THE PROTECTED PROFITS BENCHMARK: PRECISION VERSUS ADMINISTRABILITY

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There has been a great deal of discussion regarding what constitutes an appropriate screen to identify anticompetitive exclusionary conduct.[1] Refusals to deal and price squeezes are two claims of exclusionary conduct that may be made against a vertically integrated firm (VIF) that produces both an input as a monopolist, and an output using this input in a downstream market where it competes with a rival. The rival must buy this input from the VIF in order to produce and sell the downstream product in the downstream market. A common allegation is that the VIF has raised the input price to squeeze the rival's profit margin and drive the rival out of the downstream market.[2] The main question is: Is there an appropriate benchmark price for the essential input that may be used to determine the legality of the VIF's pricing?

As a welcome attempt to provide an answer to this question, Professor Steven Salop has proposed a screen he terms the "Protected Profits Bench-

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[1] For assessments under Section 2 of the Sherman Act, see, for example, A. Douglas Melamed, *Exclusive Dealing Agreements and Other Exclusionary Conduct—Are There Unifying Principles?*, 73 ANTITRUST L.J. 375 (2006); Mark S. Popofsky, *Defining Exclusionary Conduct: Section 2, the Rule of Reason, and the Unifying Principle Underlying Antitrust Rules*, 73 ANTITRUST L.J. 435 (2006); Steven C. Salop, *Exclusionary Conduct, Effect on Consumers, and the Flawed Profit-Sacrifice Standard*, 73 ANTITRUST L.J. 311 (2006); Gregory J. Werden, *Identifying Exclusionary Conduct Under Section 2: The "No Economic Sense" Test*, 73 ANTITRUST L.J. 413 (2006).

[2] In a practical sense, a price squeeze on an indispensable input that makes it unprofitable for the rival to enter the output market is equivalent to a refusal to deal. However, a recent decision by the European Court of Justice clarifies that the indispensability of the monopoly input is only a factor for consideration, not a necessary condition, for margin squeeze claims, which potentially differentiates these two terms. *See* Case C-52/09, Konkurrensverket v. TeliaSonera Sverige AB, 2011 E.C.R. I-00527; Javier Ruiz-Calzado & Gianni De Stefano, *In the EU the Court of Justice Rules (Again) on Margin Squeeze*, CPI ANTITRUST CHRON., July 2011, Vol. 7, No. 1.

mark" (PPB).[3] The PPB allows the VIF to charge the rival an input price to recover the profit margin it would lose on downstream sales as a result of the rival selling the downstream product. In the simplest situation when the downstream products are homogeneous:

$$PPB = c_2 + (p - c_1) \qquad [1]$$

where c_2 is the VIF's input cost, p is the VIF's downstream product price, and c_1 is the VIF's downstream product cost, equal to the sum of its input cost, c_2, and its incremental downstream product cost.[4] As is well recognized, the PPB in this case is identical to the Efficient Component Pricing Rule (ECPR).[5]

When the downstream products made by the VIF and the downstream rival are differentiated, Professor Salop proposed to adjust the VIF's profit margin for its downstream product in the PPB formula by multiplying by the diversion ratio, *Div*:

$$PPB = c_2 + Div(p - c_1) \qquad [2]$$

Professor Salop argues that the PPB is consistent with the equally efficient competitor standard, the profit sacrifice standard, and the consumer welfare standard.[6]

The PPB is based on the VIF's lost profit associated with its lost downstream sales as a result of selling the essential input to the rival. Despite possessing a number of desired properties, the PPB also has some disadvantages, as recognized by Gilbert[7] and Tardiff.[8] Most importantly, it is not easily administrable in practice.

I propose the ECPR be considered as an alternative benchmark, even for differentiated products, because it is much more easily administrable and generally deviates less from the profit-maximizing input price standard discussed by Professor Gilbert than the PPB.

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[3] Steven C. Salop, *Refusals to Deal and Price Squeezes by an Unregulated, Vertically Integrated Monopolist*, 76 ANTITRUST L.J. 709 (2010).

[4] *Id.* at 723. Throughout this article, I adopt Professor Gilbert's notation. *See* Richard Gilbert, *The Protected Profits Benchmark: A Refusal to Deal Metric?*, *supra* this issue, 78 ANTITRUST L.J. 689 (2013).

[5] *Id.* at 690.

[6] Salop, *supra* note 3, at 721–24, 728.

[7] Gilbert, *supra* note 4.

[8] Timothy J. Tardiff, *The Protected Profits Benchmark: Input Price, Retail Price, or Both?*, *infra* this issue, 78 ANTITRUST L.J. 719 (2013).

I. PROBLEMS WITH THE ADMINISTRABILITY OF THE PPB

One problem with the PPB is related to the treatment of the diversion ratio. As Tardiff and Gilbert both have noted, the PPB is smaller when the diversion ratio is smaller.[9] In the extreme case, if the diversion ratio is 0 percent, the VIF would not be allowed to charge an input price above its cost. However, zero diversion implies that the rival's product is not in the same market as the VIF's downstream product, and in that case there is not any antitrust basis for imposing a price ceiling on the VIF's input price.[10]

The biggest problem with the PPB is that its calculation requires a substantial amount of information that makes it not administrable in practice.[11] Professor Salop notes, "Product differentiation and fringe producers complicate the calculation of the PPB to some extent."[12] This is an understatement. A reliable estimate of the diversion ratio often requires sophisticated econometric analysis and may be a subject of contention. Professor Salop suggests that the VIF's market share may be a good proxy for the diversion ratio.[13] Even if the diversion ratio can be approximated by market shares,[14] it is not clear how market shares can be accurately measured in a market that is still developing due to the rival's entry, or how the rival's market share can be estimated at all if the rival has not yet entered and the input price is still being negotiated. Requiring that a VIF determine a diversion ratio when setting its input price may place an undue burden on the VIF.

Timothy Tardiff shows that Professor Salop's discussion of the PPB misses the potential differences in "the intensity of use" of the essential input, or the input-output ratio, in the VIF and the rival's production processes, and that the PPB needs to be adjusted to reflect such differences.[15] Such an adjustment would make the PPB even more complicated to implement in practice. The rival's input-output ratio may not be known to the VIF, and could even be a trade secret that the rival would not want to be disclosed to the VIF.

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[9] *See id*. at 726; Gilbert, *supra* note 4, at 690–91.

[10] One might argue that below a certain diversion ratio the rival's product does not directly compete with the VIF's product, so that the PPB formula is no longer applicable. However, it is not clear as a practical matter what minimum threshold for the diversion ratio would be appropriate.

[11] Professor Salop argues that the PPB is administrable. *See* Salop, *supra* note 3, at 724–25. His argument is based, however, on the application of the screen in the simplest situation of homogeneous products, when the PPB is equivalent to the ECPR.

[12] *Id.* at 730.

[13] *Id*.

[14] Market share may provide a poor approximation to the diversion ratio. *See* Lars Mathiesen et al., *Merger Simulations with Observed Diversion Ratios*, 31 INT'L REV. L. & ECON. 83 (2011).

[15] Tardiff, *supra* note 8, at 724. Tardiff shows that the adjusted PPB still satisfies the equally-efficient-competitor test. *Id*.

Courts have been reluctant to rely on tests for exclusionary conduct that are based on other firms' production and cost information beyond the defendant's knowledge. Regarding the standard for evaluating predatory pricing, the Supreme Court in *Brooke Group* states that "a plaintiff seeking to establish competitive injury resulting from a rival's low prices must prove that the prices complained of are below an appropriate measure of its rival's costs."[16] Regarding the standard for evaluating bundled discounts, the Ninth Circuit in *Cascade Health Solutions v. PeaceHealth* states that "[a] potential defendant who is considering offering a bundled discount will likely not have access to information about its competitors' costs, thus making it hard for that potential discounter, under the *Ortho* standard, to determine whether the discount it wishes to offer complies with the antitrust laws."[17]

Requiring the VIF to take into account the rival's production function when setting its input price is equally unrealistic. Furthermore, the VIF would need to calculate different input prices for rivals that have different input-output ratios, which would be both burdensome to the VIF and potentially susceptible to price discrimination allegations. Finally, information exchange among competitors regarding their operating costs may raise serious antitrust concerns.[18]

In his Comment on the PPB, Professor Richard Gilbert shows that "the PPB is always less than the price that corresponds to profit-maximizing behavior by a vertically integrated firm" and thus is "an inappropriately stringent standard under the second definition of a refusal to deal,"[19] which is "the input price at which the vertically integrated firm makes no short-term sacrifice of profit assuming that rivals remain as viable competitors in downstream markets . . . ."[20] Professor Gilbert provides a linkage between the PPB and the VIF's profit-maximizing price in his Equation (1), and suggests that this equation provides a metric appropriate for a screen based on the VIF's profit-maximizing price. His formula includes an extra term accounting for the rival's demand elasticity for the essential input, and Professor Gilbert recognizes that "a measure of the elasticity of demand may require a complicated estimation . . . ."[21]

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[16] Brooke Grp. Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 222 (1993).

[17] Cascade Health Solutions v. PeaceHealth, 515 F.3d 883, 905 (9th Cir. 2008).

[18] "Other things being equal, the sharing of information relating to price, output, costs, or strategic planning is more likely to raise competitive concern than the sharing of information relating to less competitively sensitive variables." U.S. Dep't. of Justice & Fed. Trade Comm'n, Antitrust Guidelines for Collaborations Among Competitors 15 (2000), *available at* http://www.ftc.gov/os/2000/04/ftcdojguidelines.pdf.

[19] Gilbert, *supra* note 4, at 695–96.

[20] *Id.* at 692.

[21] *Id.* at 700.

The complexities surrounding practical implementation of the PPB and its refinements suggest that it would remain merely of theoretical interest unless modified to make it easier for the VIF to determine, and for the courts to rely on.[22]

II. ECPR AS AN ALTERNATIVE BENCHMARK

The ECPR deserves consideration as a screen even in the case of differentiated products. Instead of attempting to determine the loss of profit due to the downstream sales displacement caused by the rival, it will often be more practical to focus on the VIF's current profit margin generated by the input through the production and sale of the downstream product.[23] As noted earlier, the ECPR is equivalent to the PPB with homogeneous products, as specified in Equation [1]. It is more administrable since all the information required to make the calculation is in the VIF's possession. It does not require any knowledge about the rival's production function, or how the VIF and the market would be impacted by the rival's entry or output expansion.[24]

The ECPR satisfies the profit sacrifice test under a different interpretation: the VIF is compensated for its input based on how much incremental profit it would get from the downstream product sales given the current market conditions if the extra unit of the input sold to the rival were used for its own production of the downstream product. The ECPR will not compensate the VIF for its sales loss in the downstream market if the loss results from the rival using a technology that depends less on the VIF's input than the VIF does.

One might argue that the VIF is allowed to charge too much for its input under the ECPR if the rival only displaces, say, 80 percent of the VIF's sales in the downstream market. Note that discounting the PPB by the diversion ratio is equivalent to allowing a full profit margin for the 80 percent displaced downstream sales and a zero profit margin for the other 20 percent of the rival's downstream sales that does not displace the VIF's downstream sales. There is no good reason why the other 20 percent of the VIF's input sales should not be entitled to a profit margin at all.

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[22] Commentators have noted that the current state of the law regarding price squeezes lacks clarity. *See* Thomas Barnett, Shimica Gaskins & John Graubert, *Price Squeeze Claims Succumb to Need for "Clear Rules,"* GLOBAL COMPETITION POL'Y, Summer 2009, Vol. 8, No. 2.

[23] Professor Salop has provided this interpretation in his article: "[T]he monopolist's opportunity cost of selling the unit of the input to the competitor is the direct profit that it would have earned from using the input itself to produce and sell output at the going output price." *See* Salop, *supra* note 3, at 720. However, Professor Salop instead focuses on the resulting loss of profit from selling one unit of the input in proposing his PPB.

[24] To the extent the VIF takes into account the rival's output and price decisions, such considerations are already reflected by the VIF's downstream product price.

Besides improved clarity over the PPB, the ECPR is likely a metric that comes closer to Professor Gilbert's profit-maximizing price standard when the VIF takes into account the effects of its input price on downstream competition, but without requiring the substantial information needed to calculate the VIF's profit-maximizing price. This is because in the normal situation, the diversion ratio is less than one so the ECPR is higher than the PPB, which, as demonstrated below, can be significantly below the VIF's profit-maximizing input price. On the other hand, the ECPR may often exceed Professor Gilbert's more precise metric. As implied by Equation [1], the ECPR exceeds the VIF's profit-maximizing input price when the VIF earns a higher profit margin (in dollar per unit terms) on its downstream product than on its input sales.

Since price squeezes are often called margin squeezes, with the implication that the rival's profit margin has been decreased, it is useful to look at the conditions under which the ECPR is less than the profit-maximizing input price in terms of the profit margins of the VIF and the rival. Following Professor Gilbert's Equation (A.1), the ECPR is less than or equal to the VIF's profit-maximizing input price if the following condition is satisfied:[25]

$$\frac{\mathrm{r} - \mathrm{a} - \mathrm{c_r}}{p - c_1} \geq (1 - Div)\left({}^{dr}/_{da}\right) \qquad [3]$$

where $p - c_1$ is the VIF's profit per unit of the downstream product, $\mathrm{r} - \mathrm{a} - \mathrm{c_r}$ is the rival's profit per unit of the downstream product, and $\frac{dr}{da}$ is the rival's pass-through rate.

Equation [3] says the rival's per-unit profit on the downstream product needs to be sufficiently high relative to the VIF's in order for the ECPR to be less than the profit-maximizing input price.[26] Thus, the ECPR would be expected to provide a better approximation of Professor Gilbert's profit-maximizing price standard than Professor Salop's PPB when the ratio of the rival's profit margin to the VIF's profit margin satisfies Equation [3]. But even when Equation [3] is not satisfied, and the ECPR becomes larger than the VIF's profit-maximizing input price, as long as the deviations are reasonably small, the ECPR may still serve as a useful screen.

To give a concrete example, I adopt Professor Gilbert's notation and assume that the VIF and the rival produce differentiated downstream products and face the following linear demand curves:

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[25] See Appendix I for details.

[26] It should be noted that generally the profit margins, the diversion ratio, and the pass-through rate are all determined in the equilibrium, and are interrelated depending on the specific demand functions faced by the VIF and the rival.

$$VIF: \quad x = A_1 - b_1p + b_2r$$

$$Rival: \quad y = A_2 - b_3r + b_4p,$$

where A_1 and A_2 indicate the size of the demand for the VIF's and for the rival's downstream products, and the *b* parameters indicate the own and cross-price effects. The diversion ratio in this model setup is b_2/b_3. Following Professor Salop's numeric example, I assume that the VIF has an input cost of \$10 and an incremental downstream product cost of \$30. The VIF sets its input price, and then competes in price in the differentiated downstream product market with the rival, who buys the input from the VIF. Based on different configurations of the model's demand and cost parameters, I run various simulations of the model and calculate the VIF's profit-maximizing input price, the PPB, and the ECPR for each simulation.[27]

Assuming that the rival is as efficient as the VIF in that its incremental downstream product cost is also \$30, and that holding prices constant, the sizes of the demand for the VIF's and for its rival's products are the same (i.e., A_1=A_2), Figure 1 shows on average how much the PPB and the ECPR deviate from the profit-maximizing input price depending on the diversion ratio.[28] Based on 3,428 simulations, the average PPB deviation ((PPB−a)/a) is −40.6 percent and the average ECPR deviation ((ECPR−a)/a) is 7.9 percent. The ECPR is generally much closer to the profit-maximizing input price than the PPB for virtually all levels of the diversion ratio. As Professor Gilbert has shown in the more general setting, the PPB is always below the profit-maximizing input price. Importantly, the gap between the PPB and the profit-maximizing input price increases as the diversion ratio decreases, suggesting that the PPB is too restrictive when there is less anticompetitive concern. In contrast, while the gap between the ECPR and the profit-maximizing input price is generally also greater when the diversion ratio is lower, seemingly suggesting the ECPR being lax where the diversion ratio is low, that is when the VIF is less likely to have the incentive to exclude the rival.

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27 Appendix II provides a detailed description of the model's solutions and numeric simulations.

28 Equation [3] indicates that the rival's pass-through rate also plays a role when comparing the ECPR to the VIF's profit-maximizing input price. Simulations show that the rival's pass-through rate is positively correlated with the diversion ratio, and the ECPR deviates less from the profit-maximizing input price when the rival's pass-through rate is higher.

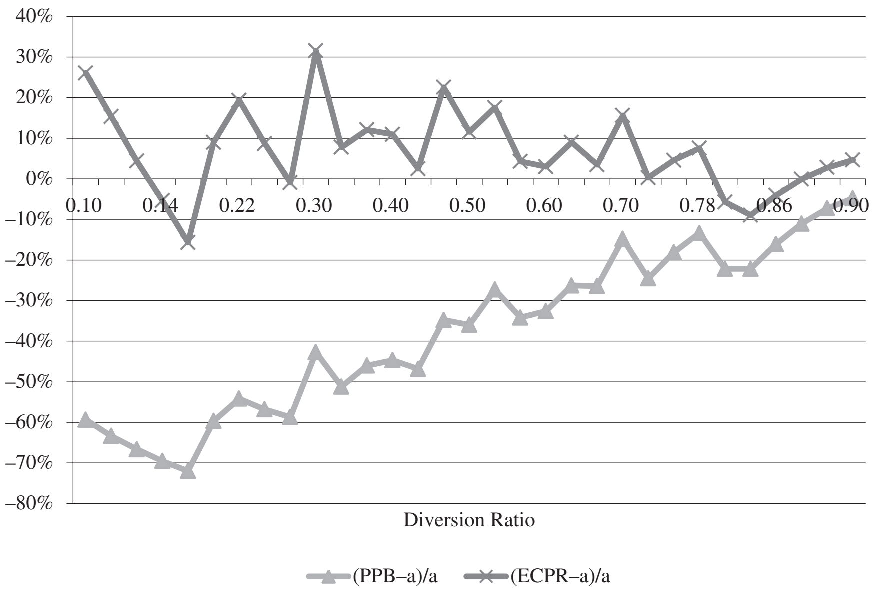

FIGURE 1: PPB'S AND ECPR'S DEVIATIONS FROM PROFIT-MAXIMIZING INPUT PRICE BY DIVERSION RATIO

I next explore the effects of the rival having a larger or a smaller demand than the VIF in the downstream products, while still assuming the rival is as efficient as the VIF. Table 1 shows, based on 12,495 simulations, how the PPB's and the ECPR's average deviations from the profit-maximizing input price change when the ratio of the VIF's demand to the rival's demand (as measured by the intercepts of their demand functions, A_1 and A_2) changes, both across all values of the diversion ratio and for values of the diversion ratio less than 50 percent and greater than 50 percent, respectively. The PPB is closer to the profit-maximizing input price when the VIF's downstream product has a sufficiently larger demand than the rival's,[29] while the ECPR tends to be closer to, and below, the profit-maximizing input price when the rival's product has a larger demand. To the extent the rival's product is more popular, and thus has a higher demand than the VIF's product, the VIF may have a higher incentive to exclude the rival by charging a high input price. But that is when the ECPR is generally below the profit-maximizing input

[29] Though the PPB performs better than the ECPR in this case, the PPB is still generally far below the profit-maximizing input price. Furthermore, as I argue below, it may be more desirable to have a screen above the profit-maximizing input price.

price and thus is a conservative screen. Another observation is that both the PPB and the ECPR are closer to the VIF's profit-maximizing input price when the diversion ratio is higher, consistent with what is shown in Figure 1 above.

TABLE 1: PPB'S AND ECPR'S DEVIATIONS FROM PROFIT-MAXIMIZING INPUT PRICE BY DEMAND RATIO

Ratio of VIF Demand to Rival Demand	(PPB – a)/a			(ECPR – a)/a		
	All	Diversion Ratio<=50%	Diversion Ratio>50%	All	Diversion Ratio<=50%	Diversion Ratio>50%
0.10	–52.5%	–65.4%	–46.6%	–33.7%	–40.6%	–30.5%
0.14	–46.9%	–57.3%	–43.2%	–29.4%	–32.5%	–28.2%
0.25	–31.7%	–35.4%	–30.7%	–16.2%	–10.9%	–17.6%
0.40	–53.1%	–65.1%	–37.7%	–21.4%	–25.5%	–16.1%
0.57	–47.1%	–58.2%	–31.6%	–12.4%	–14.8%	–9.1%
0.70	–49.9%	–62.2%	–30.5%	–5.8%	–6.2%	–5.3%
1.00	–40.6%	–51.7%	–23.0%	7.9%	10.7%	3.4%
1.43	–39.0%	–50.0%	–19.6%	25.0%	32.5%	11.7%
1.75	–31.9%	–39.4%	–16.4%	34.8%	44.6%	14.5%
2.50	–30.5%	–37.5%	–13.9%	54.7%	69.1%	20.8%
4.00	–15.9%	–19.2%	–9.3%	31.0%	37.4%	18.5%
7.00	–18.7%	–22.7%	–7.9%	68.3%	83.5%	27.0%
10.00	–20.8%	–25.2%	–7.2%	88.6%	107.4%	30.4%

I now explore the effects of the rival being more or less efficient than the VIF in producing the downstream products, while still assuming that the demands for the VIF's and for the rival's products are the same size. Table 2 shows, based on 17,089 simulations, the PPB's and the ECPR's average deviations from the profit-maximizing input price when the rival is more efficient (the rival's incremental downstream product cost, c_r, is below \$30) or less efficient (c_r is above \$30). The PPB's deviations from the profit-maximizing input price do not vary substantially with how efficient the rival is compared to the VIF. But the ECPR becomes closer to the VIF's profit-maximizing input price when the rival is more efficient, the scenario that is more likely to be of antitrust interest. Furthermore, the ECPR's average deviations from the profit-maximizing input price are quite small when the diversion ratio is higher than 0.5, suggesting that the ECPR can be a reasonable screen when the diversion ratio is high regardless of whether the rival is more efficient than the VIF or not.[30]

[30] The division of the diversion ratios at 0.5 in Tables 1 and 2 is for illustration only and is not meant to be an exact threshold for determining whether the diversion ratio is high or low in a particular case.

TABLE 2: PPB'S AND ECPR'S DEVIATIONS FROM PROFIT-MAXIMIZING INPUT PRICE BY RIVAL'S INCREMENTAL DOWNSTREAM PRODUCT COST

Rival's Incremental Downstream Product Cost	(PPB − a)/a			(ECPR − a)/a		
	All	Diversion Ratio<=50%	Diversion Ratio>50%	All	Diversion Ratio<=50%	Diversion Ratio>50%
$25.0	−42.1%	−53.6%	−24.5%	4.3%	6.4%	1.0%
$27.5	−41.4%	−52.7%	−23.7%	6.0%	8.5%	2.2%
$30.0	−40.6%	−51.7%	−23.0%	7.9%	10.7%	3.4%
$32.5	−40.0%	−50.7%	−22.5%	9.6%	12.8%	4.5%
$35.0	−39.4%	−49.9%	−21.9%	11.3%	14.8%	5.4%

The fact that the ECPR is typically somewhat larger than the VIF's profit-maximizing input price may raise concerns regarding its use as a screen on the grounds that it would be too lax. However, the deviations of the ECPR from the profit-maximizing price are on average small in the simulations I have conducted, and smaller when the diversion ratio is higher. Moreover, a "buffer zone" may be desirable because caution is warranted in Section 2 cases, where distinguishing competition from exclusion can be a challenge. Under Judge Easterbrook's error-cost framework,[31] which suggests a preference for false negatives (wrongful acquittal of true antitrust violations) over false positives (wrongful conviction of lawful conduct), small upward deviations of the ECPR from the profit-maximizing input price should not be a substantial concern.

Besides being more administrable and likely being closer to the profit-maximizing input price, the ECPR is also consistent with the standard for assessing a refusal to deal claim that is based on predatory pricing,[32] i.e., whether the input is priced so high that an equally efficient rival cannot compete with the VIF. Ignoring fixed costs, if the underlying technology used by the VIF and by the rival are similar,[33] an input price set at or below the ECPR would allow an equally efficient rival to compete as long as consumers were willing to pay a price for its product at least equal to the price of the VIF's product. Under prevailing predatory pricing law, the VIF has no obligation to keep the

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[31] *See* Frank H. Easterbrook, *The Limits of Antitrust*, 63 TEX. L. REV. 1 (1984). The error-cost framework has been often used in evaluating antitrust enforcement policy. *See, e.g.*, James C. Cooper, Luke M. Froeb, Dan O'Brien & Michael G. Vita, *Vertical Antitrust Policy as a Problem of Inference*, 23 INT'L J. INDUS. ORG. 639 (2005).

[32] This standard is similar to what Professor Gilbert discusses in his first definition of refusal to deal. *See* Gilbert, *supra* note 4, at 692.

[33] That is, the input-output ratios are similar.

input price low in order to allow the rival to be profitable despite being less efficient or offering a product that is less preferred by consumers.[34]

Another benefit of the ECPR is that it ties the maximum input price the VIF can safely charge to the price it charges on its downstream product. Tardiff suggests that the VIF might both increase the input price and lower its downstream price as part of an anticompetitive price squeeze.[35] Since the ECPR has a one-to-one correspondence with the downstream product price, a decrease in the downstream product price would lead to a corresponding decrease in the maximum input price the VIF can charge without violating the ECPR standard. Thus, the ECPR effectively puts a constraint on the VIF's ability to use a decrease in its downstream price to effect a margin squeeze.

III. CONCLUSION

In the Supreme Court's *linkLine* decision Justice Roberts wrote, "This Court has repeatedly emphasized the importance of clear rules in antitrust law. . . . Moreover, firms seeking to avoid price-squeeze liability will have no safe harbor for their pricing practices."[36] By proposing the PPB as a screen for evaluating price squeeze and refusal to deal claims, Professor Salop has attempted to provide the safe harbor that Justice Roberts seeks.[37] The PPB screen is based on the VIF's profit loss as a result of selling the input to the rival. However, when applied to differentiated products, the PPB screen leads to the perverse conclusion that the VIF's input should be priced at marginal cost when its downstream product does not compete at all with the rival's product. Refinements offered by Tardiff and Professor Gilbert, while providing an improved screen as a theoretical matter, tend to add more complications in practice. The PPB and its refinements likely involve complex calculations and estimations that reduce their administrability.

I propose that the ECPR be considered as an alternative candidate. Though it is not the most theoretically precise benchmark, the ECPR provides an administrable safe harbor[38] for the VIF. There is a trade-off among the properties of Professor Salop's PPB, Professor Gilbert's more precise profit-maximizing price standard, and the ECPR. Ultimately, however, a screen is only useful in

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[34] In this sense, the ECPR is consistent with the *Brooke Group* standard, which has been embraced by the Supreme Court. *See* Salop, *supra* note 3, at 717.

[35] Tardiff, *supra* note 8, at 720.

[36] *See* Pac. Bell Tel. Co. v. linkLine Commc'ns, Inc., 555 U.S. 438, 440 (2009).

[37] The PPB screen is only proposed as a safe harbor for firms' pricing practices. As Professor Salop noted, failing the screen does not necessarily lead to consumer harm. Plaintiffs need to make additional showings to establish consumer harm. Salop, *supra* note 3, at 734.

[38] This is not meant in the sense that all input prices below the ECPR cannot be exclusionary, but rather that such prices are not significantly higher than the normal profit-maximizing input price and are often difficult to discern from legitimate pricing decisions.

practice if it is administrable. On this basis, the ECPR has a clear advantage. The ECPR can be easily determined based on the VIF's cost information and its downstream product price. Such information is readily available to the VIF, lowering its compliance cost and making price squeeze and refusal to deal disputes easier for the court to adjudicate.

APPENDIX I

Professor Gilbert's Equation (A.1)[39] can be rewritten as:

$$a = c_2 + (p - c_1) - (1 - Div)(p - c_1) - \frac{y}{dy/dr}\frac{1}{dr/da} \qquad [A.I.1]$$

The rival maximizes the following profit function:

$$\Pi_r = (r - a - c_r)y(r,p) \qquad [A.I.2]$$

where c_r is the rival's incremental downstream product cost. The first order condition leads to:

$$-\frac{y}{dy/dr} = r - a - c_r \qquad [A.I.3]$$

Substituting [A.I.3] into [A.I.1] leads to:

$$a = ECPR - (1 - Div)(p - c_1) + \frac{r - a - c_r}{dr/da} \qquad [A.I.4]$$

It follows that the ECPR is less than or equal to the profit-maximizing input price if:

$$\frac{r - a - c_r}{p - c_1} \geq (1 - Div)\left(dr/da\right) \qquad [A.I.5]$$

The term *dr/da* is the rival's pass-through rate, i.e., how much of the increase in the VIF's input price is passed on in the form of an increase in the rival's downstream price. Equation [A.I.5] indicates that the ECPR is less than or equal to the profit-maximizing input price if the per-unit profit ratio between the rival and the VIF in the downstream product is larger than or equal to the product of one minus the diversion ratio and the rival's pass-through rate.

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39 Gilbert, *supra* note 4, at 702.

APPENDIX II

Following Professor Gilbert's setup of the model and notation,[40] the VIF's and the rival's profit functions are:

$$\Pi_{VIF} = (p - c_1)x(p,r) + (a - c_2)y(r,p) \quad \text{[A.II.1]}$$

$$\Pi_r = (r - a - c_r)y(r,p) \quad \text{[A.II.2]}$$

The three first order conditions are:

$$\frac{d\Pi_{VIF}}{dp} = x + (p - c_1)\frac{\partial x}{\partial p} + (a - c_2)\frac{\partial y}{\partial p} = 0 \quad \text{[A.II.3]}$$

$$\frac{d\Pi_r}{dr} = y + (r - a - c_r)\frac{\partial y}{\partial r} = 0 \quad \text{[A.II.4]}$$

$$\frac{d\Pi_{VIF}}{da} = y + (a - c_2)\frac{\partial y}{\partial r}\frac{dr}{da} + (p - c_1)\frac{\partial x}{\partial r}\frac{dr}{da} = 0 \quad \text{[A.II.5]}$$

Because the VIF sets p and the rival sets r based on what value the VIF chooses for a, both p and r are functions of a. Applying the envelope theorem, Equation [A.II.3] is used in deriving [A.II.5].

I assume the demand system is linear of the following form:

$$x = A_1 - b_1 p + b_2 r \quad \text{[A.II.6]}$$

$$y = A_2 - b_3 r + b_4 p \quad \text{[A.II.7]}$$

where all parameters (A_1, A_2, b_1, b_2, b_3, and b_4) are positive.

Equations [A.II.3] – [A.II.5] become:

$$2b_1 p - b_2 r - b_4 a = b_1 c_1 - b_4 c_2 + A_1 \quad \text{[A.II.8]}$$

$$-b_4 p + 2b_3 r - b_3 a = b_3 c_r + A_2 \quad \text{[A.II.9]}$$

$$-\left(b_4 + b_2\frac{dr}{da}\right)p + b_3 r + b_3\frac{dr}{da}a = (b_3 c_2 - b_2 c_1)\frac{dr}{da} + A_2 \quad \text{[A.II.10]}$$

[40] *See* Gilbert, *supra* note 4, at 701–02 (Appendix).

Because p and r are both functions of a, total differentiations of [A.II.8] and [A.II.9] lead to the following system of two equations:

$$2b_1 \frac{dp}{da} - b_2 \frac{dr}{da} = b_4 \qquad \text{[A.II.11]}$$

$$-b_4 \frac{dp}{da} + 2b_3 \frac{dr}{da} = b_3 \qquad \text{[A.II.12]}$$

Solving [A.II.11] and [A.II.12] gives:

$$\frac{dr}{da} = \frac{2b_1 b_3 + b_4^2}{4b_1 b_3 - b_2 b_4} \qquad \text{[A.II.13]}$$

Substituting [A.II.13] into [A.II.10], Equations [A.II.8]–[A.II.10] can be solved for p, r and a. The diversion ratio with linear demand is:

$$Div = -\frac{\partial x / \partial r}{\partial y / \partial r} = \frac{b_2}{b_3} \qquad \text{[A.II.14]}$$

Then the PPB and the ECPR can be solved for:

$$PPB = c_2 + Div(p - c_1) = c_2 + \frac{b_2(p - c_1)}{b_3} \qquad \text{[A.II.15]}$$

$$ECPR = c_2 + (p - c_1) \qquad \text{[A.II.16]}$$

Following Professor Salop's numerical example, c_1=\$40 and c_2=\$10.[41] Simulations were run for the following parameter configurations:

TABLE A.II.1: PARAMETER VALUES FOR THE SIMULATIONS

Parameter	Number of Evenly Distributed Values	Min	Max
c_r	5	25	35
A_1	4	100	1000
A_2	4	100	1000
b_1	6	5	10
b_2	9	1	9
b_3	6	5	10
b_4	9	1	9

[41] Varying c_1 and c_2 does not change the general results.

There are a total of 233,280 combinations of the parameter values shown in Table A.II.1. I exclude those simulations that do not have a solution and further impose the following conditions to exclude unrealistic scenarios:

$b_1 > b_2$, $b_1 > b_4$, $b_3 > b_4$, and $b_3 > b_2$

$x > 0$ and $y > 0$

$p > c_1$, $r > a + c_r$, *and* $a > c_2$

The resulting 62,340 simulations are used in the analyses.