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### Vertical relations in cartel theory: managerial incentives, buyer groups & antitrust damages

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## 6 The Overcharge As a Measure for Antitrust Damages

**Abstract.** Victims of antitrust violations can recover damages in court. Yet, the quantification of antitrust damages and to whom they accrue is often complex. An illegal price increase somewhere in the chain of production percolates through to the other layers in a ripple of partial pass-ons. The resulting reductions in sales and input demands lead to additional harm to both downstream (in)direct purchasers and upstream suppliers. Nevertheless, U.S. civil antitrust litigation is almost exclusively concerned with direct purchaser claims for (treble) damages calculated on the basis of the overcharge. In the E.U., a private damages litigation practice is currently emerging, potentially based on the overcharge. In this chapter, we show that there exists no structural relationship between the direct-purchaser overcharge and the harm caused by an antitrust violation on all of the direct and indirect purchasers and sellers in a vertical chain of production.

*This chapter is based on the identically titled paper joint with Maarten Pieter Schinkel\* and Jan Tuinstra†, available online at [carteltheory.com/damages](http://carteltheory.com/damages). We thank Simon Anderson, Leonardo Basso, Patrick van Cayseele, John Connor, Franklin Fisher, Andrew Gavil, Martin Hellwig, Pierre Larouche, William Page, Martin Peitz, and Jeroen van de Ven for constructive discussions and comments. We are also grateful to participants at the IIOC 2009 in Boston, the Workshop on Private Enforcement of Competition Law 2008 at TILEC in Tilburg, the IIOC 2008 in Washington, DC, the CCP Young Researchers Workshop in Competition Policy 2008 at the University of East Anglia (Norwich), NAKE 2008 in Utrecht, the Workshop on The Law and Economics of Competition Policy 2007 in Bonn, as well as to seminar participants at the University of Amsterdam, University of Antwerp, ESMT in Berlin, ZEW in Mannheim, and the Netherlands Competition Authority (NMA).*

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## 6.1 Introduction

Anticompetitive acts to eliminate competition can cause widespread harm. In the U.S., under Section 4 of the Clayton Act: “Any person who shall be injured in his business or property by reason of anything forbidden in the antitrust laws [...] shall recover threefold the damages by him sustained.” The vast majority of civil actions for antitrust damages concerns cartels. In Europe, a private litigation practice is currently emerging.<sup>107</sup>

The identification of antitrust harm can be complicated. In longer supply chains, in which one product is an input in the production of the next, an illegal price increase somewhere in the chain can percolate through to the other layers in a ripple of partial pass-ons. The resulting reductions in sales cause additional harm to direct and indirect customers and suppliers of the wrongdoer(s).

In order to determine who is affected by an antitrust violation and to what extent, in principle all actual trades need to be compared to what would have been the market allocation without the anticompetitive behavior—the so-called “but-for” world.<sup>108</sup> In practice this is often difficult. At a minimum, it requires information about consumer demand and the structure of the market, such as the number of layers in the production chain, the type and level of competition among firms in each layer, their production technologies and costs.

In the U.S., some of these complexities have been reduced by case law. At least since *Chattanooga Foundry* (1906) have direct purchasers been entitled to recover damages on the basis of the overcharge they paid as a result of the antitrust infringement.<sup>109</sup> According to this prevailing method, basic damages—before trebling and interest, if applicable—are calculated as the difference between the anticompetitive price and the competitive but-for price, multiplied by the amount actually purchased. The overcharge ignores lost profits on transactions that could have been made at lower prices, which courts have been reluctant to award.

Indirect purchasers often do not have standing to sue. In *Hanover Shoe* (1968), the Supreme Court ruled against the use of the pass-on defense in Federal antitrust damage actions.<sup>110</sup> In a pass-on defense, the defendant attempts to show that the plaintiff did not in fact suffer the amount of damages claimed on the argument that it was able to pass on all or part of the overcharges on downstream to its customers. In addition, in *Illinois Brick* (1977) the Supreme Court established that only the direct purchasers have legal

<sup>107</sup> See, for example, the European Commission’s 2008 *White paper on damages actions for breach of the EC antitrust rules*, pp. 3 and 7.

<sup>108</sup> See Fisher (2006) for a survey of the methods that can be applied to determine but-for prices.

<sup>109</sup> *Chattanooga Foundry & Pipe Works v. Atlanta*, 203 U.S. 396 (1906).

<sup>110</sup> *Hanover Shoe Inc. v. United Shoe Machinery Corp.* 392 U.S. 481 (1968).

standing in Federal court to sue for antitrust damages.<sup>111</sup> *Hanover Shoe* and *Illinois Brick* together cemented the use of the overcharge, which indeed disregard pass through.

Direct suppliers to a buyers cartel that colluded to depress input prices can in principle maintain a treble-damages action after *Mandeville Island Farms* (1948).<sup>112</sup> Yet, standing was denied by the Supreme Court to suppliers damaged by anticompetitively restricted demand for their produce in *Associated Contractors* (1983).<sup>113</sup> As a result of these legal constraints, in the vast majority of U.S. antitrust damages actions, the plaintiffs are direct purchasers and their claim is based on the overcharge.

In this chapter, we consider the effects of anticompetitively raised prices somewhere in a chain of production with an arbitrary number of layers. We will mostly refer to cartels, but our results have wider antitrust application. Competition in each layer is specified between perfect competition and monopoly. This allows us to exactly characterize the effects of the cartel's direct and indirect purchasers, as well as its direct and indirect suppliers. We assess the bias introduced by relying on the overcharge on the direct purchasers, which we refer to as the *direct-purchaser overcharge*, for the estimation of the actual antitrust harm in the chain.

We find that even in the most basic of settings—with unit pricing and input price taking—the direct-purchaser overcharge is a poor measure of the true antitrust harm. The overcharge can grossly underestimate the actual antitrust harm, depending on such characteristics of the market as the shape of demand, the number of producers, the type of competition, and the location of the cartel in the chain of production. In particular, we show that lost profit harm ignored by the direct-purchaser overcharge may increase without bound with the length of the production chain. Moreover, the method misses harm sustained upstream from the cartel, which can be substantial. The ratio of antitrust harm to the direct-purchaser overcharge can be anything between one and infinity.

The existing literature on cartel pass-on effects uses a model with only three layers: a top layer of input producers that form a cartel upstream, a layer of direct purchasers downstream who sell to a third layer of final consumers.<sup>114</sup> Hellwig (2006) shows that the deadweight-loss of a direct purchaser monopolist from discrete cartel price increases is equivalent to the part of the overcharge it was able to pass on to consumers. On this basis, Hellwig argues that the direct-purchaser overcharge is a good measure for the actual

<sup>111</sup> *Illinois Brick Co. v. Illinois* 431 U.S. 720 (1977). Later, in *California v. ARC America Corp.* 490 U.S. 93 (1989) the Supreme Court left it to the discretion of individual states whether or not to allow indirect purchaser suits. As a result, the rules on antitrust standing vary across the states, with a small majority allowing indirect purchaser suits under state law. See also Schinkel, Tuinstra and Rüggeberg (2008).

<sup>112</sup> *Mandeville Island Farms, Inc. v. American Crystal Sugar Co.*, 334 U.S. 219 (1948).

<sup>113</sup> *Associated Gen. Contractors of Cal., Inc. v. Carpenters*, 459 U.S. 519 (1983). Suppliers standing is discussed more extensively in Subsection 6.3.2.

<sup>114</sup> See Harris and Sullivan (1979) and Kosicki and Cahill (2006).

antitrust harm sustained by this group. Verboven and Van Dijk (2009) use this model to analyze an infinitesimal cartel price increase to determine “discounts” to be given on the direct-purchaser overcharge to correct for pass-on to consumers and output effects locally. Basso and Ross (2010) extend the approach to differentiated products, so that there can be input substitution, to produce a numerical table of correction factors for a discrete cartel price increase. Boone and Müller (2008) express the share of (otherwise unspecified) total antitrust harm borne by consumers for an infinitesimal price increase as a function of common measures such as the HHI and PCM.

This chapter is organized as follows. In Section 6.2, we decompose the various welfare effects caused by a cartel anywhere in a chain of production and relate aggregate and individual effects to the overcharge on the direct purchasers. In Section 6.3, we evaluate the direct-purchaser overcharge as an for antitrust harm. Section 6.4 concludes.

## 6.2 Cartel Effects in a Vertical Production Chain

In this section, we present the model (6.2.1); decompose cartel harm (6.2.2); and express this harm in terms of the direct-purchased overcharge.

### 6.2.1 A Vertical Model of Production

Consider a vertical chain with several layers of intermediaries, each adding value to produce a homogenous consumer product. Let consumer demand for the final product be represented by an inverse demand function  $P : \mathbb{R}_+ \rightarrow \mathbb{R}_+$ , which is non-increasing, twice differentiable and continuous in aggregate production  $Q$ . Let there be  $K$  layers of production, with  $n_k$  firms active in layer  $k$ . Except for layer 1, where the raw materials originate, the firms in any layer  $k$  each transform a homogeneous input they purchase from firms in layer  $k - 1$ , using a one-to-one technology, into a homogeneous new output, which they sell on to the firms in layer  $k + 1$ . Eventually, the firms in layer  $K$  sell the final product to consumers. Figure 6.1 illustrates.

We assume that the number of firms in each layer is exogenously given and fixed. The cost function for firm  $j$  in layer  $k$  is given by  $p_{k-1}q + c_{jk}(q)$ , where  $p_{k-1}$  is the unit price for the input from layer  $k - 1$  (with  $p_0 = 0$ ), and  $c_{jk}(q)$  are the costs for transforming  $q$  units of the input into  $q$  units of the output. We abstract from nonlinear pricing or more general types of vertical relations between firms from different layers.

Firms move simultaneously within the same horizontal layer, and sequentially following the layer above—so layer 1 moves first, layer 2 second, and so on. That is, we assume that all firms in each layer are price takers in their input market. As a result, all upstream antitrust effects in our model are reduced input demand effects.

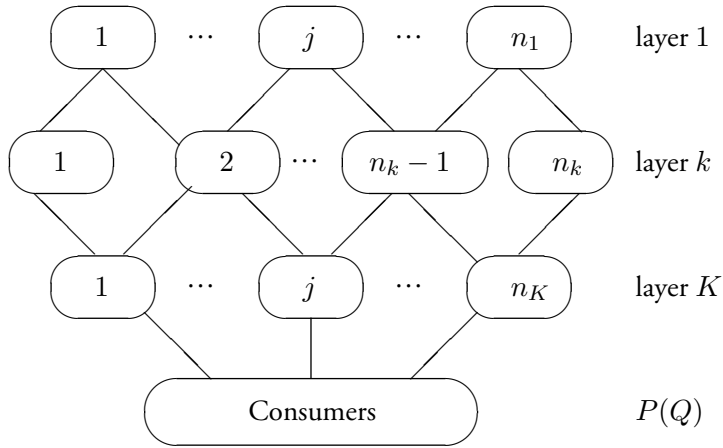


FIGURE 6.1 A longer vertical chain of production.

The market equilibrium is found by backward induction. First consider layer  $K$ . For any possible input price  $p_{K-1}$ , and given final consumer demand  $P(Q)$ , we can determine the resulting equilibrium output in layer  $K$ . Let the relationship between this equilibrium quantity and  $p_{K-1}$  be represented by a uniquely defined, non-increasing, continuous and differentiable function  $p_{K-1}(Q)$ . This function serves as the inverse demand function for the firms in layer  $K - 1$ .<sup>115</sup> Firms in layer  $K - 1$  then determine, for any  $p_{K-2}$  and given their inverse demand function  $p_{K-1}(Q)$ , their optimal production quantity. This, in turn, leads to an inverse demand function  $p_{K-2}(Q)$  for firms in layer  $K - 2$ , and so on.

For analytical convenience, we analyze a model with conjectural variations to simulate various types of competition in each layer.<sup>116</sup> That is, in each layer  $k$  firm  $j$ 's conjecture about the reaction of the other firms in that layer to its quantity decision is  $\vartheta_k = \frac{\partial Q}{\partial q_{j^k}}$ . We assume that  $\vartheta_k$  is the same for all firms in a horizontal layer, but may be different for firms across different layers. Hence, given input price  $p_{k-1}$ , the first-order condition for a symmetric equilibrium in layer  $k$ , with conjectural variations parameter  $\vartheta_k$  is

$$p_k(Q) + \frac{\vartheta_k}{n_k} Q p_k'(Q) - c_k - p_{k-1} = 0. \tag{6.1}$$

Note that the classic Cournot conjecture corresponds to  $\vartheta_k = 1$ . If  $\vartheta_k = 0$ , all

<sup>115</sup>This is an assumption in so far that *a priori* it can be that for a certain value of  $p_k$  there exist multiple equilibria in the quantity-setting subgame in layer  $k$ . For all specifications considered in this chapter, however, an explicit, continuous and differentiable relationship between  $p_k$  and  $Q$  exists for every  $k$ .

<sup>116</sup>Basso and Ross (2010) take the same approach. For a conceptual critique of the conjectural variations approach, see Hahn (1989).

firms in layer  $k$  are price takers, so that in equilibrium prices will equal marginal costs, i.e.,  $p_k = p_{k-1} + c_k$ . The specification  $\vartheta_k = n_k$  is analytically equivalent to full horizontal collusion in layer  $k$ . Other values of  $\vartheta_k$  close to  $n_k$  can be interpreted as forms of imperfect collusion, in which joint-profit maximization is further constrained, for example, when the cartel members understand that the risk of discovery and the size of a consequential damage claim are likely to depend upon the cartel's pricing and production strategy.<sup>117</sup>

We denote the ultimate equilibrium quantity on the inverse demand function  $p_1(Q)$  faced by the firms in layer 1 by  $Q^*$ . Equilibrium prices then clear as  $p_1^* = p_1(Q^*)$ ,  $\dots$ ,  $p_{K-1}^* = p_{K-1}(Q^*)$  and  $p_K^* = P^* = P(Q^*)$ . The individual level of production of firm  $j$  in layer  $k$  equals  $q_{jk}^*$ , with  $\sum_{j=1}^{n_k} q_{jk}^* = Q^*$ . Equilibrium profits and consumer surplus follow straightforwardly from these quantities and prices.

Now suppose that the firms in some layer  $g \in \{1, \dots, K\}$  form a cartel, while competitive conditions in all other layers remain the same—note that these may include pre-existing cartels elsewhere in the chain. Our set-up implies that the cartel uses its obtained market power to raise unit prices *vis-à-vis* its customers, but remains a price-taker on the market for its inputs. We further assume that there are no cartel-specific efficiency gains that would somehow allow the cartel to produce at lower costs than its members could in competition. Let the resulting equilibrium quantity and equilibrium prices under the cartel regime be denoted by  $Q^g$  and  $p_k^g$  for  $k = 1, \dots, K$ .<sup>118</sup> Firm  $j$  in layer  $k$  produces  $q_{jk}^g$  with  $\sum_{j=1}^{n_k} q_{jk}^g = Q^g$ , for all  $k$ .

## 6.2.2 Decomposition of Cartel Effects

The presence of the cartel causes harm to welfare in the form of high unit prices, resulting in lost profits throughout the chain of production, lost consumers surplus, and deadweight-losses, while the cartel members raise their profits. That is,  $Q^g < Q^*$  and  $p_g^g > p_g^*$ . Typically also  $p_k^g > p_k^*$  for  $k > g$  and downstream intermediaries and consumers are harmed by the price conspiracy. Under certain specifications, the profits of some downstream intermediaries, in particular direct purchasers, may actually increase in response to the upstream price increases.<sup>119</sup> Also, prices higher up in the chain may either in- or decrease, depending upon the shape of demand and cost functions. *In toto*, however, collusion on unit prices is always bad for welfare.

<sup>117</sup>Salant (1987) and Harrington (2004b) offer analyses of such additional incentive constraints.

<sup>118</sup>In our model it is optimal for the cartel to increase prices symmetrically, so that the cartel price  $p_g^g$  is the same for each direct purchaser. Verboven and Van Dijk (2009) also consider various asymmetric cartel price mark-ups in their reduced form model. This could be relevant, for example, if some of the direct purchasers are integrated with a colluding firm.

<sup>119</sup>For an analysis of comparative statics effects in Cournot models, see Dixit (1986) and Quirmbach (1988).

The impact of the  $g$ -level cartel's unit price increase on one particular layer  $k$  of production that is downstream from layer  $g$  can be decomposed into three distinct effects. The *overcharge effect* on layer  $k$  is the amount by which the firms in this layer are overcharged by the previous layer  $k - 1$ . Part of the burden of this overcharge may be passed on by the firms in layer  $k$  to the next layer of production, layer  $k + 1$ . This is the *pass-on effect*. Finally, the *output effect* results from the decrease in production due to the cartel. It amounts to the losses in profits from the reduction in sales.<sup>120</sup> We consider each of these effects separately, as they are borne out in lost profits. Appendix E.1 graphically illustrates these effects.

Consider the aggregate profits of firms in layer  $k$ . In the competitive benchmark, these are  $\pi_k^* = (p_k^* - p_{k-1}^*) Q^* - \sum_{j=1}^{n_k} c_{jk} (q_{jk}^*)$ . Under the cartel regime, they are  $\pi_k^g = (p_k^g - p_{k-1}^g) Q^g - \sum_{j=1}^{n_k} c_{jk} (q_{jk}^g)$ . The difference  $\Delta \pi_k = \pi_k^* - \pi_k^g$  can be decomposed as follows

$$\begin{aligned} \Delta \pi_k &= Q^g (p_{k-1}^g - p_{k-1}^*) - Q^g (p_k^g - p_k^*) + \\ &\quad \left[ (Q^* - Q^g) (p_k^* - p_{k-1}^*) + \sum_{j=1}^{n_k} c_{jk} (q_{jk}^g) - \sum_{j=1}^{n_k} c_{jk} (q_{jk}^*) \right] \quad (6.2) \\ &= \xi_k - \omega_k + \sigma_k. \end{aligned}$$

The first factor is the overcharge effect on firms in layer  $k$ , thus defined as

$$\xi_k = Q^g (p_{k-1}^g - p_{k-1}^*), \quad (6.3)$$

or the price increase of the product of the previous layer  $k - 1$ , multiplied by the quantity purchased under the cartel regime.

The second factor,

$$\omega_k = Q^g (p_k^g - p_k^*), \quad (6.4)$$

corresponds to the pass-on effect, which is the amount of the price increase that layer  $k$  passes on to layer  $k + 1$ . It is equal to the price increase of layer  $k$  multiplied by the quantity produced under the cartel regime. Note that  $\omega_k$ , the pass-on effect of layer  $k$ , equals the overcharge effect suffered by layer  $k + 1$ , that is,  $\xi_{k+1} = \omega_k$ .

<sup>120</sup>Our decomposition follows Hellwig (2006), but we use a slightly different terminology. Where he distinguishes between a *direct cost effect* and a *business loss effect*, we use *overcharge effect* and *output effect*, respectively. Verboven and Van Dijk (2009) also analyze both effects, but for exogenous infinitesimal changes in the input prices, rather than endogenous discrete equilibrium effects. They speak of *direct cost effect* and *output effect*, respectively. All three papers share the definition of the *pass-on effect*.



The last factor in equation (6.2) is the output effect,

$$\sigma_k = (Q^* - Q^g) (p_k^* - p_{k-1}^*) + \sum_{j=1}^{n_k} \left( c_{jk} (q_{jk}^g) - c_{jk} (q_{jk}^*) \right). \quad (6.5)$$

This part represents the loss of profits that could have been made on the larger volume in the competitive benchmark. It can be rewritten as the sum of individual firm output effect,  $\sigma_k = \sum_{j=1}^k \sigma_{jk}$ , with

$$\sigma_{jk} = \left( q_{jk}^* - q_{jk}^g \right) \left( p_k^* - p_{k-1}^* - \bar{c}_{jk} (q_{jk}^*) \right) + q_{jk}^g \left( \bar{c}_{jk} (q_{jk}^g) - \bar{c}_{jk} (q_{jk}^*) \right).$$

Here  $\bar{c}_{jk} (q_{jk}) = c_{jk} (q_{jk}) / q_{jk}$  are the average costs for firm  $j$  in layer  $k$ , evaluated at  $q_{jk}$ . The first part of the individual output effect,  $\left( q_{jk}^* - q_{jk}^g \right) \left( p_k^* - p_{k-1}^* - \bar{c}_{jk} (q_{jk}^*) \right)$ , equals the lost sales times the average profit margin and is always positive. The sign of the second part,  $q_{jk}^g \left( \bar{c}_{jk} (q_{jk}^g) - \bar{c}_{jk} (q_{jk}^*) \right)$ , is ambiguous. It is positive (negative) if average costs for firm  $j$  in layer  $k$  are decreasing (increasing).

The effects on layers *upstream* from cartel layer  $g$  (i.e., layers  $k < g$ ) can be decomposed in much the same way. These layers also each face an overcharge, a pass-on and an output effect. The effect of the cartel on upstream prices results from reduced derived demand and are ambiguous. As a result, so are the signs of the upstream overcharge and pass-on effects. If all upstream prices increase, the upstream overcharge and pass-on effect are positive. If all upstream prices decrease, both the overcharge effect and the pass-on effect of the upstream layers will be negative, corresponding to a decrease in input costs and a decrease in revenues, respectively. In certain specifications, it may also be that all upstream prices remain the same so that there are no upstream overcharge and pass-on effects. Generally, some of the upstream prices may increase and others decrease.

All the way at the end of the supply chain, the loss in consumer surplus of the final consumer is given by

$$\Delta CS = CS^* - CS^g = \xi_C + \sigma_C,$$

in which

$$\xi_C = Q^g (p_K^g - p_K^*) \text{ and } \sigma_C = \int_{Q^g}^{Q^*} [P(Q) - P(Q^*)] dQ,$$

where  $p_K^g = P(Q^g)$  and  $p_K^* = P(Q^*)$ . Note that, since these are the final consumers,

there is no pass-on effect. Also note that, because  $Q^g < Q^*$ , both  $\xi_C$  and  $\sigma_C$  are strictly positive and final consumers unambiguously suffer from the cartel.

Our decomposition of cartel effects allows us to formulate the following basic insight.

**Proposition 6.1** *The direct-purchaser overcharge is equal to the sum of all downstream overcharges, net of pass-ons,  $\sum_{k=1}^K (\xi_k - \omega_k) + \xi_C = \xi_{g+1}$ .*

*Proof.* This follows directly from  $\xi_{k+1} = \omega_k$  for all  $k$  and  $\xi_C = \omega_K$ .  $\square$

Note that in an overcharge conception of compensatory damages, this result justifies obtaining the direct-purchaser overcharge proceeds first, and then redistributing them among indirect purchasers later.

### 6.2.3 Measure of Antitrust Harm

We are primarily interested in the relationship between the direct-purchaser overcharge and the net actual antitrust harm to total welfare. The latter is equal to the change in total profits in the chain,  $\sum_{k=1}^K \Delta\pi_k$ , plus the change in consumer surplus,  $\Delta CS$ , i.e.,

$$\Delta W = \sum_{k=1}^{g-1} \Delta\pi_k + \Delta\pi_g + \left[ \sum_{k=g+1}^K \Delta\pi_k + \Delta CS \right] = d_U + \Delta\pi_g + d_D.$$

The *cartel gains* are  $\Delta\pi_g$ . The *downstream damages*  $d_D = \sum_{k=g+1}^K \Delta\pi_k + \Delta CS$  correspond to losses in profits and consumer surplus by all direct and indirect purchasers. In addition, there are *upstream damages*,  $d_U = \sum_{k=1}^{g-1} \Delta\pi_k$ , equal to profit losses incurred by direct and indirect suppliers to the cartel.

We can use our decomposition of harm in equation (6.2) to evaluate each of these terms separately. We find

$$\Delta W = \sum_{k=1}^K (\xi_k - \omega_k + \sigma_k) + \xi_C + \sigma_C = \sum_{k=1}^K \sigma_k + \sigma_C,$$

where we used  $\xi_1 = 0$  and the fact that the overcharge on layer  $k+1$  equals the pass-on of layer  $k$ ,  $\xi_{k+1} = \omega_k$  for  $k = 1, \dots, K$  and  $\xi_C = \omega_K$ . The total welfare effect, therefore, coincides with the sum of the output effects.

Cartel profits are  $\Delta\pi_g = \xi_g - \omega_g + \sigma_g$ . Downstream harm can be represented as

$$d_D = \sum_{k=g+1}^K (\xi_k - \omega_k + \sigma_k) + \xi_C + \sigma_C = \xi_{g+1} + \sum_{k=g+1}^K \sigma_k + \sigma_C,$$

or the sum of all output effects of direct and indirect purchasers plus the direct-purchaser overcharge. Upstream harm is equal to

$$d_U = \sum_{k=1}^{g-1} (\xi_k - \omega_k + \sigma_k) = -\omega_{g-1} + \sum_{k=1}^{g-1} \sigma_k = -\xi_g + \sum_{k=1}^{g-1} \sigma_k.$$

We study the direct-purchaser overcharge,  $\xi_{g+1}$ , in relation to these actual welfare effects. That is, we evaluate the ratio

$$\lambda_W = \frac{\Delta W}{\xi_{g+1}} = \lambda_g + \lambda_D + \lambda_U,$$

in which

$$\lambda_g = \frac{\Delta \pi_g}{\xi_{g+1}} = \frac{\xi_g + \sigma_g}{\omega_g} - 1, \quad (6.6)$$

are the cartel gains expressed in the direct-purchaser overcharge,

$$\lambda_D = \frac{d_D}{\xi_{g+1}} = 1 + \sum_{k=g+1}^K \frac{\sigma_k}{\xi_{g+1}} + \frac{\sigma_C}{\xi_{g+1}}, \quad (6.7)$$

is the downstream harm to the direct-purchaser overcharge ratio, and

$$\lambda_U = \frac{d_U}{\xi_{g+1}} = -\frac{\xi_g}{\omega_g} + \sum_{k=1}^{g-1} \frac{\sigma_k}{\xi_{g+1}}, \quad (6.8)$$

is that ratio upstream.

In addition to these aggregate measures, we specify the individual harm to direct purchasers and to consumers as:

$$\lambda_{g+1} = \frac{\xi_{g+1} - \omega_{g+1} + \sigma_{g+1}}{\xi_{g+1}} = 1 - \frac{\omega_{g+1} - \sigma_{g+1}}{\xi_{g+1}} \text{ and } \lambda_C = \frac{\xi_C + \sigma_C}{\xi_{g+1}}. \quad (6.9)$$

In the next section, we evaluate how these various ratios vary with the intensity of competition, the number of firms in each layer, the number of layers, and the position of the layer in which the anticompetitive behavior emerges in a vertical production model.

### 6.3 Damages Based On the Direct-Purchaser Overcharge

In order to explicitly characterize the ratios introduced above, we need to further specify our model. Suppose that marginal costs are constant and identical for every firm in the same layer. That is, for layer  $k$  we have  $c_{jk}(q) = c_k q$ , for each  $j \in \{1, \dots, n_k\}$ .<sup>121</sup> Let the inverse demand function be

$$P(Q) = a - bQ^\gamma, \quad (6.10)$$

with  $a, b$  and  $\gamma > 0$ .<sup>122</sup> Inverse demand is a convex function of quantity for  $0 < \gamma < 1$ , a concave function for  $\gamma > 1$  and a linear function for  $\gamma = 1$ .

In this set-up, the equilibrium quantity and prices can be expressed as follows:<sup>123</sup>

$$Q^* = \left[ \frac{1}{b} \left( \prod_{i=1}^K \frac{n_i}{n_i + \gamma \vartheta_i} \right) \left( a - \sum_{j=1}^K c_j \right) \right]^{\frac{1}{\gamma}}, \quad (6.11)$$

$$p_k^* = \left( 1 - \prod_{i=1}^k \frac{n_i}{n_i + \gamma \vartheta_i} \right) \left( a - \sum_{j=1}^K c_j \right) + \sum_{l=1}^k c_l \quad \forall k \in \{1, \dots, K\} \quad (6.12)$$

The competitive benchmark is characterized by a vector of conjectural variations parameters  $(\vartheta_1, \vartheta_2, \dots, \vartheta_K) \in \times_{k=1}^K [0, n_k]$ .

Collusion among the  $n_g$  firms in layer  $g$  (with  $n_g > 1$ ) results in an increase in  $\vartheta_g$  to  $\vartheta_g^c \in (\vartheta_g, n_g]$ . It follows straightforwardly from equation (6.11) that such an increase in any  $\vartheta_k$  decreases the equilibrium quantity. For  $n_g > 1$  and  $\vartheta_g^c \in (\vartheta_g, n_g]$ , we can write the ratio of collusive output to total competitive output  $r$  as

$$r = \frac{Q^g}{Q^*} = \left( \frac{n_g + \gamma \vartheta_g}{n_g + \gamma \vartheta_g^c} \right)^{\frac{1}{\gamma}}.$$

Note that, although both  $Q^*$  and  $Q^g$  depend on market characteristics of every layer, apart from  $\gamma$ , their ratio is a function only of characteristics of the colluding layer. If  $\gamma = 1$ ,  $r \in [\frac{1}{2}, 1)$ , with the lower bound corresponding to perfect competition in layer  $g$  in the but-for world. An increase (decrease) in  $\gamma$  above (below) 1 decreases (increases)

<sup>121</sup>In order to have gains from trade in this market, we naturally require  $a > \sum_{j=1}^K c_j$ . That is, the consumer's willingness to pay for the first unit ( $a$ ) must exceed total costs to produce that unit ( $\sum_{j=1}^K c_j$ ).

<sup>122</sup>Demand is nonnegative and non-increasing as well for  $a \geq 0$ ,  $b < 0$  and  $\gamma < 0$ —see Genesove and Mullin (1998). We restrict attention to  $b, \gamma > 0$ , since in that case second-order conditions are always satisfied. Corbett and Karmarkar (2001) develop a multi-layered Cournot model with linear demand.

<sup>123</sup>See Proposition E.1 in Appendix E.3.

this lower bound value.<sup>124</sup>

Taken together, we can now characterize cartel profits in layer  $g$  in terms of the direct-purchaser overcharge as

$$\lambda_g = \frac{\xi_g + \sigma_g}{\omega_g} - 1 = \frac{\gamma \vartheta_g}{n_g} \frac{(1-r)}{r(1-r^\gamma)} - 1.$$

Note that  $\lambda_g = -1$  if prior to collusion layer  $g$  was in perfect competition ( $\vartheta_g = 0$  or  $n_g \rightarrow \infty$ ). In that case,  $\sigma_g = 0$  and the total cartel profit equals the overcharge on the direct purchasers. In all other benchmarks, (positive) cartel profits are always smaller than the direct-purchaser overcharge.

### 6.3.1 Downstream Damages

Downstream from cartel layer  $g$ , it follows from equation (6.12) that equilibrium prices  $p_k^*$  (weakly) increase in all layers  $k \geq g$ , as each subsequent layer passes on part of the price increase it receives from its suppliers to its customers.<sup>125</sup> A full characterization of which player faces what passed-on price increase allows us to consider the direct-purchaser overcharge ratios derived above. To begin with, consider

$$\lambda_{g+1} = \frac{\gamma \vartheta_{g+1}}{n_{g+1} + \gamma \vartheta_{g+1}} \frac{1-r^{\gamma+1}}{r(1-r^\gamma)}.$$

This expression reveals that the direct-purchaser overcharge must generally be a poor estimator for actual direct purchaser harm. In the case of linear demand, for example, we obtain  $Q^* \leq 2Q^g$  from equation (6.11), resulting in  $\lambda_{g+1} \in [0, \frac{3}{2}]$ . The upper bound is reached when the pre-cartel equilibrium in layer  $g$  was perfectly competitive, so that  $Q^* = 2Q^g$ .<sup>126</sup> The region only slightly changes when demand is non-linear.

The actual antitrust harm of direct purchasers will typically be small when there is strong competition between them, and/or competition in layer  $g$  was weak to begin with. In these cases, the direct-purchaser overcharge will significantly overestimate the actual harm that direct purchasers suffer. In particular, if  $n_{g+1} \geq 2$  and  $\vartheta_{g+1} \leq 1$ , in all cases

<sup>124</sup>In particular,  $\lim_{\gamma \rightarrow \infty} r = 1$  for all parameter values and  $\lim_{\gamma \rightarrow 0} r = e^{-1}$  for  $\vartheta_g^c = n_g$  and  $\vartheta_g = 0$ .

<sup>125</sup>For  $k \geq g + 1$ , this *pass-on rate*  $R_k$  can be expressed as

$$R_k = \frac{\omega_k}{\xi_k} = \frac{p_k^g - p_k^*}{p_{k-1}^g - p_{k-1}^*} = \frac{n_k}{n_k + \gamma \vartheta_k}.$$

Note that unless in perfect competition ( $\vartheta_k = 0$ ), each layer will absorb some of the price overcharge it receives. The less competitive a layer is, the lower is the pass-on fraction.

<sup>126</sup>This is the principal result in Basso and Ross (2010).

$\lambda_{g+1} \leq 1$ .<sup>127</sup> If on the other hand layer  $g + 1$  is governed by a monopolist or a cartel itself (i.e.,  $\vartheta_{g+1} = n_{g+1}$ ), the direct-purchaser overcharge always underestimates the actual harm sustained by indirect purchasers. Naturally, it is possible to construct market structures in which the direct-purchaser overcharge turns out to be exact. This is so, for example, if direct purchasers have sufficient market power and pre-cartel competition in the colluding layer was strong. Such examples are specific, however.<sup>128</sup>

Next consider normalized harm to final consumers<sup>129</sup>

$$\lambda_C = \frac{\gamma}{\gamma + 1} \frac{1 - r^{\gamma+1}}{r(1 - r^\gamma)} \prod_{i=g+1}^K \frac{n_i}{n_i + \gamma\vartheta_i}.$$

Again we find for  $\gamma = 1$  that  $\lambda_C \in [0, \frac{3}{2}]$  with a slightly changed upper bound for nonlinear demand. If all intermediate layers downstream from the cartel are sufficiently competitive, the direct-purchaser overcharge underestimates actual final consumer harm and  $\lambda_C > 1$ . If instead there is substantial market power in enough of these layers, the direct-purchaser overcharge will overestimate consumer harm and  $\lambda_C < 1$ .

Aggregate downstream welfare effects relate to the direct-purchaser overcharge as<sup>130</sup>

$$\lambda_D = \frac{1 - r^{\gamma+1}}{r(1 - r^\gamma)} \left( 1 - \frac{1}{\gamma + 1} \prod_{i=g+1}^K \frac{n_i}{n_i + \gamma\vartheta_i} \right). \quad (6.13)$$

Clearly,  $\lambda_D$  decreases with  $r$ , a decrease in competition in one of the downstream layers, and an increase in the number of downstream layers. Note also that  $\lambda_D$  is unaffected by changes in the number of upstream layers and their competitiveness.

In the case of linear demand,  $\frac{1}{2} \frac{Q^* + Q^g}{Q^g} \leq \lambda_D < \frac{Q^* + Q^g}{Q^g}$ . So we find quite intuitively that downstream harm is greater when the cartel reduces output more, which is the case,

<sup>127</sup>Verboven and Van Dijk (2009) propose their “discounts” on the direct-purchaser overcharge when awarding damages in direct purchaser suits on the claim that  $\lambda_{g+1} \leq 1$ , i.e., that the pass-on effect would always outweigh the output effect,  $\omega_{g+1} \geq \sigma_{g+1}$  and, therefore, the direct-purchaser overcharge overestimates the actual harm. Note that this need not be true in our more general setting.

<sup>128</sup>Hellwig (2006) bases his argument for restricting standing to sue to direct purchasers to the claim that the direct-purchaser overcharge exactly coincides with the actual harm if the direct purchaser layer is monopolized—and, thus, overestimates the actual harm in all other cases. Verboven and Van Dijk (2009) reproduce this result as a special case of their analysis. The marginal price increases in both papers correspond to a marginal increase in  $\vartheta_g$  in our setting, for which we obtain  $\lambda_{g+1} = \frac{2\vartheta_{g+1}}{n_{g+1} + \vartheta_{g+1}}$ , which indeed equals 1 for  $\vartheta_{g+1} = n_{g+1}$  and is smaller otherwise.

<sup>129</sup>Note that  $\lambda_c$  can be written as  $\lambda_c = \frac{1}{2} \frac{Q^* + Q^g}{Q^g} R_C$ , where  $R_C = \prod_{i=g+1}^K R_i = \frac{p_K^g - p_K^*}{p_g^* - p_g^g}$  is the part of the price increase due to the cartel that ends up being paid by the final consumers.

<sup>130</sup>See Proposition E.2 and Corollary E.1 in Appendix E.3 for details of the derivation.

for example, when the pre-cartel equilibrium is more competitive. When all intermediate layers are perfectly competitive, every layer fully passes on the overcharge which then is eventually borne by the end users, i.e.,  $\lambda_D = \lambda_C = \frac{\xi_C + \sigma_C}{\xi_C} = \frac{1}{2} \frac{Q^* + Q^g}{Q^g} > 1$ . This provides the lower bound of the actual harm. Monopolistic competition in the intermediate downstream layers increases actual downstream antitrust harm, with a strict upper bound of  $\lambda_D < \frac{Q^* + Q^g}{Q^g}$ .<sup>131</sup> Interestingly enough, we here find a rationale for awarding treble damages according to Section 4 of the Clayton Act.

**Proposition 6.2** *For linear demand, three times the direct-purchaser overcharge is the exact upper bound of total downstream harm, i.e.,  $1 < \lambda_D < 3$ .*

*Proof.* See Appendix E.2. □

The two top-panels of Figure 6.2 plot the value of absolute and relative aggregate downstream antitrust harm against the number of cartel members (upper-left panel) and the number of direct purchasers (upper-right panel) in an example with linear demand.<sup>132</sup> The value of  $\lambda_D$  increases monotonically with the number of firms in the cartel layer, since more competing firms implies a lower but-for price  $p_g^*$  and higher competitive output  $Q^*$ . These changes increase the direct-purchaser overcharge  $\xi_{g+1}$ , as well as the output effects,  $\sum_{k=g+1}^K \sigma_k + \sigma_C$ . The net effect on the downstream damages measure  $d_D$  is positive, because output effects grow faster than the direct-purchaser overcharge. The downstream multiplier decreases if competition in any downstream layer rises. Both the downstream harm  $d_D$  and the direct-purchaser overcharge  $\xi_{g+1}$  increase because of increased output, but the latter increases at a faster rate. As a result,  $\lambda_D$  decreases in the number of direct purchasers of the cartel.<sup>133</sup>

In the lower-left panel of Figure 6.2, the three parameters are plotted for the same specifications and a cartel in layer 1, varying the total number of downstream layers  $K$ . Increasing the number of similarly imperfectly competing downstream layers steeply decreases  $\lambda_D$ . Each additional downstream layer of production introduces an extra markup, which reduces implied demand for the colluding layer, thereby decreasing the direct-purchaser overcharge. As a result, less demand is affected by the cartel.<sup>134</sup>

<sup>131</sup>This upper bound is reached with an infinite number of imperfectly competitive layers downstream. This limit case implies zero equilibrium quantities,  $\lim_{K \rightarrow \infty} Q^* = \lim_{K \rightarrow \infty} Q^g = 0$ —see equation (6.11).

<sup>132</sup>Although the multiplier  $\lambda_D$  does not depend upon the values of  $a$ ,  $b$  and  $\sum_{k=1}^K c_k$ , the direct-purchaser overcharge  $\xi_{g+1}$  and the total downstream harm  $d_D$  do. We have chosen these parameters in such a way that the three functions can be presented in the same graph, but they are otherwise non-specific.

<sup>133</sup>For this parameter configuration, the downstream damage multiplier is equal to  $\frac{329}{216} \approx 1.52$  for  $n_g = 2$  and equal to  $\frac{47}{24} \approx 1.96$  when  $n_g \rightarrow \infty$ , as can be easily checked from (6.13). Moreover, it is equal to  $\frac{52}{27} \approx 1.93$  for  $n_{g+1} = 2$  and equal to  $\frac{14}{9} \approx 1.56$  when  $n_{g+1} \rightarrow \infty$ .

<sup>134</sup>Note that an increase in the number of downstream layers decreases the equilibrium quantity, as can be seen from equation (6.11), but leaves the equilibrium price in layer  $g$  unaffected—see equation (6.12).

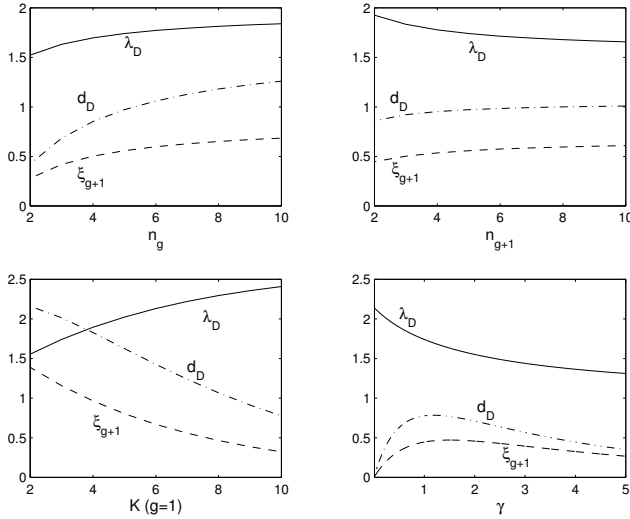


FIGURE 6.2 Downstream cartel effects under different numbers of firms per layer for  $\gamma = 1$ ,  $K = 5$ ,  $n_k = 5$ ,  $\vartheta_k = 1$ ,  $g = 3$ , and  $\frac{1}{b} \left( a - \sum_{k=1}^K c_k \right)^2 = 10$ . For the upper two panels,  $\vartheta_3^c = 5$ . The upper-left panel shows the effect of an increase in the number of cartel members, the upper-right panel in the number of direct purchasers. The lower-left panel displays downstream harm under different numbers of downstream layers of production when there is a cartel in the first layer for  $\vartheta_1^c = 5$ . The lower-right panel plots the effects of non-linearity of consumer demand.

The sum of output effects is the resultant of two opposite effects: the extra mark up increases downstream harm and the decrease in production decreases downstream harm. In the example in the figure, the first effect outweighs the second. However, the effect on the direct-purchaser overcharge dominates, leading to a monotonic increase in  $\lambda_D$ .

The lower-right panel of Figure 6.2 shows the effect of variations in the shape of demand. Both  $d_D$  and  $\xi_{g+1}$  decrease both sides from linearity, resulting in a monotonically decreasing value of  $\lambda_D$  over the spectrum.

It appears in these examples that the ratio between actual downstream harm and the direct-purchaser overcharge may be high. The following result establishes that there is no upper bound on the downstream damages multiplier.

**Proposition 6.3** *For any finite number  $\overline{M} > 0$ , there exists a market structure such that  $\lambda_D \geq \overline{M}$ .*

*Proof.* See Appendix E.3 and E.4. □



This result obtains as long as there is some degree of market power in sufficiently many downstream layers.<sup>135</sup> The intuition is that in a two-layered model with cartelized suppliers directly supplying final consumers, the deadweight-loss triangle becomes a smaller fraction of the overcharge quicker when demand is more concave than when demand is increasingly convex. In both limit demand curves, the output effect goes to zero, but a decrease in  $\gamma$  increases the output effect relative to the overcharge. The proof of Proposition 6.3 uses the fact that when demand becomes relatively elastic in the relevant region ( $\gamma \rightarrow 0$ ), the output effect becomes large relative to the overcharge.

Finally, we compare total downstream harm with the sum total of direct-purchaser overcharges and lost profits (dead-weight loss). That is, we define

$$\tilde{\lambda}_D = \frac{d_D}{\xi_{g+1} + \sigma_{g+1}}.$$

For some parameter specifications, adding the direct purchasers' dead-weight loss to the denominator changes the damage multiplier somewhat. The total direct effect remains a poor estimator of total true antitrust harm, however. To see this, first note that if layer  $g + 1$  is perfectly competitive—that is,  $\vartheta_{g+1} \rightarrow 0$  and/or  $n_{g+1} \rightarrow \infty$ —there is no output effect for this layer of direct purchasers, i.e.,  $\sigma_{g+1} = 0$ . This implies  $\tilde{\lambda}_D = \lambda_D$ . Obviously,  $\tilde{\lambda}_D$  can, therefore, also take on any value. On the other hand, the output effect of the direct purchaser layer is large when this layer is fully monopolized, i.e.,  $\vartheta_{g+1} = n_{g+1}$ . Yet even in that case there exists no upper bound on  $\tilde{\lambda}_D$ .<sup>136</sup> One way of interpreting this finding in contrast to Proposition 6.1 is as the “direct purchaser dead-weight loss” being a poor estimator of “total chain deadweight-losses.” Hence, even if lost profits would be recognized as (part of) antitrust harm, damage assessment at the direct purchaser level only in general provides no proper sense of the sum of actual downstream harm sustained in the chain.

### 6.3.2 Upstream Damages

Upstream from the cartel, the derived demand for inputs is reduced. Depending on market conditions, suppliers may optimally respond to this shift in demand by in- or decreasing output, resulting in an ambiguous effect on upstream prices. Under constant marginal costs of production, in our chosen demand specification (6.10) the price decreasing effect from reduced demand and the price increasing effect from reduced pro-

<sup>135</sup>In fact,  $\lambda_D$  is bounded from above by  $(1 + K - g)(e - 1)$ , with  $e$  being the natural number. This bound is exact for  $\gamma \rightarrow 0$ ,  $\vartheta_g = 0$  and  $\vartheta_g^c = n_g$ , and  $\vartheta_k = n_k$  for all downstream layers  $k = g + 1, \dots, K$ . See Appendix E.3.3.

<sup>136</sup>See Lemma E.3 in Appendix E.4.

duction exactly offset. To see that upstream prices are indeed not affected by downstream overcharges, note that in equation (6.12) the equilibrium price in layer  $k$  does not depend on  $\vartheta_l$  or  $n_l$  for any  $l > k$ . This implies that collusion in layer  $g$  will not have any effect on prices upstream:  $p_k^g = p_k^*$  for all  $k < g$  and all upstream overcharges and pass-on effects vanish,  $\xi_k = 0$  for  $k = 1, \dots, g$  and  $\omega_k = 0$  for  $k = 1, \dots, g - 1$ .<sup>137</sup> This set-up allows us to focus on upstream output effects. In Appendix E.5, we offer an example of an upstream input price decrease (an “undercharge”) by which damages are passed up.

Moreover, the case of linear demand suffices to establish some limit properties of  $\lambda_U$ . Aggregate upstream antitrust harm relates to the direct-purchaser overcharge as

$$\lambda_U = \frac{(1-r)}{r(1-r^\gamma)} \frac{n_g + \gamma\vartheta_g}{n_g} \left( \prod_{i=1}^{g-1} \frac{n_i + \gamma\vartheta_i}{n_i} - 1 \right), \quad (6.14)$$

so that we immediately have the following result.

**Proposition 6.4** *For any finite number  $\bar{M} > 0$ , there exists a market structure such that  $\lambda_U \geq \bar{M}$ .*

*Proof.* See Appendix E.3 and E.6. □

Note also that  $\lambda_U$  increases with a decrease in competition in one of the upstream layers, as well as with an increase in the number of imperfectly competitive upstream layers. It is furthermore invariant to changes in the number of downstream layers and their competitiveness.

The upper-left panel of Figure 6.3 shows numerically that both upstream antitrust harm  $d_U$  and the direct-purchaser overcharge  $\xi_{g+1}$  grow with the number of firms in the colluding layer—increasing competition in the “but-for” world—but that the upstream damage multiplier  $\lambda_U$  remains constant. The upper-right panel shows the effect of an increase in the number of firms in one of the upstream layers. This decreases upstream harm  $d_U$ , since an increase in the number of firms in one layer decreases the mark up, and thereby the output effect, in that layer. This effect is only partially outweighed by an increase in the output effect that occurs due to the increase in production. At the same time, the direct-purchaser overcharge decreases with an increase in the number of firms in an upstream layer and the net effect is a decrease in the upstream damage multiplier.<sup>138</sup>

<sup>137</sup>Greenhut and Ohta (1976) and Haring and Kaserman (1978) find analogously for the case of linear demand and constant marginal costs that output changes but upstream input prices remain the same under vertical integration. In the next subsection we discuss variations in demand and cost functions.

<sup>138</sup>For the parameter values here considered, the upstream damage multiplier is equal to  $\frac{8}{5}$  for  $n_{g-1} = 2$  and equal to  $\frac{2}{5}$  when  $n_{g-1} \rightarrow \infty$ , as can be easily checked from equation (6.14).

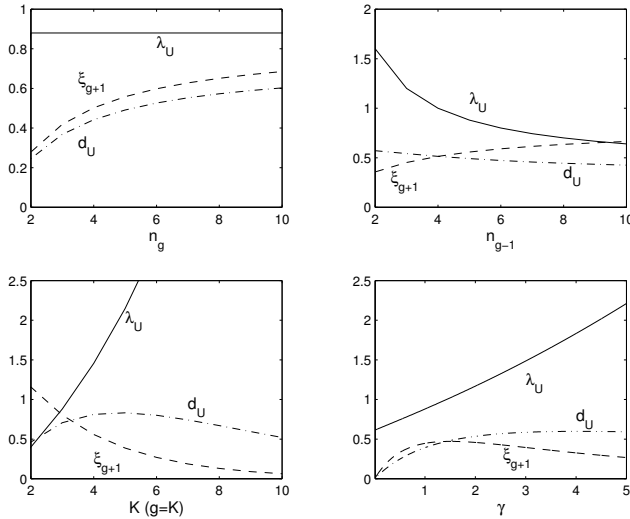


FIGURE 6.3 *Upstream cartel effects under different numbers of firms per layer for  $\gamma = 1$ ,  $K = 5$ ,  $n_k = 5$ ,  $\vartheta_k = 1$ ,  $g = 3$  and  $\frac{1}{b} \left( a - \sum_{k=1}^K c_k \right)^2 = 10$ . For the upper two panels,  $\vartheta_3^c = 5$ . The upper-left panel shows the effect of an increase in the number of cartel members, the upper-right panel in the number of direct suppliers. The lower-left panel displays upstream harm under different numbers of downstream layers of production when there is a cartel in the final layer  $K$  for  $\vartheta_K^c = 5$ . The lower-right panel displays the effects of non-linearity of consumer demand.*

The lower-left panel shows how the upstream damage multiplier varies with the number of upstream layers. If the number of (imperfectly competitive) upstream layers increases, production decreases, which decreases the direct-purchaser overcharge. The relationship between downstream damages  $d_U$  and the number of upstream layers is non-monotonic in this linear example. An increase in the number of layers introduces additional mark-ups but decreases production. The first effect has a positive, and the second a negative impact upon upstream output effects. From Figure 6.3 it follows that the first (second) effect dominates when the number of layers is small (large). The net effect of an increase of the number of upstream layers on the upstream damage multiplier is always positive.

### 6.3.3 Cartel Location and the Distribution of Harm

Equations (6.13) and (6.14), as well as Figure 6.3 suggest that the upstream damages multiplier  $\lambda_U$  is substantially larger than the downstream damage multiplier  $\lambda_D$ . This raises the question whether it is possible for total antitrust harm to be higher when the location of the colluding layer is closer to the final consumers. *A priori*, such proximity

might increase the harm done upstream more than it decreases the harm done downstream. While indeed the multipliers do not trade off perfectly, the absolute level of total cartel harm is unaffected by the location of the cartel.

**Proposition 6.5** *Consider two layers,  $g$  and  $h > g$  that have the same characteristics:  $n_h = n_g$ ,  $\vartheta_h = \vartheta_g$ , and, if one of these layers would collude,  $\vartheta_h^c = \vartheta_g^c$ . Let  $\Delta W_k$  be the change in welfare if layer  $k$  colludes. Then  $\Delta W_h = \Delta W_g$ ,  $\xi_{h+1} < \xi_{g+1}$  and  $\lambda_{W,h} > \lambda_{W,g}$ .*

*Proof.* See Appendix E.3 and E.7. □

The location of the cartel affects its ability to impose and overcharge. All other things equal, the lower the cartel is in the chain, the smaller is the direct-purchaser overcharge, while total cartel harm remains the same. Therefore, the upstream damages multiplier increases when the cartel is lower in the chain. The reason for this is that if the number of layers upstream from where the cartel forms is large, each of these layers will have put some mark-up on the price. This effectively reduces the scope for abuse of market power by the colluding layer. At the same time, more layers upstream and less downstream from the cartel implies that the direct-purchaser overcharge misses more of the total of effects.

Formally, the price overcharge is given as

$$p_g^g - p_g^* = \Psi \prod_{i=1}^g \frac{n_i}{n_i + \gamma \vartheta_i},$$

where  $\Psi$  is a function of the parameters of the model and independent of the location of the colluding layer. Clearly, when the number of imperfectly competitive layers (or for that matter: market power of existing upstream layers) increases, this difference decreases. As a consequence, the total welfare measure  $\lambda_W$  increases when the colluding layer is further downstream in the chain of production, not because absolute welfare effects are higher, but because the direct-purchaser overcharge goes down. Figure 6.4 illustrates.

Given that final output is independent of the location of the cartel, so is the increase of final consumer prices. Therefore if the colluding layer is higher up in the chain of production, only a larger increase in prices would result in the same increase in final consumer prices. This is because part of the price increase is absorbed by intermediate downstream layers. For this reason, the direct-purchaser overcharge for a cartel higher up the chain is higher. Hence, the closer the cartel is to the final customers, the more the direct-purchaser overcharge underestimates the actual harm, the larger share of which is borne by the producers upstream in the chain of production.

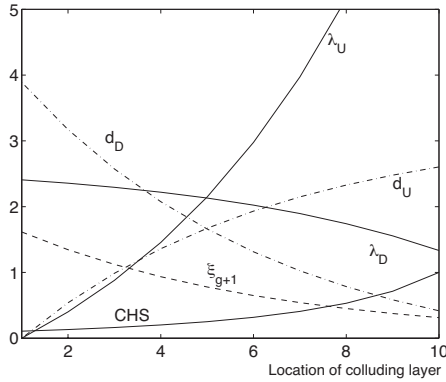


FIGURE 6.4 Damages and CHS as a function of cartel location. Down- and upstream damages and the CHS as a function of the location of the cartel in the chain of production for  $n_k = 5$  and  $\vartheta_k = 1$  for all  $k$ ,  $\frac{1}{b} \left( a - \sum_{k=1}^K c_k \right)^2 = 50$ , and  $\vartheta_g^c = 5$ .

Figure 6.4 also plots the “consumer harm share” ( $CHS$ ), a concept introduced in Boone and Müller (2008) as the share of final consumers in the sum total of downstream harm, that is,  $CHS = \frac{\Delta CS}{d_D}$ . So defined, the value of  $CHS$  increases, the closer the cartel is to the consumer market. In our set-up, the  $CHS$  is defined as the share in the total welfare effects. Since the sum of all welfare effects in the chain is independent of the location of the cartel, in our definition the consumer harm share is constant.

### 6.4 Concluding Remarks

We have assessed the pass-on of antitrust welfare effects in longer vertical supply chains, in which an antitrust violation may occur in any layer of production. We find that the direct purchaser overcharge generally grossly underestimates the total antitrust harm. While the direct-purchaser overcharge is equal to the sum of all passed on overcharges downstream, it misses the output effects in every layer. This problem is not generally remedied by including the direct purchaser output effect in the damage assessment. The share in total harm sustained by suppliers to the wrongdoer(s) may be large. Relying on the direct-purchaser overcharge becomes increasingly problematic, the longer the vertical chain of production and the closer the illegal price increases occur to the final consumers.

We conclude that there exist no simple multiplication factors to correct the established direct-purchaser overcharge for actual markets that rely on basic market structure characteristics—not even in the case of unit price overcharges. Nor are the lost profits of the direct purchasers a good measure for total chain deadweight-losses. This implies that it

will not generally suffice to collect the direct-purchaser overcharge first, and then redistribute this money over all antitrust victims later. The flip side is that duplicative recovery of uncorrected overcharges at several levels in the chain of production can easily create a problem of multiple liability for the defendant.

As the models in the existing literature, our model contains some specific assumptions. We have abstracted from non-linear cartel price elements, for example, which can reduce deadweight-losses, but also from additional negative effects that many cartels have on product quality and innovation. We have also not considered the effects of partial vertical integration in the chain of production. The cost structures we use are special, albeit that our results remain qualitatively unchanged in various variations with smoothly in- and decreasing marginal costs of production. In addition, we have not specified how cartels could use their market power *vis-à-vis* suppliers.<sup>139</sup>

Our assumptions of homogeneity of products within each layer and one-to-one production between layers are not entirely innocuous either. Our fixed-proportion production technology implies that products of different layers are perfect complements. When there would be substitution possibilities between inputs instead, a price increase in one layer might induce firms in the next layer to substitute away from that input and toward an input produced in another chain all together. We ignore this competitive constraint on pricing in our analysis. The industry supplying the other input is furthermore likely to benefit from the cartel, since its demand may go up and it can raise prices as a result of the reduced competition. This is sometimes called the “umbrella effect.”<sup>140</sup>

In light of our results, it appears to be an unbalanced spending of resources to devote considerable effort and econometric expertise to the characterization of but-for worlds—as is often the case in U.S. antitrust damage cases—only to subsequently use the so found but-for price to calculate the direct-purchaser overcharge. With the information obtained in such detailed but-for economic analyses, structural estimations are often possible and courts would do well to consider them. The same is true for claims of antitrust injury sustained by direct and indirect suppliers to antitrust violators.

We warn in this context also against the European Commission’s call for “simplified rules on estimating the loss” from infringements of the competition rules in its 2008

<sup>139</sup>One way to represent upstream bargaining power in our model is as a reduction of  $\vartheta_{g-1}$  to  $\vartheta_{g-1} = 0$  in response to a cartel forming in layer  $g$  if the cartel has full bargaining power. Lower input costs induce the cartel to produce more, thus reducing some of its detrimental effects. This approach is not entirely free from problems, however. For example, it leaves pre-cartel bargaining power unspecified.

<sup>140</sup>See Areeda and Hovenkamp (1992), para. 337.3, on the rules of standing for “umbrella” plaintiffs. The authors argue that purchasers from non-cartel members that were overcharged because of the umbrella effect should generally be granted standing to sue the cartel for damages, in particular when products are homogeneous. When products are differentiated, the authors recognize that it may be difficult to draw the line where standing ends.

White Paper. The Commission's stated primary objective and guiding principle in this document is full compensation of victims, which is in line with decisions of the European Court of Justice.<sup>141</sup> It furthermore recognizes "actual damages, lost profits, and interest" for both direct and indirect purchasers. The Commission should realize that there is no hope for very simple rules on antitrust damage estimation.<sup>142</sup>

Finally, our analysis has clarified the antitrust damages caused to direct and indirect suppliers. These upstream effects of a downstream cartel appear not to be properly viewed as antitrust damages in U.S. antitrust law. In *Mandeville Island Farms*, the Supreme Court had held that growers of sugar beets could maintain a treble-damages action against refiners who had allegedly conspired to fix the price that they would pay for the beets. In *Radovic* (1957) the Court further recognized a wide "zone of harm" caused by an antitrust violation that could potentially include customers as well as suppliers.<sup>143</sup> Indeed in *Wilson v. Ringsby Truck Lines* (1970), truck drivers and warehousemen of Ringsby, a common carrier transporting between Colorado and Wyoming, were recognized by a district court as antitrust victims when their services were no longer needed after Ringsby joined a cartel that divided their markets geographically.<sup>144</sup>

However, in the 1970s a number of supplier suits for antitrust damages failed when circuit courts gave no standing to classes of employees and suppliers of cartels.<sup>145</sup> In *Illinois Brick*, the Supreme Court had concluded that: "An antitrust violation may be expected to cause ripples of harm to flow through the Nation's economy; but despite the broad wording of Section 4 there is a point beyond which the wrongdoer should not be held liable." In *Associated Contractors* (1983), the Court then denied standing to a class of carpenters who sought antitrust damages for business loss resulting from the contractors association using anticompetitive means to work around their union. It ruled that the carpenters union was not a person injured by reason of a violation of the antitrust laws within the meaning of Section 4, because of the "tenuous and speculative character of the causal relationship," and the existence of "more direct victims" of the conspiracy, meaning consumers and competitors.

<sup>141</sup> See pp. 3 and 7 of the White Paper in fn. 107.

<sup>142</sup> In addition, the Commission means to assist indirect purchasers by introducing a peculiar "rebuttable presumption that the illegal overcharge was passed on to them in its entirety"—see p. 8 of the White Paper in fn. 107. The use of "them" in this quote suggests that the drafters of the White Paper indeed had the mainstream two-layer upstream cartel model in mind.

<sup>143</sup> *Radovich v. National Football League* 352 U.S. 445 (1957). See Comment (1972), pp. 403–404.

<sup>144</sup> See *Wilson v. Ringsby Truck Lines, Inc.*, 320 F. Supp. 699 (D. Colo. 1970).

<sup>145</sup> In *Contreras v. Grower Shipper Veg. Ass'n of Cent. Cal.*, 484 F.2d 1346 (9th Cir. 1973), the 9th Circuit Court denied a class of employees laid off by an alleged price-fixer standing to sue for antitrust damages. In *Comet Mechanical Contractors, Inc. v. E.A. Cowen Constr. Inc.*, 609 F.2d 404 (10th Cir. 1980) a subcontractor could not seek compensation for reduced demand for its services resulting from alleged bid rigging by general contractors. See Page (1985), p. 1492.

Antitrust violations can cause substantial direct and indirect supplier harm. Analogous to customers of a cartel facing higher prices and reduced quantities of output, suppliers to a cartel may obtain lower prices for a reduced volume of input sales, even when the cartel does not execute collusive buyer power. It remains an open question of law, therefore, where exactly are the points beyond which the wrongdoers should no longer be held liable for the harm caused by their illegal actions.