THE EFFECTS OF MERGER EFFICIENCIES ON CONSUMERS OF DIFFERENTIATED PRODUCTS

GREGORY J. WERDEN, LUKE M. FROEB AND STEVEN TSCHANTZ*

A. Introduction

Although efficiencies from mergers may play somewhat different roles under different control regimes, all regimes appear to inquire into the consumer benefits from the efficiencies. In the US, the case law credits efficiencies only to the extent that they benefit consumers and suggests that a merger's net effect on prices is the primary test for legality.[1] Moreover, in deciding whether to challenge a proposed merger, the US federal enforcement agencies have indicated that they focus on "whether cognizable efficiencies likely would be sufficient to reverse the merger's potential harm to consumers, eg, by preventing price increases" although they "also consider the effects of efficiencies with no short-term, direct effect on prices".[2]

In the European Union, Recital 29 of the revised Merger Regulation notes that efficiencies may "counteract the . . . potential harm to consumers" from a merger and "as a consequence" it is possible that the merger "would not significantly impede effective competition".[3] Article 2 of the Merger Regulation

* Gregory Werden is Senior Economic Counsel, Antitrust Division, US Department of Justice. Luke Froeb and Steven Tschantz are on the faculty of Vanderbilt University, Froeb in the Owen School of Management and Tschantz in the Department of Mathematics. The views expressed herein are not purported to be those of the US Department of Justice. We thank Jon Baker for comments relating to the *Staples* case.

1 *FTC v HJ Heinz Co* 246 F 3d 708, 720 (DC Cir 2001) ("a defendant who seeks to overcome a presumption that a proposed acquisition would substantially lessen competition must demonstrate that the intended acquisition would result in significant economies and that these economies ultimately would benefit competition, and hence, consumers"); *United States v Long Island Jewish Medical Center* 983 F Supp 121, 147, 149 (EDNY 1997) ("the defendants must show that [merger efficiencies] ultimately would benefit the consumers"); *United States v Rockford Memorial Corp* 717 F Supp 1251, 1289 (ND Ill 1989) ("defendants must establish by clear and convincing evidence that the efficiencies provided by the merger produce a significant economic benefit to consumers"), affirmed, 898 F 2d 1278 (7th Cir 1990).

2 US Department of Justice and Federal Trade Commission, Horizontal Merger Guidelines, s 4 and n 37 (2 April 1992, revised 8 April 1997). See generally W Kolasky and A Dick, "The Merger Guidelines and the Integration of Efficiencies into Antitrust Review of Horizontal Mergers" (2003) 71 *Antitrust Law Journal* 207; G Werden, "An Economic Perspective on the Analysis of Merger Efficiencies" [Spring 1997] *Antitrust* 12.

3 Council Regulation (EC) No 139/2004 of 20 January on the control of concentrations between undertakings, [2004] OJ L 24/1, Recital 29.

itself provides that the Commission "shall take into account . . . the development of technical and economic progress provided that it is to consumers' advantage".[4] Guidelines implementing the Merger Regulation similarly indicate that "efficiencies brought about by a merger [may] counteract the effects on competition and in particular the potential harm to consumers it might otherwise have" and efficiencies therefore are considered in determining whether "whether a merger would significantly impede effective competition".[5] In particular, the European Commission focuses on whether merger-specific efficiencies would "enhance the ability and incentive of the merged entity to act pro-competitively for the benefit of consumers".[6]

Guidelines issued by the authorities in Australia, Ireland and New Zealand similarly have indicated that they permit mergers likely to generate efficiencies that would prevent price increases to consumers.[7] Matters are more complicated in Canada, where the Competition Act provides that no remedy shall be imposed if a proposed merger is likely to "bring about gains in efficiency that will be greater than, and will offset, the effects of any prevention or lessening of competition".[8] Recent court interpretation of this provision[9] has led to a complex treatment of efficiencies in which the net price effect of a merger plays a significant role but is not the primary test.[10]

In the UK, the Enterprise Act makes merger-specific efficiencies relevant both to whether a merger would result in a "substantial lessening of competition" and to whether a remedy is warranted for a merger that would. In the latter context, the Competition Commission may consider "any relevant customer benefits",

4 *Ibid*, art 2(1)(b).

5 Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings, para 76, [2004] OJ C31/03.

6 *Ibid*, para 77.

7 Australian Competition and Consumer Commission, Merger Guidelines, s 5.173 (June 1999) ("If efficiencies are likely to result in lower (or not significantly higher) prices, increased output and/or higher quality goods or services, the merger may not substantially lessen competition."); Competition Authority (Ireland), Notice in Respect of Guidelines for Merger Analysis, s 5.9 (16 December 2002) (the Authority uses a "'net price test': by considering whether the price paid by consumers will rise or fall as a result of the merger"); Commerce Commission (New Zealand), Mergers and Acquisitions Guidelines, s 7.4 (1 January 2004) ("the efficiency gain might be sufficient to reduce price, in which case the acquisition could be regarded as having a pro-competitive effect overall").

8 Competition Act, RSC 1985, c C-34, art 96(1).

9 *Superior Propane Inc v Canada (Commissioner of Competition)* [2001] 11 CPR (4th) 289, [2001] FCA 104.

10 Competition Bureau, Merger Enforcement Guidelines, pt 8 (September 2004). Before this recent court interpretation, Canadian law had been understood to be indifferent to whether efficiencies were passed on to consumers. See generally M Sanderson, "Efficiency Analysis in Canadian Merger Cases" (1997) 65 *Antitrust Law Journal* 621. The ultimate disposition of the case in which the court asserted this new interpretation has been argued to return matters basically to where they had been. See T Ross and R Winter, "The Efficiency Defense in Merger Law: Economic Foundations and Recent Canadian Developments" (2005) 72 *Antitrust Law Journal* 471, 472, 487–94.

such as price reductions that offset the lessening of competition from a merger.[11] The Commission has indicated that it looks for "cost reductions" that can "be expected to result in prices lower than if the merger did not take place".[12] In addition, the OFT has indicated that it will not refer a merger if there are "clear" "customer benefits" such as "lower prices".[13]

In light of the foregoing, it is important to understand how merger efficiencies can be expected to affect consumer prices, and we address that issue in the context of differentiated consumer products. We consider only the short-term effects of efficiencies on prices, and thus focus on reductions in short-run marginal cost—the only cost reductions that directly and immediately affect prices. We explain and illustrate three distinct ways in which marginal-cost reductions are passed through in the form of reductions in consumer prices.

The most important pass-through effect, and the one we examine in greatest detail, is the direct effect of the reduction in a product's marginal cost on its own price: a reduction in the marginal cost of any of the merged firm's products causes a reduction in its price by an amount largely determined by the curvature of that product's demand curve. The other two ways in which marginal-cost reductions affect consumer prices relate to the nature of the competitive interaction among differentiated products. When a reduction in the marginal cost of one of the merged firm's products causes a reduction in that product's price, the price reduction causes a shift in the demand curves of the merged firm's other competing products. Consequently, the merged firm adjusts the prices of all the competing products it sells in response to a reduction in marginal cost for any one of those products. In addition, non-merging sellers of competing products adjust their prices in response to the price changes of the merged firm.

We show that the magnitudes of all three pass-through effects depend on properties of demand curves, such as curvature, that cannot readily be observed. This can make it difficult to determine, even roughly, the rate at which cost reductions would be passed through. Fortunately, an alternative analysis avoids making this determination. Marginal-cost reductions sufficient to fully compensate for the price-increasing effects of a merger depend on only prices, market shares, and demand elasticities, all of which, in principle, can be measured. Thus, it may be feasible to determine the net effect of a merger on prices without directly addressing pass-through rates.

In addition, we explain that the factors that determine pass-through rates also significantly affect the magnitude of the unilateral anticompetitive effects of

[11] Enterprise Act 1998, ss 30(1), 35(5), 36(4).

[12] Competition Commission, Merger References: Competition Commission Guidelines, s 4.41 (CC2, June 2003).

[13] Office of Fair Trading, Mergers: Substantive Assessment Guidelines, ss 7.7–7.8 (OFT 561, May 2003).

differentiated products mergers. The properties of demand curves giving rise to greater price increases from a merger in the absence of marginal-cost reductions also cause any marginal-cost reductions to be passed through at a higher rate. This suggests useful consistency checks on predictions of price increases and pass-through rates. We illustrate this in the context of the *Staples* case from the US, in which a low estimated pass-through for cost reductions was cited in concluding that claimed efficiencies were insufficient to outweigh the anticompetitive effects of the merger.[14]

Finally, we consider how the degree of competition affects pass through. We show that greater competition may not imply greater pass through; in fact, the reverse is true for some senses in which the degree of competition may be increased. This finding is in some tension with the statement in the European Commission's merger guidelines that the "incentive on the part of the merged entity to pass efficiency gains on to consumers is often related to the existence of competitive pressure from the remaining firms in the market".[15]

B. The Economics of Pass Through in Differentiated Products Industries

At least for purposes of relatively short-term competitive analysis, it is natural and conventional to assume Bertrand competition among differentiated consumer products, which means that competitors act only by setting their prices. Bertrand competition yields a set of prices—the Bertrand equilibrium—such that each competitor is happy with its price (or prices) in light of the prices of competing products.[16] The condition determining the price charged in equilibrium by a Bertrand competitor selling a single product looks just like the condition determining the price changed in equilibrium by a monopolist: The price–cost margin (price minus marginal cost, all divided by price) for both must equal the reciprocal of the elasticity of demand (expressed as a positive quantity) faced by the firm. It is therefore useful to begin by analysing pass through by a monopolist.

[14] *FTC v Staples, Inc* 970 F Supp 1066, 1090 (DDC 1997).
[15] EC merger guidelines, *supra* n 5, para 84.
[16] This is an application of the concept of Nash, non-cooperative equilibrium, named for mathematician John F Nash Jr, who was awarded a share of the 1994 Nobel Memorial Prize in Economics for this work.

1. The Effect of Marginal-cost Reductions in Single-product Monopoly

If a monopolist experienced a reduction in its marginal cost but did not change its price, its price–cost margin would increase while its elasticity of demand would stay the same. If the monopolist were in equilibrium before the cost reduction, it no longer would be after the cost reduction. To restore equilibrium, it would have to reduce its price, and that reduction in price would cause the pass through to consumers of a portion of the cost reduction.

To see why there is some pass through, it suffices to observe that the monopolist's equilibrium condition is equivalent to the condition that marginal cost equals marginal revenue. Since marginal revenue, like demand, must slope downward, a downward shift in the monopolist's marginal-cost curve causes the intersection of marginal cost and marginal revenue to occur at a lower price. Thus, a monopolist passes through a portion of any marginal-cost reduction.

Determining the rate at which a monopolist passes through marginal-cost reductions is not as straightforward. From the monopolist's equilibrium condition, it is clear that the magnitude of the price decrease necessary to restore equilibrium after a marginal-cost reduction depends on the responsiveness of the elasticity of the monopolist's demand to changes in its price. This responsiveness can be approached in two convenient ways, and the Appendix derives useful pass-through results for both.[17]

One approach focuses just on the curvature of demand. For the simplest case—a straight-line demand curve—it is easy to show that the pass-through rate is 50% at every point along the demand curve. In addition, it is not difficult to show that the pass-through rate is greater than 50% at every point on a demand curve that is convex throughout its range (ie if the quantity sold increases at a decreasing rate as price is reduced), and it is less than 50% if demand is concave through out its range (ie if the quantity sold increases at an increasing rate as price is reduced). Pass-through rates of over 50% must be considered reasonably likely, since convex demand is considered normal.

Another approach focuses on the rate at which the elasticity of demand changes as price changes. Whether the pass-through rate is greater or less than 100% is easily shown to depend on the elasticity of the elasticity of demand, ie the proportionate rate of change in the elasticity of demand as price is changed. If the elasticity of demand increases as price increases in the same proportion as the price increase, the pass-through rate is 100%. If the proportionate increase

[17] These or similar results are found in R Bishop, "The Effects of Specific and Ad Valorem Taxes" (1968) 82 *Quarterly Journal of Economics* 198; J Bulow and P Pfleiderer, "A Note on the Effect of Cost Changes on Prices" (1983) 91 *Journal of Political Economy* 182; and J Stennek and F Verboven, Merger Control and Enterprise Competitiveness: Empirical Analysis and Policy Recommendations (3 May 2001), available at http://www.iui.se/wp/Wp556/IUIWp556.pdf, accessed on 5 July 2005.

in the elasticity of demand is less than the proportionate increase in price, the pass-through rate is less than 100%. And if the proportionate increase in the elasticity of demand is greater than the proportionate increase in price, the pass-through rate is greater than 100%. No economic intuition appears to discount the possibility of pass-through rates of over 100%, and such pass-through has been observed.[18]

Figure 1 depicts four demand curves exhibiting pass-through rates of 25, 50, 100 and 200%. The demand curve exhibiting a 25% pass-through rate is concave, the demand curve exhibiting a 50% pass-through rate is linear, and the demand curves exhibiting pass through rates of 100 and 200% are convex. Normally, pass-through rates change as one moves along a demand curve, but, as detailed in the Appendix, there is a family of demand curves that have the same pass-through rate at every point along the curve. The four demand curves in Fig. 1 are from that family, and these four demand curves were constructed so that they share a common price–quantity combination (at the lower left) and have the same demand elasticity at that point.[19]

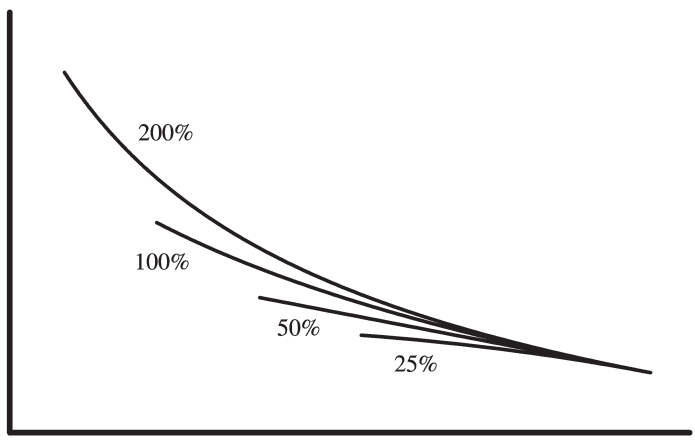

Fig. 1 Demand Curves Exhibiting Different Pass-through Rates

[18] Market-wide pass through by retailers in excess of 100% was observed from increases in sales taxes by T Besley and H Rosen, "Sales Taxes and Prices: An Empirical Analysis" (1999) 52 *National Tax Journal* 157. Product-specific pass through by retailers in excess of 100% has been observed from increases in wholesale prices. See Stennek and Verboven, *supra* n 17.

[19] To make Fig. 1 serve another purpose when revisited later, it displays only a segment of each demand curve. If marginal cost equals the price at the point the four demand curves share, the segments depicted are those between the competitive and monopoly prices. The competitive equilibrium is, by definition, the point at which price equals marginal cost. The corresponding monopoly price for each demand curve is the point at which marginal revenue equals the marginal cost used to define the competitive price.

2. Price Effects from Marginal-cost Reductions in Bertrand Competition

With single-product monopoly, the only possible price effect is what we term the "own pass-through effect", the direct effect of a reduction in the marginal cost of a particular product on that product's own price. The analysis of the own pass-through rate with single-product monopoly carries over to the case of differentiated products mergers with Bertrand competition,[20] but there are additional pass-through effects with Bertrand competition.

Anything that affects the price of one product in Bertrand competition necessarily affects the prices of competing products (even if only slightly), since the equilibrium price of each product depends on the prices of all competing products. The nature of this price interdependence differs, however, between other products of the same firm and products of rival firms. The merged firm necessarily produces at least two competing products, and the price of each of its products affects the demand and hence the prices of the others, which gives rise to a second pass-through effect. Unless the merged firm is a monopolist, competitive interaction with competing products of non-merging firms gives rise to a third pass-through effect, since the prices of non-merging competitors respond to those of the merged firm. These additional pass-through effects are directly related to the unilateral anticompetitive effects from Bertrand mergers.[21]

We use the term "cross pass-through effect" to describe the price response of any of the merged firm's products to a reduction in the marginal cost of any of its other products. The mechanism of this effect is easiest to follow if each merging firm produces a single product and the merger reduces the marginal cost of just one of them. Because a change in the price of one of the merged firm's products alters the profit-maximisation calculus for the other, the price of the product that does not experience a cost reduction is affected by the change in price for the product that does. As is illustrated in the next section, cross pass-through effects can be positive or negative, and large or small, depending primarily on the particular functional form of demand. Hence, the sum of the own and cross pass-through effects, which we term the "direct pass-through effect", can be greater than or less than the single pass-through effect with monopoly, although it is apt to be roughly the same.

[20] In carrying these results over to a Bertrand industry, we presume sufficient product differentiation to generate substantial market power at the product or brand level. Otherwise, modest cost changes can cause huge quantity shifts among products.

[21] See generally R Deneckere and C Davidson, "Incentives to Form Coalitions with Bertrand Competition" (1985) 16 *RAND Journal of Economics* 473; G Werden, "A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products" (1996) 44 *Journal of Industrial Economics* 409; G Werden and L Froeb, "Unilateral Competitive Effects of Horizontal Mergers", in P Buccirossi (ed), *Advances in the Economics of Competition Law* (Cambridge, MA, MIT Press, forthcoming).

When the merged firm's prices change as a result of the merger, its rivals are no longer happy with their prices. The rivals adjust their prices to restore equilibrium with "accommodating" price changes. They raise their prices in response to price increases and reduce their prices in response to price decreases. This occurs whether or not the merger generates efficiencies, and to the extent that merger-specific efficiencies moderate the price increases of the merged firm, that moderation, in turn, moderates the accommodating price responses of rivals. Hence, there is an additional, typically small, pass-through effect, which we term the "indirect pass through effect", operating through rivals' reactions to the direct pass-through effect.

Each of the three pass-through effects feeds back into the others. For example, reduced accommodating price responses by the non-merging firms cause the merged firm to raise prices less than it otherwise would. All of the feedback effects are accounted for in the post-merger equilibrium, and all can be simulated just as the anticompetitive price effects of mergers absent efficiencies can be simulated.[22] Because cross and indirect pass-through effects are apt to be small relative to the own pass-through effect, the main factor determining the rate of pass through for marginal-cost reductions in differentiated products industries generally is the curvature of demand, just as it is the sole factor determining the pass-through rate with monopoly.

3. An Example Based on the Proposed Merger of WorldCom and Sprint

Further clarification of the nature of the three pass-through effects is provided by a concrete example based on the proposed merger of WorldCom and Sprint, which was abandoned when challenged by the US Department of Justice.[23] Our analysis of the merger is intended only to illustrate the three pass-through effects, and how they differ depending on the functional form of demand. The analysis is highly simplified and may not be indicative of the effects of the merger would have produced.

We simulate the price effects of the Sprint–WorldCom merger using four functional forms for demand that have previously been used in merger simulations—linear, logit, AIDS and isoelastic demand. The linear and isoelastic demand functions are fairly straightforward (with isoelastic demand all the own

[22] See generally P Crooke, L Froeb, S Tschantz and G Werden, "The Effects of Assumed Demand Form on Simulated Postmerger Equilibria" (1999) 15 *Review of Industrial Organization* 205; G Werden, "Merger Simulation: Potentials and Pitfalls", in P van Bergeijk and E Kloosterhuis (eds), *Modelling European Mergers: Theory, Competition Policy and Case Studies* (Cheltenham, Edward Elgar, 2005); G Werden, "Simulating Unilateral Competitive Effects from Differentiated Products Mergers" [Spring 1997] *Antitrust* 27.

[23] *United States v WorldCom, Inc* (DDC, filed 27 June 2000). The parties announced the termination of their merger agreement on 13 July 2000.

and cross elasticities of demand are constant), and it is not important to understand exactly what the other two functions are.[24] It is sufficient to note that each of these four functions differs from the others in ways that turn out to matter. These demand functions exhibit differing curvature, which produces differing own pass-through rates, and have other important differences, which produce differing cross and indirect pass-through effects. One thing these functions have in common is that none is concave; hence, the own pass-through rate must be at least 50% for all of them.

We base our simulations on estimates of the relevant demand elasticities for domestic long-distance service made by economist Jerry Hausman and included in a submission opposing the merger before the FCC.[25] We have no information on the likely efficiencies from the proposed Sprint–WorldCom merger and we arbitrarily assume that the merger would have reduced Sprint's marginal cost by 10% while not changing WorldCom's marginal cost.

Since price changes cause quantity changes, there are several alternative ways to calculate the pass-through effects associated with this merger, none clearly better than the others. The figures in Table I were produced by dividing the total dollars of cost reduction realised by Sprint (its simulated post-merger total cost with the assumed cost reduction, minus its pre-merger total cost) into the reductions in the total dollar amount consumers pay each long-distance carrier that are attributable to the assumed cost reductions (its simulated post-merger total revenues with the assumed cost reductions minus its post-merger simulated total revenues without the cost reductions).

Table I: Per Dollar Effects of Sprint Marginal-cost Reductions on Consumer Expenditures

Demand functional form	Sprint (own pass through)	WorldCom (cross pass through)	Other firms (indirect pass through)	Total
Linear	0.51	0.01	0.17	0.68
Logit	0.91	–0.08	0.18	1.01
AIDS	1.85	0.11	1.36	3.32
Isoelastic	3.69	–1.26	0.00	2.44

[24] For details on all four of these demand functions, see Crooke *et al*, *supra* n 22.

[25] Declaration of Professor Jerry A Hausman (16 February 2000). Hausman's analysis did not provide information on prices, and we assume that all carriers charge the same price prior to the merger. This assumption has no significant effects on what follows. The logit demand system cannot be fit to the full elasticity matrix estimated by Hausman, so instead we calibrated it to the aggregate demand elasticity for long-distance service Hausman estimated and the own-price elasticity of demand he estimated for AT&T. We simplify the AIDS model by assuming the absence of income effects.

The Sprint column in Table I illustrates that the magnitude of own pass-through effect on Sprint's price varies greatly with the curvature of demand, which differs significantly among these demand functions. The effect of the assumed reduction in Sprint's costs on its own price is more than seven times as great with isoelastic demand as with linear demand. Demand curvature has previously been observed to affect the predicted price increases from differentiated products mergers in the same manner.[26] The relative magnitudes of the own pass-through effects in Table I correspond roughly with the relative magnitudes of the predicted price increases these demand functions have been found to yield.

The WorldCom column in Table I illustrates that cross pass-through effect of Sprint's cost reduction on WorldCom's price can be positive or negative, and large or small, as a result of idiosyncratic properties of the various functional forms for demand. For three of the four demand functions, the cross pass-through effect is quite small—much smaller than the own pass-through effect on Sprint's price. The exception is isoelastic demand, for which there is a large negative cross pass-through effect, which offsets some of the huge own pass-through effect. That offset reduces the range of the direct pass-through effects (the sum of the own and cross effects) across the four demand functions, although the direct pass-through effect on the prices of the merging firms is still nearly five times as great with isoelastic demand as with linear demand.

The indirect pass-through effect of Sprint's cost reduction on the prices of non-merging firms cannot be negative, but it can be large, small and even nil, and all three possibilities actually occur with at least one of these four demand functions, as is seen in the Other Firms column of Table I.[27] In domestic long-distance service, Sprint and WorldCom were two of the three large providers, the other being AT&T. The figures in the Other Firms category include both AT&T and numerous small firms. For three of the four demand functions, the indirect pass-through effect is quite small—again much smaller than the direct pass-through effect. The exception is AIDS demand, which yields a vastly larger indirect pass-through effect than the other three demand functions.

The foregoing example was constructed in the hope of producing non-trivial cross and indirect pass through effects, although those effects actually turn out to be quite modest for linear and logit demand. Indirect pass-through effects tend to be fairly small because, absent marginal-cost reductions, the accommodating price responses of non-merging firms tend to be far smaller than the price increases of the merging firms. This example generates indirect pass-through

[26] See Crooke *et al*, *supra* n 22.

[27] For example, isoelastic demand yields no indirect pass through because the elasticities of demand faced by non-merging firms do not change as their demand curves shift, so these firms do not make accommodating price adjustments to price changes by the merged firm.

effects as large as it does because AT&T was an extraordinarily large non-merging firm. Moreover, to simplify matters and highlight the cross pass-through effect, cost reductions were assumed to affect just one of the merged firm's products. This fact pattern is not particularly unusual. It arises when efficiencies stem from the transfer of technology from one merging firm to the other, or from the rationalisation of production facilities between a high-cost firm and its lower-cost merger partner.

C. A Practical Pass-through Analysis

1. Compensating Marginal-cost Reductions

The actual pass-through rate in any case is determined by properties of demand functions that are not easily observed. Suppose, for example, that the point shared by the four demand curves in Figure 1 were the pre-merger equilibrium. If one could observe only prices, quantities and demand elasticities, there would be no way to distinguish among those four demand curves, or others with even higher and even lower pass-through rates. The estimation used to support the unilateral effects analysis of differentiated products mergers assumes a functional form for demand, and in making this assumption, it effectively assumes the pass-through rate. There are ways in which one might attempt to estimate demand curvature, and there are ways in which pass-through rates might be estimated directly,[28] but we doubt the ability to do either with sufficient accuracy.

If an accurate estimate of the pass-through rate actually were required before merger-specific efficiencies could be given any weight, that requirement could effectively preclude any consideration of efficiencies. But to the extent that the issue posed by efficiencies is whether they are sufficient to prevent price increases, there is no need ever to directly consider, much less estimate, pass-through rates. In the standard unilateral effects analysis, it is possible instead to calculate the marginal-cost reductions that would exactly restore the pre-merger prices. These are termed the "compensating marginal-cost reductions", or CMCRs, and they depend only on prices, quantities and demand elasticities, all of which, in principle, can be observed.

Curvature and idiosyncratic properties of particular demand functions do not affect the extent of marginal-cost reductions necessary to exactly compensate for the price-increasing effects of mergers, and the reason is straightforward. If marginal-cost reductions from a merger result in post-merger prices that are the same as the pre-merger prices, they also must result in the post-merger quantities and demand elasticities that are the same as those pre merger. And if the merger

[28] This possibility is further discussed below in the context of the *Staples* case.

does not change prices, quantities and demand elasticities, then demand curvature, which indicates how the elasticities change as prices change, is irrelevant. Thus, the determinants of the pre-merger equilibrium, eg elasticities of demand, also determine the magnitude of the CMCRs.

It can be tedious to calculate the CMCRs for differentiated products mergers in Bertrand competition,[29] but it is quite simple in the case of single-product merging firms with the same costs, market shares, and demand elasticities. In that case, the CMCRs, expressed as a fraction of pre-merger price, are both $md/(1 - d)$, where m is the pre-merger price–cost margin (defined as in the monopoly case) and d is the diversion ratio, ie the proportion of either merging firm's lost sales from a price increase recaptured by the other.[30] Thus, if $m = 0.5$ and $d = 0.2$, the CMCRs are both 12.5% of the price, which is 25% of the marginal cost.

There is always a unique set of CMCRs for the merged firm's products that exactly compensate for the price-increasing effects of the merger. If the likely marginal-cost reductions from merger-specific efficiencies exceed the CMCRs for every competing product of the merged firm, the merger causes all prices in the relevant market fall (by at least a tiny amount). Hence, there is always a useful condition under which efficiencies are sufficient to assure that a merger does not cause any price increases. The only major difficulty comes when the marginal costs of some of the merged firm's products are likely to fall by more than the fully compensating amount, while others are not. That easily could be the case if cost fell for only one merging firm.

2. Pass-through Rates and Price-increase Predictions

A critical point about CMCRs is that they are not just another way to get at pass-through rates. Suppose, as in the simple example above, it was calculated that marginal-cost reductions of 12.5% of price were necessary to prevent price increases from a particular merger, and suppose that we knew that merger-specific efficiencies would reduce marginal costs by the required amount. Knowing this, we neither know nor care whether the pass-through rate is 25% or 250%. In either event, the net effect of the merger is not to increase prices.

Given the factors that determine the CMCRs, a wide range of price increases still would be predicted under different demand assumptions. But in this simple example, marginal-cost reductions of 12.5% of price would totally compensate for the price-increasing effect of the merger no matter how large or small the price increases would have been in the absence of the cost-reductions. The

[29] With single-product merging firms, the general formula for the CMCR for product i is $(m_i d_{ji} d_{ij} + m_j d_{ji} p_j / p_i)/(1 - d_{ji} d_{ij})$, where d_{ji} is the diversion ratio to product j from product i. With multi-product merging firms, the general formula is derived by Werden, *supra* n 21.

[30] See Werden and Froeb, *supra* n 21. The similar formula presented in Werden, *supra* n 21, indicates the CMCRs as a fraction of pre-merger marginal cost.

reason there is a single set of CMCRs for a wide range of pass-through rates and prices increases absent any cost reductions is that the properties of demand systems that determine pass-through rates also determine the magnitude of price increases from mergers in the absence of cost reductions.[31] Demand properties that lead to relatively large predicted price increases necessarily imply high pass-through rates.

In fact, there is a very simple relationship between pass-through rates and predicted price increase absent cost reductions. If merger-specific efficiencies produce marginal-cost reductions at exactly the compensating levels, the net price effect is zero. Consequently, the pass-through rate associated with those particular marginal-cost reductions must be the predicted price increase divided by the CMCR.

For two different demand curves, the lines in Fig. 2 depict the percentage price increase resulting on net from a merger, given the marginal-cost reduction on the horizontal axis. The lines share a common intercept on the horizontal axis, which is the amount of the CMCR (relative to pre-merger price). The intercepts on the vertical axis are the price increases with no cost reductions. Both intercepts are determined by prices, quantities, and demand elasticities (or diversion ratios), but only the vertical intercept is affected by demand curvature and idiosyncratic properties of demand. Holding constant prices, quantities and demand elasticities, changing the demand function rotates the line around the

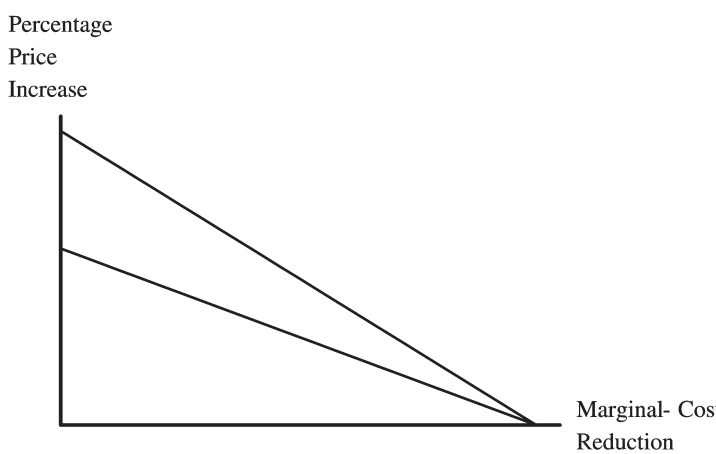

Fig. 2 Relationship between CMCRs and Price Increases

[31] A rigorous demonstration of the validity of this assertion is provided by L Froeb, S Tschantz and G Werden, "Pass-Through Rates and the Price Effects of Mergers" (forthcoming) *International Journal of Industrial Organization*.

CMCR point on the horizontal axis, and as the line rotates, the price increases with no cost reduction and pass-through rates necessarily move together.[32]

Figure 2 also illustrates an interesting point: uncertainty about curvature and other properties of demand implies a significant range of possible price increases resulting from differentiated products mergers. That range is reduced, perhaps substantially, by merger-specific cost reductions insufficient to prevent price increases. Rather than complicating the unilateral effects analysis, cost reductions actually make it more precise.

3. An Illustrative Application to the *Staples* Case

The interrelationship between the magnitude of price effects absent cost reductions and the rate at which cost reductions are passed through has practical implications we illustrate in the context of the *Staples* case. We base the following strictly on published accounts, although additional non-public facts could be very useful. We also assume Bertrand competition, while the parties to the case may have had other theories.

Based on econometric analysis, the Federal Trade Commission (FTC) predicted that the merger of Staples and Office Depot would cause them to increase prices a bit more than 7% averaged across all cities in which both competed.[33] In many of those cities, a third office supply superstore, Office Max, was present, although it was seen a much less important competitor than either of the merging firms. We are unable to locate separate price increase predictions for cities with and without Office Max, and assume the predicted price increase was 6% for the cities with all three superstores and 7.5% for the cities in which the merging firms were the only office supply superstores. We are also unable to locate separate price-increase predictions for the individual stores, and we understand that all of the superstores in each city were predicted to raise their prices by the same amount.

On the basis of another econometric analysis, the FTC argued that the merging firms had been passing through marginal-cost reductions unique to either of them at a rate of 15%,[34] and it appears that the FTC and the court

[32] Between the intercepts, the lines indicate the precise price increase caused by a merger only if the marginal-cost reduction is "balanced", ie if the reductions in marginal costs preserve the relative price changes that would occur in the absence of any cost reductions. CMCRs are balanced, as are any other set of marginal-cost reductions proportionate to the CMCRs. When marginal-cost reductions are unbalanced, the plot provides only a rough approximation of the relationship between price increases and pass through.

[33] See generally J Baker, "Econometric Analysis in *FTC v Staples*" (1999) 18 *Journal of Public Policy & Marketing* 11; S Dalkir and F Warren-Boulton, "Prices, Market Definition, and the Effects of Mergers: Staples–Office Depot", in J Kwoka Jr and L White (eds), *The Antitrust Revolution: Economics, Competition, and Policy* (Oxford University Press, 2004), 52.

[34] The FTC's pass-through analysis is presented by O Ashenfelter, D Ashmore, J Baker and S-M McKernan, "Identifying the Firm-specific Cost Pass-through Rate" (January 1998) FTC

treated this as the relevant pass-through rate for the merger.[35] If 15% was the relevant pass-through rate, it is simple to calculate the implied CMCRs. For the cities without Office Max, dividing the pass-through rate into the predicted price increase yields CMCRs equal to 50% of price (7.5%/15%) for both merging firms, and for the cities with Office Max, this yields CMCRs 40% of price (6%/15%).

Since the FTC appears to have made the same price-increase and pass-though rate predictions for both of the merging firms, we assume the merging firms were symmetric in all relevant respects. In that event, the simple CMCR formula above applies. For cities with just two office supply superstores, this means that $md/(1 - d)$ must equal 0.5, which implies a particular relationship between m and d. Moreover, the symmetry assumption also implies a particular relationship between d and the aggregate elasticity of demand for office superstores, ε.[36] If we knew the actual value of m, d or ε in the case, we could infer the values of the other two, and the parties in the case should have had some information about all three of these quantities.

Because there were many other significant sources of office supplies, and because customers were likely to use office supplies less as price rose, we suspect

Working Paper No 217. In contrast to the very low estimate of the pass-through rate for firm-specific marginal-cost changes, the FTC estimated that industry-wide marginal-cost changes were passed-through at a rate of 85%. Wide divergence between the firm and industry pass through rates is expected in a perfectly competitive industry, since firm-specific marginal-cost reductions are not passed on at all in competitive industries, while industry-wide changes in marginal cost are fully passed through. But such wide divergence in pass-through rates is not to be expected with just a few competitors, as is easily shown for a symmetric n-firm industry. With Bertrand competition, the industry-wide pass-through rate is the firm-specific pass-through rate plus $n - 1$ times the rate at which other firms in the industry indirectly pass through another firm's marginal-cost reductions. This indirect pass-through rate must be less than the own pass-through rate, because there would otherwise be no equilibrium, since firms would respond to price increases by rivals with even larger price increases. Thus, if the firm-specific pass-through rate is 15%, the industry-wide pass-through rate can be at most 30% for a two-firm industry and 45% for a three-firm industry. Stennek and Verboven, *supra* n 17, derive a similar result with Cournot competition among symmetric firms. They show the industry-wide pass-through rate is n times the firm-specific pass-through rate.

[35] The FTC estimated just an own pass-through rate, although the total pass-through rate is what matters to the ultimate effect of the merger on competition. In the cities where the merging firms were the only superstores, the difference between own and total pass through is cross pass through, which can be positive or negative but is apt to be small. The own pass-through rate, thus, may be a reasonable estimate of the total pass-through rate in the two-superstore cities. The FTC also estimated a pre-merger pass-through rate, although pass-through rates change with mergers, and it is the post-merger pass-through rate that matters. The effect of mergers on own pass-through rates, however, was slight in cases we have examined.

[36] In Bertrand equilibrium, each superstore's elasticity of firm-specific demand must equal $1/m$. Symmetry between the merging firms implies that ε, divided by the elasticity of demand faced by each individual superstore, equals $1 - d$, so we have $\varepsilon = (1 - d)/m$. And since the condition in the text, $md/(1 - d) = 0.5$, implies $d = 1/(1 + 2m)$, it follows that $\varepsilon = 2/(1 + 2m)$.

that ε was rather large.[37] If one believed that ε was greater than 2, there likely would have been a clear inconsistency in the FTC's predictions, since that implies negative margins, and we very much doubt that margins were negative.

On the other hand, with three symmetric superstores, the FTC's predictions imply the margin must be at least 40%,[38] which seems implausibly high, especially since the FTC argued that margins were low.[39] Although the published record in the case suggests that Office Max was not nearly as strong a competitor as the merging firms, there surely was significant substitution from the merging firms to non-superstores, so the evidence may have indicated that d was less than 0.5 even if the three superstores were not symmetric. In that event, the FTC's two predictions would have been inconsistent with each other in the three-superstore cities, even if not in the two-superstore cities.

D. Competition and Pass Through

It has been suggested that the force of competition is what causes cost reductions to be passed on to consumers. In the US, this argument has found its way into scholarly works and was endorsed by at least one court.[40] In Europe, this sort of argument may have been embraced in EC's merger guidelines, which maintain that the "incentive on the part of the merged entity to pass efficiency gains on to

[37] A high demand elasticity is not necessarily inconsistent with the court's finding that the relevant market was limited to office supply superstores. That finding implies an upward bound on the elasticity of demand for office supply superstores, but if their price–cost margins were relatively low, as seems likely (see *infra* n 39) that bound exceeds 2. See generally G Werden, "Demand Elasticities in Antitrust Analysis" (1998) 66 *Antitrust Law Journal* 363, 390.

[38] If all three superstores were symmetric, ε divided by the elasticity of demand faced by each individual superstore would equal $1 - 2d$. Since ε cannot be negative, the diversion ratio could be at most 0.5, even if there was no substitution from the merging firms to non-superstores. Since $d \leq 0.5$ implies $d/(1 - d) \leq 1$, it follows that $md/(1 - d) = 40\%$, as implied by the FTC's predictions, implies a margin of at least 40%.

[39] The court described the defendants as "high volume, discount office supply chain stores". *Staples*, *supra* n 14, 1078. The FTC referred to the superstores having "low profit margin per dollar of sales". Plaintiff's Memorandum of Points and Authorities in Support of Motions for Temporary Restraining Order and Preliminary Injunction, *FTC v Staples, Inc*, n 34 (10 April 1997), available at http://www.ftc.gov/os/1997/04/pubbrief.pdf, accessed on 5 July 2005.

[40] See *FTC v Tenet Healthcare Corp* 17 F Supp 2d 937, 948 (ED Mo 1998) (rejecting efficiency claims in part because the merged firm was "unlikely to pass these savings on to its consumers absent competitive pressure to lower prices"), reversed on other grounds, 186 F 3d 1045 (8th Cir 1999); L Sullivan and W Grimes, *The Law of Antitrust* (St Paul, MN, West Group, 2000), 609 (arguing that one of two relevant efficiencies-related questions is "will competition require those efficiencies to be passed on to consumers?"); R Pitofsky, "Proposals for Revised United States Merger Enforcement in a Global Economy" (1992) 81 *Georgetown Law Journal* 195, 207 (the only way "any defender of a merger can demonstrate with certainty that the benefits of the merger will be passed through to consumers" "is to prove that the merger is taking place in a near perfectly competitive market").

consumers is often related to the existence of competitive pressure from the remaining firms in the market".[41]

The analysis of pass through with monopoly makes it clear that this argument has no support in economic theory. A monopolist passes through marginal-cost reductions to a significant extent, and that extent is determined by the curvature of the monopolist's demand curve, rather than by its "good intentions". Moreover, some market power is essential for any pass through. If a merged firm has no market power, it cannot affect the prices consumers pay, so a reduction in the merged firm's costs cannot affect the prices consumers pay. These points are well known,[42] but several others are not.

An important insight from our analysis is that higher own pass-through rates are likely to be associated with greater market power because demand curvature substantially determines both. This can be seen by revisiting the demand curves in Fig. 1, which depicts a segment of four demand curves specially constructed to have the same pass-through rate at every point (see Appendix). The segment of each demand curve plotted in Fig. 1 is that between the monopoly price on the left and competitive price on the right, which is the same for all four of the demand curves.[43] The amount by which the monopoly price exceeds the competitive price is a useful and conventional way to assess the quantum of market power inherent in each demand curve,[44] and these four demand curves obviously differ significantly in this regard. Correlating the pass-through rates displayed in Fig. 1 with the inherent market power in each demand curve, it is apparent that a greater degree of market power is associated with higher pass-through rates.

Our analysis also offers additional insights into how pass-through rates are affected by ways in which the intensity of competition might be varied. Other things being equal, increased competition in the form of more elastic demand, or a lower price–cost margin, in the post-merger equilibrium can have a positive or negative effect on the own pass-through rate. As shown in the Appendix, when the own pass-through rate is less than 100%, as with linear and logit demand, increasing competition in this way increases the own pass-through rate. And when the own pass-through rate is greater than 100%, as with AIDS or isoelastic demand, increasing competition in this way decreases the own pass-through rate.[45]

41 EC merger guidelines, *supra* n 8, para 84.

42 See P Yde and M Vita, "Merger Efficiencies: Reconsidering the 'Passing-on' Requirement" (1996) 64 *Antitrust Law Journal* 735.

43 See *supra* n 19. Figure 1 is not drawn to scale in order to make it more readable. The monopoly price with the 200% pass through demand curve is just twice the competitive price.

44 Since the competitive price is marginal cost, this is a conventional way in which to measure the degree of market power and is referred to as the Lerner Index. See Werden, *supra* n 37, 372.

45 Simulations using these four demand functions suggest that the same result holds for the total pass-through rate.

Secondly, decreasing competition by increasing concentration of the non-merging firms, all else being equal, increases indirect pass through (except with isoelastic demand). This proposition follows immediately from the fact that larger non-merging firms increase their prices more in response to the price increases of the merged firm. When cost reductions cause the merged firm to reduce prices relative to levels absent cost reductions, the larger the non-merging firms, the more they decrease prices in response.

Thirdly, decreasing the degree of competition by transferring ownership of products from non-merging firms to the merged firm causes some indirect pass through to be traded for some cross pass through. Since the latter may be negative, while the former cannot be, this can reduce the total pass through of cost reductions. As the Sprint–WorldCom example above illustrates, the magnitude of this effect depends on demand function idiosyncrasies, but it can be significant.

None of the foregoing suggests that efficiencies from mergers to monopoly or near monopoly are likely to be sufficient to prevent price increases. Very large cost reductions are apt to be required, and merger efficiencies normally would not be nearly great enough.

E. Conclusions

In differentiated products industries, the extent of the pass through of merger-specific marginal-cost reductions is determined largely by demand properties that cannot be observed. Pass-through rates depend not so much on familiar properties, like demand elasticities, as on the curvature of demand and idiosyncratic properties of particular functional forms for demand. Without knowledge of these unobservable properties of demand functions, the range of possible pass-through rates is huge. Practically none of the cost reductions might be passed through, and the pass-through might be far in excess of the cost reductions.

Estimating pass-through rates is likely to be infeasible because nature generally has not performed the necessary experiment or data from that experiment are unavailable. Own and indirect pass-through rates can be identified if there have been significant marginal-cost changes affecting a single product of interest, but that normally is not the case. Moreover, mergers generally are reviewed prior to consummation, so it is normally impossible to estimate post-merger pass-through rates, which differ somewhat from pre-merger pass-through rates, or to estimate the cross effects created by a merger.

For the foregoing reasons, addressing pass through as a separate and distinct component of merger analysis is likely to be unproductive. An alternative approach is to determine whether merger-specific marginal-cost reductions are

sufficient to offset entirely the price-increasing effects of a merger. With information on prices, market shares and demand elasticities, it is straightforward to calculate for each competing product of the merging firms what marginal-cost reductions would exactly compensate for the price-increasing effects of a merger. It is likely to be clear in many cases that merger-specific efficiencies could not decrease marginal costs by enough to prevent price increases, and in some cases, that the reverse is likely to be true.

Appendix

Consider a single-product monopolist that maximises profit by choosing a price, p, given a demand $x(p)$, with first and second derivatives $x'(p)$ and $x''(p)$. Assuming (purely for simplicity of the exposition) that the monopolist has a constant marginal cost c, one convenient form of the necessary condition for profit maximisation is

$$(p - c)x'(p) + x(p) = 0.$$

Using θ to denote the marginal effect on p of a change in c, and totally differentiating this condition yields after some rearrangement:

$$\theta = [2 - x''(p)x(p)/(x'(p))^2]^{-1}.$$

From this expression, it is apparent that θ depends on the curvature of demand, in particular:

$x''(p) < 0$, which implies concave demand, $\theta < 0.5$
$x''(p) = 0$, which implies linear demand, $\theta = 0.5$
$x''(p) > 0$, which implies convex demand, $\theta > 0.5$.

Another form of the necessary condition for profit maximisation is the familiar inverse-elasticity condition. Letting $\varepsilon(p)$ be the price elasticity of demand (and adopting the convention in economics of having own elasticities be negative quantities), we can write this condition as

$$-\varepsilon(p) = p/(p - c) \equiv 1/m.$$

Define $\eta(p)$ to be the price elasticity of the price elasticity of demand, ie $\varepsilon'(p)p/\varepsilon(p)$, and totally differentiate this condition to yield after rearrangement:

$$\theta = [1 + (\eta(p) - 1)m]^{-1} = \varepsilon(p)[1 + \varepsilon(p) - \eta(p)]^{-1}.$$

From this, it immediately follows that

$\eta(p) > 1$ implies that $\theta < 1$
$\eta(p) = 1$ implies that $\theta = 1$
$\eta(p) < 1$ implies that $\theta > 1$.

The degree of monopoly power may be varied by changing m or ε, and the effect of that is easily seen from $\theta = [1 + (\eta(p) - 1)m]^{-1}$. If $\eta(p) > 1$, a lower m implies a higher pass-through rate, and if $\eta(p) < 1$, a lower m implies a lower pass-through rate. When $m = 0$, as under perfect competition, the first expression for θ simplifies to just 1. The proper interpretation of this result is that the industry-wide pass-through rate is 1 under perfect competition.

Through mathematics more complex than are appropriate here, it can also be shown that there is a family of demand curves with constant pass-through rates:

$x = (a - bp)^{\theta/(1-\theta)}$ for $\theta < 1$
$x = a\exp(-bp)$ for $\theta = 1$
$x = (a + bp)^{\theta/(1-\theta)}$ for $\theta > 1$.