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Bounds on the damages from a price overcharge

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Abstract

In antitrust cases where the defendant, whether it's a cartel or a dominant supplier, overcharges a firm, the defendant typically makes three claims: (1) the firm passed on the higher price to its customers, (2) its sales volume did not decrease materially, and (3) the damages are small. To calculate the damages, these cases usually estimate the price pass-on and sometimes consider the volume decrease. This study establishes direct bounds on the damages using minimal data: the sales figures with and without the overcharge, along with the exact amount of the overcharge. These bounds reduce the risk of over- or under-compensation and offer a sense-check on any alternative estimates of the damages.

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1 Introduction

Pass-on is the extent to which an increase in the price of an input causes a firm to increase the price of its output. An input price increase may be an illegal overcharge by, e.g., a cartel or a dominant firm abusing its position. An overcharge gives rise to a claim for damages (the lost profit). The pass-on defence against a claim for damages is well described in the EU Directive 2004/104/EU §39: "*When an injured party has reduced its actual loss by passing it on, entirely or in part, to its own purchasers, the loss which has been passed on no longer constitutes harm for which the party that passed it on needs to be compensated.*"[1] This defence was raised in approximately half the cartel cases in the EU from 1998 to 2020 (Laborde, 2021), and also in patent overcharge disputes and abuse of dominance litigation (e.g., margin squeeze or partial foreclosure).

Pass-on and the corresponding defence only consider the price increase, even though the damages also depend on the decrease in the sales volume (the *volume effect*). When neglecting the volume effect, the conventional pass-on argument is inconsistent with a rational firm, because if the firm could raise price without a volume effect, then it would have done so already, with or without an overcharge. Raising price without losing sales volume is always profitable. Surprisingly, pass-on and the volume effect are estimated separately in precedents and the legal literature, despite their acknowledged link.[2] Separate estimation is admitted to be difficult and imprecise.[3] The bounds in this paper use the link between the volume effect and pass-on. Such additional information enables estimating the damages more precisely.

This paper bounds the damages in terms of observables: the quantity sold with and without the overcharge, and the size of the overcharge. The bounds address the need identified in the European Commission (2013) Practical Guide on Quantifying Harm in Actions for Damages §120 for "*an upper- or lower-bound or approximate estimate for the harm suffered.*" The bounds are a consistency check on any other estimate of overcharge damages.

The results may be obvious to an economic theorist, but not to courts and regulators, based on the EU directive, its methodology guide, and law articles.[4] Competition economists may have derived similar results in confidential expert testimony, but citing a publicly available peer-reviewed article would carry more weight and may eventually align the relevant law with economic principles.

The bounds use the assumption that the overcharge is passed on by one firm at a time, e.g., because only one firm was overcharged, or the overcharged firms change their prices at different times for exogenous reasons. Taxes, tariffs, regulations and shortages also increase the production cost, which a firm passes on, so the same calculation can be used to put bounds on the loss of producer surplus caused by policy changes or world events. The bounds apply directly to the effect of a tax on a monopolist, but even in a multi-firm industry, a seemingly uniform tax increase or regulation may affect one firm at a time. For example, only one firm in the industry may use the taxed or regulated input (imported, sanctioned, declared harmful to health or the environment). Each firm exhausts its pre-tax stockpile of the input at a different time, at which point the more

[1] Council of the European Union (2014)

[2] Weber (2020) p. 438, European Commission (2013) §175, Council of the European Union (2014) §40, German Supreme Court in Rails V (Krüger, 2021).

[3] European Commission (2013) §193, Weber (2020) p. 438.

[4] European Commission (2013); Council of the European Union (2014); Weber (2020) *op. cit.* in footnote 2.

expensive input raises its cost. Supply contracts with locked-in prices also end at different times for different firms—such contracts enabled Toyota to avoid the chip shortage which other carmakers suffered during the Covid pandemic.[5]

Even if part of the overcharge is passed on to the consumer or to the next level of the supply chain, it still causes harm, simply to a different victim, so the initial firm cannot claim damages for that part. Similar bounds on the damages apply to each downstream level of the supply chain—the input price increase is the part of the overcharge that is passed on from immediately upstream. Calculating the bounds on the damages at a level of the supply chain requires data on the input price increase, which is the upstream level's output price increase. If the output price, input price and quantity are known for a level of the supply chain before and after the overcharge, then the damages at that level can be calculated directly. If the intermediate prices are not known, then in a supply chain of successive monopolies (causing multiple marginalisation), the bounds apply to the fall in producer surplus. The intermediate prices divide the producer surplus between the levels of the supply chain, thus the *changes* in intermediate prices divide the damages from an overcharge between the levels. The bounds on the total damages to the supply chain are useful even without knowing the distribution of harm, because to incentivise socially optimal behaviour, whoever causes harm must be made to compensate the total harm they caused, regardless of its distribution.

Verboven and van Dijk (2009) use demand elasticities and slope to calculate the decrease in profit after a small increase in cost. They get a more precise answer than the bounds, but require more data, and the cost change must be small.

Hinnosaar (2023) calculates the lost profit caused by higher costs (tariffs) in a network where each firm is either a price taker or a monopolist. The loss is proportional to an influentiality measure, which requires more data than the bounds.

Han et al. (2009) assume linear demand and calculate the loss of total surplus, not damages to an individual firm, in terms of the increase in price, not cost.

The European Commission (2013) parts 2-3 extensively discuss estimating pass-on and the volume effect, but do not combine these, which this paper does in the following section to derive the bounds on the damages.

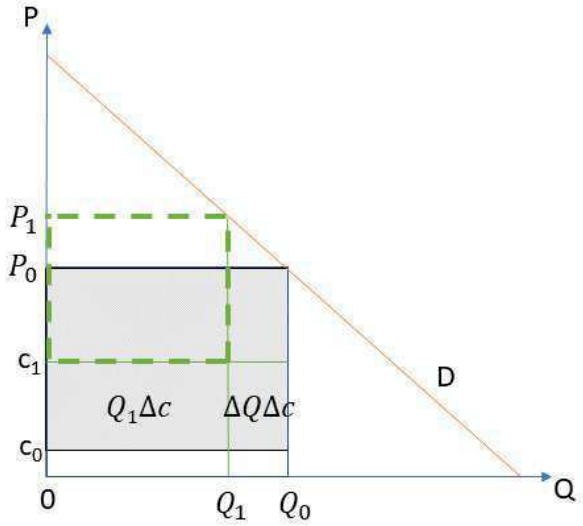
2 The bounds

The economic environment is as follows (generalisations are in Section 2.1). A profit-maximising firm faces the residual demand curve $D(P)$. The firm may be an oligopolist, monopolist or competitive. Without an overcharge, the firm has marginal cost $c_0 \geq 0$, sets price P_0 and sells quantity $Q_0 = D(P_0)$. With the overcharge Δc, the firm has marginal cost $c_1 = c_0 + \Delta c$, sets price P_1 and sells $Q_1 = D(P_1)$.

The firm can usually prove to a court its volume sold and overcharge suffered (using sales documentation, contracts with the supplier showing the input price before, during and after the overcharge). The court has the power to request input price documentation from the defendant. All parties receive copies of all documents, thus observe the sales volumes and the overcharge. These observables are sufficient to bound the damages, as shown next.

[5] https://www.reuters.com/article/us-japan-fukushima-anniversary-toyota-in-idUSKBN2B1005

Figure 1: Bounds on the profit decrease caused by an overcharge



Proposition 1. *If the firm's marginal cost rises from c_0 to $c_1 = c_0 + \Delta c$, causing the firm to change its price from P_0 to P_1, then the firm's profit decreases by an amount between $\Delta c D(P_1)$ and $\Delta c D(P_0)$. The bounds are tight.*

Proof. If at cost level c_0 (without the overcharge), a rational firm chose P_0, then P_0 was more profitable than any $P_1 > P_0$, i.e., $(P_0 - c_0)D(P_0) \geq (P_1 - c_0)D(P_1)$. If the price after the overcharge is P_1, then the profit is $(P_1 - c_1)D(P_1)$. The decrease in profit is at least $(P_0 - c_0)D(P_0) - (P_1 - c_0 - \Delta c)D(P_1) \geq (P_1 - c_0)D(P_1) - (P_1 - c_0 - \Delta c)D(P_1) = \Delta c D(P_1)$.

If at cost level c_1 (after the overcharge), a rational firm chose P_1, then P_1 is more profitable than any $P_0 < P_1$, i.e., $(P_1 - c_1)D(P_1) \geq (P_0 - c_1)D(P_0)$. The decrease from the profit $(P_0 - c_0)D(P_0)$ before the overcharge to $(P_1 - c_1)D(P_1)$ after the overcharge is at most $(P_0 - c_0)D(P_0) - (P_1 - c_0 - \Delta c)D(P_1) \leq (P_0 - c_0)D(P_0) - (P_0 - c_0 - \Delta c)D(P_0) = \Delta c D(P_0)$.

If $D(P) = Q_0 \mathbf{1}\{P \leq P_0\}$, then $Q_1 = Q_0$, the bounds coincide and are thus tight.

The proofs are similar if the firm chooses quantity instead of price. For the lower bound, if the firm chose Q_0 at c_0, then $(P(Q_0) - c_0)Q_0 \geq (P(Q_1) - c_0)Q_1$. The decrease in profit is at least $(P(Q_0) - c_0)Q_0 - (P(Q_1) - c_0 - \Delta c)Q_1 \geq (P(Q_1) - c_0)Q_1 - (P(Q_1) - c - \Delta c)Q_1 = \Delta c Q_1$. □

The intuition for Proposition 1 is illustrated in Figure 1. The shaded rectangle is the profit without the overcharge, the dashed rectangle with the overcharge.

The defence of a cartel or a dominant firm is that the claimant's pass-on $P_1 - P_0$ of the overcharge was large and the volume effect $Q_0 - Q_1$ small. If so, then the claimant's price increase would have caused little reduction in sales volume even without the overcharge, thus would have been profitable (in Figure 1, the dashed rectangle plus $Q_1\Delta c$ would be larger than the shaded area, so the demand curve would be steep between P_0 and P_1). Any rational firm would have raised price in such a situation until the volume effect became large enough to outweigh the higher margin. The fact that the claimant did not raise price without the overcharge rules out the *combination* of high pass-on and a small volume effect, whatever these were separately. Therefore, any price increase that the claimant was forced to implement by the overcharge reduced its profit at its original

cost (without the overcharge). The overcharge further reduced profit by $Q_1\Delta c$. This is a lower bound on the damages.

The upper bound on the lost profit is $Q_0\Delta c = Q_1\Delta c + \Delta Q\Delta c$, which in Figure 1 is the bottom part of the shaded rectangle (below c_1). To see why, suppose the firm could not change its price in response to the cost increase. Then its loss would be the old quantity times the change in the cost—$Q_0\Delta c$. This overestimates the loss, omitting the gain in the top part of the dashed rectangle (above P_0), which is the added profit $\Delta P Q_1$ from the higher price at the new quantity.

The absence of a volume effect would imply a vertical demand curve between P_0 and P_1, which implies $Q_1 = Q_0$. If $P_1 > P_0$, then raising the price is strictly profitable for any $c_0 \leq c_1$. This is the inconsistency in the conventional pass-on defense without a volume effect.

The bounds proof does not apply when the overcharge increases the costs for two or more firms which set prices simultaneously. This includes industry-wide cost increases, which may benefit all firms (Ireland, 1984; Seade, 1985; Cabral and Villas-Boas, 2005).

The result applies to an oligopolist, monopolist, or perfectly competitive firm. The only requirement is that two or more competing firms do not revise their price simultaneously. For example, a cartel could start overcharging all its buyers at the same time (or different times), but the result applies if each buyer has a different date for revising its price: one on 1 January, another on 1 June, another upon launching a new product. Taking as given the observed prices of the others and the overcharge, each buyer separately updates its price at its usual date. After updating its price, the buyer's damages from the overcharge are bounded by Proposition 1. Before updating, i.e., between start of the overcharge and the time of revising the price, the damages are simply the cost difference Δc times the quantity Q_0.

2.1 Generalisations

The proof shows that the bounds apply regardless of whether the firm chooses price or quantity.

The bounds hold for any pricing mechanism m (including two-part tariffs) if the cost is separable from the revenue R. The proof for the lower bound becomes

$$R(m(c_0)) - c_0Q_0 \geq R(m(c_1)) - c_0Q_1 = R(m(c_1)) - c_1Q_1 + \Delta cQ_1.$$

The proof for the upper bound becomes

$$R(m(c_1)) - c_1Q_1 \geq R(m(c_0)) - c_1Q_0 = R(m(c_0)) - c_0Q_0 - \Delta cQ_0.$$

If the marginal cost function $c(Q)$ is not constant, then $Q_1\Delta c$ becomes $\int_0^{Q_1}[c_1(Q) - c_0(Q)]dQ$, and $\Delta Q\Delta c$ becomes $\int_{Q_1}^{Q_0}[c_1(Q) - c_0(Q)]dQ$. Fixed cost can be added to the marginal cost of the first unit produced.

The bounds remain valid for a multiproduct and multi-input firm. Let $\vec{w}$ be the vector of input prices and C the total cost. The lower bound on the damages is $C(\vec{Q}_1, \vec{w}_1) - C(\vec{Q}_1, \vec{w}_0)$, because

$$\vec{P}_0\vec{Q}_0 - C(\vec{Q}_0, \vec{w}_0) \geq \vec{P}_1\vec{Q}_1 - C(\vec{Q}_1, \vec{w}_0) = \vec{P}_1\vec{Q}_1 - C(\vec{Q}_1, \vec{w}_1) + [C(\vec{Q}_1, \vec{w}_1) - C(\vec{Q}_1, \vec{w}_0)].$$

The upper bound on the damages is $C(\vec{Q}_0, \vec{w}_1) - C(\vec{Q}_0, \vec{w}_0)$, because

$$\vec{P}_1\vec{Q}_1 - C(\vec{Q}_1, \vec{w}_1) \geq \vec{P}_0\vec{Q}_0 - C(\vec{Q}_0, \vec{w}_1) = \vec{P}_0\vec{Q}_0 - C(\vec{Q}_0, \vec{w}_0) - [C(\vec{Q}_0, \vec{w}_1) - C(\vec{Q}_0, \vec{w}_0)].$$

The bounds on firm i's damages remain valid if competitors respond after observing firm i's price. Any equilibrium outcome of any game among the firms which observe a price update by firm i defines a demand for firm i as a function of its price. This demand is used in the proof of Proposition 1, which remains unchanged. Formally, replace $D(P)$ with $D_i(P_i, P_{-i}(P_i))$, where $P_{-i}(P_i)$ is the best response of competitors, who may move sequentially or simultaneously among themselves. Then simplify notation to $D_i(P_i)$ and apply the proof. If firm i responds to the response of the competitors, they again respond, etc for a finite number of periods, then the bounds remain valid—just replace $D_i(P_i)$ with

$$D_i(P_{i0}, P_{-i1}(P_{i0}), P_{i2}(P_{-i1}(P_{i0})), P_{-i3}(P_{i2}(P_{-i1}(P_{i0}))), \ldots),$$

where the second subscript $0, 1, 2, \ldots$ denotes the iteration of the best responses. Then simplify notation to $D_i(P_{i0})$ and apply the proof.

3 Conclusion

This paper derives bounds on the damages from an overcharge. The bounds are a consistency check on other estimates of the damages, require less data and are simple to calculate. The bounds fulfill the need that the EC guidance identified. Incorporating these into regulatory guidance would improve the accuracy of damages estimation, clarify competition law and put it on firmer economic foundation.

The bounds apply to general pricing mechanisms, multiproduct firms, and to the total damages to a vertical supply chain of successive monopolies. Information on total damages is useful for providing incentives for socially optimal behaviour. The bounds proof does not apply to a supply network where a firm buys from many suppliers or sells to many buyers—more data is needed in that case to estimate the damages. This estimation is left for future research.

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