ABSTRACT

We analyse the key determinants of umbrella effects, which arise when the price increase or quantity reduction of a cartel 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 (in the sense of a SSNIP test), provided that the cartel’s price increase is substantial. Further, a shift of demand to non-cartelists, triggering a price increase, can be induced also when their purchasers themselves benefit from higher demand as rivals purchase from the cartel and pass-on the respective price increase. 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. 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 Classification: K21, L13, L41.

Keywords: umbrella effect, partial cartel, pass-on, cartel effect, quantification of damage, merger effects, private enforcement, standing, market definition, cellophane fallacy, antitrust.

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I. INTRODUCTION

The importance of private enforcement as a complement to public enforcement of competition law has rapidly increased in the EU in the last few years. This is due not least to the efforts of the European Commission culminating in the recent publication of a draft guidance paper on the quantification of harm and a proposal for a “Directive of the European Parliament and the Council on certain rules governing actions for damages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”.

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) and, at least since Courage and Crehan and Manfredi, it is generally accepted that any individual can claim compensation for harm suffered from an infringement of EU competition rules. This would at least seemingly imply that victims that have suffered harm based on so-called “umbrella effects” of cartels should be entitled to claim compensatory damages.

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

Understanding (and quantifying) umbrella effects is of particular importance in the context of private enforcement in the EU as they are – economically speaking – directly attributable to the cartel (in the sense of causality) and no convincing argument has been presented so far as to why they should not be legitimate actionable claims for damages. As the proposed Directive does not address causality (foreseeability and remoteness) and thereby delegates this 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 being bound by the principles of equivalence and effectiveness, a harmonized and economically coherent treatment remains feasible.

The pressing need for a coherent legal interpretation of umbrella effects is a matter that was further emphasized by a recent request to the Court of Justice of the European Union for a preliminary ruling from the Oberster Gerichtshof, the highest court in Austria, concerning the question whether EU competition law has to be “interpreted 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)”.

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

This is also of central importance for the overall coherence of competition law, in particular in light of a more economic approach, since the consideration of such effects is also important for the proper assessment of


3 See joined cases C-295/04 to C-298/04, Manfredi, [2006] ECR I-6619.

4 For a legal introduction and overview of the topic see the contributions in David Ashton and David Henry (eds.), COMPETITION DAMAGES ACTIONS IN THE EU: LAW AND PRACTICE, Edward Elgar (2013). In particular, an overview emphasizing the economic aspects of damage actions and quantification is given by Frank Maier-Rigaud and Ulrich Schwalbe, Quantification of Antitrust Damages, forthcoming in: David Ashton and David Henry (eds.), COMPETITION DAMAGES ACTIONS IN THE EU: LAW AND PRACTICE, Edward Elgar (2013) and Roman Inderst, Frank Maier-Rigaud and Ulrich Schwalbe, Quantifizierung von Schäden durch Wettbewerbsbeeinträchtigungen, handbuch der privat-en kartellrechtsschutz, forthcoming in: Andreas Fuchs und Andreas Weitbrecht (eds.) HANDBUCH DER PRIVATEN KARTELLRECHTSDURCHSETZUNG, C.H. Beck, München (2014).

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 increase the magnitude of the optimal price increase of the merged entity. This will be briefly discussed below in the context of the SSNIP test.


7 See Case C-121/03,香甜 and Crehan v Manfredi, [2006] ECR I-6619, [at 98].

8 See Case C-557/12, Request for a preliminary ruling from the Oberster Gerichtshof (Austria) lodged on 3 December 2012 - KONE AG, Otis GmbH, Schindler Aufzüge und Fahrtei tren GmbH, Schindler Liegenschaftsverwaltung GmbH, ThyssenKrupp Aufzüge GmbH v ÖBB-Infrastruktur AG.
effects in the context of the merger review process and 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.\(^9\)

From a legal point of view, it may be noteworthy to point out that reactions of cartel outsiders, whether in the same relevant market or not, cannot be considered free-riding in the sense of a wilful exploitative act (possibly to be sanctioned by competition law in itself) but should rather be seen as an economically optimal reaction by these outsiders to changes in demand. In fact, when cartel outsiders are price-takers (“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 higher prices or lower output of cartel members, as we explore below, it may sometimes even mitigate the negative effects of the cartel depending on the nature of strategic interaction in the market; albeit the price for the cartel outsider’s own output increases 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. Still, when firms that are 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 but are unaffected by the cartel. An umbrella effect will then still be very likely as an increase of these firms’ derived demand will cause their respective suppliers to increase prices. In this case, however, firms purchasing from these suppliers may overall not suffer damages from the cartel as they benefit from the increase in their rivals’ costs. Overall, our analysis also explores the relationship between pass-on and the umbrella effect.

In order to formulate the economics of umbrella effects we proceed as follows. As noted above, one of our objectives in this paper is to show that if the market is not fully covered, a price increase also by cartel outsiders can typically be expected at least when the cartel operates for a sufficiently long time and when its price increase is substantial. We also describe specific circumstances when such a price increase should be rather 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 behaviour of the cartelized firms. We also demonstrate that further determinants such as for example 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 amount of the umbrella effects. Further, we demonstrate that umbrella effects and market definition are conceptually related. As cartels in general lead to higher prices, products become substitutes at the inflated cartel prices which would not be considered substitutes under effective competition. Finally, we discuss some problems that are related to the economic theory of the formation of partial cartels.

This paper deals mainly with the theory of umbrella effects, but the presence of such an effect has also implications for the quantification of damage. This concerns first and foremost the quantification of damage that is itself caused through umbrella effects. While in principle the same econometric tools that are employed to quantify damage for direct purchasers of cartel members can be employed here as well, we note, in particular, in Sections IV and V that in this case 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 (e.g., in a cost-price margin yardstick analysis). Then, to the extent that there is an umbrella effect, using the respective prices in this way would result in an underestimation of damage also for purchasers from cartel members.

II. PRINCIPLES

In this section we discuss the economic foundations of umbrella effects caused by cartels. Depending on the conditions in the respective markets, different scenarios have to be considered. For example, the magnitude of

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\(^9\) 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 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'. [...] the 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 complementary 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". See Commission Decision in case M.6497 Hutchison 3G Austria/Orange Austria, Rectalts 367-372.

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, or there is downstream competition.

At a first stage, we consider in this section a scenario where i) the non-cartelized firms behave competitively and where ii) the parties that are affected by the price increase are final consumers or firms that are not in competition with each other. The lack of competition on the direct purchaser level will, as we show further below, take away a channel that may both 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 of cartel members and a reaction of cartel outsiders. If there is competition and firms are differently affected, however, there are additional effects at play, which we discuss in Section IV below.

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 group one set the prices of their products strategically, that is taking into account the effects of their behaviour on the other firms while the firms in group two, the suppliers of a substitute good, are price takers given their small size, i.e. we assume a “competitive fringe”. We further assume that all firms produce with increasing marginal cost. With constant marginal cost and in the absence of 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. To the extent that there are viable non-cartelized substitutes this will increase the demand for these substitutes, at least when the mark-up is substantial and when the cartel operates for a sufficiently long time.11 Graphically speaking, the price increase induced by the cartel has the immediate effect of shifting outwards the residual demand curve faced by the competitive fringe, i.e. the demand that is not satisfied by the cartelized firms. Notice that our assumption of increasing marginal cost implies that the supply function of the competitive fringe is not perfectly elastic. Otherwise, as noted above, any attempt by a cartel to increase the market price is defeated by an increase in the supply of the competitive fringe.

When the supply curve of the competitive fringe is strictly increasing, a profitable price increase of the cartel is possible even when the cartelized and the outsiders’ products are relatively close substitutes (or even in the case of perfect substitutes). The umbrella effect in the case of homogeneous product price competition with a competitive fringe is illustrated in Figure 1 taken from Blair and Maurer (1983).

Figure 1. Umbrella effect with price-taking cartel outsiders

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11 This model is equivalent to models of collusive price leadership which have been analysed e.g. by Claude d’Aspremont, Alexis Jacquemin, Jean J. Gabszewicz, and John A. Weymark, On the Stability of Collusive Price Leadership, CANADIAN JOURNAL OF ECONOMICS, 16, 17-25 (1983) or Marie-Paule Donsimoni, Stable Heterogeneous Cartels, INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION, 3, 451-467 (1986).
This is the case when more of the displaced demand is indeed diverted to the substitute of substitutability between the cartelized and non-given price increase induced by the cartel, the umbrella effect should be more pronounced of substitutability entry.

resulting from the outward shift in residual demand remains higher is small or when their average costs of production increase steeply with a larger quantity. This should in turn be the case when the respective firms’ capacity is decreasing average cost. Note that holding the technology of the fringe firms constant, however, this would not occur. A profit maximizing firm does not produce in a region of decreasing average cost.

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 in 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 for example Carl Shapiro, Mergers with differentiated products, ANTITRUST, 10(2), 23-30 (1996), OECD, Market Definition, OECD BEST PRACTICE ROUNDTABLES IN COMPETITION POLICY, written for the OECD Secretariat by Ulrich Schwalbe and Frank Maier-Rigaud, June (2012) or Simon Bishop and Mike Walker, The Economics of EC Competition Law: Concepts, Application and Measurement, 3rd ed, Sweet & Maxwell/Thomson Reuters (2010). Consider the following example taken from Shapiro (1996): Assume A has an own-price elasticity of demand of 2.0, so that a 1% increase in the price of A results in a reduction of the marginal sales by 2%. 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, i.e. 25 %. This means that one-quarter of the lost marginal sales of

While a positive umbrella effect arises under the discussed 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 costs.

When we take a given reduction in the quantity of the cartelized firms, the umbrella effect is ceteris paribus the higher the lower the price elasticity of the supply of the competitive fringe is, i.e. the steeper the residual supply curve is in the relevant range. This should in turn be the case when the respective firms’ capacity is small or when their average costs of production increase steeply with a larger quantity. The price increase resulting from the outward shift in residual demand remains higher also 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 umbrella effect should be more pronounced the higher the degree of substitutability between the cartelized and non-cartelized product is, as the increase in residual demand is more pronounced. This is the case when more of the displaced demand is indeed diverted to the substitute good. 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, i.e. when the market coverage of the cartel is small. In this case, the residual supply curve should be more elastic.

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 the cartel outsiders own (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 is sometimes meant to capture firms’ choice of capacity. These models are 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 group that behaves strategically, i.e. chooses the quantities taking into account the effect on the market price, and one group where the firms behave non-strategically. 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. This 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 total quantity supplied remains reduced. Thus, the resulting market price is higher in a cartelized market as compared to a situation where the firms in group one behave non-cooperatively.

Similar results arise in models with quantity competition and differentiated products e.g. where the product of the firms in group one differs from the product of the fringe firms. In such cases the quantity reduction induced by the cartel leads to a less pronounced quantity expansion of the competitive fringe the more differentiated the products are. The reason is that the diversion of demand from the cartelized to the non-cartelized firms is less pronounced the more differentiated the products are. Thus, the prices of both products increase, but the price of the cartelized product increases by more than the price of the non-cartelized product, i.e. the price difference between the two products changes. The degree of differentiation can be captured by a similar measure as the diversion ratio used in the case of price competition. While for the latter case 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.

The discussion has shown that under quantity competition, despite the fact that the non-cartelized firms produce a larger quantity (of substitutes), the total quantities produced decline as 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 also with quantity competition, both with homogeneous products and with differentiated products. This implies that also the customers of the fringe firms pay higher prices as compared to a situation without a cartel. Note, however, that the question of the magnitude of the umbrella effect only arises when the substitute good and the cartelized good are differentiated so 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-induced 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

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outsiders was presently represented by the respective supply curve, as derived from their profit-maximizing behaviour. An umbrella effect arises from the interplay of the increase in residual demand induced by the diversion of demand away from cartel members and the imperfectly elastic supply of the substitute. 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. Then, each of the cartel outsiders no longer acts as a price taker when it faces an increase in its residual demand. Firms with market power do not simply accommodate the higher demand, but adjust prices optimally.

If firms are identical, produce a homogeneous product with constant marginal cost and compete in prices, we are in the standard Bertrand model where the market outcome is the same as in a market where all firms are price takers. Forming a non-inclusive cartel to increase the market price is pointless as capacity unconstrained competition of the non-cartelized firms will drive down the price 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 now depend on how it trades off an increase in the price of its own product, resulting in a higher margin, with a more or less pronounced 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. As cartelization leads to a price increase of 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 products of the non-cartelized firms is given by the slope of the best reply function of the respective firms.

Figure 2. Umbrella effects with price competition and strategic outsiders

To illustrate this, consider the case of a linear demand function and constant marginal cost. With linear demand an incremental increase in price has always the same incremental effect on demand, irrespective of the prevailing price and quantity level. In this case, intuitively also the best-reply functions of firms are linear, i.e. when a firm anticipates that the price of a rival is incrementally larger, then 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.

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18 This holds if the demand function is log-concave. See e.g. Xavier Vives, *Oligopoly Pricing*, MIT PRESS, Cambridge, Mass. (1999:94).
Take now the situation before a cartel forms. Here, 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 choose the respective prices, it is also optimal for the considered firm to choose the 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, now 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 a representative cartel member shifts upward and the new equilibrium prices are now given by the intersection of the best-reply functions of a cartel member and the outsider. Note that the outsider may not be aware of the cartel formation, in which case the respective prices may only be obtained over time. Once the new prices are obtained, the direct effect of the cartel 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 $p^*_e$.

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 spill-over from the cartel to the non-cartelized outsiders is more pronounced the closer substitutes the products are. Likewise, the magnitude depends positively on the size of the cartel. Intuitively, if the cartel has only a 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.

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 price of an outsider, the cartel and the umbrella effect for cartels with different degrees of market coverage. We vary cartel size from 2 to 9, i.e. all firms except one form a cartel. As previously, we do not take a fixed cartel price as we vary the market coverage of the cartel. Instead, each time we construct an equilibrium as previously: We suppose that the cartel jointly behaves optimally, that is akin to a merged firm, and then 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 respective prices should obtain in the long run, after firms have adjusted to the respective changes in prices and demand.

Table 1. Umbrella effects and cartel size

<table>
<thead>
<tr>
<th>Cartel size</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price outsider</td>
<td>2.908</td>
<td>2.918</td>
<td>2.933</td>
<td>2.954</td>
<td>2.983</td>
<td>3.020</td>
<td>3.066</td>
<td>3.123</td>
</tr>
<tr>
<td>Cartel effect</td>
<td>0.077</td>
<td>0.164</td>
<td>0.261</td>
<td>0.370</td>
<td>0.494</td>
<td>0.634</td>
<td>0.794</td>
<td>0.977</td>
</tr>
<tr>
<td>Umbrella effect</td>
<td>0.005</td>
<td>0.0145</td>
<td>0.023</td>
<td>0.052</td>
<td>0.080</td>
<td>0.117</td>
<td>0.163</td>
<td>0.220</td>
</tr>
</tbody>
</table>

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% and 23% of the cartel price. This is so even though we have chosen a low low degree of substitutability between the products.

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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 $d = 0.1$.

20 Of course this effect is driven by the fact that small (large) market coverage induces moderate (more pronounced) price increases in turn affecting 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 might satisfy the conditions of internal and external stability. This problem is discussed in section V.

22 In fact, the diversion ratio is only 5%.
2. **Quantity Competition**

If firms compete in quantities or in capacities installed, quantities or capacities are strategic substitutes in most cases. As one or several competing firms decrease their respective quantities, it is optimal for any other firm to increase its own. The reason is that a decrease in the supply by the cartelized firms will lead to an increase in the market price and this makes it attractive for the outsiders to profit from a larger quantity sold at a higher price.

The price increase induced by the cartel will typically not be overcompensated by the increased quantity of the non-cartelized firms so that total quantity produced decreases and the price increases. Similar results hold in the case where the cartelized and non-cartelized firms produce differentiated products. The main difference between the model with a competitive fringe and a strategic fringe with respect to the umbrella effects is that in the latter case the quantity responses of the fringe firms are less pronounced as they take into consideration the impact of their quantity choice on the market price.

The preceding discussion has shown that umbrella effects arise in a variety of circumstances, e.g. with price or quantity competition, with homogeneous or differentiated products, and if the non-cartelized firms act as price takers or if they behave strategically. The magnitude of the umbrella effects depends negatively on 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 only to a limited diversion of demand from the cartelized to the non-cartelized firms and thus only to a limited reaction in form of a 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 or size of the cartel.

### III. UMBRELLA EFFECT, CARTEL STABILITY AND MARKET DELINEATION

#### A. Umbrella Effect with Partial Coverage of the Relevant Market

Before considering umbrella effects under a partial cartel, i.e. a situation where the cartel covers the relevant market only partially, the relevant market has to be determined. In many jurisdictions a key tool in defining the relevant market is the hypothetical monopolist test (HMT). This test asks whether a hypothetical profit-maximizing monopolist would cause a small but significant and non-transitory increase in the price (SSNIP) of its products. Here, “small but significant” is usually taken to be about 5%-10% and “non-transitory” a time period of about one year. If, starting from a “candidate market”, this condition is not satisfied, then a profit-maximizing monopolist would not engage in such a price increase as this would lead to considerable demand substitution by customers. Therefore, the candidate market is enlarged by adding substitutes and carrying out the HMT for this enlarged set of products. The relevant market is then defined as the smallest set of products that satisfies this condition, i.e. would allow a profitable price increase by a hypothetical monopolist. Proceeding in this way, the boundary of the market is drawn where such a price increase is profit-maximizing for the hypothetical monopolist as products not in the relevant market do not exert sufficient discipline to render the price increase unprofitable as they do not attract enough demand.

In merger control the analysis usually starts at the prevailing price level, whereas under abuse of dominance the price level from which the analysis starts is the hypothetical price level that would prevail under effective competition. The analysis at the hypothetical level under effective competition is conceptually necessary, albeit difficult to accomplish in practice, as an analysis at the prevailing prices could fall foul of the

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23 Under strategic substitutes, best reply functions are downward sloping. This is satisfied if the demand function is not too convex, i.e. if a firm’s marginal revenue decreases if any competitor increases its output. See e.g. Xavier Vives, *Oligopoly Pricing*, MIT PRESS, Cambridge, Mass. (1999:94).

24 A stable cartel with a Cournot-fringe exists if demand is linear and firms are producing with constant marginal cost and the cartel is not too large, i.e. the number of fringe firms is sufficiently large. See for example Sherrill Shaffer, *Stable Cartels with a Cournot Fringe*, SOUTHERN ECONOMIC JOURNAL, 61, 744-754 (1995).

25 It is interesting to note that when firms compete in quantities and when these are indeed strategic substitutes, then for a given cartel output the price increase, both of the cartelized good and the substitute good, would be more pronounced when cartel outsiders do not learn (sufficiently quickly) about the changed market conditions. This is the case 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.

so-called “cellophane fallacy”. As a firm with significant market power could have already raised the prices for its products to the monopoly level, a further increase would be unprofitable as a large number of consumers would switch to other products. As a result the market would be expanded leading to a relevant market that is too large as it comprises also products that are substitutes only at the monopoly price but were not substitutes at a price that would prevail under effective competition. As a result, the market share and the market power of a dominant firm would be underestimated.28

If a cartel in a properly defined relevant market does not cover the market fully, it risks that cartel outsiders will free ride on it. This is depicted in Figure 3 where firms A to C are cartelized and firm D, which is part of the relevant market, is a cartel outsider. In the shadow of the cartel, outsiders may then be able to enjoy a much larger demand, but they are also able to raise their price. Demand replacement is, arguably, lower when the umbrella effect is stronger, i.e., when in response to a higher cartelized price also cartel outsiders increase their 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 firms outside the candidate market, umbrella effects are closely linked to the HMT. If the conditions of the HMT are not satisfied based on a particular candidate market and competitive prices, it is not only clear that the relevant market is larger but also that even a complete cartel covering this candidate market is unlikely to be profitable in the absence of umbrella effects. This cartel might become profitable only if those firms whose products are in the relevant market but were excluded in the candidate market also increase their prices. As the SSNIP excludes responses for products that are not part of the candidate market, the SSNIP in particular excludes umbrella effects.30 Expanding the candidate market gradually by adding substitutes, enlarges the set of products in the new candidate markets by those that are most central to the cartel, up to the point where a candidate market is found on 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 on the relevant market defined in this fashion are part of the cartel, as cartelists can count on umbrella effects not part of the SSNIP analysis.

**Figure 3. Umbrella effects within and outside the relevant market**

![Umbrella effects diagram](image)

Suppose that the HMT indicates that the products of cartelists (firms A, B and C in Figure 3) and of an outsider firm (firm D) belong to the same relevant market. Suppose also that absent the cartel, it could be demonstrated that highly competitive prices would prevail, e.g., in case of sufficiently homogeneous products. By definition of the relevant market, a price increase above the competitive level of 5-10% would not be profitable for cartel members (A, B and C). Hence, if the cartel imposes a high mark-up, this 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 mark-up, it emphasizes that an umbrella effect is very likely when cartel outsiders belong to the same market.

As a result of 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 as diversion between products (substitutes) within a relevant market is large. In fact, as we discussed a partial cartel can then only be (substantially) profitable if outsider firms increase prices sufficiently.31 That is, in this case it

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

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

31 With homogeneous products and in the absence of capacity constraints this is particularly salient as the cartel will not be profitable and therefore not be formed 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.
must be either that the cartel mark-up is very small so that diversion is limited even in the absence of umbrella effects, or that the umbrella effect is sufficiently large.

That umbrella effects not only arise within a properly defined relevant market in case of cartel outsiders but may also arise outside a relevant market is the subject of the next section.

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, i.e. 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 instead of competitive prices, cartel prices are considered. In particular, if the cartel mark-up over the competitive price is substantial, products that are not part of the relevant market become substitutes for consumers at cartel prices. As a result, if cartel prices are substantially above competitive prices, these consumers will divert demand to these products even if they are not sufficiently close substitutes at competitive prices 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 mark-up.

This is intuitive if one considers the cellophane fallacy already mentioned previously. If cartel prices were used in the market definition, the relevant market would be defined too widely (comprising the products of firms A to E) as products would be treated as substitutes that are only substitutes at these higher prices. If, however, a complete cartel is formed on a properly defined relevant market (products of firms A to D), then umbrella effects may occur outside that relevant market (product of firm E) 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.

Firm 1 and 2 produce close substitutes and firm 3 produces a more distant substitute. If these firms maximize profits independently, a set of equilibrium prices can be derived. Applying the SSNIP test by increasing the price of the products of firm 1 and firm 2 by 10% above this competitive price and calculating profits reveals that such a price increase is profitable.

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, i.e. a cartel comprised of firm 1 and 2, while firm 3, whose product is a substitute but not in the relevant market, is not part of the cartel. If firm 1 and 2 form a cartel, they will maximize their joint profit. As a result, not only the prices of the products of firm 1 and 2 but prices of all three products will increase. If now a SSNIP test of 10% is performed based on the cartel prices of firm 1 and 2, such a further price increase would not be profitable, wrongly suggesting that product 3 should be included in the relevant market. This will also hold for an increase of only 5%. Under this test, it is again assumed that firm 3 does not adjust its price in response to the price increase. If, however, firm 3 were to adjust the price of its product optimally to the 10% increase in prices for product 1 and 2, it would render the 10% increase profitable. This would also hold for a 5% SSNIP with optimal adjustment of the price of product 3. This shows that a product that is not in the relevant market under conditions of effective competition may become a relatively close substitute under cartel prices.

While this is nothing else than an example of the cellophane fallacy (if one were to base market definition on this test), it demonstrates that products that are not in the relevant market may become important substitutes when it comes to cartel prices. As a result, even when the cartelization of a market is complete, the firms that are not in the relevant market may generate umbrella effects as their products become relevant substitutes under cartel prices diverting 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 section it is shown that this makes an important difference. 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 or may not be harmed by the presence of a cartel even when there is an increase also of the price of non-cartelized producers of substitutes (firm D and E).

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

33 The example is derived from the following profit functions for the three firms: \( \pi_1 = p_1(a_1 - b - p_1 + dp_1 + ep_1) - c_1p_1; \) \( \pi_2 = p_2(a_2 - b p_2 + dp_2 + ep_2) - c_2p_2; \) \( \pi_3 = p_3(a_3 - b p_2 + ep_3) - c_3p_3, \) where \( a_1 < a_2, b > d > e \) 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.
Recall first that if suppliers offer perfect substitutes and if there are no capacity constraints or particular 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. Consider now the opposite scenario for illustration, namely that, from the point of view of the respective direct purchasers, there is no direct substitution between the cartel’s products and products supplied as inputs by other firms (i.e. firms F and G can only purchase from A to C and firm H and I only from D and E). As an example, consider the case where the respective input, given its cost of transportation, is only locally procured but where the final product is offered on a national or global market (i.e. firm F through I operate on a common market). While this should indeed preclude direct substitution between the cartel’s product and the product offered by other suppliers, a higher price of one product will still push up demand for the other and possibly lead to a higher price. As we show, the implications of such a price increase triggered by the cartel will, however, be markedly different. Once this is established, we consider again the case where the cartel’s product and the product offered by outsiders are substitutes.

Take a given price increase of a cartel that the direct purchasers F and G (partially) pass-on to their indirect purchasers. The larger this pass-on, the less competitive these 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 demand more of the respective input provided by other suppliers not part of the cartel (firms D and E). Following the arguments presented before, this should typically induce a price increase of these inputs. Moreover, as the size of the expected price increase depends clearly on how far demand has shifted outwards, this effect is closely related to the pass-on of direct purchasers to indirect purchasers and, thereby, to the cartel mark-up. Typically, the competitive advantage of the rivals H and I vis-à-vis the direct purchasers F and G will remain (albeit reduced) despite the fact that their own input prices increase as well. After all, it is the expansion in their own demand, following a reduction of competitiveness of direct purchasers of the cartel that subsequently leads to an expansion of their 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 F and G 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 while maintaining that 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 for why the price of cartel outsiders (D and E) increases. 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 that, instead have a preference for 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. It should be noted that these two effects should, however, not be considered as complementary or mutually reinforcing.

35 In case of price competition, when there are outsiders to the cartel and goods are homogeneous, then the cartel will not be in a position to raise the price above the competitive level to begin with.
Instead, when competition in the downstream market is more intense, as there is a relatively higher number of firms that remain unaffected by the direct effects of the cartel mark-up, the direct purchasers of the cartel will respond to this more intense competition by not passing-on as much of the cartel mark-up to indirect purchasers as they would otherwise do. It is intuitive that in this case also the cartel will have reduced incentives to raise prices, as this would trigger a larger reduction in demand.

The essential point is that the two reasons for why the demand for the product of cartel outsiders increases and for why cartel outsiders will increase prices have rather orthogonal implications for the consequences inflicted on 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, the immediate effect should be that these firms 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 compared to an actual or hypothetical counterfactual market, would fail to uncover this difference. On the other hand, a full analysis of damages, which includes particularly changes in quantity and pass-on, would not face this pitfall.\(^\text{36}\) 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, i.e. a mark-up and its multiplication with actual quantity, may provide a very poor reflection of the damages emanating from an umbrella effect.

As a final remark note that even when the firms that face higher input prices from suppliers that are not members of the cartel actually benefit from the operation of the cartel (firms H and I), their purchasers, i.e. consumers or firms operating at the next lower level of the vertical value chain (not depicted in Figure 4), will still be harmed. Even when they purchase from firms that are not purchasers of the cartel and that, at least in our extreme example, could not even claim that the cartel’s price increase has deprived them of a cheaper alternative source of supply, they may still face a price increase caused ultimately by the cartel.

V. UMBRELLA EFFECTS AND ENDOGENOUS CARTEL FORMATION

So far it was simply assumed that cartels exhibit only partial market coverage instead of this partial coverage being derived as an equilibrium within a theoretical model. This assumption could be justified in the case where the firms that constitute the cartel, all other firms in the market are each insignificantly small with respect to the market. In this case, it can be assumed that these fringe firms behave non-strategically as price takers. However, in many instances cartels are observed with relatively low market coverage\(^\text{37}\) or where firms with a significant market share do not participate in the cartel.\(^\text{38}\) In such cases, the assumption of non-strategic behaviour is unconvincing and economic theory has to explain under which conditions 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.\(^\text{39}\)


\(^{37}\) See case COMP/39396 – Calcium carbide and magnesium based reagents for the steel and gas industries, Commission Decision of 22.7.2009, C(2009) 5791 final, where in recital 37 the Commission notes that in addition to the cartelist there were seven other producers/suppliers with an estimated combined market share of 15% for calcium carbide market share and 31% for calcium carbide granulates. A 50% market share of the cartel was identified (see recital 89) in case COMP/38543 – Services de déménagements internationaux, Décision de la Commission du 11.3.2008, C (2008) 926 final. See also Case COMP/38.628 - Nitrile Butadiene Rubber (also known as synthetic rubber), Commission Decision of 23.1.2008, C(2008)282 final, recital 15, where the cartelists Bayer and Zeon have respective market shares of 36% and 19% leaving 45% to competitors whose names and shares were considered confidential information. Note that Commission decisions will identify as cartelists only those cartel members and 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.

\(^{38}\) This was the case for instance in case COMP/39482 – Exotic Fruit (Bananas), see Commission Decision C(2011) 7273 final, of 12.10.2011, where the Commission identified 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% and 40% for the two relevant years in Portugal, the only country with a 25% market share of fringe players in addition to the big four. The market shares of the cartel where 50% in Italy and 65-70% and 60% in Greece (see recital 22 and 326). See also case COMP/39188 – Bananas, Commission Decision of 15.10.2008, C(2008) 9555 final, recital 457 where the combined market share of the undertakings for which an infringement could be established is estimated to be at least around 40-45%. More general studies include the following. James M. Griffin, *Previous Cartel Experience: Any Lesson for OPEC?*, in: Lawrence R. Klein and Jamie Marquez (eds.) *ECONOMICS IN THEORY AND PRACTICE: AN ECLECTIC APPROACH*, Kluwer Academic Publishers, Dordrecht (1989) reports the cartel’s market share for a sample of fifty-four international cartels: 35% of the cartelists in his sample have market shares of at least 75%, while 17% (9 cartel) have market shares of at least 90%. Valerie Y. Suslow, *Cartel Contract Duration: Empirical Evidence from Inter-War International Cartels*, INDUSTRIAL AND CORPORATE CHANGE, 14, 705-744 (2005:12) reports that, for 39 of the 71 cartels in the sample with market share data, the average cartel had at least 50% of the market. In their paper on U.S. price-fixing cases, George A. Hay and Daniel Kelley, *An Empirical Survey of Price Fixing Conspiracies*, JOURNAL OF LAW AND ECONOMICS, 17, 13-38 (1974:22-23) report estimates of industry concentration that are roughly comparable to what we find: “In thirty-eight of fifty cases for which some concentration ratio was available, the ratio averaged sixty 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 whether the strategies employed by the firms are strategic complements or substitutes. With price competition, strategies are strategic complements and cartel outsiders always have an incentive to join the cartel. See Raymond Deneckere and Carl Davidson, *Incentives to Form Coalitions with Bertrand Competition*, RAND JOURNAL OF ECONOMICS, 16, 473–486 (1986). With quantity
The basic theoretical approach to analyse cartels is a repeated interaction model where 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. To thoroughly analyse umbrella effects of cartels, economic theory has to provide an answer to the question of 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 whether or not a member of the cartel faces an incentive to stick to the cartel. This will be the case 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, i.e. a cartel will be externally stable if no outsider has an incentive to participate in the cartel. This condition is satisfied if the increase in price due to joining the cartel is not sufficient to increase the profit of a cartel member compared to 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 in raising price, i.e. in 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. While coverage is important, it will also be important to include the firms producing the closest substitutes. The products or those firms that would be included already in early candidate markets are more relevant than those only included towards the end just before the relevant market is found ceteris paribus.

A recent strand of literature on partial cartels has analysed several aspects of partial cartels in a homogenous good framework, including cartel formation, cartel behaviour and industry structures that make partial cartels particularly likely. If firms differ with respect to their capacities and if cartel formation is costly, a cartel will not include all firms in the industry provided that the costs of cartelization increase in 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 in the degree of market coverage. This 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 in industries where the size distribution of firms is asymmetric, partial cartels are more likely than in markets where firm size is more evenly distributed.

Thus, the literature that analyses homogenous product cartels with partial market coverage as an equilibrium outcome seems by and large in accordance with the results derived above, i.e. the degree of market coverage and the magnitude of the umbrella effect are positively correlated. The analysis of partial cartels is, however, not very well developed and focusses exclusively on homogenous products. Further analysis could be able to 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 both when the respective cartel outsiders act merely as competitive, however, quantities are strategic substitutes and, provided the cartel is not very large compared to the overall market, partial cartels are unstable as outsiders are better off free riding on the higher prices induced by the cartel’s quantity reduction. This has been demonstrated for the linear case by Martin K. Perry and Robert H. Porter, Oligopoly and the Incentive for Horizontal Merger, AMERICAN ECONOMIC REVIEW, 75(1), 219-227 (1985). However, this assumption is maintained that all firms in a market participate in the cartel.

This issue does, however, not arise in models where only homogenous product Cournot competition is considered. See Iwan Bos, Incomplete Cartels and Antitrust Policy: Incidence and Detection, Tinbergen Institute, Thela Thesis. (2009), Iwan Bos and Joseph E. Harrington, Endogenous Cartel Formation with Heterogeneous Firms, RAND JOURNAL OF ECONOMICS, 41(1), 92-117 (2010) and Marc Escriuèla-Villar, Partial Coordination and Mergers among Quantity-Selling Firms, INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION, 26, 803-810 (2008b), Marc Escriuèla-Villar, A Note on Cartel Stability and Endogenous Sequencing with Tacit Collusion, JOURNAL OF ECONOMICS, 96, 137-147 (2009a).

As discussed before, this literature is focusing 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 when a cartel with a larger market coverage, exhibiting a different composition of firms is not under differentiated products. This 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 substitutability characteristics of the products in the market.
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 prices and when products are more or less differentiated. That said, all these factors together with others such as the form of cost functions (or, more generally, the elasticity of supply) affect the size of umbrella effects. For a given price increase of a cartel, umbrella effects should depend positively on the degree of substitutability, as this increases the extent to which demand is diverted away from cartel members to outsiders, and likewise on the size of the cartel. Interestingly, whether outsiders strategically react or not can both dampen or increase the overall effect of a cartel and thereby also the size of an umbrella effect, i.e., the impact that the cartel has on the purchasers from cartel outsiders.

We work out the relationship between umbrella effects and market definition. Sizeable umbrella effects may occur, at least theoretically, also when the respective firms are not in the relevant market, as it is commonly defined in antitrust analysis. In particular, when the cartel has led to a persistent and sizable price increase, products become substitutes that are not substitutes under effective competition and the then prevailing lower prices. On the other hand, when cartel outsiders (with sizable capacity) are in the relevant market, then the cartel’s price increase can only be significant and profitable at the same time when cartel members can expect a sizable umbrella effect. Our analysis thus points out that cartel size and market coverage, the size of the cartel’s price increase and umbrella effects are all closely interlinked. A thorough analysis should thus treat them jointly and has to consider to what extent the respective findings are mutually consistent (akin to an equilibrium analysis).

Finally, we also show that demand substitution towards non-cartel members, which then triggers an increase in their respective prices, 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 of firms that are purchasers from the cartel and rival firms that end up purchasing, instead, from non-cartelized suppliers. While also the latter channel leads to a price increase, rivals that are not purchasers from the cartel may overall 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.