlated. The analysis of partial cartels is, however, not very well developed and focuses exclusively on homogenous products. Further analysis could describe this relation in more detail, including the effect of differentiated products.

VI. CONCLUSION

Our analysis of umbrella effects reveals several insights. First and foremost, we show that umbrella effects can occur in a wide range of circumstances, most notably when the cartel outsiders act merely as price-takers and when they strategically adjust their prices in response to higher demand as cartel members raise prices or restrict output. Also, we show how umbrella effects arise both when firms compete in quantities (capacities) or in prices and when products are more or less differentiated. That said, these factors, together with others such as the form of the firms' cost functions (or, more generally, the elasticity of supply), affect the size of umbrella effects. For a given price increase by a cartel, umbrella effects should depend positively on the degree of substitutability (because substitutability increases the extent to which demand is diverted away from cartel members to outsiders) and on the size of the cartel. Interestingly, whether outsiders strategically react or not can either dampen or

(2010); Marc Escrihuella-Villar, *Partial Coordination and Mergers Among Quantity-Setting Firms*, 26 INT'L J. INDUS. ORG. 803 (2008); Marc Escrihuella-Villar, *A Note on Cartel Stability and Endogenous Sequencing with Tacit Collusion*, 96 J. ECON. 137 (2009).

⁴⁴ As discussed before, this literature focuses on homogenous products and therefore does not treat differences in substitutability between firms' products. It may be perfectly reasonable to expect that a smaller cartel in terms of market coverage is stable, whereas a cartel with larger market coverage exhibiting a different composition of firms is not. This scenario will, in particular, be a possibility when the former is made up of firms with relatively close substitutes whereas the latter has a more representative set of firms in terms of the market products' substitutability characteristics.

increase the overall price effect of a cartel and thereby also the size of an umbrella effect—that is, the impact that the cartel has on the purchasers of products from cartel outsiders.

We work out the relationship between umbrella effects and market definition. Sizeable umbrella effects may occur, at least theoretically, for firms not in the relevant market, as the market is commonly defined in antitrust analysis. In particular, when the cartel has sustained a persistent and sizable price increase, products that were not substitutes under effective competition become substitutes. On the other hand, when cartel outsiders (with sizable capacity) exist in the relevant market, the cartel's price increase can only be significant and profitable if cartel members can expect a sizable umbrella effect. Our analysis thus indicates that the size of the cartel, its market coverage, its price increase, and the umbrella effects are all closely interlinked. A thorough analysis should thus examine these factors jointly and consider to what extent the respective findings are mutually consistent (akin to an equilibrium analysis).

Finally, we also show that demand substitution toward non-cartel members triggers an increase in their respective prices, and may, in fact, work through two different channels: either a direct substitution effect away from cartel members or an indirect effect that works through downstream competition between firms that purchase from the cartel and rival firms that end up purchasing, instead, from non-cartelized suppliers. While the latter channel also leads to a price increase, rivals that do not purchase from the cartel may benefit from the cartel. To identify the actual damage, it is thus key to take into account the overall adjustments among cartel members and outsiders as well as their respective, potentially competing purchasers.