COMMENT ON MURIS AND SMITH, "ANTITRUST AND BUNDLED DISCOUNTS: AN EXPERIMENTAL ANALYSIS"

PATRICK GREENLEE
DAVID REITMAN
DAVID S. SIBLEY*

In a recent issue of *Antitrust Law Journal*, Timothy J. Muris and Vernon Smith summarize laboratory experiments performed by Smith and several coauthors that were reported in Caliskan et al.[1] Muris and Smith claim that these experiments demonstrate that anticompetitive effects from bundling are unlikely. Consequently, they argue that "regulation of bundling based upon theoretical models of exclusionary harm is premature and misguided."[2] In discussing theoretical models of bundling, Muris and Smith refer primarily to our earlier paper as well as several papers by Barry Nalebuff.[3]

We welcome empirical work that throws light on the applicability of various theories. However, the experimental design implemented by Caliskan et al. makes key assumptions that do not match the framework of our earlier paper or Nalebuff's. Therefore, the inferences that Muris and Smith attempt to draw from the Caliskan et al. results have very little to say about theoretical

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* The authors are, respectively, Research Economist at the Antitrust Division of the U.S. Department of Justice, Vice President at Charles River Associates, and John Michael Stuart Centennial Professor of Economics at the University of Texas at Austin. The authors thank, without implicating, Alex Raskovich, Barry Nalebuff, and *Journal* Editor John Johnson. The views expressed herein are not purported to reflect those of the U.S. Department of Justice.

[1] *See* Timothy J. Muris & Vernon L. Smith, *Antitrust and Bundled Discounts: An Experimental Analysis*, 75 ANTITRUST L.J. 399 (2008). The experiments they summarize are presented and discussed in Anil Caliskan, David Porter, Stephen Rassenti, Vernon L. Smith & Bart J. Wilson, *Exclusionary Bundling and the Effects of a Competitive Fringe*, 163 J. INSTITUTIONAL & THEORETICAL ECON. 109 (2007).

[2] Muris & Smith, *supra* note 1, at 403.

[3] *See* Patrick Greenlee, David Reitman & David S. Sibley, *An Antitrust Analysis of Bundled Loyalty Discounts*, 26 INT'L J. INDUS. ORG. 1132 (2008) [hereinafter *Antitrust Analysis*]; *see* also Barry Nalebuff, *Exclusionary Bundling*, 50 ANTITRUST BULL. 321 (2005) [hereinafter *Exclusionary Bundling* (2005)]; Barry Nalebuff, *Bundling as an Entry Barrier*, 119 Q.J. ECON. 159 (2004) [hereinafter *Bundling as Entry Barrier* (2004)].

models of bundling, such as ours or Nalebuff's, and in particular are not informative about whether the bundling strategies discussed in our paper and Nalebuff's would likely be observed in practice. We propose alternative approaches that would match these bundling models more closely and may prove fruitful for future empirical investigation.

A critical foundation for experimental tests of bundling theories is a proper understanding of the assumptions and theoretical implications of a given model. We find that Muris and Smith mischaracterize certain motivations, implications, and results of our 2008 article and the related 2005 article by Nalebuff.[4] One source of confusion appears to be a lack of recognition of a critical difference between these articles and the experimental design in Caliskan et al., which we explain in further detail here.

In addition, Muris and Smith point to the prevalence of mixed bundling in experimental results from Caliskan et al., and claim that these results refute the implications of our theoretical work.[5] One of the critical parts of our 2008 article that is missed in the Muris and Smith analysis is our model that *predicts* mixed bundling. In our original 2008 article, we describe our efforts to devise a simple price-based approach to determine whether bundled discounts raise or lower consumer welfare. The key principle underlying these tests is that consumers are not harmed by bundled discounts as long as standalone prices for both goods do not increase once bundling is introduced. We present two such tests––one assuming perfect competition in a contestable market and the other assuming Hotelling differentiated product competition.[6] One implication of the second model is that mixed bundling emerges as an optimal strategy. It is important to incorporate the market characteristics that drive these tests within empirical work that purports to test exclusionary bundling theories.

I. MISMATCHED EXPERIMENTAL DESIGN

The experimental design in Caliskan et al. fails to incorporate a key idea in the Greenlee, Reitman, and Sibley (GRS) model and the 2005 Nalebuff

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[4] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3; Nalebuff, *Exclusionary Bundling* (2005), *supra* note 3.

[5] *See* Muris & Smith, *supra* note 1, at 418 (noting that "critical assumptions of the exclusionary bundling models were not observed in the experimental data. For example, the exclusion models assume that the monopolist will use pure bundling. The monopolist subjects in the initial experimental setting offered an AB bundle 86 percent of the time. In just under half (44 percent) of these bundling cases, however, the monopolist used mixed bundling (that is, the standalone price of A was set so that both the bundle and the standalone A good were sold.)").

[6] The Hotelling model, which is a standard model of product differentiation in the economics literature, assumes that a parameter representing customer preferences is evenly distributed along a line segment, with the parameter for each customer indicating the relative preference for two competing products. Harold Hotelling, *Stability in Competition*, 39 ECON. J. 41 (1929).

model. As a result, the Caliskan et al. experiments do not allow for the main motivation in our article and in Nalebuff's that makes bundling profitable. Thus, in the environment that Caliskan et al. study, their finding that allowing bundled discounts does not generate a statistically significant increase in the incidence of exclusion actually is *consistent* with our earlier analysis and Nalebuff's. Consequently, Muris and Smith are incorrect when they interpret the Caliskan et al. experiments as a refutation of these two models of bundling.

In our article, and in Nalebuff's, consumers have downward-sloping demand curves for multiple units of a monopoly good A and a competitive good B.[7] Given downward-sloping demands, when the monopolist reduces the price of A, the consumer surplus gain exceeds the profit lost on sales of A by the area of the deadweight loss triangle. At the monopoly price for A, small price reductions generate only second order profit losses (graphically the profit function has only a slight slope near its peak) but first order consumer gains. If the monopolist has a means to capture some of this consumer surplus gain as profit, the monopolist will benefit from reducing the price for A below the monopoly level. The monopolist can accomplish this by charging a premium for B when bundled with A. That is, if the consumer is willing to purchase B from the monopolist (at a premium), then the consumer gets a deal on A. As Theorem 1 in our 2008 article demonstrates, bundling in this manner can benefit the consumer and the firm.[8] The usefulness of this pricing strategy, it should be noted, requires a total surplus (consumer surplus plus profit) gain in A. Muris and Smith accurately describe this motivation in their introduction.[9]

The implementation of the experimental design of Caliskan et al. rules out this benefit of a bundled pricing strategy from the start. In the Caliskan et al. experiments, demand is represented by a collection of robot consumers with heterogeneous preferences that each purchases zero or one unit of each of the two goods, A and B. Under independent pricing, a robot purchases a unit of A if and only if its valuation for A exceeds the best available price for A, and similarly for B. That is, consumers have perfectly inelastic demands for a single unit of each good.[10] Valuations vary across the robot consumers, so sellers in aggregate face downward-sloping demand curves for A and for B.

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[7] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3, at 1135, 1144; Nalebuff, *Exclusionary Bundling* (2005), *supra* note 3, at 339.

[8] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3, at 1136. Note that while our analysis focuses largely on an environment with a perfectly competitive B market, this rent extraction motivation for bundling does not require perfect competition in the rivalrous market.

[9] Muris & Smith, *supra* note 1, at 405 (presenting a cola and bottled water example from Nalebuff, *Exclusionary Bundling* (2005), *supra* note 3, and concluding that "[t]he example does not, however, make an antitrust case for condemning the multi-product firm's bundled discounts. The primary reason is that bundling in this example increases both consumer and total welfare.").

[10] Caliskan et al., *supra* note 1, at 111.

This is a critical divergence from the environments studied in our 2008 article and in Nalebuff's 2005 article. In those analyses, the monopolist (seller of A) designs a pricing plan for a single consumer who has downward-sloping demand for multiple units of each good. As described above, this feature is what makes loyalty programs profitable in these models, but is absent in the experiments reported in Caliskan et al.[11]

Given that the demands of individual robot consumers are for single units of the two goods, the monopolist cannot manipulate prices for the two products so that profit and individual consumer surplus both increase. Consider reducing the price of A from p_A to $p_A-\Delta$ and focus on an existing individual customer. The consumer continues to purchase one unit of A, so the price cut generates a consumer surplus gain in A equal to Δ. Since consumers demand at most one unit of B, the firm can recapture at most a price premium in B equal to Δ. For a consumer who would purchase A at $p_A-\Delta$ but not at p_A, the premium that can be charged in B is strictly less than Δ. This general property holds for all possible prices and implies that the firm cannot increase consumer surplus without lowering profit. This differs sharply from the key insight described above and used in our earlier article and in Nalebuff's, and suggests that loyalty discounts in the Caliskan et al. experimental environment are unlikely to increase profit compared to independent pricing and therefore are unlikely to exclude rival firms.

Muris and Smith repeatedly state that the Caliskan et al. experiments were designed to match theoretical models in the bundling literature: "methodology allowed the empirical investigation to focus on seller competitive behavior with demand precisely implemented as in the theoretical model."[12] The above discussion demonstrates that, contrary to this bold claim, the demand system employed in the experiments actually shares little in common with those used in our 2008 article and in Nalebuff's 2005 article. Thus, the experiments do not address the theory presented in these two articles.[13] If the goal is to empirically test the conclusions presented in these two articles, one could remedy this design defect. Instead of using many robots that have single-unit demands for each of the two goods, one could construct a single robot with downward-

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[11] This feature (downward-sloping rather than rectangular demand) would return if the robots got together and formed a group purchasing organization that would buy A and B for its members.

[12] Muris & Smith, *supra* note 1, at 414.

[13] The demand system of the experimental design more closely resembles that in Nalebuff's 2004 article. *See* Nalebuff, *Bundling as Entry Barrier* (2004), *supra* note 3. One potentially important difference that remains, however, is that the incumbent firm in Nalebuff (2004) does not know which market (A or B) will face competition while the experimental design has the competitors always in the B market. *Id.* at 164. Nalebuff emphasizes this bundling benefit in his conclusion: "By bundling these two goods together, the incumbent is able to use each of the monopolies to protect the other one." *Id.* at 183.

sloping, multi-unit demand curves. Such a scheme would come closer to matching the framework studied in our 2008 article and in Nalebuff's 2005 article.

Not only would this assumption be a better match for the theoretical work in articles that Muris and Smith purport to test, it is also a better match for most litigated loyalty discount cases. Bundled discounts in these cases usually apply to retailers rather than final consumers.[14] Since retailers aggregate the heterogeneous demands of their customer base, they face downward-sloping demands like those used in our 2008 article and in Nalebuff's 2005 article rather than the "rectangular" demands of the robot consumers in the experiments. Given that Muris and Smith clearly understand the key insight of our 2008 article and the 2005 Nalebuff article, it is hard to see why they thought that the Caliskan et al. experiments were valid tests of these theories.

II. MISCHARACTERIZATIONS OF OUR 2008 ARTICLE

We do not believe Muris and Smith characterized the theoretical models (Models 1 and 2) in our 2008 article correctly. First, they did not discuss the second of the two main models in our original article.[15] Our first model assumes perfect competition in the B market (Model 1), while our second model assumes Hotelling competition between differentiated products (Model 2). To ignore either model leads to erroneous conclusions both about our motivations and our results.

Our original article carefully states that bundled discounts can increase welfare and that antitrust enforcers should be cautious about condemning them. It contains extensive simulation results that show bundled discounts can either raise or lower consumer and total surplus, depending on the relevant numerical assumptions.[16] Indeed, we conclude our article by stating, "The conditions that determine whether aggregate consumer welfare rises or falls, however,

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[14] Cascade Health Solutions v. PeaceHealth, 502 F.3d 895, 903 (9th Cir. 2007) (PeaceHealth offered package discounts for hospital care to health insurers); LePage's Inc. v. 3M, 324 F.3d 141, 170 (3d Cir 2003) (3M established discount programs with several office supply retailers); Virgin Atl. Airways, Ltd. v. British Airways PLC, 69 F. Supp. 2d 571, 574 (S.D.N.Y. 1999) (British Airways entered into incentive agreements with "travel agents (acting as aggregators of demand for individual customers) and corporate customers."); SmithKline Corp. v. Eli Lilly & Co., 427 F. Supp. 1089, 1091 (E.D. Pa. 1976), *aff'd*, 575 F.2d 1056 (3d Cir. 1978) (Eli Lilly offered multi-product discount to hospitals for cephalosporin pharmaceuticals.)

[15] We introduced Model 2 in our analysis after the experiments were initially designed by Caliskan et al. As such, our discussion here focuses not on the fact that the laboratory experiments did not test Model 2, but on the lack of discussion of Model 2 (beyond a few brief mentions) by Muris and Smith.

[16] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3, tbls. 1–5; *id*. at 1137 (discussing Pareto Improvement Theorem: "although foreclosure is often discussed as reducing welfare, this need not hold for bundled rebates."); *id*. at 1147 (discussing one set of simulations for Model 2: "Aggregate net consumer surplus and producer surplus both rise in each of our simula-

are subtle and likely hard to measure in practice. This suggests that prospective antitrust enforcement for bundled discounts should be conservative."[17]

The discussion in Muris and Smith suggests that there is significant confusion about the underlying implications of the two models we have presented. To illustrate the confusion about the empirical implementation of our theory, we highlight examples of how each test in the original GRS article could be applied in various litigated cases involving bundled discounts.

A. Model 1: Perfectly Competitive Market for Product B

In the Model 1 setting, we propose a price test for the consumer welfare effects of bundled discounts under the assumption that the B market is perfectly competitive. The test based on Model 1 compares the price of the monopoly product (A) under independent pricing to the standalone price of that product under bundling. If the new standalone price exceeds the previous price of A, then we conclude that the new pricing scheme reduces consumer welfare. If, however, the standalone price falls, we conclude that consumer welfare increases. Thus, given the limitations of assuming perfect competition in the contested market (B), we have a bright-line test for the consumer welfare effects of bundled discounts.[18] The utility of the test is necessarily limited by the applicability of the model assumptions.

In their analysis, Muris and Smith assert that applying the test requires judgment about the monopolist's optimal standalone price in the absence of bundling.[19] Determining whether consumer surplus has fallen, however, does not require knowing the optimal monopoly price in the absence of bundling. All that is required is comparing the standalone prices for A before and after the pricing change. If the A market actually is a secure "textbook" monopoly, then the independent price observed prior to the pricing change would be the monopoly price. The test, it should be emphasized, does not require determining the monopoly price, and works as long as there are standalone prices from before and after bundling was implemented that can be compared.[20]

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tions. Thus these simulations illustrate the case in which the pricing strategy fails the *Ortho* test even though consumer surplus and total welfare both increase.").

[17] *Id.* at 1150.

[18] Our Model 1 results would be unchanged if we had assumed Bertrand competition among three or more firms selling homogenous goods, each with capacity sufficient to serve the market.

[19] Muris & Smith, *supra* note 1, at 431 (discussing feasibility of price test: "This test also can place impossible informational demands on the fact finder, requiring judgment about the monopolist's optimal standalone price in the absence of bundling.").

[20] One might object that applying the test requires one to account for cost and other market changes. In many cases, however, the analyst may be only interested in welfare changes immediately before and after a move to bundled discounts, and a comparison of the pre-bundling price of A to the standalone price of A would probably not require such an adjustment. Apart from that, such prices can always be adjusted for inflation, and as long as the basic attributes of the A

If our test had been applied to *LePage's*, for example, the A product would have been Scotch tape, and our test would have compared the price of Scotch tape prior to the date on which 3M adopted bundled discounts to the out-of-bundle price of Scotch tape after bundled discounts were in place. In most litigated loyalty discounts cases, there is a well-defined point at which discount programs were introduced or modified.[21] In our 2008 article, we used the *SmithKline* litigation to illustrate how to apply the test. As that example demonstrates, our test does not place "impossible informational demands"[22] on the finder of fact. In fact, quite to the contrary, it is fairly easy to implement.

B. MODEL 2: PRODUCT DIFFERENTIATION IN THE B MARKET

We also present a test for the effects of bundled discounts when the B market is a differentiated product duopoly in which all equilibrium prices exceed marginal cost.[23] This test states that a sufficient set of conditions for consumer welfare to increase under bundled discounts is: (1) the standalone price of A is no higher than the pre-bundling price of A, and (2) the competitor's price of B is no higher than before bundling.[24]

Once more, this is not a hard test to apply. An example with suitable price data is *Ortho Biotech v. Amgen*.[25] This case involved two drugs that enhance the growth of red blood cells, Ortho's Procrit and Amgen's Aranesp. These drugs are differentiated from each other, especially in dosing frequency. Amgen also sells Neulasta and Neupogen, which both stimulate the growth of white blood cells, and are patent-protected, leading products. Neulasta is by far the more popular of the two, so we focus on it. These drugs are all highly

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product have not changed much, the test is straightforward, certainly by comparison to other procedures that are considered routine in applied economics.

[21] *See, e.g.*, Cascade Health Solutions v. PeaceHealth, 502 F.3d 895, 903 (9th Cir. 2007) (PeaceHealth offered improved discounts to Regence and to Providence health insurers in 2001); LePage's Inc. v. 3M, 324 F.3d 141, 170–71 (3d Cir 2003) (in 1993, 3M begins to offer "bundled" discounts; "Executive Growth Fund" test program developed for eleven retailers in 1993 and fifteen in 1994); Concord Boat Corp. v. Brunswick Corp., 207 F.3d 1039, 1044 (8th Cir. 2000) (Brunswick first offered market share discounts to boat builders and dealers in 1984 and modified its program in 1995); SmithKline Corp. v. Eli Lilly & Co., 427 F. Supp. 1089, 1091 (E.D. Pa. 1976) (Revised Cephalosporin Savings Plan created in April 1975).

[22] Muris & Smith, *supra* note 1, at 431. Since the test for the *SmithKline* analysis relies on a comparison of the new bundled pricing structure to the simpler structure it replaced, and does not involve interpreting transaction prices, no examination of demand or cost shocks is necessary.

[23] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3, at 1144. Note that the inclusion of the differentiated product model is contrary to the claim by Muris and Smith that we limit our "bundling results and test for anticompetitive bundling to cases when the non-monopoly market is perfectly competitive." Muris & Smith, *supra* note 1, at 408.

[24] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3, at 1148.

[25] Ortho Biotech Prods., L.P. v. Amgen, Inc., No. 05-4850, U.S. Dist. LEXIS 85331 (D.N.J. Nov. 21, 2006). David Sibley served as an expert in that case.

demanded by oncology clinics. Assume that the Hotelling model adequately describes the market for red blood cell growth factors, Procrit and Aranesp being the only such products at the time.

Procrit has been sold since the 1990s and Aranesp since 2002. From its introduction, Aranesp sales took off quickly, and Ortho responded with price cuts over time. In 2004, Amgen began to offer discounts on Neulasta that were based on an oncology clinic's usage of Aranesp relative to Procrit. Suppose that between 2002 and late 2005 (the last data point available), the real list price (i.e., inflation adjusted and non-discounted) of Neulasta trended down, as did the price of Ortho's Procrit.[26] Letting Neulasta be the A product and Procrit be the non-bundler's version of the B product, under the Hotelling assumption our test applies and shows that consumer welfare rose over the time period covered by the data. Apart from the usual difficulties in working with price data, this would not have been a hard test to perform.

Both of these tests involve the same principle: if the out-of-bundle prices of the monopoly good and the contestable good fall, all consumers are better off than they were prior to the onset of bundled discounts. Strictly speaking, the claims are only proven within the assumptions of Models 1 and 2. We suspect, however, that the intuition applies much more broadly. It is important to emphasize that neither test requires calculating the monopoly price of A.

III. TESTING EXPERIMENTAL BUNDLING MODELS

Neither Muris and Smith nor Caliskan et al. appear to have applied the price tests we introduce. The statistical analysis in Caliskan et al. focuses on consumer surplus, rather than transaction prices. Looking at the transaction price data presented graphically in Tables 8 and 9 of Appendix I of Caliskan et al. suggests that, had a price test from our 2008 article been applied, the conclusion would be that consumer surplus did not decline. This would coincide with the Caliskan et al. regression analyses that generally find no harmful effects on consumer surplus. If this is correct, then both the Muris and Smith article and our 2008 article would have reached similar conclusions regarding the observed effects of bundling in the experimental environment studied by Caliskan et al.

A. TESTS BASED ON OBSERVED BUNDLING STRATEGIES

An important lesson of the models in our 2008 article is that welfare-decreasing bundling strategies need not look different from welfare-enhancing bundling strategies. An example of that is whether the strategy involves pure or mixed bundling. While pure bundling emerges in the perfectly competitive

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[26] This supposition is consistent with the recollection of one of the authors.

framework in Model 1, we present in Model 2 both an analytical result (Theorem 3) and simulation results (in Tables 2–4) showing that, in the differentiated product framework we employ for the B market, some customers *always* buy at the standalone price of the monopoly good while others *always* buy the bundle.

Mixed bundling is a key feature of equilibrium pricing in our 2008 article's Model 2. This is because, intuitively, the role of the standalone price in Model 1 is only to steer consumers toward the bundle; nobody buys at that price. In Model 2, the standalone price steers some consumers into the bundle, but also plays a price discrimination role that reduces the steering effect. Some consumers of A and B strongly prefer Firm Two's brand of B to that of Firm One. To induce such consumers to buy the bundle requires a heavily discounted bundle price of A, implying substantial forgone profits from consumers who prefer Firm One's brand of B.

Theorem 3 in our 2008 article shows that in equilibrium it is optimal for Firm One to set a standalone price of A low enough that it will be chosen by some A-and-B customers who prefer Firm Two's version of B and who will buy from Firm Two, forgoing the bundle. Other consumers of both products buy only at the bundle prices. Since our simulation results for Model 2 demonstrate both the use of mixed bundling in equilibrium, and that bundling can enhance or diminish welfare, it follows that mixed bundling is used both when bundling is welfare decreasing as well as when it is welfare increasing.

This mixed bundling result in our 2008 article contrasts with what Muris and Smith claim is one of the testable hypotheses of the bundling literature, which is that "monopolists engaged in exclusionary bundling should sell only a pure bundle (i.e., consumers purchase only the bundle and not the standalone goods)."[27] Consequently, observing whether the experimental results involve mixed or pure bundling is not useful for distinguishing procompetitive and anticompetitive uses of bundled discounts. Contrary to the claims in Muris and Smith, Model 2 predicts mixed bundling and is therefore *consistent* with the experimental results in Caliskan et al. that show substantial use of mixed bundling.[28]

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[27] Muris & Smith, *supra* note 1, at 418.

[28] *Id.* Again, though, we do not believe that Caliskan et al. test our 2008 article correctly. We should note that, because Caliskan et al. assume homogeneous products, their results are not really a test of our Model 2. Capacity constraints for the firms in the experimental design imply that, unlike Greenlee, Reitman & Sibley, *Antitrust Analysis, supra* note 3, there are no pure strategy price equilibria, and as a result, equilibrium might entail some use of mixed bundling. (Neither Caliskan et al. nor Muris and Smith determine the equilibrium predictions for the oligopoly setting that Caliskan et al. study experimentally.) Hence their results are not really a test of our Model 1 either. Our point here is simply that Muris and Smith claim that in our 2008 article, we only find pure bundling in equilibrium, ignoring our Model 2.

If the experimental design directly implements the market setting in a theoretical bundling model, it may be possible to test some of the specific implications of the theoretical equilibrium. For example, the models in our 2008 article predict that customers who buy the bundle pay more for the B product than those who purchase A and B separately.[29] Moreover, these models predict that Firm One's mixed bundling price for just A is greater than the price it charges for A without bundling. That is, the standalone price for A increases when a bundling scheme is introduced. However, it may not be possible to extrapolate these results to other market settings, and they would be particularly hard to interpret in a market setting like that used in Caliskan et al., in which fixed costs and capacity constraints imply that the only equilibrium in the market when firms do not use bundling involves mixed (randomized) pricing strategies.[30]

B. Tests Based on Market Outcomes

It is also problematic to try to identify anticompetitive conduct based on readily observable changes, such as a decrease in the number of competitors in the market. If bundling is anticompetitive, it may foreclose competition without completely driving competitors out of the market or perhaps maintain monopoly by preventing new competitors from being able to enter. This is consistent with such cases as *LePage's* and *SmithKline*, in which bundling was found to be anticompetitive even though LePage's and SmithKline were still operating in the market. Likewise, exit by inefficient firms does not necessarily imply a significant lessening of competition. In our 2008 article we describe conditions in our simulations under which the single product firm has an incentive to exit.[31]

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[29] Note that in the downward-sloping demand framework we use in the 2008 article, the prices of individual products in the bundle matter, since they affect the quantities purchased of each product. This contrasts with the unit demand framework used in the Caliskan et al. experiments, in which only the total price of the bundle matters, not the price charged for each component of the bundle.

[30] Caliskan et al., *supra* note 1, at 113. The absence of pure strategy equilibria in the experimental design raises two additional issues. First, unlike perfectly competitive markets, (mixed strategy) equilibria for settings with capacity-constrained firms selling homogeneous goods frequently yield positive expected net profits for the firms. Second, laboratory subjects tend not to play mixed strategies as predicted by theory, while in at least some settings "experts" do. *See*, *e.g.*, Mark Walker & John Wooders, *Minimax Play at Wimbledon*, 91 AM. ECON. REV. 1521 (2001); P.-A. Chiappori, S. Levitt, & T. Groseclose, *Testing Mixed-Strategy Equilibria When Players Are Heterogeneous: The Case of Penalty Kicks in Soccer*, 92 AM. ECON. REV. 1138 (2002) (discussing how laboratory experiments have generally had difficulty confirming mixed strategy equilibrium predictions, and then analyzing, respectively, serves in Grand Slam and Masters tennis matches between highly ranked players, and penalty kicks in French and Italian elite football leagues). Together these suggest that not observing exclusion in the laboratory may be an artifact of the experimental design rather than an empirical refutation of the theory.

[31] Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3, at 1149.

Muris and Smith claim that a second testable hypothesis is that "exclusionary bundling should decrease the number of competitors in the B market and, to be deemed anticompetitive, long-run welfare should fall."[32] However, this is not an implication of bundling models but rather a statement about what Muris and Smith claim it means for conduct to be exclusionary. It is necessary to have some definition of exclusionary conduct to determine whether the experimental results depict procompetitive or anticompetitive outcomes. But, given the important differences of assumptions between the bundling literature and the Caliskan et al. experimental design, the experiments are ill-equipped to test for the exclusionary conduct that is predicted in the theoretical models.

C. TESTS BASED ON EXCLUSIONARY CONDUCT

We agree with Muris and Smith that there is value to testing experimentally whether behavior observed in market models is consistent with exclusionary conduct that is predicted by those models, using some definition of what exclusionary conduct entails. In this regard, Muris and Smith succeed in showing that exclusionary conduct is possible: Table 4 describes an outcome in which bundling reduces the numbers of competitors while (slightly) decreasing consumer surplus and total surplus.[33] It is possible that exclusionary conduct may be less difficult to generate in experiments with consumers that have downward-sloping demand rather than unit demand. In any case, settings with downward-sloping demand would be a more fruitful place to look for exclusionary conduct (or a lack thereof) because this better characterizes the bundling literature that Muris and Smith seek to test as well as the market settings for many litigated cases. It would also be useful to see whether adding more complex market characteristics to the experimental design, such as customer heterogeneity and bundling efficiencies (which are typically omitted from theoretical models), changes the likelihood of observing exclusionary conduct or the magnitude of the associated harm.[34]

D. TESTS BASED ON PREDICTIVE POWER

Aside from asking whether exclusionary bundling is even possible, experiments could be invaluable as a way of determining the accuracy of various

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[32] Muris & Smith, *supra* note 1, at 418.

[33] *Id.* at 420. Muris and Smith note that these results still have substantial amounts of mixed bundling, suggesting that they are inconsistent with exclusionary bundling as identified in the literature. However, as discussed above, the use of mixed bundling is not inconsistent with our 2008 article. Greenlee, Reitman & Sibley, *Antitrust Analysis*, *supra* note 3.

[34] In our 2008 article, we briefly consider customer heterogeneity and examine how a firm would optimally design a menu of (potentially non-linear) pricing plans for a population of heterogeneous consumers. *Id.* at 1143.

tests that have been proposed for anticompetitive bundling. These include the consumer welfare test introduced in our 2008 article and the *Ortho* test and variations discussed in Muris and Smith.[35] The question would be whether these tests correctly indicate exclusionary harm or whether they frequently generate false positives, given that subjects may not use equilibrium strategies and that experimental environments may include additional market characteristics beyond those presented in theoretical research.[36] Of course, the utility of such experimental exercises would depend on how well the tested environments coincide with real-world markets. There is little reason for policy concerns if experimental results suggest that examples of exclusionary conduct are rare, but tests for exclusionary bundling correctly flag only those few instances of harmful conduct.

IV. CONCLUSION

Implicit in Muris and Smith's comments is a fundamental misunderstanding about what the tests in our 2008 article and Nalebuff's 2005 article try to accomplish. Muris and Smith appear to believe that the purpose of our earlier article and Nalebuff's is to promote the view that bundled discounts should be illegal and that our results are designed with that end. The ultimate goal of these articles and others that propose tests for exclusionary bundling is for antitrust practitioners and courts to be able to distinguish legitimate from exclusionary conduct. In some applications (such as the *SmithKline* example above), a test can be used to show that conduct reduced consumer surplus, but in others (such as the *Ortho v. Amgen* example above) a test can be used to show that conduct benefited consumers. The mere existence of a test does not increase the likelihood that bundling will be deemed anticompetitive, nor does demonstrating a theoretical possibility of exclusionary applications of bundling imply that such applications are prevalent. Arguably the best way to prevent frivolous or unnecessary bundling litigation is to advocate clear tests, which is a major goal of our 2008 article.

We agree with Muris and Smith that additional empirical work on the competitive effects of bundled discounts would be valuable for competition policy considerations. Well-designed experiments may throw additional light on the applicability of various theories, including those presented in our 2008 article and in Nalebuff's 2005 article. The experiments conducted by Caliskan et al. and reported in Muris and Smith, however, were not set up to test these theo-

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[35] Muris & Smith, *supra* note 1, at 410.

[36] As described above, neither the Muris and Smith nor Caliskan et al. articles appear to have applied the price tests we introduce, and there is reason to believe that the test would have correctly identified the experimental environment as one in which bundling does not reduce consumer surplus.

ries.[37] Muris and Smith's attempt to use them for that purpose is unsuccessful. We encourage experimentalists such as Caliskan et al. to work with us in order to better test the empirical implications of bundling theories.

[37] We are currently engaged in a detailed analysis of the experimental design in Caliskan et al.