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Abstract

We describe a simple initial indicator of whether a proposed merger between rivals in a differentiated product industry is likely to raise prices through unilateral effects. Our diagnostic calibrates upward pricing pressure (UPP) resulting from the merger, based on the price/cost margins of the merging firms' products and the extent of direct substitution between them. As a screen for likely unilateral effects, this approach is practical, more transparent, and better grounded in economics than are concentration-based methods.

KEYWORDS: mergers, antitrust, oligopoly, unilateral effects

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In recent years, the Antitrust Division of the Department of Justice (DOJ) and the Federal Trade Commission (FTC) have reviewed over a thousand mergers and acquisitions, valued at over $1 trillion, annually.[1] And in the past ten years, the DOJ initiated 1697 investigations of mergers under §7 of the Clayton Act, compared with only 75 investigations of monopolization under §2 of the Sherman Act.[2] Merger review looms very large in antitrust analysis.

Since it is highly disruptive to "unscramble the eggs" by separating two firms after they have joined, merger review is usually prospective. Under the 1976 Hart-Scott-Rodino Act, merging parties must generally notify the DOJ and the FTC of a substantial proposed merger,[3] and must supply information demanded by the agency that takes responsibility for reviewing it within a statutorily prescribed time, culminating with thirty days following substantial compliance with the agency's "second request" for information from the merging parties.[4] To block a merger, the agency must convince a court that the merger's effect "may be substantially to lessen competition, or to tend to create a monopoly."[5] Merger review thus involves predicting the economic effects of a structural change in an oligopoly.

The need for an informative yet simple and speedy indicator of the likely effects of a proposed merger has long been recognized. The established approach uses market concentration: proposed mergers that substantially increase concentration in a "relevant antitrust market" are presumed to be anti-competitive. However, as discussed below, that approach can be clumsy and inaccurate in industries with differentiated products where the theory of harm is related to unilateral (rather than coordinated) effects. The approach developed here is

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[1] "Hart-Scott-Rodino Annual Report, Fiscal Year 2008," http://www.ftc.gov/os/2009/07/hsrreport.pdf. In Fiscal 2008, there were 172 HSR transactions each valued at more than $1 billion (Ibid., Exhibit A, Table I).

[2] "Antitrust Division Workload Statistics FY 1998-2007," http://www.usdoj.gov/atr/public/workstats.htm.

[3] The "size of transaction" threshold was set at $50 million in 2000 and indexed to GNP; it is $63.4 million in 2010.

[4] Modified procedures apply to hostile takeovers. In addition to information from the merging parties, the antitrust agencies can subpoena information from others, using a "civil investigative demand."

[5] This language is from Section 7 of the 1914 Clayton Act, as amended in 1950. The procedure is somewhat different for the FTC versus for the DOJ. Much bargaining takes place in the shadow of the statute, and many more mergers are abandoned "voluntarily" by the parties, or modified under a negotiated settlement, than are actually adjudicated by courts. In Fiscal 2008, 1726 transactions were reported to the agencies, who issued a second request demanding additional information in 41 cases and challenged 37, leading to 28 settlements, two administrative complaints, one of which was litigated in federal court, and seven restructured or abandoned transactions. See "Hart-Scott-Rodino Annual Report, Fiscal Year 2008," cited above.

designed to apply to those cases. Following existing practice in such mergers, we focus primarily on assessing the change in pricing incentives due to the proposed merger.[6]

Drawing heavily on ideas developed by Werden (1996) and by O'Brien and Salop (2000), this paper describes a simple approach to gauging concerns about unilateral price effects in markets for differentiated products. This approach, based directly on the underlying economics of pricing, asks whether the merger will generate net upward pricing pressure (UPP). This involves comparing two opposing forces: the loss of direct competition between the merging parties, which creates upward pricing pressure, and marginal-cost savings from the merger, which create (offsetting) downward pricing pressure. We show how these two forces can be compared *without* predicting the full equilibrium adjustment of the industry to the merger. In the pure form of our test, a merger is flagged for further scrutiny if the net effect of the two forces creates upward pricing pressure. We also sketch some modified forms of our test, in part to facilitate comparison with existing practice, including merger simulation.

Where firms compete to sell differentiated products, we argue that our approach is often simpler, as well as much more directly based in economics, than the market concentration approach. While our approach offers an alternative to that method, they have much in common:

- Each approach involves a simple test designed to calibrate concerns, recognizing the difficulty of fully analyzing and proving effects;
- Each approach reflects a core economic idea about the change in pricing incentives resulting from a merger. Broadly, the market concentration approach (as it applies to concerns about unilateral effects) is inspired by the fact that higher share lowers a firm's marginal revenue in Cournot oligopoly with homogeneous products, while our approach derives from Bertrand oligopoly with differentiated products;
- The test can be calibrated – in the case of concentration measures, by choosing thresholds at which concentration evokes concern; in our case, by choosing how much credit to give for efficiencies before they are studied closely;

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[6] We address innovation competition in Section 8. On aspects of merger policy beyond the immediately proposed merger see e.g. Lyons (2002) and Nocke and Whinston (2008). Since firms, like other human organizations, probably do not reliably optimize, policy could consider a less intense focus on incentives and more focus on biodiversity-like concepts of resilience; but here we stick to the standard approach.

- Neither approach purports to quantify the likely equilibrium effects (e.g., price change) of the merger; and
- Neither approach attempts to capture the full complexity of competitive effects. As under existing practice, we envision a subsequent "back-end" analysis that looks much more fully at effects, and may try to quantify them.

1. Problems with the Approach Based on Concentration

Merger control policy has long relied on a presumption that a merger which substantially increases market concentration is likely to be anti-competitive. In the landmark 1963 *Philadelphia National Bank* case, the Supreme Court held:[7]

> This intense congressional concern with the trend toward concentration warrants dispensing, in certain cases, with elaborate proof of market structure, market behavior, or probable anticompetitive effects. Specifically, we think that a merger which produces a firm controlling an undue percentage share of the relevant market, and results in a significant increase in the concentration of firms in that market, is so inherently likely to lessen competition substantially that it must be enjoined in the absence of evidence clearly showing that the merger is not likely to have such anticompetitive effects.

This "structural presumption" drew on the then-dominant structure-conduct-performance paradigm in industrial organization, linking concentration to poor market performance. In recent decades, however, industrial organization scholars and the courts have been more apt to stress that high concentration can be compatible with vigorous competition and efficient market performance. Thus, while *Philadelphia National Bank* has never been overruled, the strength of its structural presumption has weakened over the past 30 years: see Baker and Shapiro (2008).

Broadly, the agencies consider two basic theories of competitive effects.[8] "Coordinated effects" arise if the merger would make (perhaps tacit) collusion between the merged firm and its rivals more likely, or make their behavior more accommodating. "Unilateral effects" arise if the merger would give the merged entity a unilateral incentive to raise prices (or otherwise harm consumers).[9] The

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[7] United States v. Philadelphia National Bank, 374 U.S. 321, 363 (1963).

[8] See the 1992 *Horizontal Merger Guidelines*, available at http://www.usdoj.gov/atr/public/premerger.htm. These effects may both be present and the boundaries between them can be unclear.

[9] In practice the concept of "unilateral effects" is often interpreted as "effects within a static oligopoly model." See for instance Baker and Reitman (2009). A more general definition, which we adopt here, is "effects of a change in the merging firms' incentives, holding fixed other firms'

DOJ and the FTC have perhaps the world's largest concentrations of Ph.D. industrial organization economists,[10] and they do not mechanically rely on concentration and market shares, but seek flexibly to understand the economics of the industry. Economic analysis of unilateral effects, in particular, has advanced greatly in recent decades, but the Guidelines begin by describing an approach to defining relevant markets, and stress market concentration as a primary signal of competitive effects.

This approach does not always work well in the large class of mergers in which the merging firms sell differentiated products and the agencies must weigh concerns about unilateral effects. Product differentiation can make defining the relevant market problematic, notably because products must be ruled "in" or "out", creating a risk that the outcome of a merger investigation or case may turn on an inevitably artificial line-drawing exercise.[11]

The Guidelines offer a specific algorithm for market definition. Under this "hypothetical monopolist" test, a "relevant product market" is (roughly) a collection of substitute products that could profitably be monopolized. While this approach addresses the market definition problem in principle, it echoes the difficulty of merger investigation itself by requiring the analyst to predict price changes by a counterfactual firm. In some cases it can thus fail to provide the desired simple, practical, rapid, and reasonably accurate diagnostic.

The hypothetical monopolist test faces another challenge, too. When gross margins are substantial, it often leads to relatively narrow markets that exclude some products that undoubtedly compete to some degree with those of the merging parties.[12] Some courts have been inclined to define markets more broadly, including all "reasonable substitutes" to the merging firms' products.[13]

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reaction functions." See Werden and Froeb (2007) for an extended discussion of unilateral effects in mergers.

[10] The FTC's Bureau of Economics currently has 75 Ph.D. economists (roughly 50 of whom focus on antitrust matters), while the DOJ's Economic Analysis Group currently has about 60 Ph.D. economists.

[11] Jonathan Baker (2007) argues that: "Throughout the history of U.S. antitrust litigation, the outcome of more cases has surely turned on market definition than on any other substantive issue." While much has been written in antitrust economics on how best to define markets, the fact is that in many differentiated-product industries, there is no clearly right way to draw boundaries that are inevitably somewhat arbitrary.

[12] See Shapiro (1996), Katz and Shapiro (2003), and O'Brien and Wickelgren (2003), or more recently Farrell and Shapiro (2008).

[13] As the District Court in *Whole Foods* stated (p. 13), quoting *Microsoft*: "A market 'must include all products reasonably interchangeable by consumers for the same purposes.'" By contrast, a *Guidelines*-defined market includes only enough substitutes so that a hypothetical monopolist would impose a small but significant increase in price.

Thus the agencies have not always prevailed in court when they advance relevant markets based on the Guidelines algorithm.

The merger proposed in 2007 between Whole Foods and Wild Oats, two chains of grocery stores specializing in natural and organic food, illustrates the problem. Seeking to block the merger, the FTC argued that Whole Foods and Wild Oats competed in a market for "premium natural/organic supermarkets" (PNOS). In the PNOS market, the merger greatly increased concentration in some locales. The FTC asserted the structural presumption in the PNOS market. But Whole Foods' customers can also buy groceries—even many organic foods—at traditional supermarkets. Whole Foods and Wild Oats emphasized in court that many of their patrons "cross shop" at traditional supermarkets. Thus the District Court ruled that "…the FTC has not met its burden to prove that 'premium natural and organic supermarkets' is the relevant product market in this case for antitrust purposes."[14] The Court stated (at 5):

> [If] the relevant product market is, as the FTC alleges, a product market of "premium natural and organic supermarkets" consisting only of the two defendants and two other non-national firms, there can be little doubt that the acquisition of the second largest firm in the market by the largest firm in the market will tend to harm competition in that market. If, on the other hand, the defendants are merely differentiated firms operating within the larger relevant product market of "supermarkets," the proposed merger will not tend to harm competition.

Whether or not the merger was anticompetitive, the market definition inquiry addressed that question at best indirectly. Only clumsily could it ask how strongly Whole Foods and Wild Oats were differentiated from traditional supermarkets. To this key question, it was open to only two answers: either they are so strongly differentiated that they are (almost) their own separate market, making it a merger (almost) to monopoly, or they are so weakly differentiated that one should treat them as two rather small players among all supermarkets.[15]

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[14] Federal Trade Commission v. Whole Foods Mkt., Inc., 502 F. Supp. 2d 1 (D.D.C. 2007), p. 36. The FTC appealed and won a remand; 533 F.3d 869 (C.A.D.C., 2008). This case was resolved in March 2009 with a consent order requiring Whole Foods to sell 32 premium natural and organic supermarkets and related assets. See http://www.ftc.gov/os/adjpro/d9324/index.shtm.

[15] In other cases, antitrust agencies have been unable to block a merger due to their inability to establish the precise boundaries of the relevant market. For example, the DOJ sued to stop Oracle from acquiring PeopleSoft. The DOJ showed that Oracle and PeopleSoft were important, direct competitors in high-function human relations management (HRM) and financial management systems (FMS) software, for which their proposed merger would have reduced the number of major competitors from three (SAP being the third) to two. But the court observed some competition from other suppliers and ruled that the DOJ had failed to establish its proposed relevant product market and thus could not invoke the structural presumption. Although

Neither answer seems a good way of expressing substantial-but-not-overwhelming product differentiation. Neither fits well with the economic way of thinking. In this paper we explore an approach that draws much more directly on very basic and general economic principles.

2. Pricing Pressure Effects of a Merger

Merger investigation usually begins by considering the merger's effects on pricing incentives, holding fixed the set of products.[16] When rivals merge, there are two direct effects on pricing incentives. First, the merging firms no longer compete with each other to attract customers: this generically encourages higher prices.[17] Second, the firms' assets can now be managed jointly to achieve efficiencies: this can lower marginal costs, encouraging lower prices.

We quantify the loss of direct competition in terms that can be directly compared against estimates of marginal-cost efficiencies. We then specialize the extremely robust and general underlying economic idea to the standard Bertrand setting.

A. Quantifying Cannibalization

Consider a merger between rival Firms A and B, whose profits are denoted by π_A and π_B. Before the merger, each firm set prices and perhaps made other decisions (advertising, R&D spending, etc.) to sell its products. Following a standard idea in unilateral-effect analysis, think of the merged firm as operating the former Firms A and B as Divisions A and B. Suppose, for now, that the merger involves no efficiencies.

Consider a sales-boosting variable z (below, this will often be price, measured inversely) chosen by Firm A before the merger. The merger changes incentives because the merged firm newly takes into account the impact of z on

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sophisticated customers testified that they would be harmed by the loss of competition, the merger was permitted to go forward.

[16] The focus on prices is partly a matter of convenience, partly reflects a view that incentives to raise prices would be echoed in incentives to compete less hard in other ways, and partly reflects the fact that U.S. antitrust law generally evaluates mergers based on their impact on consumers.

[17] Some horizontal mergers cause *no* loss of competition. For example, in a Cournot industry in which firms produce at low marginal cost up to capacity, a merger that does not concentrate capacity too much will not change short-run incentives for production up to capacity. But in a differentiated-product framework, any horizontal merger typically encourages at least some price increase if there are no efficiencies.

π_B: since A and B are rivals, an increase in z will lower π_B, because some of the sales won by A when it increases z are cannibalized from B.

Using the implicit function theorem, the change in the profit-maximizing level of z resulting from the merger can broadly be gauged by $\pi_B'(z)/[-\pi_A''(z)]$.[18] The numerator captures the cannibalization of B's profits by changes in z. But, as we discuss in Section 3, when z corresponds to the firm's price, the denominator, $\pi_A''(z)$, depends on the curvature—not just the elasticity—of the firm's residual demand curve. This is a difficult quantity to estimate and does not seem the stuff of simple diagnostics that can be used for screening purposes.

Instead, we normalize the numerator $\pi'(z)$ differently, and in a way that has a natural economic intuition. We treat cannibalization as an opportunity cost of selling more of a product. Suppose that when Firm A increases z it stimulates the sales of A's Product 1 according to $X_1(z)$. After a merger Division A internalizes the effect of z on π_B, and this affects A's incentives in choosing z just as would a per-unit tax of $-\pi_B'(z)/X_1'(z)$ on Product 1.[19] We argue below that these first-derivative terms are likely to be much easier to estimate than terms based on second derivatives. The fundamental idea of our approach is that when this tax is substantial, one can expect a reduction in z and hence in the output of Product 1.

This core idea is very general; we now make it more concrete by specializing to the simple case of single-product static Bertrand competitors with differentiated products.[20] Firm A sells Product 1 at price P_1, and Firm B sells Product 2 at price P_2; their marginal costs are C_1 and C_2. The pre-merger values of these variables are denoted by $\overline{P}_1$, $\overline{P}_2$, $\overline{C}_1$, and $\overline{C}_2$. After the merger, corporate headquarters wants Divisions A and B to maximize joint profits, which pre-merger equilibrium prices fail to do. Headquarters can control this cannibalization in a decentralized manner through an internal tax on each Division's output: this tax is equal to the incremental profitability of the business

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[18] More precisely, if one thinks of Firm A purchasing a share θ of Firm B, and holds fixed Firm B's strategy, then $dz/d\theta \approx -\pi_B'(z)/\pi_A''(z)$.

[19] In general, Firm A may choose several strategic variables, including various prices, each of which affects the sales of Product 1 and Firm B's profits. The ratio can differ for the different variables; we focus on the own-price effect.

[20] As will become clear, the assumptions we actually use below are considerably weaker.

cannibalized. Then each Division can continue to maximize its own profits, but now net of these internal taxes.[21]

We begin by calculating the *first-round* value of the tax—that is, the inter-division externality evaluated at pre-merger prices, outputs, and costs. (Proposition 2 will later characterize equilibrium values of the taxes, but we will argue that the first-round value is more helpful.)

This first-round tax on Product 1 is $\overline{T}_1 \equiv \left| \frac{d\pi_B}{dX_1} \right|$. Because Firm B has set its price P_2 to maximize its profits, the envelope theorem allows us to calculate the impact of a change in P_1 on B's profits as if P_2 did not change.[22] We can thus re-write the first-round tax as $\overline{T}_1 \equiv \frac{d\pi_B}{dX_2} \left| \frac{dX_2}{dX_1} \right|$, where:

$\frac{d\pi_B}{dX_2}$ is the change in B's profits if sales of Product 2 increase by one unit, holding fixed its price: that is, its absolute gross margin, $\overline{P}_2 - \overline{C}_2$.

$\left| \frac{dX_2}{dX_1} \right|$ measures the impact on sales of Product 2 when P_1 falls by enough to sell one more unit of Product 1: this is the diversion ratio from Product 1 to Product 2, at pre-merger prices, which we denote by D_{12}.

Therefore, the first-round tax on Product 1 is equal to

$$\overline{T}_1 = D_{12}(\overline{P}_2 - \overline{C}_2). \quad (1)$$

Similarly, the first-round tax on Product 2 is $\overline{T}_2 = D_{21}(\overline{P}_1 - \overline{C}_1)$. Since Products 1 and 2 are substitutes, $\overline{T}_1$ and $\overline{T}_2$ are both positive.

Starting with these first-round taxes, the effect of the merger can be viewed as the result of the following iterative procedure: (a) impose internal taxes $\overline{T}_1$ and $\overline{T}_2$ on Divisions A and B; (b) allow the oligopoly to re-equilibrate;[23] (c) re-

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[21] This is of course a very familiar idea in mechanism design and welfare economics. See for instance Groves and Loeb (1979). This assumes that the reaction functions of firms other than Firms A and B do not shift as a result of the merger. As noted above, this is the general definition of "unilateral effects" that we adopt here.

[22] This expression for the impact on B's profits is where the Bertrand assumption comes in, in a very weak form. For instance, if for any other reason the price of Product 2 would not change in response to a change in *z*, the same expressions would hold.

[23] Since prices are strategic complements, re-equilibration raises prices at each stage. So, with constant marginal costs and constant diversion ratios in the relevant range, the tax rates must rise

calculate the internal taxes at these new prices and outputs; and then repeating steps (a) through (c) until convergence.

The motive force behind the unilateral price effects of the merger can thus be thought of as an initial increase of $\overline{T}_1$ and $\overline{T}_2$ in the marginal costs of Product 1 and 2. The equilibrium unilateral price effects are those that result from working through a shift in Product 1's marginal cost (a non-uniform shift that, at pre-merger output, is an increase of $\overline{T}_1$), along with an analogous cost increase for Product 2. Other firms' cost functions do not shift, and nor do their reaction functions in "unilateral effects." It is reasonable to expect that an increase in some firms' marginal costs, with no shift in other firms', at least weakly raises equilibrium prices.[24] We express this very general idea by saying that the loss of competition between Firms A and B causes gross upward pricing pressure.

We thus view $\overline{T}_1$ as a measure of the initial impetus for Product 1's price to rise as a result of this loss of competition. But it would be a radical (and highly questionable) policy to forbid all mergers involving some Product 1 with $\overline{T}_1 > 0$, and it would be wasteful overkill to flag all such mergers as problematic. Rather, one would look for $\overline{T}_1$ to be in some sense "substantial;" indeed the Clayton Act refers to a "substantial" harm to competition. In Subsections B and C, we present a clean and simple interpretation of what is "substantial" that fits well with widespread assertions that (a) merger enforcement's goal is to protect consumers against price increases due to loss of competition, and that (b) there is no "tolerance" for small anticompetitive price increases. We then discuss some broader interpretations.

B. Merger Efficiencies

By permitting combinations of factors that it would be hard to bring together across organizational boundaries, a merger can lower costs. If it reduces marginal cost, this factor mitigates and can reverse the upward pricing pressure measured by $\overline{T}_1$. Because $\overline{T}_1$ is a virtual marginal cost, it is directly comparable with marginal-cost efficiencies.

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at each stage. Echenique (2002) shows that with strategic complements one can analyze equilibrium comparative statics of stable equilibria using this kind of dynamics. This is also assumed in using Newton's method for merger simulation, as in Froeb et al. (2005).

[24] See, for example, Deneckere and Davidson (1985). Weyl and Fabinger (2009) show such a result with symmetry and the assumption that each firm's pass-through rate is less than 100%. This result also follows if the products are strategic complements.

That fundamental logic could be implemented using a variety of means to estimate marginal-cost efficiencies from a particular proposed merger. For specificity, however, and because this is not an article about how to estimate merger-specific efficiencies, we illustrate using a starkly simple default value for efficiencies. Since merger-specific efficiencies are often very hard to predict, even for the firms themselves but especially for antitrust agencies and courts, and since we are seeking a simple initial screen, we explore the approach (in line with current practice) of postponing detailed evaluation of merger efficiencies. Along those lines, the simplest preliminary test would credit some default marginal-cost efficiencies for each overlap product. Following Warren-Boulton (1985), we call this the "standard deduction:" merging parties need not prove these efficiencies ("itemize"), which could broadly reflect evidence of efficiencies in ordinary or comparable mergers.[25] Indeed, this idea might lie behind the established policy of allowing most horizontal mergers without special showings of efficiencies.

To illustrate how such "default efficiencies" can be balanced against the opportunity cost terms developed above, we simply assume here that Product 1 is credited with default efficiencies equal to $E_1\overline{C}_1$, and Product 1 is credited with default efficiencies equal to $E_2\overline{C}_2$. While the default efficiencies could be set at a constant fraction of pre-merger marginal cost for all overlap products, giving $E_1 = E_2 = E$, this would likely be too stark: for instance, it would imply that a large product experiences such efficiencies from merging with a small rival product.[26] In other cases, a merger may lead to improved product quality, which is not naturally measured as a percentage of marginal cost. The precise way in which default efficiencies are handled is not central to our main line of argument.

Indeed, the default efficiency parameter need not be thought of narrowly in terms of marginal-cost efficiencies. Viewed more generally, it establishes a threshold in terms of gross upward pricing pressure, above which mergers are subjected to further scrutiny. The optimal threshold level could depend upon a

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[25] The extent to which mergers in general, or horizontal mergers in particular, generate efficiencies is the subject of some debate. For example, Röller, Stennek, and Verboven (2006) survey the literature on merger efficiencies, concluding (p. 112) that "there seems to be no support for a general presumption that mergers create efficiency gains," although they find efficiency gains in particular cases. The logic underlying the approach we advocate here, and its virtues, do not depend upon one's optimism or pessimism about the ability of mergers to create synergies. The default efficiency parameter can be set accordingly. This parameter also can be set to reflect other considerations, such as the costs of false positive and false negative test results at the screening stage.

[26] With firm-level declining marginal costs, the merged firm will have a lower marginal cost than either merging firm, and the reduction in marginal cost will be larger for the smaller product.

variety of decision-theoretic considerations. We address some of these considerations below in Section 3

C. Net Pricing Pressure

In its pure form, our test asks whether, on balance, the merger causes upward pricing pressure. Intuitively—with a caveat described below—it does so for Product 1 if the cannibalization term $\overline{T}_1$ exceeds the default marginal-cost efficiencies credited to Product 1. This test thus flags mergers that may significantly harm competition in the sense that, net of credited efficiencies, they create upward pricing pressure.

If the merger creates net UPP for Product 1, basic economic theory unambiguously predicts that the price of Product 1 will rise, holding fixed other prices and products.[27] That is, net UPP shifts Product 1's price *reaction function* locally upward.[28] Below, we offer some formal sufficient conditions for such a shift to raise equilibrium prices, but we think that robust and intuitive inference is a sensible basis for real-world policy.

In general the gross upward pricing pressure term $-\pi_B'(z)/X_1'(z)$ depends on the nature of demand and oligopoly interactions, as we discuss below. With two single-product, Bertrand price-setting firms, the merger creates net upward pricing pressure for Product 1 if

$$D_{12}(\overline{P}_2 - C_2) > E_1\overline{C}_1 . \tag{2}$$

The left-hand side of inequality (2) depends upon the margin between price and marginal cost for Product 2, accounting for any efficiencies for Product 2. Crediting Product 2 with its default efficiencies implies that $C_2 = \overline{C}_2(1-E_2)$, in which case inequality (2) becomes

$$D_{12}(\overline{P}_2 - \overline{C}_2(1-E_2)) > E_1\overline{C}_1 . \tag{3}$$

In inequality (3), greater default efficiencies for Product 2 cause more upward pricing pressure for Product 1, as we discuss in subsection D below. While this is technically correct, it has the unattractive property that it seemingly

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[27] Given a demand curve, the inference that an increase in marginal cost leads a profit-maximizing firm to set a higher price is extremely general. Indeed, it seems plausible that even a firm that does not maximize profits will typically raise its price in response to an increase in its marginal cost.

[28] As discussed below, it is possible that the price will barely rise, or in the extreme case remain unchanged, in response to strictly positive net UPP. We explain below why this possibility is best treated as a rebuttal to an initially heightened level of concern that net UPP will lead to a significant price increase.

could flag a merger for further scrutiny because of credited efficiencies. A simpler formula for upward pricing pressure for Product 1, which avoids this criticism, can be obtained by using the pre-merger marginal cost of Product 2:

$$D_{12}(\bar{P}_2 - \bar{C}_2) > E_1\bar{C}_1 . \quad (4)$$

Inequality (4) is more difficult to satisfy than inequality (3), so (other things equal) it leads to a less strict test. Using inequality (4), we define the net upward pricing pressure on Product 1 as:

$$UPP_1 = D_{12}(\bar{P}_2 - \bar{C}_2) - E_1\bar{C}_1 .$$

We say that the merger causes *upward pricing pressure* for Product 1 if $UPP_1 > 0$, i.e., if inequality (4) is satisfied. Our basic proposal is to flag for closer scrutiny mergers that generate upward pricing pressure.

We can express our basic test in terms of unit-free variables. Define the relative margin (as a fraction of price) on Product 2 as $M_2 \equiv (P_2 - C_2)/P_2$, and likewise for Product 1. Dividing inequality (4) by P_1 and simplifying, $UPP_1 > 0$ if and only if

$$D_{12}\bar{M}_2 \frac{\bar{P}_2}{\bar{P}_1} > E_1(1 - \bar{M}_1) . \quad (5)$$

In the symmetric case, where Products 1 and 2 have the same prices and costs, the diversion ratios are equal in both directions, and the efficiencies credits for both products are the same, the test for upward pricing pressure for either product becomes

$$D\frac{\bar{M}}{1-\bar{M}} > E . \quad (6)$$

To illustrate, with an efficiency credit of 10% and pre-merger margins of 25%, the merger would generate upward pricing pressure if the diversion ratio is greater than 30%.

D. A More Accurate – But More Complex – Test

We have calculated the upward pricing pressure for Product 1, using the pre-merger price and marginal cost of Product 2. Our measure UPP_1 was designed to be based in a simple manner on pre-merger variables, and does not account for the fact that any cost reduction on Product 2 will raise Product 2's margin and thus raise the value of sales diverted to Product 2 when the price of Product 1 rises. Equation (3) above accounts for this, and we pursue it here.

In path breaking work incorporating this feedback, Werden (1996) calculated the critical merger efficiencies for the two products that just

compensate for the loss of competition in a Bertrand industry, leaving both prices unchanged.[29] In our notation, the critical level of $\hat{E}_1$ is given by

$$D_{12}(\overline{P}_2 - \overline{C}_2) + D_{12}D_{21}[\overline{P}_1 - \overline{C}_1] = \hat{E}_1\overline{C}_1[1 - D_{12}D_{21}], \qquad (7)$$

with a corresponding condition for $\hat{E}_2$.[30] Following Werden, one could use equation (7) to measure upward pricing pressure for Product 1 as

$$D_{12}(\overline{P}_2 - \overline{C}_2) + D_{12}D_{21}[\overline{P}_1 - \overline{C}_1(1 - E_1)] - E_1\overline{C}_1.$$

which equals $UPP_1 + D_{12}D_{21}[\overline{P}_1 - \overline{C}_1(1 - E_1)]$.

This expression is greater than UPP_1. Once feedback effects are included, somewhat larger efficiencies are required to keep prices from going up than are captured using our upward pricing pressure tests for the two products.

One could use this expression rather than $UPP_1 = D_{12}(\overline{P}_2 - \overline{C}_2) - E_1\overline{C}_1$ as a diagnostic measure. This would have the advantage of greater accuracy, and the two measures based on Werden (1996) require no additional data than are required to calculate UPP_1 and UPP_2. However, the basic economic logic of viewing $D_{12}(\overline{P}_2 - \overline{C}_2) - E\overline{C}_1$ as a measure of net upward pricing pressure seems much more transparent than introducing simultaneous equations, as (7) requires. Using UPP_1 accords with our emphasis on simplicity and transparency. UPP_1 does not seem more complex than the HHI measures which feature prominently in the Guidelines.

We can see how big a difference it would make to use the more complex but more accurate expression. In the symmetric case, equation (7) implies upward pricing pressure if

$$\frac{D}{1-D}\frac{\overline{M}}{1-\overline{M}} > E.$$[31]

This inequality is easier to satisfy than inequality (6). It is equivalent to performing our test using an efficiency credit of $E(1-D)$. Our simpler approach will lead to false negative test results when D is moderately high and $\overline{M}$ is relatively low. To illustrate, with a 10% efficiency credit and a diversion ratio of one-third, $UPP > 0$ if $\overline{M} > 0.23$, while the more accurate test shows prices going up if $\overline{M} > 0.17$.

When the two products are close competitors, say $D > 0.25$, evaluating upward pricing pressure using UPP can significantly underestimate the loss of

[29] For a Cournot version, see Farrell and Shapiro (1990).
[30] See Werden (1996), equation (5) on p. 411.
[31] Werden (1996) reports this result as a special case of his analysis.

competition. This could cause a worrisome merger to be overlooked, especially if the competition between the two merging firms is the reason why pre-merger margins are relatively low. In such cases, the merger could still be flagged for further review by using the more complex measure of upward pricing pressure. Alternatively, one could perform the traditional market definition exercise and ask whether a hypothetical monopolist controlling both products could profitably raise prices a small but significant amount above pre-merger levels.

E. Upward Pricing Pressure Leads to Higher Prices

Our test has the enormous practical virtue that it relies only on pre-merger data on prices and costs, along with the key feature of demand that is inherently central to unilateral effects: the diversion ratio, D_{12}.[32] This simplicity depends on asking only about the presence or absence of net upward pricing pressure. As discussed below, the *magnitude* of the price change will depend in a more complex and less transparent way on the overall demand system and on oligopoly conduct. Thus we propose that any such calculations, perhaps including merger simulation, should normally await the fuller analysis that follows the raising of a flag based on UPP.

Our focus on UPP is justified by the following Proposition:

Proposition 1: Suppose that the price charged by the merged firm for each product is increasing in the marginal cost of that product and non-decreasing in the marginal cost of the other product, over the relevant range of costs. If there is net upward pricing pressure for both products, then a merger with no more than the default level of efficiencies raises the prices of both products.

Proof: Denote by $\boldsymbol{P}^*(\boldsymbol{C})$ the function mapping a pair of post-merger marginal costs to a pair of post-merger prices. Define $\hat{C}_1 = \overline{C}_1(1-\hat{E}_1)$, where $\hat{E}_1$ is defined using equation (7), and likewise for Product 2. Solving equation (7) for $\hat{E}_1$ tells us that $D_{12}(\overline{P}_2 - \overline{C}_2) < \hat{E}_1\overline{C}_1$. With net upward pricing pressure for both products, we have $E_1\overline{C}_1 < D_{12}(\overline{P}_2 - \overline{C}_2)$ and likewise for Product 2. Therefore, we know that $E_1\overline{C}_1 < D_{12}(\overline{P}_2 - \overline{C}_2) < \hat{E}_1\overline{C}_1$, so $E_1\overline{C}_1 < \hat{E}_1\overline{C}_1$ and likewise for Product 2. This in turn implies that $\overline{C}_1(1-E_1) > \overline{C}_1(1-\hat{E}_1)$. Applying the $\boldsymbol{P}^*(\boldsymbol{C})$ function to each side, and using the monotonicity of $\boldsymbol{P}^*(\boldsymbol{C})$, we have

[32] Models of unilateral effects in price-setting games in which market shares matter typically reach this result by assuming that diversion ratios mirror shares: see Willig (1991) and our discussion in Section 6 below.

$\boldsymbol{P}^*(\bar{\boldsymbol{C}}(1-\boldsymbol{E})) > \boldsymbol{P}^*(\bar{\boldsymbol{C}}(1-\hat{\boldsymbol{E}}))$. (Here we multiply vectors according to $(\mathbf{xy})_i = \mathbf{x}_i\mathbf{y}_i$.) The right-hand side of this inequality is $\boldsymbol{P}^*(\hat{\boldsymbol{C}})$, which by construction is equal to $\bar{\boldsymbol{P}}$, the pre-merger price vector. The left-hand side is the vector or post-merger prices for a merger that generates the default efficiencies. We thus have shown that this merger causes both prices to rise. Again using the monotonicity of the $\boldsymbol{P}^*(\boldsymbol{C})$ function, a merger that generates smaller efficiencies leads to even higher prices. Q.E.D.

Proposition 1 relies on the assumption that the price charged by the merged firm for each product is increasing in the marginal cost of that product and non-decreasing in the marginal cost of the other product, over the relevant range of costs. While this assumption seems very reasonable for screening purposes, Edgeworth's paradox of taxation tells us that it is not always met; see Weyl (2009). A milder assumption, sufficient for merger enforcement using a consumer surplus standard, is that consumer surplus is decreasing in the marginal cost of each product. Following the same logic as in the proof of Proposition 1 with that assumption proves:

Corollary: Suppose that post-merger consumer surplus is decreasing in the cost of each product. If there is net upward pricing pressure for both products, then a merger with no more than the default level of efficiencies reduces consumer surplus.

Proposition 1 and this Corollary provide a formal theoretical justification for our test, somewhat as results about Cournot equilibrium, or differentiated product competition with logit demand, formally justify a focus on concentration and shares. But our test has power because it captures the idea, much more general than the formal Proposition 1, that the loss of competition between the merging firms is significant enough to outweigh the efficiencies presumed to result from the merger—somewhat as tests based on market shares have power because they capture the general idea that high share encourages output restriction by lowering marginal revenue.

F. Non-Bertrand Behavior

The fact that a merger between Products 1 and 2 will raise the opportunity cost of selling additional units of Product 1, by internalizing the sales gained at the expense of the substitute Product 2, is extremely general. So is the idea that this increase in marginal cost will elevate the price of Product 1 and harm consumers. Furthermore, this opportunity cost generally varies with the margin on Product 2.

However, we derived our specific measure of upward pricing pressure using the assumption of classic, Bertrand price setting behavior between the two merging firms. Outside that case, if one represents the marginal profit

cannibalization on Product 2 when Product 1 attracts an additional unit of sales by lowering its price as $D_{12}(P_2 - C_2)$, the standard definition of the diversion ratio, D_{12}, will not be precisely correct. Glen Weyl has shown how the formula continues to apply if one substitutes a modified diversion ratio that calculates changes in each product's sales varying P_1, holding fixed P_2, but applying the actual equilibrium oligopoly strategies of other firms in the industry.[33]

Intuitively, the more pre-merger "accommodation" there is between the two merging firms, other things equal, the smaller is the short-run loss of competition due to the merger, and hence the smaller is the marginal-cost efficiency that will compensate. This intuition is at least consistent with the polar case in which Firms A and B fully coordinate their pricing, whether through an explicit collusive scheme, a tacit replica of such a scheme, or merely consciously parallel pricing. In that case, there is no competition between A and B to be lost through their merger, and any marginal-cost efficiency will create downward pricing pressure, relative to a continuation of the status quo.

Nonetheless, UPP_1 might well signal a concern based on unilateral effects. As a purely technical matter, this would constitute a false positive. In a broader merger-review context, however, this technical false positive is of real concern only if one would not really want to flag such a merger for further scrutiny. To be flagged by UPP_1, the merger would involve two products viewed by consumers as relatively close substitutes (as a relatively high value for the standard diversion ratio genuinely indicates, whatever oligopoly conduct may be), that currently limit their competition with one another, and that face competition from other firms' products that is limited enough so that these products have relatively high margins. Although the assumptions lying behind the UPP_1 screen do not strictly apply under these conditions, we would suggest that scrutiny is appropriate for

[33] Glen Weyl (2010a). If the oligopoly strategies of the other firms take the form of supply functions, holding these supply functions fixed is not generally the same as holding their prices (or outputs) fixed. Both the generality of the overall concept and the subtlety sometimes required for non-Bertrand cases are illustrated by the Cournot model of oligopoly with a homogeneous product. In that model, the sales of Product 2 do not adjust when Firm A changes its output of Product 1, but the (common) price does change. Farrell and Shapiro (1990) show that the formula for upward pricing pressure that we derived above for Bertrand competition applies in a Cournot market, but with a rather artificial diversion ratio of unity: they show (equation (7), p. 112) that a merger between Firms A and B in Cournot oligopoly will raise price if the pre-merger (absolute) margin at Firm B is greater than the reduction in marginal cost at Firm A and conversely. The Cournot diversion ratio is unity in Weyl's sense if one takes the limit of differentiated product equilibria as firms' products become undifferentiated.

such a merger. The technical false positive would be an accidental feature, not really a bug.

Given the desirability of having a simple indicator based on the underlying economics to flag when a horizontal merger seems apt to cause adverse unilateral effects, we propose using inequality (4) for screening purposes, while recognizing that the merging firms may well not be setting prices independently in a Bertrand fashion. If the UPP diagnostic signals concern, the manner in which the two merging firms interact can then be studied more closely as part of an in-depth analysis. If the merging firms are found to be setting their pre-merger prices in a relatively independent manner, the initial assumption underlying the UPP test would have proved accurate. If the firms are found to be coordinating their pre-merger prices, the inquiry might well focus more on theories of coordinated effects rather than unilateral effects. While no simple screen is flawless, the value of further analysis following a UPP test is not very different from what happens following the familiar HHI test: the many possible reasons why concentration may not accurately gauge competitive effects are set aside for further analysis. Inequality (4) certainly seems more grounded in economic logic as a screen for unilateral effects than do HHIs, which themselves follow an often complex and delicate market definition exercise.[34]

G. Measurement Issues

How practical is it to measure pre-merger gross margins (most obviously by measuring prices and marginal costs), and the diversion ratios between the two products? Before addressing that question in detail, we stress two overarching points. First, we do not claim that our test is *always* tractable, only that it often is. Second, such variables must also be measured for critical loss analysis, a common quantitative technique of market definition.[35] Any method of implementing the hypothetical monopolist test must estimate how customers respond to price changes.

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[34] The HHI approach to screening and our UPP test share the feature, or bug, that they do not capture differences across industries in their pre-merger patterns of pricing dynamics. The UPP test avoids the policy error of allowing firms to permanently eliminate competition between them through merger just because they have temporarily found a way to soften competition through accommodating behavior. The Guidelines seek to avoid this error while using HHIs by not taking the SSNIP from the prevailing price if there are strong indications of pre-merger coordination.

[35] More precisely, gross margins are essential for critical loss analysis, and "aggregate" diversion ratios are necessary if such analysis is to use the evidence of firms' own pre-merger pricing choices. See Farrell and Shapiro (2008) and references therein.

1. Measuring Gross Margins

Gross margins are commonly measured in predatory pricing litigation, where the question of whether price is above or below cost tends to be central. Areeda and Turner (1975) argued that marginal cost may be hard to observe. However, in the predatory pricing context cost is apt to be near price and/or relatively hard to observe (else there might not be actual litigation), and differences between "just above" and "just below" may matter a lot. In many potentially troubling mergers, by contrast, gross margins are fairly high, and the result of the UPP test may not be sensitive to the precise measurement of marginal cost.[36]

Research economists have also attempted to measure price/cost margins in different industries. These efforts are reflected in the large empirical industrial organization literature analyzing the determinants of gross margins, often at a relatively aggregated industry level.[37] A recognized criticism of this literature is that gross margins are hard to measure using public data (such as the financial accounting reports required of publicly traded firms) and methods sufficiently standardized for cross-sectional studies. However, firms have an incentive to keep track of their cost functions via managerial accounting tools, for instance to know how far they can profitably cut prices. Such information is seldom available to academic researchers, but normally is available to antitrust agencies and courts. In our experience, agency economists are often able to measure gross margins with good accuracy using the information available under the Hart-Scott-Rodino Act.

2. Measuring Diversion Ratios

The diversion ratio might be estimated using evidence generated in the merging firms' normal course of business. Firms often track diversion ratios in the form of who they are losing business to, or who they can win business from. Customer surveys can also illuminate diversion ratios,[38] as can information about customer switching patterns. Diversion ratios can also be estimated via econometric methods, but this is more likely to be practical as part of the full, back-end analysis than at the initial screening stage.

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[36] To illustrate, consider the symmetric case in which the price is \$100 per unit, the marginal cost is estimated at \$60 per unit, so the margin is $M = 0.4$. Suppose that $E = 0.1$. The merger creates net UPP if and only if $D > 0.15$. If marginal cost is instead only \$50, then $M = 0.5$ and the test becomes $D > 0.10$.

[37] See Schmalensee (1989) and Salinger (1990).

[38] Reynolds and Walters (2007) describe the use of surveys, notably to measure diversion ratios, by the UK Competition Commission.

In bidding markets, the diversion ratio is the probability that Product 2 is the buyer's second choice when Product 1 wins.[39] Agencies and courts often have access to data on how buyers ranked bidders in past bidding events, or at least which firms bid and which won.

3. Sensitivity Analysis

For clarity we have presented our test in terms of point estimates for the gross margin, the diversion ratio, and the default efficiencies. But because the logic of the UPP test is explicit, one can use sensitivity analysis intelligently.[40]

3. Pass-Through: From Pricing Pressure to Competitive Effects

In principle, one would like to estimate the magnitude of any post-merger price changes.[41] In this section we discuss the prospects for making such estimates at the screening stage, and the information this would require, beyond that needed to measure upward pricing pressure.[42] We defer until Section 5 our discussion of structural estimation of price effects using full-blown merger simulation.

We explain in this section why it is easier and far more robust to predict the *sign* of a merger's price effects than to predict their *magnitude*. The UPP test gains generality, robustness, and elegance from eschewing attempts to estimate magnitudes. The critical ingredient for the test, as applied to Product 1, is a single feature of demand, namely the diversion ratio to Product 2. As explained in this section, estimating the magnitude of the post-merger price increase for Product 1 requires information about the rate at which cost increases are passed through into price increases. And pass-through rates depend upon the *curvature* of demand.

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[39] On unilateral effects in bidding markets, see Werden and Froeb (2007) and Klemperer (2007).

[40] For example, suppose one believes the relative gross margin is between one-third and one-half. Using the illustrative efficiency parameter of 10%, with a relative gross margin of one-third, there is upward pricing pressure if the diversion ratio is at least 20%; with a relative gross margin of one-half, there is upward pricing pressure if the diversion ratio is at least 10%. Then one could infer upward pricing pressure if the diversion ratio is clearly more than 20%, and need not develop a precise estimate. On uncertainty in the antitrust analysis of mergers see Katz and Shelanski (2007).

[41] Strictly, one wants to compare what will happen if the merger takes place with what will happen if it does not; the language of "post-merger" versus "pre-merger" outcomes is well established as a shorthand for this comparison.

[42] Our analysis here need *not* apply to the use of more direct evidence for the purpose of estimating post-merger price effects, such as by comparing past prices before and after entry or exit by one of the merging firms.

While information about pass-through rates can certainly be useful when available, in our experience that is rarely the case at the initial screening stage.

As a practical matter, then, one is left with two choices for an initial screen: (1) base the screen on the direction, but not the magnitude, of predicted price effects, which means using some measure of upward pricing pressure, or (2) adopt a default assumption about the pass-through rate, such as is implied by assumptions about the form of conduct and the curvature of demand, or by general learning about pass-through. We explore the second route in this section.

A. Price Effects Depend Upon Pass-Through Rates

We have emphasized that, by internalizing the cannibalization of sales of the former rival's product, a merger introduces an opportunity cost. Taking this idea one step further, the price effects of a merger can be thought of as the pass-through of that new cost, net of efficiencies.

Proposition 2: Corporate headquarters can decentralize the post-merger equilibrium prices P_1^* and P_2^* by imposing taxes $t_1^* = D_{12}^*(P_2^* - C_2^*)$ and $t_2^* = D_{21}^*(P_1^* - C_1^*)$ on the divisions which sell Products 1 and 2 and are operated to maximize divisional profits.

Intuitively, the specified taxes internalize the externality imposed on the other division when one division sells one more unit. Therefore, the first-order condition for divisional profits, at the post-merger prices, is the same as the first-order condition for joint profit maximization.

Note that the variables in Proposition 2 are measured at post-merger levels. Proposition 2 thus does not provide a constructive method of calculating post-merger prices. But Proposition 2 shows how we can intuitively think of the merger's price effects as the pass-through of a cost shift for the merging firms' products, without any change in industry structure. Costs shift upwards due to the "internalization tax" and, possibly, downward due to merger-specific efficiencies.

B. Pass-Through Rates Are Hard to Estimate

This discussion shows the importance of the rate at which cost increases are passed through into higher prices. Importantly, this is not the pass-through rate for industry-wide uniform cost increases (widely studied in the public finance literature). Rather, it is the pass-through rate for cost increases that apply only to the merging firms' products.

Given other prices, profit-maximizing pass-through of a single-product cost shock is complex but well understood. Consider a firm with constant

marginal cost C facing demand $X(P)$ with elasticity $\varepsilon(P) = -\frac{P}{X}\frac{dX}{dP} > 1$. Bulow and Pfleiderer (1983) show that the pass-through rate is

$$PTR \equiv \frac{dP}{dC} = \frac{\varepsilon}{\varepsilon - 1 + (P/\varepsilon)(d\varepsilon/dP)}.$$

For constant elasticity demand, $PTR = \frac{\varepsilon}{\varepsilon - 1} > 1$, and at the profit-maximizing price, $PTR = P/C$. More generally, writing the elasticity of the slope of the demand curve as $\beta \equiv \frac{PX''(P)}{X'(P)}$, we have

$$PTR = \frac{1}{2 + \beta M}.$$

For linear demand, $\beta = 0$ and $PTR = 1/2$. For a convex demand curve (including most non-linear functional forms that economists use), $X''(P) > 0$ so $\beta < 0$ and $PTR > 1/2$. For a concave demand curve, $X''(P) < 0$ so $\beta > 0$ and $PTR < 1/2$.

Summarizing, the pass-through rate for cost changes applying to a single product, holding all other prices fixed, depends on the *second* derivative of the demand function for the product. The second derivative is typically very hard to determine in a simple manner suitable at the initial screening stage, if at all.

And the situation is even more complex in an oligopoly setting. In an oligopoly, the equilibrium price effects of a cost shock that applies to one firm depend upon the pricing responses by rival firms. With upward sloping reaction schedules in Bertrand oligopoly, this implies higher pass-through rates than in the single-firm case, but in a way that depends on oligopoly behavior and the whole demand system. And these effects can matter a lot. For the proposed MCI-Sprint merger, Froeb et al. (2005) found that the estimated price effect using constant-elasticity demand was over seven times greater than that using linear demand; Slade (2009) simulated UK beer mergers and likewise found striking differences. As Froeb et al. (2005) observe, because demand curvature is difficult to estimate, it is typically *assumed* via choice of functional form for the demand system.[43] This modeling choice imposes a link between estimated point elasticity and

[43] In merger simulation, Froeb et al. (2005) observe that the estimated pass-through of merger efficiencies depends on the choice of demand system (and show that this dependence can matter quite dramatically), and that demand systems that yield higher estimates of pass-through of efficiencies also yield higher "competitive effects" (predicted price increases on the assumption of no efficiencies). Our Proposition 2 explains this observation, by noting that competitive effects *are* the pass-through of the cannibalization terms.

estimated curvature. Furthermore, Proposition 2 tells us that the price effects of the merger depend upon a *pair* of cost shocks that apply to the two products sold by the merging firms.

Equilibrium pass-through rates of asymmetric shocks might be estimated using historical data if we can assume that pass-through rates are constant and if such cost shocks have taken place and their price effects can be observed.[44] In our experience these circumstances are relatively rare even in the back-end analysis, let alone at the initial screening stage.

Proposition 2 warns us that this complexity is unavoidable if one seeks to quantify the price effects of a merger. Because the magnitude of predicted price effects depends so much on factors that are opaque to non-economists and are often assumed rather than estimated, the methodology is hard to make robust and transparent, and unsuitable at the initial screening stage. But there is an alternative: making simple, default assumptions about pass-through rates (equivalently: the curvature of demand) at the initial screening stage. UK competition authorities have described such an approach as the calculation of an "illustrative price rise."[45] These assumptions could then potentially be refined in cases where a full-blown analysis is conducted.

C. Test Based on a "Significant" Price Increase

We now develop several simple tests designed to determine whether the proposed merger, without efficiencies, would lead to a "significant" price increase. This question is posed by the 1992 Guidelines, which consider efficiencies only at the tail end of the analysis. For the purpose of developing these tests, we assume that a "significant" price increase means one that is at least a fraction G of the pre-merger price.[46]

Internalizing the cannibalization effect on Product 1 measured at pre-merger prices and costs would induce a "significant" increase in the price of

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[44] Baker and Bresnahan (1988) rely on such idiosyncratic cost changes to estimate a firm's residual demand curve.

[45] See for instance UK Competition Commission (2005), especially Annex D, and UK Office of Fair Trading (2009).

[46] Some might benchmark G at 5% or 10% via the *Guidelines'* use of the term "small but significant and non-transitory increase in price" ("SSNIP") in market definition; the SSNIP is usually taken to be 5% or 10%. However, the *Guidelines* (§1.0) stress that "The 'small but significant and non-transitory' increase in price is employed solely as a methodological tool for the analysis of mergers: it is not a tolerance level for price increases." Schmalensee (2009) suggests a different potential practical reason for thresholds for price increases: even if there is no "tolerance" in underlying law or policy, the agencies must prioritize among merger investigations.

Product 1 if $R_1\overline{T}_1 > G\overline{P}_1$, where intuitively and loosely R_1 is the equilibrium pass-through rate for cost shocks idiosyncratic to Product 1. Using $\overline{T}_1 = D_{12}(\overline{P}_2 - \overline{C}_2)$, this test asks whether $R_1 D_{12}(\overline{P}_2 - \overline{C}_2) > G\overline{P}_1$, i.e., whether

$$\frac{D_{12}(\overline{P}_2 - \overline{C}_2)}{\overline{P}_1} > \frac{G}{R_1}. \tag{8}$$

However, as we argued above, R_1 is hard to estimate for a given merger, especially at the initial screening stage, and thus requiring such an estimate specific to the merger or even to the industry is not suitable for an initial diagnostic measure. Pending a more fully developed theoretical and empirical literature on these pass-through rates, one sensible way to proceed is to proxy the pass-through rate using a default value, such as $R_1 = 0.5$.[47] With this proxy, inequality (8) becomes

$$\frac{D_{12}(\overline{P}_2 - \overline{C}_2)}{\overline{P}_1} > 2G. \tag{9}$$

This type of test has been advocated by Salop and Moresi (2009) and Moresi (2010), who defines $\frac{D_{12}(\overline{P}_2 - \overline{C}_2)}{\overline{P}_1}$ as the Gross Upward Pricing Pressure Index, or "GUPPI." If *G* is taken to be 5%, inequality (9) becomes

$$\frac{D_{12}(\overline{P}_2 - \overline{C}_2)}{\overline{P}_1} > 0.1. \tag{10}$$

A variation on this basic approach combines (8) with a default allowance for marginal-cost efficiencies, but we do not pursue this here.

All of these tests, like those based on UPP_1 in the previous section, can generate false negative results because they do not fully account for the feedback effects between the two products. As noted above, to quantify price effects one may have to make default assumptions about oligopoly conduct and demand structure, much as merger simulation normally does. Perhaps most simply one could assume for screening purposes a linear demand structure and Bertrand competition. Then one can solve explicitly for the equilibrium price increases, $(P_1^* - \overline{P}_1)/\overline{P}_1$ and $(P_2^* - \overline{P}_2)/\overline{P}_2$ in terms of six unit-free variables: $\overline{M}_1$, $\overline{M}_2$, D_{12},

[47] Holding rivals' prices fixed, the single-firm pass-through rate is one-half with linear demand and higher with convex demand. Accommodating pricing responses by rivals raise the equilibrium pass-through rate. Some may find this an adequate justification in practice for taking one-half as a default value, pending further investigation, although one would not want to apply this to a Cournot industry.

D_{21}, E_1, and E_2.[48] This method is advocated by Schmalensee (2009). In the symmetric case, he shows that the equilibrium price increase is given by[49]

$$\frac{P^* - \bar{P}}{\bar{P}} = \frac{DM}{2(1-D)} - \frac{1}{2}E(1-M).$$

Note that the equilibrium price rises if and only if $\frac{D}{1-D}\frac{M}{1-M} > E$, a condition derived in the symmetric case with *arbitrary* demand by Werden (1996) that we reported above. The payoff to assuming linear demand is that one can go beyond this general result about directionality and quantify the equilibrium price increase, with or without an efficiency credit. However, this approach requires that one impose a great deal of structure on the demand system, and the expressions for the equilibrium price increase become considerably more complex in the asymmetric case.[50]

D. Competition and Low Pass-Through: Could Price Effects Be Small Despite UPP?

While the pass-through rate may generally be hard to quantify, one might hope to identify circumstances in which it is low. In particular, a leading intuitive argument is that a horizontal merger that leaves the industry "workably competitive" is unlikely to be harmful. This depends in large part on what one means by calling an industry "workably competitive."

One meaning would be that gross margins are low. Another would be that the industry is unconcentrated and the merging parties are not especially close competitors. In either case, the product of the diversion ratio and absolute gross margin is low, and the UPP test will not sound the alarm. On the other hand, for a merger with substantial diversion ratios in an industry where gross margins are not small, the predicted price effect can be small only if the relevant pass-through rate is low.

A natural economic intuition suggests that the equilibrium pass-through of cost shocks idiosyncratic to one or two firms in a "fairly competitive" industry will be low. Consistent with this intuition, Bergstrom and Varian (1985) show that in a Cournot oligopoly with *N* active firms and linear demand the equilibrium

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[48] Carl Shapiro, (2009), "Unilateral Effects Calculations", at http://faculty.haas.berkeley.edu/shapiro/unilateral.pdf displays the necessary calculations.
[49] Shapiro (1996) reports this formula in the absence of efficiencies.
[50] See our paper, "Upward Pricing Pressure and Critical Loss Analysis: Response," *Global Competition Review*, 2010, and the calculations in Shapiro (2009) just noted.

pass-through rate of firm-specific cost shocks is $1/(N+1)$, even if the firm subject to the shock has a large share.[51]

But it is easy to see that the intuition is not always reliable. In a differentiated-products industry, as discussed above, a firm can face a highly elastic (residual) demand curve, and yet have a high pass-through rate for idiosyncratic cost shocks. Indeed, if a firm's residual demand is everywhere highly elastic, then its price will be close to its marginal cost, both before and after a change in the latter, so pass-through will be close to 100%. Similarly, as noted above, if the firm faces a constant elasticity of demand and has constant marginal cost, its firm-specific pass-through rate will equal $P/C = 1/(1-M)$, which exceeds 100%. Thus economic theory does not imply that single-firm pass-through rates in a "fairly competitive" differentiated-product industry are low.[52] Weyl (2010b) shows in a differentiated-product framework how single-firm pass-through rates become low as competition increases if residual demand becomes highly elastic much faster than does marginal cost, but do not become low if marginal costs are flatter than residual demand, as in our constant-elasticity example in this paragraph.

Empirically, while pass-through of industry-wide cost shocks (notably commodity taxes) has been studied extensively in public finance, the pass-through of cost shocks that apply to only some competing products has been studied most extensively in international trade.[53] When the yen appreciates relative to the dollar, how do dollar prices of Japanese cars in the US respond? This large literature generally finds that in the longer run they respond substantially, although the response is highly variable.[54] A distinct smaller literature explores firm-specific pass-through rates.[55]

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[51] Linear demand brings this principle into closed form, but a version of it applies for any demand function. Adding the firms' first-order conditions and rearranging yields $P(1-1/(N\varepsilon)) = \overline{C}$, where ε is market demand elasticity and $\overline{C}$ is the (unweighted) mean value of marginal costs among active firms.

[52] We particularly thank Glen Weyl for helpful discussions on this topic (though he does not necessarily agree with our interpretations). See Weyl and Fabinger (2009) for an extensive treatment of pass-through rates, showing how pass-through rates are central to a wide range of comparative statics results in oligopoly.

[53] Goldberg and Knetter (1997) report finding almost 700 articles on this topic; an important early contribution is Dornbusch (1987) In antitrust analysis see Ashenfelter et al. (2006) on pass-through in the Staples case.

[54] The trade literature often estimates the *elasticity* of price with respect to own marginal cost, which is equal to c/p times the industrial organization concept of pass-through rate, dp/dc. Thus a finding of less than 100% elasticity of pass-through is consistent with pass-through being,

In our present state of understanding we thus think that arguments that pass-through will be low should require much more evidence and analysis than simply an observation that the industry is fairly competitive. Correspondingly, we think a preliminary screen should flag a horizontal merger with a hefty cannibalization term, as reflected by $UPP_1 > 0$ or by $\frac{D_{12}(\bar{P}_2 - \bar{C}_2)}{\bar{P}_1} > 2G$, even when the industry is "fairly competitive." However, investigation of pass-through may be one means to exculpate such a merger. This is analogous to the established practice of flagging concentrating mergers in concentrated industries but standing ready to let them through if the parties adduce (in the words of *Philadelphia National Bank*) "evidence clearly showing that the merger is not likely to have such anticompetitive effects."

4. Further Analysis of Competitive Effects

Real-world mergers are complex, and our proposed test, like the concentration-based test, is consciously oversimplified. When $UPP_1 > 0$, or when $\frac{D_{12}(\bar{P}_2 - \bar{C}_2)}{\bar{P}_1} > 2G$, further scrutiny of the merger is indicated. In the end, the evaluation of any merger that is thoroughly investigated or litigated may come down to the fullest feasible analysis of effects. As under current practice, this back-end analysis could consider product repositioning, entry, and efficiencies. A positive test result might be swept aside based on these considerations, just as a high level or change in the HHI can be swept aside, for example, if entry is sufficiently easy.

As part of the full analysis of competitive effects, the simple diagnostic test used at the initial screening stage can be refined, checked further for consistency with the empirical evidence, and probed for robustness. In the cases at issue here, namely those involving differentiated products and unilateral pricing effects, the same types of evidence that went into the screening test may well play a prominent role in the full analysis. That analysis can account for the myriad of complications that can arise in real-world markets. We comment here only on a few ways in which the back-end analysis may relate to the diagnostic used at the screening stage.

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in our sense, 100% or even above. Campa and Goldberg (2004) report that among OECD countries an unweighted average of pass through elasticities is about 64% in the longer term.

[55] See, for example, Besanko, et. al. (2001) and Besanko, et. al. (2005). For a overview of this literature, see the empirical section of Weyl and Fabinger (2009).

A. Revised Estimates of the Variables in the UPP Test

Re-examination might show that there is actually no upward pricing pressure once the relevant variables are measured more accurately. For example, it might show that pre-merger marginal costs are higher than was initially thought.[56] Similarly, further analysis of diversion ratios could show them to differ from initial estimates. Alternatively evidence might surface that likely efficiencies are much higher, or lower, than the standard deduction.

B. Pressure But No Significant Movement

As discussed in Section 3 above, it is possible that, even with net upward pricing pressure, there will be no "significant" price increase because the relevant pass-through rates are low. A full analysis may uncover evidence of pass-through rates and thus alleviate, or heighten, concerns about post-merger price increases.[57]

C. Mixed Test Results

Proposition 1 tells us that a merger with the default level of efficiencies will raise prices in Bertrand duopoly if there is UPP for both products. Proposition 1 is silent if there is net UPP for only one product, i.e., if $UPP_1 > 0$ but $UPP_2 < 0$. We nevertheless suggest that a positive test result for any (significant) product should be enough to trigger further scrutiny. In cases with mixed test results, the full inquiry can explore whether consumers are likely to gain more from a price decrease on Product 2 than they will lose from any price increase on Product 1.

Economic theory implies a link between test results for Products 1 and 2, but it is not a simple one. Using Slutsky symmetry (that is, working with compensated demand curves) one can show that the ratio of the gross upward pricing pressure measure for Product 1, $D_{12}(P_2 - C_2)$, to the corresponding

[56] For instance, Schmalensee (2009) argues that average variable cost, which is sometimes used as a proxy for marginal cost, systematically underestimates the latter.

[57] If mergers are motivated by increases in profit, and if there is little or no anticompetitive effect, one can infer that there must be another profit motive, such as cost savings (though not necessarily in marginal costs). Janusz Ordover and Robert Willig (1993) state that "the potential magnitude of [unilateral] effects is likely to be small if the combined share of the parties is not substantial [<35%], so that the transaction is likely driven by its creation of efficiencies rather than by market power." See also Willig (1991). Note that this interpretation of the 35% threshold differs from that in the 1992 Guidelines.

measure for Product 2, is equal to $\frac{\varepsilon_2 M_2}{\varepsilon_1 M_1}\frac{X_2}{X_1}$, where Product i has demand elasticity ε_i and sales X_i. This further simplifies to $\frac{X_2}{X_1}$ if the Lerner equation applies to each product's pre-merger pricing.

D. Oligopoly Conduct

The UPP test is based on the diversion ratio, which applies if the firms set their prices independently prior to the merger. If the firms behave in a more accommodating manner prior to the merger, smaller efficiencies may be sufficient to overcome the loss of head-to-head competition resulting from the merger. The back-end analysis might well uncover such accommodation. As noted above, this might obviate concerns based on unilateral effects but heighten concerns based on coordinated effects.

5. Relationship to Merger Simulation

For many economists, a natural alternative to the market definition approach would be to (a) model the industry and the nature of competition, (b) calibrate the model using pre-merger data, and then (c) use the calibrated model to predict post-merger prices.[58] This general approach is often called "merger simulation." Our analysis uncovers the fact that merger simulation must implicitly or explicitly estimate the pass-through rate of the asymmetric cost shock described in Proposition 2. It is therefore unsurprising that, as Froeb et. al. (2005) found (see also Slade 2009), merger simulation's price predictions depend very strongly on the demand system used. This often creates a battle of the experts, and although merger simulation is used by the antitrust agencies and by merging parties arguing before the agencies, we are not aware that any judge has accepted merger simulation as primary evidence on whether a merger would harm competition.[59]

Merger simulation also takes on more than necessary: it typically seeks to fit a structural model to pre-merger data and then use that model to predict post-

[58] Another alternative is to exploit "natural experiments" in which one observes market outcomes with and without competition between the merging parties. This could make it unnecessary to engage separately in market definition or other preliminary diagnostics, including ours. The Staples case is often cited as a prime example of the use of natural experiments, although in that case the FTC still built its case by defining a relevant antitrust market.

[59] For a recent survey of the use of merger simulation in litigation, see e.g. Budzinski and Ruhmer (2008).

merger prices. As such, it tries to explain price *levels*. In complex industries this risks mis-specification by omitting the less immediate and concrete aspects of firms' objectives.[60] Our focus on the *net change* in marginal cost automatically nets out such complexities that are present both before and after the merger.

Merger simulation can be a valuable part of the full analysis of competitive effects. Unfortunately, merger simulation can be demanding in terms of data requirements, can generate results that are sensitive to the functional form used, and tends to be opaque to non-specialists. Hopefully, merger simulation can become more transparent and more robust as practice evolves and improves over time.

Our simple diagnostic test is designed to avoid those problems and to serve a very different role than merger simulation. While merger simulation relies on a great deal of data and assumptions, and aims to predict the magnitude of post-merger price increases, our test is designed to generate a simple and informative diagnostic regarding whether the merger is likely to lead to price increases.

6. Relationship to Market Definition

We now explore how our diagnostic test relates to the market definition and market concentration methods featured in the Guidelines and commonly used by the courts.

To begin with, it is worth noting that the profit-maximizing "hypothetical monopolist test" prescribed by the Guidelines to define relevant markets hinges on pass-through rates, although this fact is not generally appreciated.[61] Indeed, market definition under the Guidelines is closely related to the simulation of a hypothetical merger to monopoly of all the products in a proposed relevant market.[62] Our approach does not require estimating the pass-through rate, and in this respect it is simpler than the market definition methodology.

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[60] Merger simulation sometimes "backs out" estimates of marginal costs from firms' pricing choices, in which case it might capture these effects through the back door. As far as we know, however, this has not been thoroughly explored in the merger simulation literature.

[61] One can implement the hypothetical monopolist market definition test in the *Guidelines* by applying the fact that the price effect resulting when a group of competing firms set their prices to maximize joint profits can be evaluated as the pass-through of a cannibalization term. We develop this approach in Farrell and Shapiro (2010a).

[62] Like merger simulation, market definition, as performed in practice using critical loss analysis, often fails to focus on the *change* in pricing incentives. By instead attempting to model the pricing incentives of a hypothetical monopolist from scratch, some experts engaged in critical loss analysis have been led to opine that a hypothetical monopolist would face such elastic demand that

Once a market has been defined, diversion ratios could be estimated or proxied based on market shares in that market. The resulting diversion ratios can then be substituted into inequality (5), which provides the basic test for upward pricing pressure.

Suppose that the relevant market contains Products $1, 2, ..., N$. Suppose that we can estimate the "market recapture ratio" REC_1, meaning the fraction of sales lost by Product 1 from a small increase in P_1 that are gained by Products $2, ..., N$ collectively.[63] Denote by s_i the market share of Product *i*. If Products $2, ..., N$ are all roughly equally close substitutes for Product 1,[64] we can use $REC_1 \frac{s_2}{1-s_1}$ as a proxy for the diversion ratio D_{12}. Then $UPP_1 = \frac{s_2}{1-s_1} REC_1(\bar{P}_2 - \bar{C}_2) - E_1\bar{C}_1$. Substituting into inequality (5), there is upward pricing pressure for Product 1 if

$$\frac{s_2}{1-s_1} REC_1 \bar{M}_2 \frac{\bar{P}_2}{\bar{P}_1} > E_1(1-\bar{M}_1). \qquad (11)$$

Testing for upward pricing pressure using this proxy for the diversion ratio requires measuring the two margins, the market shares of the two products, and the market recapture ratio REC_1.

To illustrate this approach, suppose the per-merger margins are one-third, the pre-merger prices of the two products are equal, and we use a 10% default efficiency credit. With those numbers, inequality (5) tells us $UPP_1 > 0$ if $D_{12} > 0.2$. If the two products sold by the merging firms each have 20% of the sales in the relevant market, $D_{12} = \frac{0.2}{0.8} REC_1 = 0.25 \times REC_1$. We therefore have upward pricing pressure if the market recapture ratio is at least 80%.

Using $REC_1 \frac{s_2}{1-s_1}$ as a proxy for the diversion ratio D_{12} substitutes estimation of the market recapture ratio for estimation of that diversion ratio. In some cases the market recapture ratio may be easier to estimate based on the

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it would have an incentive to lower the price below pre-merger levels, a glaring problem with the methodology. Werden (2008) calls this "Critical Loss Analysis by Defendants."

[63] In previous work, we called this the "aggregate diversion ratio."

[64] This "equally close" assumption underlies merger simulation using the logit demand system, which assumes that there is no variation in "proximity" among a group of products. See Willig (1991) or Werden and Froeb (2007). See also Section 2.211 of the 1992 *Guidelines*.

available evidence. If this method is used, one can also adjust the proxy for the diversion ratio up or down based on evidence that the two products are relatively close or distant to each other in comparison with the other products in the relevant market.

Note that the test for upward pricing pressure does *not* revert to an HHI-based test, even if one uses market shares as proxies for diversion ratios. First, the UPP test uses margins as well as market shares. The larger are the pre-merger margins, the greater is the upward pricing pressure, for any given shares or level of concentration. Second, the distribution of shares among the non-merging firms matters greatly in calculating HHI but has no effect on UPP, which depends on market shares only via the term $\frac{s_2}{1-s_1}$. Lastly, the market recapture rate does not play an explicit role in an HHI test (although it and margins do enter into market definition using the hypothetical monopolist test).

7. Tailoring and Transparency

We have described a simple test to flag horizontal mergers that, based on fundamental economics, seem likely to raise prices or similarly harm competition. As discussed above, we envision that if the simple screen goes clearly awry, that will quickly be revealed once the merger is studied more closely. Even so, errors in the screen may be socially costly. Should the screen itself seek to incorporate more of the possible complexities that will certainly arise in the detailed back-end analysis?

This is a question of judgment more than of economic analysis as such. Our antitrust experience suggests to us that a simple and transparent screen, combined with the prospect of more detailed analysis later in the process, is probably more realistic than trying to anticipate many of the nuances at the screening stage, when the available information may be quite limited. This is certainly the approach taken in using market definition and HHIs to establish the structural presumption (to the extent that market definition remains a relatively simple exercise and does not shade into merger simulation for a hypothetical merger among all products in a candidate market). But we do not suggest that one apply even simple screening tests blindly.

As an example, what if the merging firms control multiple products prior to the merger? In practice one can often simplify by sensibly aggregating "products." For example, if Firm B owns several (narrowly defined) products with roughly equal absolute gross margins, the UPP test only requires that one estimate the diversion ratio from Product 1 to those products as a group. Similarly, if firms primarily compete for customers who then buy multiple (narrowly defined) "products," it may be adequate to evaluate the gross profit

margin on "a customer" and the diversion ratio in customers. Accounting for such factors at the screening stage seems practical and relatively straightforward.

In other cases one may eventually need to get further into details. If Firm A owns just Product 1 while Firm B owns substitute Products $2,...,n$, the cannibalization term should be:

$$\overline{T}_1 = \sum_{j=2}^{n} D_{1j}(\overline{P}_j - \overline{C}_j).$$

The same formula applies if, say, Firm B's Product 3 is a *complement* to Product 1. Combining Product 1 and Product 3 encourages the merged firm to sell more of Product 1, since that will spur sales of Product 3. This is captured in that D_{13} will be negative. If Firm B only sells substitute Product 2 and complement Product 3, and if $\overline{T}_1 = D_{12}(\overline{P}_2 - \overline{C}_2) + D_{13}(\overline{P}_3 - \overline{C}_3) < E_1\overline{C}_1$, there would be no true UPP. Such issues clearly should be addressed in the overall process, but they could either be part of the initial screening test or deferred to the back-end.

A closely related issue arises if additional sales generate intangible benefits (or costs) as well as direct and readily quantifiable net receipts. Often, Firm B gains value from additional sales of Product 2 beyond the concrete short-term absolute gross margin, $\overline{P}_2 - \overline{C}_2$. Conceptually, such follow-on (often future) benefits add to Product 2's gross margin. These additional benefits may be concrete sales of spare parts or other complements, or less tangible: in markets with network effects, learning by doing, or customer switching costs, incremental sales today will generate additional profits in the future. Follow-on profits are sometimes illuminated in firms' business documents. For example, firms may have methods of valuing their installed base of customers, perhaps to evaluate the profitability of customer acquisition.[65] Even if follow-on profits cannot be measured, we may at least know their sign, treat the "hard" profit accounting as a bound, and keep track of the direction of error.[66] Since firms usually benefit in the future from making more sales today, we expect that in most cases accounting for these effects will raise the margin on Product 2, making UPP for Product 1 more likely.

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[65] American Airlines, for example, invested in a sophisticated management accounting system, AAIMSPAN, to quantify follow-on profits reflecting the fact that serving a route from B to C (or increasing the frequency of service on that route) will boost sales on routes A-to-B and C-to-D. This accounting played an important role when the Justice Department unsuccessfully sued American for exclusion of entrants at DFW: see Edlin and Farrell (2002).

[66] This issue also arises when measuring gross margins in critical loss analysis; see Farrell and Shapiro (2008).

8. Innovation Competition

The tests developed so far in this paper apply to the pricing incentives of the merging firms. In principle, the merger could harm competition along any dimension of competition, and parallel tests could be pursued for different dimensions of competition. There is no reason in general to expect those tests to yield the same results as the pricing-focused UPP approach developed here. This is not a flaw or inconsistency in the test, but reflects an underlying reality: a merger can impact different dimensions of competition very differently.

To illustrate how our methods could be generalized to non-price dimensions of competition, including product selection and product variety, we now show how an analogous test would apply to innovation competition. We also include this case to stress the fundamental breadth of the idea that the *direction* of merger effects depends upon the relative strength of cannibalization effects and merger-specific efficiencies.

The impact of a merger on pricing incentives might not match up very closely with its impact on innovation incentives. For example, the two merging firms might not currently offer directly competing products, but they could both be working on new products that will compete more directly, either with each other or with the firms' current offerings. Where innovation competition is very important, a key question is whether the merger will lead to less rapid innovation.

If Firm A devotes more resources to improving its products, it will (on average) increase its operating profits (gross of its R&D expenditures) and reduce Firm B's profits. This simple logic leads to the "innovation diversion ratio," which is distinct from the usual (pricing) diversion ratio. The innovation diversion ratio to Firm A from Firm B is the fraction I_{AB} of the extra gross profits earned by Firm A when it devotes more resources to innovation that come at the expense of Firm B.[67]

To illustrate, suppose that Firm A is considering a risky R&D investment that, if it succeeds, will yield $100 million in profits for Firm A and reduce Firm B's profits by $30 million. Since 30% of the extra profits to Firm A come at the expense of Firm B, $I_{AB} = 30\%$. Relative to pre-merger incentives, the merger effectively puts a 30% cannibalization tax on the fruits of R&D investments by Firm A. Against this tax, the merger may generate some R&D efficiencies, e.g., by allowing the two firms to combine their R&D teams. Another possible source

[67] It is natural here to go straight to the profit impact, but worth noting that in a more detailed accounting of revenues and costs, the relevant incremental costs for product introduction may well include costs that would be "fixed" in an analysis of incentives to cut price and attract marginally more business.

of efficiency arises if the merged entity can internalize spillovers that would otherwise occur when Firm B benefits from Firm A's innovation, as when Firm B can copy Firm A's innovation without infringing Firm A's intellectual property, or when Firm B can capture gains from trade by licensing intellectual property from Firm A. As in the pricing analysis above, mergers might be credited with some standard level E_R of R&D efficiencies, which means that the cost of R&D falls by a factor $1-E_R$. Following this logic, a proposed merger between Firms A and B will tend to retard innovation on Firm A's products if

$$I_{AB} > E_R .$$

The innovation diversion ratio in a given case may well be hard to estimate. Likewise, the default level of innovation efficiencies to be applied in general may well be hard to establish. But these are not gratuitous difficulties. The impact of the proposed merger on innovation incentives really does depend on the extent to which Firm A's pre-merger rewards from innovation come at the expense of Firm B, and on merger efficiencies relating to innovation.

In cases where concerns about innovation effects are salient, simple screens based on upward pricing pressure, or based on historical market shares, may not be very informative. The innovation diversion ratio may be far more informative.

9. Conclusion

We have described a simple diagnostic test to flag horizontal mergers that are most likely to lead to unilateral anti-competitive price effects in markets for differentiated products. We argued that in such industries our approach is often simpler and more disciplined than flagging mergers based on market definition and concentration. Pending convincing empirical comparisons, there are strong *a priori* reasons to favor our approach for those cases.[68] It is much more solidly grounded in the underlying economics of unilateral effects than is the conventional approach based on market definition and market concentration.

[68] Ideally, the reliability of different methods of evaluating proposed mergers should be gauged by an intelligent combination of theoretical analysis and empirical evaluation. The most direct way to do the latter is to compare the observed changes from completed mergers against pre-merger predictions. Regrettably, retrospective studies of merger effects have seldom compared observed effects with *ex ante* predictions, although see Peters (2006) and Weinberg and Hosken (2008). Dennis Carlton (2009) recently called for just this type of empirical research program. See Pautler (2003), Kaplow and Shapiro (2007), Weinberg (2007), and Hunter, Leonard, and Olley (2008) on merger retrospectives more generally.

While our proposed test does not rely on the traditional elements of market definition and market concentration, it is far from new. To the contrary, it systematizes many economists' recognition that there is a robust core behind the regrettably labile predictions of structural merger simulation, and that this core deserves to be more explicitly used in unilateral-effects cases. Indeed, the basic models of unilateral effects on which we rely are well established in the economic literature, and the methods we advocate here have been used, in one form or another, for some years by the antitrust agencies. We hope that, by crystallizing the key insights from those models in the form of a few very simple expressions suitable for screening purposes, we will promote the use of these robust and reliable tools.

References

Areeda, Phillip and Donald Turner, (1975), "Predatory Pricing and Related Practices under Section 2 of the Sherman Act," *Harvard Law Review* 88, 697–733.

Ashenfelter, Orley, David Ashmore, Jonathan Baker, Suzanne Gleason, and Daniel Hosken, (2006), "Empirical Methods in Merger Analysis: Econometric Analysis of Pricing in FTC vs. Staples," *International Journal of the Economics of Business*, 13(2), 265-279.

Ashenfelter, Orley and Daniel Hosken (2007), "The Effect of Mergers on Consumer Prices: Evidence from Five Selected Case Studies." *Journal of Law and Economics*, forthcoming.

Baker, Jonathan and Timothy Bresnahan, (1988), "Estimating the Residual Demand Curve Facing a Single Firm," *International Journal of Industrial Organization,* 6, 283-300.

Baker, Jonathan and David Reitman (2009), "Research Topics in Unilateral Effects Analysis," Washington College of Law Research Paper No. 2009-37, American University, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1504863.

Baker, Jonathan and Carl Shapiro, (2008), "Reinvigorating Horizontal Merger Enforcement," in *Where the Chicago School Overshot the Mark: The Effect of Conservative Economic Analysis on Antitrust,* Robert Pitofsky, ed., Oxford University Press, available at http://faculty.haas.berkeley.edu/shapiro/mergerpolicy.pdf.

Bergstrom, Theodore and Hal Varian, (1985), "Two Remarks on Cournot Equilibrium," *Economic Letters*, 19:1, 5-8.

Besanko, David, David Dranove, and Mark Shanley, (2001), "Exploiting a Cost Advantage and Coping with a Cost Disadvantage," *Management Science*, 47(2), 221-235.

Besanko, David, Jean-Pierre Dubé, and Sachin Gupta (2005), "Own-Brand and Cross-Brand Retail Pass-Through," *Marketing Science*, 24(1), 123-137.

Budzinski, Oliver and Ruhmer, Isabel, (2008), "Merger Simulation in Competition Policy: A Survey," available at http://ssrn.com/abstract=1138682.

Bulow, Jeremy and Paul Pfleiderer (1983), "A Note on the Effect of Cost Changes on Prices," *Journal of Political Economy*, 91(1), 182-185.

Campa, Jose Manuel, and Linda Goldberg (2004), "Exchange Rate Pass-Through Into Import Prices," Working Paper, Federal Reserve Bank of New York, revised September.

Carlton, Dennis (2009), "Why We Need to Measure the Effect of Merger Policy and How to Do It," *Competition Policy International*, Spring.

Deneckere, and Davidson, (1985), "Incentives to Form Coalitions with Bertrand Competition," *Rand Journal of Economics*, 16(4), 473-486.

Echenique, Federico (2002), "Comparative Statics by Adaptive Dynamics and the Correspondence Principle," *Econometrica* 70:2, 833-844.

Dornbusch, Rudiger (1987), "Exchange Rates and Prices," *American Economic Review*, 77(1), 93-106.

Edlin, Aaron and Joseph Farrell (2002), "The American Airlines Case: A Chance to Clarify Predation Policy," in *The Antitrust Revolution*. Ed. John Kwoka and Lawrence White. Oxford University Press.

Farrell, Joseph and Carl Shapiro (1990), "Horizontal Mergers: An Equilibrium Analysis," *American Economic Review*, 80(1), 107-126.

Farrell, Joseph and Carl Shapiro (2008), "Improving Critical Loss Analysis," *Antitrust Source*, February, at http://www.abanet.org/antitrust/at-source/08/02/Feb08-Farrell-Shapiro.pdf.

Farrell, Joseph and Carl Shapiro (2010a), "Upward Pricing Pressure and Critical Loss Analysis: Response," *Global Competition Review*, forthcoming.

Farrell, Joseph and Carl Shapiro (2010b), "Recapture, Pass-Through, and Market Definition," *Antitrust Law Journal,* forthcoming.

Froeb, Luke, Stephen Tschantz and Gregory Werden (2005) "Pass-Through Rates and the Price Effects of Mergers," *International Journal of Industrial Organization,* 23:703-715.

Froeb, Luke and Gregory Werden (2008), "Unilateral Competitive Effects of Horizontal Mergers," in *Handbook of Antitrust Economics*, Paolo Buccirossi, ed. (MIT Press).

Goldberg, Pinelopi and Michael Knetter (1997), "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35:3 (September), 1243-1272.

Goppelsroeder, Marie, Maarten Pieter Schinkel, and Jan Tuinstra (2007), "Quantifying the Scope for Efficiency Defence in Merger Control: The Werden-Froeb Index," *Journal of Industrial Economics*, forthcoming.

Groves, Theodore, and Martin Loeb (1979), "Incentives in a Divisionalized Firm," *Management Science*, 25(3)

Hunter, Graeme, Gregory K. Leonard, and G. Steven Olley, (2008) "Merger Retrospective Studies: A Review," *Antitrust Magazine*, 23:1, 34-41.

Kaplow, Louis and Carl Shapiro (2007), "Antitrust," in *Handbook of Law and Economics, Volume 2,* A. Mitchell Polinsky and Steven Shavell, eds., Elsevier, pp. 1073-1225.

Katz, Michael and Carl Shapiro (2003), "Critical Loss: Let's Tell the Whole Story," *Antitrust,* Spring, pp. 49-56, available at http://faculty.haas.berkeley.edu/shapiro/critical.pdf.

Katz, Michael and Howard Shelanski (2007), "Merger Analysis and the Treatment of Uncertainty: Should We Expect Better?" *Antitrust Law Journal* 74, 537-.

Klemperer, Paul (2007), "Bidding Markets", *Journal of Competition Law and Economics* 3, 1-47.

Lyons, Bruce (2002), "Could Politicians be More Right than Economists? A Theory of Merger Standards", CCP Working Paper 02-1, http://www.ccp.uea.ac.uk/publicfiles/workingpapers/ccr02-1revised.pdf

Milgrom, Paul and Chris Shannon (1994), "Monotone Comparative Statics," *Econometrica*, 62(1), 157-180.

Moresi, Serge (2010), "The Use of Upward Pricing Pressures Indices in Merger Analysis," *Antitrust Source*, available at http://www.abanet.org/antitrust/at-source/at-source.html.

Nocke, Volker and Michael Whinston (2008), "Dynamic Merger Review," NBER Working Paper No. 14526, December.

O'Brien, Daniel and Steven Salop (2000) "Competitive Effects of Partial Ownership: Financial Interest and Corporate Control," *Antitrust Law Journal*, 67:559.

Ordover, Janusz and Robert Willig (1993), "Economics and the 1992 Merger Guidelines: A Brief Survey," *Review of Industrial Organization*, 8, 139-150.

Pautler, Paul (2003), "Evidence on Mergers and Acquisitions," *Antitrust Bulletin*, 48:119-207

Peters, Craig (2006), "Evaluating the Performance of Merger Simulation," *Journal of Law and Economics*, 49:627-649.

Reynolds, Graeme, and Chris Walters (2007), "The Use of Customer Surveys for Market Definition and the Competitive Assessment of Horizontal Mergers," *Journal of Competition Law and Economics*.

Röller, Lars-Hendrik, Johan Stennek, and Frank Verboven, (2006), "Efficiency Gains from Mergers," chapter 3 in *European Merger Control: Do We Need an Efficiency Defence?*, Fabienne Ilzkovitz and Roderick Meiklejohn, eds., Edward Elgar for the European Commission.

Salinger, Michael (1990), "The Concentration-Margins Relationship Reconsidered," *Brookings Papers on Economic Activity: Microeconomics*, 287–321.

Salop, Steven and Serge Moresi, (2009), "Updating the Merger Guidelines: Comments," available at http://www.ftc.gov/os/comments/horizontalmergerguides/545095-00032.pdf.

Schmalensee, Richard (1989), "Inter-Industry Studies of Structure and Performance," in *The Handbook of Industrial Organization*, R. Schmalensee and R.D. Willig (eds.).

Schmalensee, Richard (2009), "Should New Merger Guidelines Give UPP Market Definition?" *Global Competition Review*, December.

Shapiro, Carl (1996), "Mergers with Differentiated Products," *Antitrust*, Spring 1996, available at http://faculty.haas.berkeley.edu/shapiro/diversion.pdf.

Slade, Margaret (2009), "Merger Simulations of Unilateral Effects: What Can We Learn from the U.K. Brewing Industry? " in Bruce Lyons, ed., *Cases in European Competition Policy: The Economic Analysis*, Cambridge University Press.

U.K. Competition Commission (2005), "Somerfield plc and Wm Morrison Supermarkets plc: A report on the acquisition by Somerfield plc of 115 stores from Wm Morrison Supermarkets plc," available at http://www.competition-commission.org.uk/rep_pub/reports/2005/501somerfield.htm

U.K. Office of Fair Trading (2009), "Completed acquisition by WM Morrison Supermarkets plc of 30 stores from Co-operative Group Limited" http://www.oft.gov.uk/shared_oft/mergers_ea02/2009/Morrisons_Coop.pdf.

Warren-Boulton, Fredrick (1985), "Merger Policy and Enforcement at the Antitrust Division: An Economist's Perspective," 54 *Antitrust Law Journal* 109, 112.

Weinberg, Matthew (2007), "The Price Effects of Horizontal Mergers," *Journal of Competition Law and Economics,* 4(2), 433-447.

Weinberg, Matthew and Daniel Hosken (2008), "Using Mergers to Test a Model of Oligopoly," October, http://www.ftc.gov/be/workshops/microeconomics/docs/mweinberg.pdf.

Werden, Gregory (1992), "The History of Market Delineation," *Marquette Law Review*.

Werden, Gregory (1996), "A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products," *Journal of Industrial Economics,* 44, 409-413.

Werden, Gregory (2008), "Beyond Critical Loss: Properly Applying the Hypothetical Monopolist Test," *Global Competition Policy*, February.

Werden, Gregory and Luke Froeb (2007), "Unilateral Competitive Effects of Horizontal Mergers," in P. Buccirossi, ed., *Advances in the Economics of Competition Law*, MIT Press.

Weyl, Glen (2009), "Slutsky Meets Marschak: The First-Order Identification of Multi-Product Production," December, http://www.people.fas.harvard.edu/~weyl/SlutMars_12_09.pdf.

Weyl, Glen (2010a), "Pass-Through and Merger Analysis," Harvard University, available from the author upon request.

Weyl, Glen (2010b), "Oligopoly Pass-Through," Harvard University, available from the author upon request.

Weyl, Glen and Michal Fabinger (2009), "Pass-Through as an Economic Tool," October, available at http://www.people.fas.harvard.edu/~weyl/Pass-through_10_09.pdf.

Willig, Robert (1991), "Merger Analysis, Industrial Organization Theory, and Merger Guidelines," *Brookings Papers on Economics Activity,* 281-332.