

ESTIMATING DAMAGES FROM PRICE-FIXING

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A. INTRODUCTION

The estimation of economic damages is an important task for economists engaged in litigation support. Several sources including, for example, articles by Page,¹ Rubinfeld,² Rubinfeld and Steiner,³ and Baker and Rubinfeld⁴ provide very useful general discussions of damage estimation and related topics. Damage estimation requires the application of economic principles within a particular legal framework. Both the relevant economic principles and the legal framework vary from one area of application to another. Estimating damages arising from price-fixing differs in important respects from, for example, estimation of damages arising from breach of an employment contract. In addition, the legal environment may vary across jurisdictions.

In this article we focus on estimating damages arising from price-fixing in the Canadian legal environment. Our primary objective is to pro-

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- 1 William H. Page, ed., *Proving Antitrust Damages: Legal and Economic Issues* (Chicago: American Bar Association, 1996).
- 2 Daniel L. Rubinfeld, "Econometrics in the Courtroom" (1985) 85 Colum. L. Rev. 1048.
- 3 Daniel L. Rubinfeld & Peter O. Steiner, "Quantitative Methods in Antitrust Litigation" (1984) 46 Law & Contemp. Probs. 69.
- 4 Jonathan B. Baker & Daniel L. Rubinfeld, "Empirical Methods in Antitrust Litigation: Review and Critique" (1999) 1 Am. L. & Econ. Rev. 386.

vide an overview of the major issues that arise when estimating damages in these cases. We also suggest how economists might reasonably proceed when undertaking such estimates. Our focus here will be exclusively on economic issues related to the measurement of damages in these cases and so we will not, for example, offer a comprehensive review of the use of the various techniques in the many American and few Canadian cases in which they have been applied.⁵

There are two issues of particular importance in price-fixing cases that are somewhat less important (although not wholly absent) in other contexts involving anti-competitive practices. One of these issues concerns the implications of class actions for damage estimation. In price-fixing cases, the damaged parties normally consist of a large number of economic agents (individuals, firms, and/or other organizations) who purchased goods at excessive prices. Such parties may seek redress using a class action. If so, the class action environment imposes certain constraints on damage estimation. In addition, the analysis of damages may itself be important in determining whether the damaged parties as a group, or some subset of the damaged parties, meets the legal test for being viewed as a class for the purposes of class action litigation.

The second issue of particular importance in price-fixing cases, especially in Canada, concerns the role of “pass-through.” Goods subject to price-fixing may be used as inputs in the production of downstream products. For example, several recent price-fixing cases have concerned ingredients or additives used in the production of food products. The purchasers of the good whose price is subject to price-fixing are referred to as “direct purchasers.” The direct purchasers may pass through the higher input prices in the form of higher prices for their own products. Thus, for example, price overcharges for citric acid might be partially passed on to consumers in the form of higher prices for fruit drinks and juices. If pass-through occurs, the damage to the direct purchasers might be mitigated and the “indirect” or “downstream” purchasers might suffer economic loss. Drawing inferences about how economic damage is shared between direct and indirect purchasers is a challenging problem in economic analysis.

Because of the difficulty of estimating pass-through damages, the legal regime in American federal court generally allows only direct

5 This is not to say that the discussion of the economic principles is not informed by these cases. Indeed, the authors have provided advice related to damage estimation and distribution for a number of class action cases related to price-fixing in Canada.

purchasers to make damage claims for price-fixing, and allows direct purchasers to claim the full damages associated with price-fixing, irrespective of whether those damages are passed on to indirect purchasers.⁶ In Canada (and under state law in many American states) the legal regime does not eliminate indirect purchasers and therefore implicitly requires consideration of pass-through.

In our discussion of damages we will be focusing on damages related to, and flowing from, increased prices due to price-fixing. Beyond the scope of this article, but an excellent topic for further research, is the question of how to measure damages caused by cartel behaviour that manifests itself in other ways. For example, retailer cartels may agree to close some outlets (increasing travel times for customers) or to limit operating hours of those outlets (also inconveniencing customers). In addition, cartels in many types of industries may opt to allocate territories among members, with the effect that members withdraw from each other's territories, depriving customers of access to some products.⁷

B. DEFINING DAMAGES IN PRICE-FIXING CASES

A standard definition of legal damages is “[a] pecuniary compensation or indemnity, which may be recovered in the courts by any person who has suffered loss, detriment, or injury, whether to his person, property, or rights, through the unlawful act or omission or negligence of another.”⁸ The concept of “compensation” for a “loss” suggests what is often referred to in economic analysis as “but-for” analysis. Damages are calculated by estimating the difference between what the injured party would have received “but for” the harmful event (that is, in the absence of the harmful event), and what the injured party actually received. This approach to damages is consistent with what is sometimes referred to as the “restitution” principle in law. Under this principle we compare the actual economic position of the plaintiff with the position the plaintiff

6 This regime was largely established through *Hanover Shoe, Inc. v. United Shoe Machinery Corp.*, 392 U.S. 481 (1968) and *Illinois Brick Co. v. Illinois*, 431 U.S. 720 (1977) [*Illinois Brick*].

7 Allocating markets or customers can result in higher prices as well, but the inconvenience or reduced variety costs would be in addition to the damages due to the higher prices.

8 *Black's Law Dictionary*, 6th ed., s.v. “damages.”

would have been in if the harmful event (in this context, the price-fixing) had not occurred.

As we do not actually observe the but-for situation, some form of estimation of the but-for position is necessary. The primary contribution of the economist in estimating damages often consists of estimating the but-for comparison point. It is worth remarking that the term “but-for” is rather awkward and it is unfortunate that a better term is not in common use. In some areas of economics the equally awkward term “counterfactual” is used in place of “but-for.” A broader term like “reference point analysis” or “benchmark analysis” perhaps better conveys the intent of the approach. The objective is to estimate a reference point or benchmark that can be compared with the actual economic outcome experienced by the parties.

The economist’s objective is to estimate the reference point (or but-for point) corresponding to what would have arisen in the absence of price-fixing. The reference “point” consists of a price at which the product would have sold in the absence of price-fixing, and an associated quantity of product sold. This reference point can be illustrated as a point in a standard economic diagram with price on the vertical axis and quantity on the horizontal axis, as shown in Figure 1 in the Appendix. From the price and quantity it is possible to infer the damage suffered by downstream buyers. Strictly speaking, both the price and quantity should be estimated. However, in price-fixing cases it is normal to estimate only the reference price. Let the reference price be denoted p^r , let the actual price be p^a , and let the actual quantity be q^a . Damages, D , are then normally presumed to be shown by equation 1.

$$D = (p^a - p^r)q^a \quad (1)$$

The term $(p^a - p^r)$ is sometimes referred to as the “overcharge” (or “per-unit overcharge”). Thus damage is most commonly presumed to equal the overcharge multiplied by the quantity sold. If a firm bought 100 units of the product and the product was subject to an overcharge of \$10 per unit, then the presumed damage is simply \$10 per unit multiplied by 100 units, which equals \$1000. This is illustrated as the shaded area $ABp^r p^a$ in Figure 1.

It is important to understand that this measure of damages does not include all the harm done to buyers. Specifically, it does not take into account the damages arising from reduced use of the product. Some firms, for example, might entirely abandon the product that is subject to

price-fixing. Such firms might have purchased the input had it had been offered at an undistorted price and used the input to make a product and earn positive returns. With the overcharge in place, such firms might not purchase the input at all and would therefore forego the positive returns they would have otherwise earned. This damage is not included in equation 1, which captures only the damage associated with continued purchases of the product at the excess price. This “missing damage” corresponds to the area of triangle ABC in Figure 1.

In considering the effects of price-fixing, the role of intermediate producers who might pass on part of the price increase raises several complications. Pass-through is taken up in Section D of this article. For now, to illustrate the primary points to be made in this section we assume no pass-through, as if all buyers of the product were final consumers or were firms that did not pass on the increased costs. Assuming no pass-through, the total damage to actual or potential direct purchasers of the product is shown by the area of the trapezoid p^aACp' . As drawn, the overcharge calculation captures only about 85 percent of the total injury.⁹

In Figure 1, the missing damage is a triangle because demand is linear. If demand is non-linear, the relevant region still has a roughly triangular shape but is not a strict triangle. The role of this “triangular” region ABC can be understood as follows. The net benefit to consumers from purchasing the good is the difference between the value consumers place on the good, given by the demand curve, and the price. This is called “consumer surplus.” Consumer surplus is the area under the demand curve above the price up to the quantity sold. Without price-fixing, price would be p' and quantity would be q' . With price-fixing, price is higher, at p^a , and quantity sold is correspondingly lower, at q^a . Thus the reduction in quantity arising from price-fixing is $q' - q^a$. If price-fixing had not occurred, consumption of the lost quantity would have generated surplus equal to area ABC. This lost surplus represents damage done to consumers by price-fixing, but is not captured in the simple overcharge on quantity q^a .

There are several reasons one could offer as to why it might make sense to ignore region ABC in assessing damage. First, this area may be very small relative to the overcharge estimate. This will be likely when

9 While the overcharge approach to measuring damages typically misses this triangle of harm, the “lost profits” measure of harm would typically include it if the purchaser were itself a firm and not a final consumer. See Jeffrey L. Harrison, “The Lost Profits Measure of Damages in Price Enhancement Cases” (1980) 64 Minn. L. Rev. 751.

the price overcharges are themselves small. But we must be careful: the larger the price overcharge as a fraction of the reference price, the larger the relative importance of this region. For example, assume the following conditions to be true: (i) but for the price-fixing, the price would have been set at a competitive level (equal to the firm's unit costs), but with the price-fixing it was set at the monopoly level; (ii) demand is linear; and (iii) average or unit costs do not vary with different rates of output. It is not difficult to show that, under these conditions, the triangle will be half the size of the overcharge rectangle, implying that using the overcharge alone would account for only two-thirds of the total harm done to buyers. The importance of the effects over and above the higher price on units actually bought increases considerably when we consider pass-through by buyer industries that are themselves not perfectly competitive (as described in Section D).¹⁰

A second reason why this region might be ignored is a practical one that derives from the fact that some of this loss is associated with consumers who entirely abandon the good. Under price-fixing, they would not be observable as consumers and would therefore be unlikely to be in a class defined for class action purposes. Accordingly, it is arguable that the class consisting of actual consumers should not claim for these damages. However, this reason is only a partial answer, since it should be noted that some of the reduced sales and the associated damage would be absorbed by continuing consumers.

The third main reason for not including region ABC in damage calculations is that it is much more difficult to estimate this region than it is to estimate rectangle ABp^a. We observe the actual quantity and the actual price. For the rectangle all that is needed in addition is the reference price. Region ABC is the area under the demand curve over the region corresponding to the reduction in quantity induced by price-fixing. In order to estimate this region it would necessary to estimate the

10 To see that the size of the missing triangle as a share of total damage can rise as the overcharge increases, consider the following case. The demand curve is linear and is determined by $p = a - bq$. Let the change in price (in absolute rather than percentage terms) due to price-fixing be shown by ΔP (that is, $p^a - p^f$ in Figure 1) and let Q represent the simple average of the quantities under price-fixing (q^a) and in the absence of price-fixing (q^f). Then it can be shown that the share of total damages contained in the missing triangle will be equal to $\Delta P / (2bQ)$. Since the numerator will grow as the overcharge grows and the denominator will fall (because the quantity under price-fixing will fall, dragging the average down with it), it is clear that this fraction must rise as ΔP rises.

demand curve. This would add a significant layer of complication to the analysis.

Some methods used for estimating the price overcharge provide an estimate of the demand curve as a by-product, in which case the full damage could be easily estimated. Even in this case, however, we are typically much more confident of the overcharge estimate than of the damage estimate arising from reduced quantities. Furthermore, some methods for calculating the overcharge do not provide a demand curve estimate.

C. ESTIMATING THE REFERENCE PRICE

Estimation of the reference price (or but-for price) raises important conceptual and practical issues. At the conceptual level we must address what the proper but-for price would be in principle. The actual price arising from price-fixing would reflect exploitation of market power by members of the price-fixing conspiracy.

In the absence of price-fixing it is possible that the market would be perfectly competitive. This would be an extreme case. In this case we would presume that the reference price should be the price that would arise under perfect competition. However, even in the absence of price-fixing, in only a minority of cases would the market structure be that corresponding to perfect competition. Most markets have some degree of market "imperfection." In the vast majority of these markets the price exceeds the perfectly competitive price without violation of competition law. Assuming that the reference price is necessarily the perfectly competitive price would bias the damage estimate upward relative to the most likely but-for situation.

Therefore, part of the economist's job is to make a reasonable assessment as to what market structure would prevail in the absence of price-fixing. Possibly the market would be highly competitive or even perfectly competitive, but less competitive market structures are also likely in many cases. In fact, we might expect that price-fixing cartels are more likely to arise in markets where the default market structure has limited (less than perfect) competition.

The major methods that can be used to estimate the reference price are as follows:¹¹

11 On the methods that can be employed to evaluate the reference price see also John M. Connor, *Global Price Fixing: Our Customers are the Enemy* (Boston: Kluwer, 2001), especially at 71–74.

- 1) Before-after comparisons;
- 2) Using marginal cost or average cost as a proxy for price;
- 3) Analogy (using similar markets as an analogue);
- 4) Structural econometric simulation of a competitive benchmark;
- 5) Econometric demand estimation and market simulation under imperfect competition; and
- 6) Reduced-form econometric estimation of price.

These six methods are all formal methods for estimating a reference price. It is also possible to rely on informal or heuristic methods. For example, interviews with representatives of firms engaged in or affected by a price conspiracy might yield executives' own informal estimates of overcharges. Such informal methods are subject to great uncertainty and should not be relied upon if more systematic methods can be used effectively. We do not discuss informal methods further in this article.

1) Before-After Comparisons

The primary advantage of this approach is its conceptual simplicity. As the name of this approach suggests, we simply compare the price before the price-fixing conspiracy with the price that occurred after the price-fixing conspiracy became active. Price data for an extended period is normally readily available, so this method would seem to be easily implemented.¹²

There are two major flaws with this approach. In many circumstances these flaws would be fatal. The first major flaw is that it may be difficult to determine when the price conspiracy started. In cases where the price-fixing defendants have been found in violation of competition law there will be a period of investigation that determines a particular period during which the conspiracy was in place. Typically the plaintiffs will seek damages only for this period. However, it should not be assumed that the price preceding the period of investigation necessarily corresponds to an undistorted price. The finding that a conspiracy was in place, for example, in 2004, does not rule out the possibility that a conspiracy might have been operational in 2003.

As a legal matter it might be inappropriate to presume that a conspiracy was in place in 2003 but, in the interest of accurately estimating the overcharge, it might be a serious mistake to presume that the conspiracy was not active in 2003. Often the specific period of investigation is influ-

¹² We can also use data from after the conspiracy collapsed if we believe that the price then fell to a but-for level.

enced by limited resources on the part of the competition authorities or by a lack of clear evidence one way or the other for earlier periods. It certainly should not be taken to imply undistorted pricing for all prior periods.

A second major problem with the before-after comparison is that it does not control for other factors. Suppose, for example, that we have strong evidence that a particular price-fixing conspiracy was active and effective in 2004, but not in 2003. However, the price-fixing conspiracy might be only one of several factors causing a price change between 2003 and 2004. One important cause of price changes in Canadian markets is exchange rate movement, especially changes in the United States-Canada exchange rate. This is particularly true if the product itself trades in a "world market" or if important inputs in producing the product come from the United States. If the Canadian dollar depreciates relative to the United States dollar over some period, this would normally put upward pressure on the Canadian price. If so, using a simple before-after comparison might incorrectly attribute to price-fixing what was actually due to exchange rate changes.

Other factors that might affect prices include industry-specific shocks. For example, in the summer of 2004 egg and poultry prices in British Columbia rose because most poultry in British Columbia was destroyed to prevent the spread of avian flu, leading to a shortage of poultry supply. If a price-fixing conspiracy had been alleged during this period, it would have been necessary to adjust for price changes arising from the avian flu supply shock. In addition, labour cost changes, energy price changes, demand shocks, the introduction of substitute products, supply shortages in related products, income changes, and general business conditions all might affect prices over a particular time period. The before-after method can be used with confidence only if we somehow adjust for these other factors or if we are confident that the period in question was a period of relative stability with respect to factors other than the conspiracy that might affect price.

Unfortunately, the two major problems with before-after comparisons (period definition and the role of non-price-fixing factors) have opposite implications regarding the time horizon to be used in the analysis. If we are concerned about making sure that the period we use to get the reference price corresponds to a non-conspiracy period we might want to use a period well before the period of investigation during which a conspiracy was operating. For example, if we have a finding of price-fixing for 2004, we would be more confident that prices from, say, 2000 or 2001 would

be free from price-fixing than prices from 2003. On the other hand, the further apart the reference period and the price-fixing period are in time, the more likely it is that some of the price change will be due to other factors.

In summary, before-after comparisons can provide useful information in assessing damages. However, only rarely would a before-after comparison provide definitive estimates of a price overcharge. Our view is that before-after comparisons should be used only as supporting evidence and should not be used as the only or even the primary source for determining the estimated overcharge.

2) Using Marginal Cost or Average Cost as a Proxy for Price

Another relatively simple method for estimating a reference price is to use marginal cost as the reference price. This idea arises from the fact that under perfect competition price equals marginal cost. If we can measure or at least estimate marginal cost, then we can use this estimate of marginal cost as the estimated reference price.¹³ This has the advantage of conceptual simplicity. However, it is subject to serious problems.

The first problem is that it is difficult to measure marginal cost. At a conceptual level, marginal cost depends on the period in question. The marginal cost over a quarter is different than the marginal cost over a year. To appreciate this, recall that marginal cost is the answer to the question: how much money would be saved by producing one less unit of the product? Over one quarter, costs like the rent of a building and various other overhead costs might be fixed costs and could not be reduced. Therefore, marginal cost is low. Over one year, these costs are more easily reduced, so the marginal cost (the amount saved by producing less output) would be greater. Conceptually, the reference price under perfect competition should be the long-run marginal cost — a marginal cost that includes all

13 Lawrence White suggests that this was John Connor's approach in his work for the plaintiffs in the lysine damages case. However, Connor characterizes his approach as employing the before-after comparison method. It is hard to distinguish the two approaches in this context because the price before the price-fixing approached levels consistent with reasonable estimates of marginal cost. Lawrence J. White, "Lysine and Price-Fixing: How Long? How Severe?" (2001) 18 *Review of Industrial Organization* 23 and John M. Connor, "Our Customers Are Our Enemies": The Lysine Cartel of 1992–1995" (2001) 18 *Review of Industrial Organization* 5.

relevant factors including the opportunity cost of equity capital provided to the firm (that is, including a “normal” return to shareholders).

An accounting number like the cost of goods sold excludes certain fixed costs and is therefore closer to short-run marginal cost than to long-run marginal cost. In a regression analysis, using the cost of goods sold is reasonable as long as the true marginal cost and the cost of goods sold are closely correlated. What matters is not that they are at the same level but that they move together. However, if we are to simply use the cost of goods sold as the true marginal cost and therefore as the reference price, having the correct level is crucially important. As a practical matter, the cost of goods sold is virtually always less than total cost. Therefore, requiring that price should be equal to the cost of goods sold is tantamount to requiring that the firm incur losses!

It would be better to use average cost as an estimate of the reference price. Under the long-run equilibrium of perfect competition average cost equals marginal cost and both are equal to price, so using average cost is at least as justifiable as using marginal cost. However, if the market structure is not perfectly competitive, then marginal cost does not necessarily equal average cost and neither is an appropriate reference price. Furthermore, from an economist’s point of view, total cost (and average cost) should include payments to all factors of production — including necessary payments to shareholders. No standard accounting measure includes a required payment to shareholders.

Another problem is the question of whose marginal cost we are to use as the true estimate of industry marginal cost. Under perfect competition all firms should have the same marginal cost. In accounting statements, it is virtually never true that any measured cost like average cost or per unit cost of goods sold will be the same across firms. If we used an average taken across firms, we would, in effect, be saying that some firms should have charged a price less than cost. Once again, this seems unreasonable.

Looking at average cost for an industry would be useful supplementary information to be used in estimating a reference price, but it should rarely if ever be used as the primary basis for such an estimate. Furthermore, the average cost should be adjusted to include the necessary rate of return on equity capital.¹⁴

14 Average costs should also include interest payments on debt capital, but these are normally included in various accounting cost measures.

3) The Analogy Method

A third method sometimes used for estimating a reference price might be referred to as the “analogy” method.¹⁵ The basic idea here is to find another market that is comparable to the market where price-fixing has occurred, but where price-fixing is absent. For example, suppose that price-fixing has arisen with respect to a particular vitamin. We might then find another vitamin produced under similar conditions and subject to similar patterns of demand. If this second vitamin is not subject to price-fixing, we can compare the price history of the two vitamins to draw inferences regarding the effect of price-fixing.

This method has the advantage that it might correct for other factors such as cost shocks, exchange rate movements, and some types of demand shocks. It might also help us track when a price-fixing conspiracy took place. If, for example, prices of the two vitamins move closely together for some period and then the vitamin subject to price-fixing experiences a sharp price increase relative to the other, this would be evidence of a price-fixing effect.

The disadvantage of this method is that it may be difficult to find an alternative market that is a good analogue to the market in question. To be a good analogue, the second market must be driven by very similar demand and cost forces — but not by the price-fixing. If the same producers are involved in the production of the analogous product then it is possible that the good being used as the reference point or the benchmark might itself have been subject to price pressures from anti-competitive practices. When markets for a particular product are geographically distinct, one place to look for a good analogue is in a different geographic market for the same product. For example, if it is determined that retailers in Vancouver colluded to raise the price of some product, it might be possible to use the price of the same product in Calgary or Toronto as the analogue.¹⁶

As with the before-after method, the analogy method might provide useful information in a particular case but is unlikely to be sufficiently reliable to be the primary basis for determining the overcharge in most cases.

15 We have also seen this referred to as the “benchmark” method, a term which we find to be somewhat imprecise given that all methods of estimating but-for prices are attempts to establish a benchmark.

16 For an example of such an approach, see Robert H. Porter & J. Douglas Zona, “Ohio School Milk Markets: An Analysis of Bidding” (1999) 30 *RAND Journal of Economics* 263.

4) Structural Econometric Estimation of a Competitive Benchmark

This approach involves econometric (that is, statistical) methods, normally regression analysis, to estimate the market's behaviour in the absence of price-fixing under the assumption that the market would be perfectly competitive. Such an analysis would normally be carried out by an economist with experience in applying econometric methods to industrial economics. In the case of perfect competition the econometrician would specify a demand function and a supply function for the market. If demand and supply were taken to be linear, the associated demand and supply functions might have the following form:

$$q^d = a_0 - a_1p + a_2I + \dots + e \quad (2)$$

$$q^s = b_0 + b_1p + b_2w + \dots + u \quad (3)$$

Both the quantity demanded (q^d) and the quantity supplied (q^s) depend on the market price (p). The term a_0 is a demand "intercept." Coefficients a_1 and a_2 are coefficients showing the sensitivity of quantity demanded to price and to income, I , which is normally included in demand functions. Other variables may also be included (represented by "..."), and there is a random error (e). The supply function is similar. The variable w is taken to be the wage rate of labour used in production of the good. Other factors would include, but would not be restricted to, the prices of other inputs, which might incorporate exchange rate effects. A system of this type is called a "structural" model, hence the term "structural estimation."

Estimation of the system represented by equations 2 and 3 consists of estimating the coefficients $a_0, a_1, \dots, b_0, b_1, \dots$. If we estimate the demand function and the supply function we can then solve the two estimated equations for the equilibrium price and quantity. The price would be the reference price used for the purposes of determining the overcharge. It would also then be possible to estimate the "missing triangle" referred to in Section B.

We can think of structural estimation as providing a solution to the problem of "other factors" discussed in the section on before-after comparison estimates. The other factors are accounted for by having them in the supply or demand equation as separate variables. The statistical technique will then allow changes attributable to these other factors to be properly assigned to them.

In order to estimate this system it is necessary to have data on the variables that are to be included. The data might come from variations over time (weekly, monthly, quarterly, or even annual observations) and it might come from variations over different locations (cities, provinces, or regions). Furthermore, the data should consist of observations from the period when the market was not distorted by price-fixing. Determining this period is similar to the problem of getting the right “before” period for before-after comparisons. However, structural estimation has the advantage that many different observations are included. Even if some observations are from periods with some price distortions, the overall estimates should still be reliable as long as most of the data comes from undistorted periods. Furthermore, it is possible to do econometric tests for structural change in the market. Such tests can be used to estimate when price-fixing in the market took effect.

There are several potential problems with structural estimation. First, there is the obvious problem that we might have insufficient data to estimate the coefficients. If, for example, all we have is ten years of aggregated national data, we would have only ten observations and would have little realistic prospect of providing estimates with a high degree of confidence. A related problem relates to data quality. Even if we have a large amount of data, the resulting estimates are of little value if the data contains a large number of significant errors and omissions. However, it is important to emphasize that econometric methods incorporate, and in fact are based on, the idea that we often have many small random measurement errors. As long as these errors are random and therefore tend to offset each other, econometric methods should not be negatively affected.

A second and much less obvious problem is called the “simultaneous equation” problem. This arises because both equations 2 and 3 represent relationships between contemporaneous quantity and price. If we have just price and quantity information and regressed quantity on price, it would not be clear whether we were estimating the supply curve or the demand curve (or some combination of the two). If we could be confident that demand was stable and that price changes reflected supply changes, then we would have a reliable estimate of demand, but this might not be justified in a given case. The simultaneous system can only be estimated if we have observations on other variables that enter only the demand equation and only the supply equation but not both.

A variety of other econometric issues may arise. One issue is functional form. Equations 2 and 3 are written as linear equations. The linear form might be a good approximation to demand and/or supply in a given

case and it is often used. However, other functional forms are also possible. The other commonly used form is the “log-linear” form, in which the logarithm of quantity is a linear function of the logarithm of price. However, it is quite possible that neither the linear form nor the log-linear form is a good approximation of reality. Assessing functional form is an important task for the econometrician.

Another important issue concerns market structure. Estimating a demand-supply simultaneous system is appropriate if the market is perfectly competitive in the absence of price-fixing. More accurately, we should perhaps say that estimation of a structural demand-supply system is a good approximation only if the market is highly competitive. If the market is not highly competitive then the structural system represented by 2 and 3 is not an appropriate basis for estimation. The attempt to estimate this system will provide information about whether perfect competition is an appropriate assumption. Such results, combined with other data about the market, should allow the econometrician to make a reliable assessment regarding market structure.

5) Econometric Demand Estimation and Market Simulation under Imperfect Competition

This method is similar to method four except that it applies to imperfect competition rather than perfect competition. The estimation issues raised by imperfect competition are, however, very important and justify treating structural estimation under imperfect competition as a distinct method. The most important issue is that under imperfect competition it is necessary to simulate the supply side of the market as there is no simple “supply function” that can be estimated.

If the market in question is imperfectly competitive it is possible to estimate demand, obtain information about the costs of the major producers, make an assessment regarding likely market conduct, and use this information to estimate a reference price that would arise in the absence of price-fixing. In this case we start with the demand function as set out earlier as equation 2:

$$q^d = a_0 - a_1p + a_2I + \dots + e \quad (2)$$

Under the assumption that we have all important explanatory variables included in the regression equation and that the form of the equation is stable, we can then use all data from both the price-fixing period and any other period to estimate this demand function.

The next step is to obtain information about costs for major producers. Usually it is possible to get a measure of the “cost of goods sold.” This would often correspond reasonably well to the economist’s notion of marginal cost. There should also be a total cost measure available from accounting statements. Dividing through by output yields average cost.

The next step is to assess how the firms would interact in the absence of price-fixing. There are several widely used “models” or specifications of imperfectly competitive interactions. The two most commonly used models are the Cournot model and the Bertrand model (with product differentiation).¹⁷ Armed with demand function estimates, cost information and an assessment of the form of imperfect competition (like the Cournot model), it is then possible to simulate how the market would function in the absence of price-fixing. This allows estimation of a reference price and reference quantity.

This approach has several advantages. First, it does not require any information from a non-price-fixing period. If such information is available it can be used, but it is not necessary. Second, this method can properly account for other factors that might affect price (aside from the price-fixing) by incorporating them in the demand regression. Third, it allows for imperfect competition which, in our judgment, is likely in most relevant markets. Also, this approach allows for estimation of the full damage rather than just the overcharge “rectangle.” Furthermore, the combination of estimation and simulation allows for tests of market structure to be done as part of the analysis.

This approach has three primary disadvantages. Most importantly, it relies on having a good assessment of the market structure. If, for example, the Cournot model is used but is a poor approximation of reality, then the resulting estimate for the reference price may be a poor estimate. Second, this approach is harder and more time-consuming for the analyst than other approaches, especially if various specification tests are undertaken in the course of the analysis. Third, it relies on accounting cost information that must be obtained from firms. If the cost information

17 If we have confidence that we know what kind of competition existed before the price-fixing started and we have good information about demand, we may not need to use accounting data on costs. If the economist knows something about the type of competition in which firms are engaged and the demands they face, she can infer what marginal costs must have been in order to produce the prices that were actually observed prior to the price-fixing. This technique is routinely used in merger simulation. See, for example, Gregory Werden, “Simulating the Effects of Differentiated Products Mergers: A Practical Alternative to Structural Merger Policy” (1997) 5 *Geo. Mason L. Rev.* 363.

cannot be obtained, or if the accounting information that is obtained is a misleading representation of actual economic costs, then the results may be misleading. When possible, economists normally prefer to use market information rather than accounting information. However, accounting information is becoming increasingly reliable as a guide to economic costs so we regard this problem as relatively minor.

6) Reduced-Form Econometric Estimation of Price

Regardless of whether the market is perfectly competitive or imperfectly competitive, we work from an underlying set of equations (like equations 2 and 3) that are used to approximate the behaviour of market participants. As indicated, this is a structural model. We can solve the equations in the structural model to obtain an expression for price as a function of the "exogenous" or explanatory variables in the system such as exchange rates, wage rates, other input costs, and demand shocks. One crucial explanatory factor would be whether the price-fixing conspiracy was in force.

The resulting equation for price is called a "reduced form." It is "reduced" in the sense that it corresponds to having solved an underlying structural system of equations. Because of its advantages over alternatives, estimation of reduced-form price equations is the preferred and most commonly applied method for damage estimation by economists in price-fixing cases.¹⁸

There are essentially two approaches for applying the reduced-form methodology in price-fixing cases.¹⁹ One approach is to estimate, using statistical regression methods, the reduced-form price equation using data from both inside and outside the period of price-fixing, and to add a special variable to account for the effect of the conspiracy. The estimation equation might then have the following form:

$$p = \alpha_0 + \alpha_1 I + \alpha_2 x + \alpha_3 w + \alpha_4 PF + \dots + \varepsilon \quad (4)$$

where x stands for the exchange rate and PF stands for whether price-fixing was in force. The variable PF could take on a value of one for

18 See, for example, Michael O. Finkelstein & Hans Levenbach, "Regression Estimates of Damages in Price-Fixing Cases" (1983) 46 *Law & Contemp. Probs.* 145. For some very good background material on the use of regression techniques in legal proceedings see Franklin M. Fisher, "Multiple Regression in Legal Proceedings" (1980) 80 *Colum. L. Rev.* 702.

19 See, for example, Page, above note 1 and Baker & Rubinfeld, above note 4.

observations when and where price-fixing was in force and could take on a value of zero if price-fixing is not in force. Furthermore, this method could allow for different levels of price-fixing. PF could take on a low value (like $\frac{1}{2}$) for periods when price-fixing was present but weak and a high value when price-fixing was strong. Because a variable of this type can be called an “indicator” variable, we refer here to this as the indicator variable approach.²⁰ We can get data on the variables of interest and estimate equation 4. The coefficient on the price-fixing variable gives us an estimate of the effect of price-fixing on the price. The reference price is obtained by setting other variables at their value in the period of interest and setting the indicator variable for price-fixing at zero to reflect what would happen if price-fixing were not present. The resulting price is the estimated reference price.

The indicator variable approach will allow for the influence of other demand and cost variables but will assume that the entire effect of the price-fixing will be manifest through the coefficient on the indicator variable PF. If the investigator has reason to believe that the price-fixing may have influenced some of the other explanatory variables, then this coefficient will not capture the full effect of the price-fixing on price. Suppose for example that the price-fixing led firms to have higher costs, perhaps due to internal organizational slack possible because of less-intense competition. In such a case, part of the effect of the price-fixing in equation 4 would be manifest through the indicator variable but part would be manifest through cost variables. This idea leads to the second approach to estimating a reduced form.

This alternative approach allows all the coefficients to be different during the price-fixing period. This approach typically would estimate the parameters of the regression equation using data only from outside the price-fixing period and would use these estimates to forecast what the price would have been during the price-fixing period without the conspiracy. Any deviation of actual prices from those predicted using data from the non-collusive period may then be attributed to the cartel's conduct under this “forecasting approach.”²¹ One important disadvantage of this approach is that it reduces the amount of data that can be used,

20 Such variables are sometimes also called “dummy” variables.

21 It is also possible to estimate the model using only data from the conspiracy period and then to project what prices should have been outside that period. Again, the differences between projected and observed prices will provide an estimate of the overcharge.

as only data from the non-price-fixing period can be used in the primary regression.

Both reduced-form methods are agnostic about the actual market structure and also bypass the simultaneous equation problem. Even though they are conceptually based on an underlying structural system of equations, the analyst does not need to write down that system but can proceed directly to the specification of the reduced form. This has the further advantage of being relatively transparent compared to structural estimation methods. Specifically, the econometrician is, in effect, saying that price depends on a number of factors, one of which is price-fixing. The estimation process then consists of trying to assign to the various factors the appropriate contribution of each.

Reduced-form methods have some advantages over the alternatives. Compared to the before-after comparison method, the reduced-form estimation method clearly has the advantage of correcting for other factors. It uses information in a simpler and more easily interpreted way than structural estimation and without imposing any assumptions regarding the kinds of conduct typical for the industry outside of collusive periods (which is required in the simulation approach).

While it is probably the most widely used and accepted approach to estimating damages in price-fixing cases, the reduced-form approach does present certain challenges.²²

a) Data Challenges

The investigator will need data from both inside and outside the cartel period. These data will have to provide accurate information about prices charged (actual transaction prices, not list prices) as well as about the other factors like demand and cost conditions. In some cases the product's demand comes from a particular industry and output measures from that industry will serve as good indicators of the demand for the price-fixed product.²³ In other cases, however, demand will come from diverse sources and capturing it in one or a few variables will be very difficult. Similarly, knowing what cost variables to enter will require some

22 These challenges will also affect the alternative approaches, so they do not mitigate against using the reduced-form approach in favour of any particular alternative.

23 For example, to the extent that a large fraction of demand for vitamins comes from the animal feed industry, measures of animal feed production will provide useful information on the demand for vitamins.

understanding of the technology of the industry and measures (possibly index measures) of prices for the important inputs.

In addition to needing data of high enough quality, we need it to be of sufficient quantity. Precise estimates require a large number of observations. However, in order to get a large amount of data it is normally necessary to go back a long time. When we include very old data we worry that too many other things relevant to price determination may have changed in ways that we will have trouble capturing in our regressions. For example, over a period of many years an industry's productive technology may have dramatically changed, perhaps from being highly labour-intensive to being highly capital-intensive, and thereby changing pricing strategy and competitive interactions in ways not easy to capture in a regression.

b) Dating the Conspiracy

Reduced-form estimation requires identification of the relevant period in which price-fixing took place.²⁴ Complicating this factor is the concern that the price-fixing may have been more successful at some times during the conspiracy than at others, so it might be inappropriate to identify a single per-unit overcharge to be applied across the whole period. In such cases, the investigator may choose to try to model an adjustment process that allows prices to adjust toward their cartel levels (and back to competitive levels post-cartel) over time rather than at one point in time.

c) Possible Biases

Under certain circumstances, the estimates of overcharges obtained from the reduced-form estimation method and from other methods can be biased one way or another, suggesting damages that are greater or less than actual damages. A few sources of bias have been suggested in the literature. First, if the cartel resulted from a period of unusually intense price competition, the period before the price-fixing will not provide a good indication of what "normal" prices would be, and using them to determine but-for prices will bias the damage estimate upward.

Second, if the cartel members realize that they will be liable for damages after their cartel is discovered, they will have a strong incentive to hold up prices even after the cartel has been discovered. If data from before and after the cartel are used to estimate the but-for price, this will

24 However, it is possible to use econometric methods to help establish the period in which price-fixing took place.

have the effect of biasing upward the but-for price and reducing the estimate of damages.²⁵

Third, even where they are not strategically trying to influence the estimated but-for price, firms may learn in a formal cartel period how to cooperate with each other even without direct communication and collusion. Put another way, the explicit collusion may lay the groundwork for tacit collusion later.²⁶ While the tacit collusion may itself not amount to criminal price-fixing, the higher prices it produces are a direct consequence of the earlier illegal, explicit price-fixing.²⁷ Estimates of but-for prices using post-cartel collusive prices, achieved tacitly, will again be biased upward, reducing estimated damages below the true level of damages.

Both of these last two biases can be eliminated by using only data from before and during the price-fixing period. Of course, securing enough data may then require collecting information from a period long before the cartel. If we wish to use data from after the formal cartel period we can also introduce a second indicator variable which will take on a value of one for the post-cartel period. A significant positive value on the coefficient of this variable will indicate that pricing is different after the price-fixing period than it was before the price-fixing period.

D. DAMAGES DOWN THE DISTRIBUTION CHAIN AND ESTIMATING PASS-THROUGH

The analysis above relates to situations in which the purchaser of the price-fixed product is the final consumer. In many cases, however, the first or direct purchaser is an intermediate entity which then resells the product or integrates the product into a product of its own which is sold downstream to buyers, who are then referred to as “indirect purchasers” of the price-fixed product. In this section we want to consider briefly two issues relevant to this scenario: the measurement of the total amount of damage done to all direct and indirect purchasers, and the question of allocating damages to the various stages of the distribution chain.

25 On this see Joseph E. Harrington, “Post-Cartel Pricing during Litigation” (2004) 52 *Journal of Industrial Economics* 517.

26 Connor suggests that this may explain why lysine prices did not fall significantly after the discovery of the price-fixing conspiracy. Connor, above note 13 at 19.

27 We are making a logical point here and not a legal one. It may well be that these post-cartel damages are not recoverable under current law.

Pass-through in general concerns the extent to which cost changes are passed through to final product prices. Pass-through has been extensively studied by economists in several contexts. There is, in particular, a large literature concerning the extent to which taxes on inputs are passed through to product prices, and there is also an extensive literature on pass-through of exchange rate changes to product prices. Pass-through also arises in a variety of other situations.

In our context, an input to production is subject to price-fixing and has an associated overcharge or excess price. The direct purchasers buy the input and produce a subsequent downstream product. We are then concerned about how much of the overcharge is passed on to downstream consumers, the indirect purchasers. There might be no pass-through at all, in which case the direct purchaser absorbs the full effect of the price-fixing. Alternatively, there might be partial pass-through, full pass-through, or magnified pass-through.

Consider a specific example. Suppose that a group of wines commonly used by restaurants have been subject to price-fixing. Suppose further that the standard mark-up on wine in these restaurants is 100 percent. Thus a bottle of wine purchased by the restaurant for \$15 per bottle would normally be sold at \$30. Now suppose that the group of wines previously sold to restaurants at \$15 per bottle increased in price by \$5 per bottle due to price-fixing. We can contemplate several possible actions that might be taken by the restaurant:

- i) Restaurants could leave the consumer price unchanged at \$30 per bottle. In this case their margin would fall from \$15 per bottle to \$10 per bottle. This is a case of zero pass-through.
- ii) Restaurants could raise the consumer price by some amount less than \$5, something like \$2.50, for example. This example is a case of 50 percent pass-through.
- iii) Restaurants could raise the price by the full overcharge of \$5, raising the consumer price to \$35 per bottle and keeping the absolute margin fixed at \$15 per bottle. This is a case of full pass-through.
- iv) Restaurants could maintain the percentage margin. Applying a 100 percent margin to wine that is now \$20 per bottle would raise the consumer price to \$40 per bottle. Thus consumers end up paying \$10 more per bottle even though the overage due to price-fixing is only \$5. This is a case of magnification of the overcharge.

Economists would predict the expected level of pass-through by trying to determine which approach would maximize profits for the direct purchasers, which, in the wine example, are restaurants. Depending on market structure and the nature of demand, any of the four possibilities listed above could be profit-maximizing, though we might question why it would ever be optimal to actually pass on more than 100 percent of the price overcharge. This could happen simply because of the shape of the demand curve for this particular group of wines. It could also arise because of what are sometimes referred to as “multi-market” considerations. This particular group of wines takes up space in inventory and on the menu. This has an “opportunity cost” in the sense that the restaurant could store and list some other wine or other product instead. It might be that unless the restaurant can earn a 100 percent mark-up over its cost, it is not worth selling this group of wines at all and some other product would be carried instead. In such a case it would make sense to undertake 200 percent pass-through.

This example illustrates three aspects of pass-through. First, it shows that downstream consumers might be strongly affected by price-fixing. Second, it shows that failure to consider quantity effects might lead to significant underestimates of total damage. As discussed in Section B, damage is normally understood to be the price overcharge multiplied by the quantity sold in the presence of the overcharge. Suppose the restaurant passes along a \$5 overcharge, raising the consumer price of the wine by \$5. Using the overcharge method for determining damage, we could conclude that the restaurant suffered no damage. However, it is very likely that, with the higher consumer price in place, the restaurant would sell less of this wine, and might sell fewer restaurant meals overall. This would also cause damage to the restaurant. Third, it is possible for the downstream price to rise by more than the input price. Thus, for example, if the wine overcharge were “marked up” as in case iv) above, the loss in consumer surplus at the final consumer stage would be substantial and aggregate damage would exceed aggregate damage in the absence of pass-through. Thus the pass-through issue is not concerned just with the distribution of damages among direct and indirect purchasers. The extent of pass-through also affects the overall magnitude of damages.

We see then that when the purchaser of the price-fixed product is itself a producer that uses that product as an input in its own production, the evaluation of the magnitude of damages and who suffers those damages is, in general, more complicated. Much will depend on the structure of the market in which the direct purchaser sells its output and on the

technology it uses to produce its output. We will not go over all the possible cases here, but we will illustrate the roles played by these factors and show how important they can be.

1) Competitive Downstream Markets

To take the simplest case first, suppose that the direct purchasers are themselves sellers in perfectly competitive markets, that they merely resell the product to final consumers and that they have no other costs. In such a case any direct purchaser's whole marginal cost of sales is the cost of the price-fixed input. The downstream industry's supply curve is then represented in Figure 2 in the Appendix by a flat line at this cost per unit (C_1). Intersecting this supply curve with a market demand from consumers for the final product produces a final competitive retail price (p^*). An increase in the price of the input by \$1 will increase each downstream firm's cost per unit by \$1, pushing the supply curve up by \$1 and finally increasing the retail price by \$1. In this simple extreme case, then, the direct purchaser simply passes through the price increase and the harm is borne by the final consumers.

To measure the harm suffered by final consumers we use again the concept of consumer surplus, which is the difference between what consumers are willing to pay for a given quantity of a good (that is, the most they would possibly pay for it) and the amount they actually had to pay. On a graph like Figure 2, this surplus is represented by the area beneath the demand curve but above the price paid. Before the price-fixing, when the retail price was p^* , this surplus would be equal to the areas $A+B+E$, but at the higher price consumer surplus is only equal to area A . Thus the harm to final consumers can be measured as areas $B+E$: an amount equal to the overcharge per unit times the quantity consumed (\$1 times q_1 or area B) plus an extra triangle (area E) representing lost surplus from units no longer consumed because of the higher prices.

In many cases we believe that, particularly in the short run, the supply curve describing the relationship between price and the quantity offered for sale in a competitive market is upward-sloping. In such a case we would not expect the final price to rise by the same amount as the increase in the selling firms' marginal costs. This is illustrated in Figure 3 in the Appendix where S represents the original supply curve and S^* the new supply curve after the higher price (assumed here to be \$1 higher) of the price-fixed inputs is taken into account.

If we continue to assume that one unit of input is used for each unit of output, the supply curve will shift up by the amount of the increase

in the fixed input price. In Figure 3, p^* is the original (pre-conspiracy) price of the downstream product and p_1 will be the price after these suppliers are forced to pay \$1 more for this key input. Notice that p_1 will not in general be a full \$1 higher than p^* : depending on the elasticities of the demand and supply curves the price increase downstream can be anywhere from \$0 to the full \$1.²⁸ Evaluating how the increase in input price translates into increases in output price is analogous to the famous problem in public finance economics of determining the incidence of a specific tax. Analysis of this problem reveals that the fraction of a cost increase that is passed through to buyers in the form of higher prices will be determined by:²⁹

$$\text{Pass-through fraction} = E_s / (E_s - E_d)$$

where E_s is the elasticity of supply and E_d is the elasticity of demand. Thus we see that the pass-through in competitive downstream markets is greater the more elastic is supply and the less elastic is demand. In virtually every case, of course, the harm suffered as measured by the original overcharge (\$1) times the number of units purchased (and then resold downstream) is an underestimate of the total harm because it does not take into account the foregone benefits to the downstream firm and its consumers from the larger volume of purchases that would have been made at the pre-cartel input price. In Figure 3 the larger amount paid for the price-fixed input would be area A, while the lost value due to the reduced volume of purchases of the input and sales of the output would be given by area B.

For these examples and those that follow we have made the simplifying assumption that one unit of the price-fixed input is needed for every unit of downstream production. It would make no difference to this analysis, however, if two (or any other fixed number of) units of input were

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- 28 Elasticities represent economists' preferred way of measuring the sensitivity of some variable to changes in some other variable. The elasticity of demand is the percentage reduction in quantity demanded that would result from a 1 percent increase in price. The elasticity of supply is the percentage increase in quantity supplied induced by a 1 percent increase in price. These elasticities are related to the slopes of the demand and supply curves but are not exactly the same thing. We can say, however, that for a given price and quantity, a flatter curve will be more elastic and a steeper one more inelastic.
- 29 This would be discussed in most microeconomics textbooks and virtually all public finance textbooks. See, for example, Robert S. Pindyck & Daniel L. Rubinfeld, *Microeconomics*, 6th ed. (New Jersey: Prentice Hall, 2005) at 326–29.

used for each unit of output except that the downstream buyer's marginal cost (and supply curves) would each rise by \$2 if the price per unit of the input was raised by \$1 (since each unit downstream will need two of these higher-priced inputs). On the other hand, it would make a difference if, in response to increases in the price of this input, the buyer could switch to the use of some other input in whole or in part.³⁰ However, if it were very easy for buyers to switch to alternatives, this cartel would not really have any market power since higher prices would only drive away all their customers. In general, we would expect higher cartel prices to push up the costs of downstream firms and for these firms to pass on some of this increase to their customers.

2) Downstream Markets with Market Power

The assumption that the firms buying from the price-fixers are themselves operating in perfectly competitive markets is important to the above results. Here we wish to relax this assumption to illustrate the importance of downstream market power. To do this, we work with the simplest case possible. Assume the product, produced by a cartel of manufacturers, is purchased by a retailer that is itself a monopolist in its own downstream market.

Just as the retailer faces the demand curve of final consumers, the cartel faces a "derived" demand curve of its own — for each wholesale price the cartel might choose, the retailer will buy a certain quantity of product for resale — and this demand curve can be derived from information on the final retail demand and the extent to which wholesale prices are marked up for resale. To illustrate how this can work we take the simplest possible case as defined by the following conditions: (i) the creation of the cartel transforms what was a perfectly competitive manufacturing sector into a monopolized one; (ii) manufacturing unit or average costs are constant; (iii) the retail demand curve is linear; (iv) there is a monopoly retailer who has no other costs beyond the wholesale price paid to the manufacturers; and (v) the manufacturers and the retailer all use regular "linear" pricing: a constant price per unit, no quantity discounts or two-part tariffs. We denote the retail price by p and the manufacturers' wholesale price by w .³¹

30 This situation is analyzed in Robert Cooter, "Passing on the Monopoly Overcharge: A Further Comment on Economic Theory" (1981) 129 U. Pa. L. Rev. 1523.

31 We are implicitly assuming here that the monopoly retailer takes the price charged to it as stated and incorporates this price into its own costs in deter-

This example is illustrated in Figure 4 in the Appendix. In this case, it is straightforward to demonstrate that the manufacturing cartel's derived demand curve (D_M) will also be linear, but will be twice as steep as the retailer's demand curve (D_R). Pre-collusion, manufacturers price competitively, at average (marginal) cost (that is, $w_0 = C_M$) and the quantity sold to retailers, then resold to final consumers (at price p_0), is shown as q_0 . Notice that because of the retail market power this is below the efficient quantity q^* as determined by the quantity at which final consumer demand crosses the distribution chain's total cost per unit. This (efficient) quantity would be bought and sold if both stages were competitive, but here the monopoly retailer is restricting output to push up price.³² Suppose now the cartel creates market power at the manufacturer level with the result that wholesale price rises to w_1 .³³

If we looked only at the demand curve the manufacturers faced (D_M) and evaluated damages from it as we did in Section B above, we would conclude that the retailers paid an overcharge equivalent to area J and that there was a missing triangle of foregone profits from extra sales equal to the area of triangle E. However, this is only part of the harm caused by the price-fixing. Final consumers originally received consumer surplus (shown by the area beneath their demand curve and above the retail price they pay) equivalent to areas A+B+F but will retain only A after the price increase. Thus the total harm done to the retailer and its customers by this price-fixing is shown by J+E+B+F. This is a much larger amount than the simple overcharge to the retailer times its volume of purchases (area

mining its profit-maximizing retail price. Of course, if the monopoly retailer (by virtue of its monopoly position in its output market) is also the only buyer of the manufactured product it would have buyer or "monopsony" power.

This could reduce the ability of the manufacturer cartel to push through price increases; we might then not expect the wholesale price to jump from the competitive level all the way to the monopoly level. This does not affect our essential point that looking only at areas under cartels' (here, the manufacturers') demand curve will result in underestimates of the total harm.

- 32 It may be worth emphasizing here that it is the reduction in output that creates this "deadweight" loss, not directly the increase in price. Price movements reallocate surplus but do not by themselves change the total amount of surplus in a market. If the price increase did not lead to lower output it would not create new deadweight loss.
- 33 Because of the simplifying assumptions we have made in this example, it turns out that the monopoly manufacturer picks a post-cartel wholesale price equal to the pre-cartel retail price. This is a convenient coincidence in that it removes the clutter from illustrating more prices on the same graph, but it is not material to the argument.

J). In fact, given the assumptions we have made here, the sum of the areas of $J+E+B+F$ will be 2.25 times the simple overcharge paid by the retailer.

Another important difference between the downstream monopoly and competitive cases relates to pass-through. In the example in Figure 4 we can see that the higher wholesale price as a result of the price-fixing did lead to a higher retail price. In fact, given our assumptions here it is easy to show that every \$1 increase in the wholesale price will lead to a 50 cent increase at the retail stage. It might appear then that the monopolist retailer is passing on half of the damage it suffered, but this is not the case. Even after adjusting its price to consumers upward, the retailer still suffers damages equal to areas $J+E$. To see this, note that before the cartel raised price, the retailer would have profits equal to the difference between its retail price and its wholesale cost, times the quantity it sold. This would be equivalent to areas $J+E+G$ in Figure 4. After the cartel raises wholesale price and the retailer adjusts its price, the retailer is left with profit equal to area B . Given the shapes of these curves it is easily shown that area B equals area G (and for that matter, B and G are both equal to area E). Thus, the monopoly retailer goes from profits of $J+E+G$ to profits of B (which is equal to G), implying a reduction in profits of $J+E$. The higher price is bringing in higher revenues on some units, but this is just making up for lost profits on units that will now not be sold.

Therefore, in an important sense, the monopoly buyer is not passing on any of its damages. If we use area J as a measure of the damage the retailer suffered, it would be inappropriate to claim that it got some of that back via the higher prices charged to its own customers. The key to the difference between the monopoly and competitive cases is that in the competitive case the higher input price pushes up all the prices charged by downstream buyers. This in general helps these buyers and partially offsets their losses. In short, while each firm suffers from the higher input price, so do all its rivals and this pushes up their marginal costs and also the market price. In the monopoly case, in contrast, the firm has already set its retail price as high as it wants it and there are no rivals whose prices the monopolist would like raised.³⁴

As is made clear in the preceding paragraphs, there are difficult issues of economic measurement associated with pass-through and aggregate

34 Put another way, when you are a competitive firm, you benefit from anything that pushes up other firms' marginal cost or supply curves because this will push up the market price. Of course you also pay the higher price yourself so you will still suffer damages. With monopoly there is none of this kind of partially offsetting benefit through the effect on competing firms.

damage estimation under imperfect downstream competition. There are, in addition, issues of legal principle that we do not address here. In particular it is open to question as to whether a price-fixing conspiracy should be held fully liable for injury caused in part by imperfectly competitive downstream behaviour.

The wine example shows that consideration of pass-through adds a substantial layer of complication to the analysis of price-fixing damages. These difficulties are a large part of the reason the United States Supreme Court in *Illinois Brick* determined that all of the damages should be claimable by the direct purchasers and none by indirect purchasers. This decision has produced a lively debate about whether or not pass-through should be considered in damage actions.³⁵ Other complications also arise in other situations. Perhaps the most important problem is the simple proliferation of markets that would need to be studied to estimate the distribution of damage. Consider a product like aluminum. Suppose aluminum is subject to price-fixing. Aluminum is used in foil wrap, in some automotive parts, and to make beverage containers sold to soft drink companies. It is also used to make siding for the construction industry. Many of these products will go through multiple levels in the distribution chain before reaching final consumers. For example, builders will set the prices of their buildings based on the costs of their inputs, including siding. To precisely infer the net damage associated with pass-through of aluminum price-fixing would require careful study of many different product markets, probably in many locations.

As noted earlier, it is for this reason — the high cost and great difficulty of estimating pass-through effects — that American federal courts have largely eliminated pass-through considerations by ruling that any

35 See, for example, Robert G. Harris & Lawrence A. Sullivan, "Passing on the Monopoly Overcharge: A Comprehensive Policy Analysis" (1979) 128 U. Pa. L. Rev. 269, where the authors argue that pass-through should and can be properly considered. In contrast, each of the following authors argue that the court in *Illinois Brick* was correct and that efficient enforcement demands that only direct purchasers should have the right to claim damages via class actions: William M. Landes & Richard A. Posner, "Should Indirect Purchasers Have Standing to Sue Under the Antitrust Laws? An Economic Analysis of the Rule of *Illinois Brick*" (1979) 46 U. Chicago L. Rev. 602; William M. Landes & Richard A. Posner, "The Economics of Passing On: A Reply to Harris and Sullivan" (1980) 128 U. Pa. L. Rev. 1274; William H. Page, "The Limits of State Indirect Purchaser Suits: Class Certification in the Shadow of *Illinois Brick*" (1999) 67 Antitrust L.J. 1; and Chris S. Coutroulis & D. Matthew Allen, "The Pass-On Problem in Indirect Purchaser Litigation" (1999) 44 Antitrust Bulletin 179.

and all price-fixing damages are presumed to be associated with direct purchasers only. This is one important simplification in estimating damages. In addition, use of the overcharge method, under which damages are equal only to the overcharge multiplied by the quantity sold, also simplifies the analysis. Using the overcharge method, it is not necessary to trace through the various downstream markets to estimate aggregate damage.

3) Estimating Pass-Through in Particular Cases

The above discussion should have made it clear that determining the degree of pass-through in particular cases will not be an easy task. Indeed, it will be particularly difficult when: (i) there are several stages in the distribution chain below the level at which price-fixing took place; (ii) those stages are themselves of uncertain degrees of competitiveness; (iii) the outputs at some or all stages are widely scattered among numerous purchasing industries; and (iv) data at some or all levels is difficult to secure.³⁶

This said, and as argued by Harris and Sullivan,³⁷ none of this implies that it is always too difficult to measure pass-through.³⁸ It will often be the case that reasonable estimates of pass-through and aggregate damages can be obtained. Consider, for example, a case in which the direct purchasers of a particular price-fixed food product are grocery stores. This implies that there is only one group of indirect purchasers: grocery store customers. It may not be a difficult task in such a case to study the pricing behaviour of grocery stores to learn how their retail prices relate to their wholesale prices and to determine the likely effect of the price-fixing on the prices ultimately paid by their customers.³⁹

36 Data is often easiest to acquire at the level at which the price-fixing took place because the defendants can be compelled (or may agree as part of a settlement process) to provide sales records with accurate lists of customers and real transaction prices.

37 Harris & Sullivan, above note 35.

38 Here we distinguish between the problem of measuring the damage suffered by members of a class of indirect purchasers and the second problem of determining how to deliver any awards to them in a cost-effective way. Our focus here is on the measurement question. The second problem raises fascinating questions such as those related to the appropriateness of *cy pres* distributions and to the use of coupons, which are beyond the scope of this article.

39 In addition to determining what the eventual retail price will be after an increase in the wholesale price, the analyst will have to assess how quickly the pass-through will take place.

In some other cases the purchasers may be concentrated in one or a few major industries, which could be carefully analyzed. If these industries are themselves properly viewed as competitive, estimates of their relative elasticities of supply and demand could be made. Depending on the importance attached to this work it can be done with more or less precision. For example, most simply, the analyst may look for evidence that either elasticity was of an "extreme value" (either near zero or very large), which would generate either very little or nearly complete pass-through.⁴⁰ Beyond that, and in particular if the various parties were cooperating as part of a settlement procedure, it may be enough to provide rough estimates of the relative magnitudes of the elasticities, together with an assessment of the speed with which price changes would be transmitted downstream. If it is required, of course, more detailed analysis of the downstream industries could be conducted in which demand and costs are estimated and allowances made if the downstream markets are not properly viewed as competitive.

In some cases it might be possible to evaluate the degree of pass-through by the first purchaser but the analysis of price changes in subsequent stages may be intractable. These cases raise the interesting question of what to do when damages to some indirect purchaser can be readily assessed but damages to others cannot. One possible approach is to simply take the analysis of indirect purchaser damages as far as it can go and, when it gets too difficult to go on, to assume no further pass-through from that point. This would entitle purchasers at that level to be treated as if they had absorbed any injury experienced by buyers further down the distribution chain.

E. SUMMARY AND CONCLUSIONS

In this article we have attempted to provide a brief overview of the economics of damage measurement as applied to price-fixing cases. We have reviewed the most common approaches toward measuring damages in these cases, with particular emphasis on the generally preferred approaches, which make use of statistical regression analysis. In addition, we have discussed the implications of pass-through for both competitive and non-competitive buyer markets and briefly considered conditions

40 Referring back to the pass-through fraction ($Es/(Es-Ed)$), we see that there will be little pass-through either if there is very inelastic supply or highly elastic demand, and that there will be close to full pass-through either if supply is very elastic or demand very inelastic.

under which the degree of pass-through could be estimated. The most important points we wish to emphasize are the following:

- (i) The per-unit overcharge times the quantity actually purchased is an underestimate of the total damage suffered by purchasers as a result of price-fixing. Under some circumstances this measure can miss a substantial fraction of the damages suffered by direct and indirect purchasers. This is particularly important when downstream (buying) markets are not competitive.
- (ii) Among the various methods used to estimate the overcharge attributable to the price-fixing, those that make use of statistical regression analysis have much to recommend them. Regression analysis is frequently the best way to incorporate available relevant data in a way that is objective, relatively transparent, and makes as complete use of the information as possible.
- (iii) This said, there are a number of potential biases the analyst must consider in applying this and other techniques. Depending on the source of the bias, the result can overestimate or underestimate damages incurred by buyers relative to the but-for situation.
- (iv) The problem of pass-through creates significant challenges for the analyst in estimating the damages suffered down the chain of distribution. The extent of pass-through will depend on the competitive conditions downstream as well as on characteristics of demand and firms' costs.
- (v) When downstream markets are not perfectly competitive we run the risk of incorrectly assuming that to the extent buying firms raise their own prices they recover some of the damage caused by the overcharge. We showed that for the monopoly buyer, for example, the damage suffered is still at least as great as the overcharge.
- (vi) Determining the extent to which buyers have passed on some of the damage to their own customers will be extremely difficult in some circumstances, in particular when: (a) there are several stages in the distribution chain below the level at which price-fixing took place; (b) those stages are of uncertain competitiveness themselves; (c) the outputs at some or all stages are widely scattered among numerous purchasing industries; and (d) data at some or all levels is difficult to secure.
- (vii) Finally, however, it very important to emphasize that, various difficulties notwithstanding, it is often possible to obtain reason-

able measures of pass-through and to obtain good estimates of aggregate damage. Use of the formal techniques described here will normally be superior to using purely informal or heuristic methods to assess damage. Not infrequently an argument will be made that damage estimation is not worthwhile in a particular case because the uncertainties, difficulties, and costs will be too great. This will sometimes be true. However, ignoring damages is sometimes tantamount to assuming they are zero, at least as far as consequences are concerned. Undertaking formal estimation of damages will usually provide a much more useful and accurate assessment of damages than this default assessment of zero damages.

Even with these important points made, there are several important questions for further analysis. First, is an *Illinois Brick*-type rule appropriate for Canada? This has not been settled by our analysis. To say that pass-through can be measured in some circumstances is not to say that a rule allowing it to be taken into account is appropriate given the associated costs and uncertainty. Second, when damages suffered by indirect purchasers are to be considered, is it necessary that pass-through be evaluated all the way down the chain of distribution, or can the analysis be truncated at some point? If so, what is to be done with the rest of the chain? Third, what is the best method by which to distribute damage awards to plaintiffs? For example, under what circumstances do *cy pres* distributions make economic sense and when might direct non-cash payments (such as coupons) be desirable from a public policy perspective? Each of these questions could properly be the subject of a further article.

APPENDIX

Figure 1

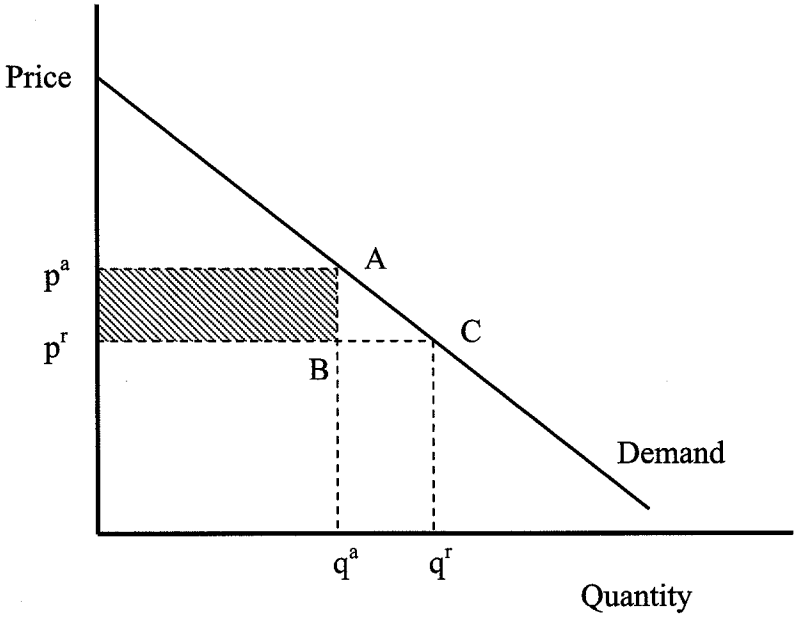


Figure 2

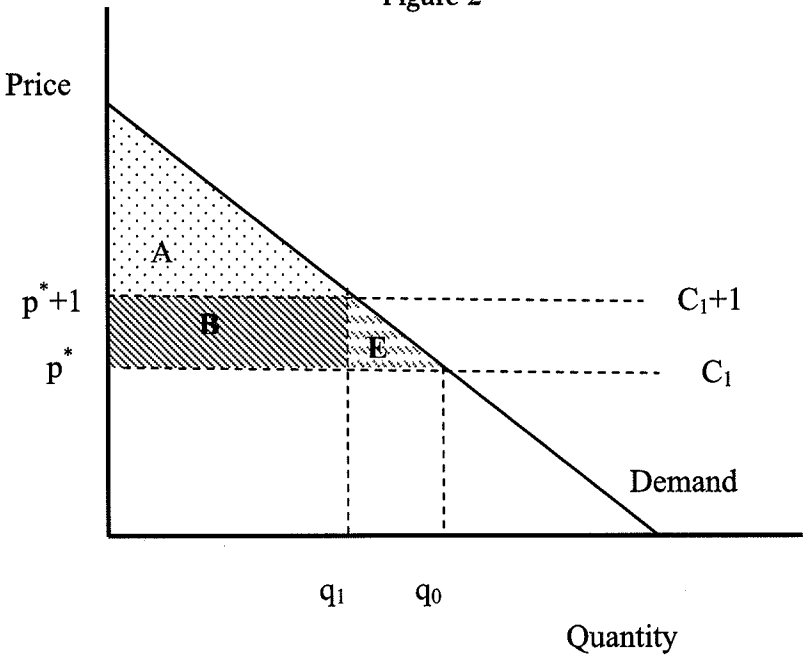


Figure 3

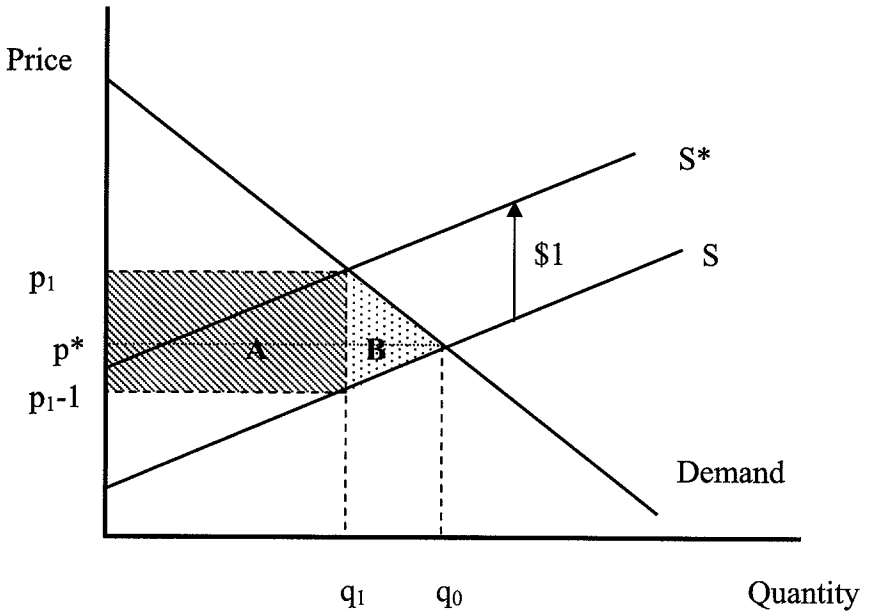


Figure 4

