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# Bundling and Consumer Misperception

Oren Bar-Gill<sup>†</sup>

*This Essay studies bundling of two (or more) products as a strategic response to consumer misperception. In contrast to the bundling and tying studied in the antitrust literature—strategies used by a seller with market power in market A trying to leverage its market power into market B—bundling in response to consumer misperception may occur in intensely competitive markets. The analysis demonstrates that such competitive bundling can be either welfare enhancing or welfare reducing. The Essay considers several “unbundling policies” that can protect consumers and increase welfare in markets where bundling is undesirable.*

## I. INTRODUCTION

Consumer misperception of the costs and benefits associated with a product or service is prevalent. It can be the product of imperfect information or imperfect rationality (or both). It can be independent of any action taken by sellers. It can be instigated by sellers. And it can be mitigated by sellers.<sup>1</sup>

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<sup>†</sup> Assistant Professor of Law, New York University School of Law. This Essay greatly benefited from comments and criticisms by Barry Adler, Jennifer Arlen, Lucian Bebchuk, Omri Ben-Shahar, Bob Cooter, Chaim Fershtman, Eleanor Fox, Clay Gillette, Marcel Kahan, Ehud Kamar, Ronald Mann, Luis Rayo, seminar participants at Bar-Ilan University, NYU, and the University of Texas, and conference participants at the University of Chicago Law School conference on *Homo Economicus*, *Homo Myopicus*, and the Law and Economics of Consumer Choice. Finally, I thank the NYU School of Law for generous financial support.

<sup>1</sup> A seller offering a superior product has every incentive to ensure that consumers appreciate the superiority of her product. Specifically, such a seller has every incentive to correct any misperception consumers might have about the shortcoming of a competing product. But correcting consumers' misperceptions is costly. A seller might thus choose to ride the tide of consumer misperception and offer an inferior product, rather than convince consumers that a superior product justifies a higher price. The concern that sellers will often lack the incentive to educate consumers is reinforced by the public-good nature of such educational efforts. If a seller succeeds in correcting consumers' misperceptions, competitors will be quick to adapt their products to the changed demand. And the seller, who brought about this desirable change in demand, will not be able to recoup her investment in educating consumers. See, for example, Ian Ayres and Barry Nalebuff, *In Praise of Honest Pricing*, 45 MIT Sloan Management Rev 24, 28 (Fall 2003) (mentioning the “first-mover disadvantage” that occurs when companies “change the environment on their own” by supplying information to the marketplace); Howard Beales, Richard Craswell, and Steven C. Salop, *The Efficient Regulation of Consumer Information*, 24 J L & Econ 491, 503–04, 506 (1981) (finding that there is often “an undersupply of general information” about products, because when a company furnishes its consumers with information about a particular product, its competitors end up benefiting too). In a recent contribution Xavier Gabaix and David Laibson argue that under some conditions sellers will shroud unattractive product attributes even when advertising costs are zero. See Xavier Gabaix and David Laibson, *Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets*, MIT Econ Working Paper No 05-18 (2005), available online at <http://ssrn.com/abstract=728545> (visited Nov 21, 2005). In some cases, signaling, for example, through warranties, can alleviate consumer misperception. See Michael Spence, *Consumer Misperceptions, Product Failure and Producer Liability*, 44 Rev Econ Stud 561, 569 (1977) (finding that product guar-

This Essay takes consumer misperception as given and studies one common strategy employed by sellers facing such misperception: the bundling strategy. “Bundling” in this Essay is used in a somewhat broader sense than is conventional in the antitrust and industrial organization literatures.<sup>2</sup> I define the bundling of products A and B to include any case where a consumer purchasing product A from seller X has a sufficiently strong incentive to purchase product B from the same seller. In a second significant departure from the antitrust and industrial organization literatures, I focus on bundling by sellers operating in competitive markets.

Consider first consumer misperception about the value of a product. To fix ideas assume that a consumer underestimates the amount of in-home printing she will choose to do if she had a printer at home, thus underestimating the value to her of owning a printer. Such underestimation of value and of use will also lead the consumer to underestimate the number of ink cartridges she will purchase over the life of the printer. For instance, the consumer may estimate that she will need fifty ink cartridges, when in fact she will need one-hundred cartridges.<sup>3</sup> The argument is that under these assumptions a seller offering printers only will find it hard to compete with a seller who bundles printers and ink, that is, who, through technological compatibility constraints and/or intellectual property protection, forces consumers who bought its printers to also purchase its ink cartridges.

The competitive advantage of the bundling seller can be explained as follows. In a competitive market a seller offering only printers will have to price its printers at the marginal cost of a printer, say \$1000. Consumers who buy printers from this seller will know that they will have to buy their ink from another seller at the marginal cost of ink, say \$10. Accordingly, the total cost of printing perceived by a consumer purchasing a printer from the printer-only seller is \$1500 (i.e.,  $\$1000 + 50 \times \$10$ ). (The actual, as opposed to perceived, total cost of printing is  $\$1000 + 100 \times \$10 = \$2000$ .)

Now consider a bundling seller. This seller may offer the same (or equivalent) printer at a below-cost price of \$500 and cover its losses by charging \$15 per ink cartridge. The total cost of printing perceived by a consumer purchasing a printer from the bundling seller is \$1250 ( $= \$500 + 50 \times \$15$ ). (The actual, as opposed to perceived, total cost of printing is  $\$500 + 100 \times \$15 = \$2000$ , as in the no-bundling case.<sup>4</sup>) Given consumer

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antees may act as signals to consumers because they are “costly to the seller” and are “systematically related to product liability”).

<sup>2</sup> See, for example, Jean Tirole, *The Theory of Industrial Organization* 333–35 (MIT 1988).

<sup>3</sup> For expositional simplicity this example and most of the analysis in the Essay assumes inelastic demand. A more general model with elastic demand is developed and studied in the appendix. The main results are qualitatively unchanged when elastic demand is introduced. See Part II.D.

<sup>4</sup> In a competitive market, the total price collected by the bundling seller cannot exceed the total cost, \$2,000 ( $= \$1000$  [cost of a printer] +  $100$  [actual cost of an ink cartridge]  $\times$   $\$10$  [cost of an ink cartridge]). Neither can the total price fall below \$2,000, otherwise the seller will lose money.

underestimation of ink usage, sellers in a competitive market must bundle printers and ink.

Overestimation of value and of use can similarly induce a bundling response by sellers. Consider the health club market. Sellers can charge a per-visit fee. Sellers can also offer a one-year subscription, which can be viewed as an intertemporal bundle (access to the club in period 1 is bundled with access in period 2). For consumers who overestimate the number of visits they will make to the health club the bundle/subscription will be the preferred option. Accordingly, in a competitive market health clubs who fail to offer subscriptions will be at a disadvantage.

The welfare implications of bundling depend on the type of misperception that triggers the bundling response. Absent bundling, underestimation of value leads to too little trade. In the printers and ink example this means that too few printers will be purchased. Bundling, with its accompanying backloaded pricing, generates an underestimation of cost that offsets the underestimation of value. Bundling restores efficiency. Overestimation of value, on the other hand, leads to excessive trade. Bundling exacerbates this inefficiency. Absent bundling with per-product marginal cost pricing, the overestimation of value is partially offset by the overestimation of cost. Bundling, with its accompanying front-loaded pricing, eliminates this beneficial offsetting effect.

The bundling strategy has distributional effects as well. When bundling is a response to underestimation of value and of use, high value/use consumers end up cross-subsidizing low value/use consumers. When bundling is a response to overestimation of value and of use, low value/use consumers end up cross-subsidizing high use consumers. The welfare implications of these distributional effects depends on the identity of the high value/use and low value/use groups.

Misperception of value is not the only type of misperception that can trigger a bundling response. Price misperception can similarly force bundling of the product whose price is misperceived and another product whose price is accurately perceived. The efficiency implications are straightforward. Bundling exacerbates the overconsumption problem created by underestimation of price. When overestimation of price leads to underconsumption, bundling alleviates this inefficiency.

The main goal of this Essay is to argue that competitive bundling in response to persistent consumer misperception is both predicted in theory and observed in practice. I therefore begin, in Part II, by developing a theory of bundling in response to consumer misperception. I then proceed in Part III to briefly consider three real world examples of misperception-based bundling. I begin with intertemporal bundling in subscription markets. I proceed to discuss the credit card market which exhibits bundling between transacting and borrowing services as well as intertemporal bun-

dling. And I end with the cell phone market where phones/handsets are bundled with calling plans.

While mainly descriptive, the analysis in this Essay has normative and prescriptive implications. I show that bundling has both efficiency and distributional consequences. The feasibility of bundling can either increase or reduce welfare, depending largely on the type of misperception that triggers the bundling response. When bundling reduces welfare, regulation that discourages bundling may provide a valuable tool for policymakers. Part V considers several unbundling policies.<sup>5</sup>

This Essay studies bundling in competitive markets. It shows that consumer misperception can lead to welfare-reducing bundling even in competitive markets. The analysis thus departs from the legal and economic literatures on bundling and tying that have focused on concentrated markets.<sup>6</sup> An important exception is a recent article by David Evans and Michael Salinger that studies bundling in competitive markets.<sup>7</sup> Evans and Salinger, however, highlight the potential cost-based *efficiency* of bundling. This Essay explores the potential *efficiency* and *inefficiency* of bundling, when the bundling strategy is adopted in response to consumer misperception.

It is important to emphasize at the outset that the proposed account of bundling, and of the pricing of the bundle and its components, as a response to consumer misperception is not offered as an exhaustive or even a dominant account. There are other important explanations for the bundling strategy that have nothing to do with consumer misperception. In particular, as noted above, many bundles can be justified on cost-saving grounds. Moreover, many observed bundles can be explained by a combination of the misperception-based and cost-based accounts.

Market responses to consumers' imperfect rationality are the subject of increasing attention in the behavioral economics literature.<sup>8</sup> An important

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<sup>5</sup> The analysis has a second policy implication. The existence of product bundles and the pricing of these bundles can be used as indicators of persistent consumer misperception in the examined market. However, bundles with similar pricing patterns may also be the product of other economic forces. Therefore, observing such bundles and pricing patterns should not be considered decisive evidence of misperception.

<sup>6</sup> See, for example, Michael D. Whinston, *Tying, Foreclosure, and Exclusion*, 80 Am Econ Rev 837, 838 (1990); Dennis W. Carlton and Michael Waldman, *The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries*, 33 RAND J Econ 194, 198 (2002); Barry Nalebuff, *Bundling as a Barrier to Entry*, 119 Q J Econ 159, 183 (2004).

<sup>7</sup> David S. Evans and Michael Salinger, *Why Do Firms Bundle and Tie? Evidence from Competitive Markets and Implications for Tying Law*, 22 Yale J Reg 37, 42 (2005). See also Richard Craswell, *Tying Requirements in Competitive Markets: The Consumer Protection Issues*, 62 BU L Rev 661, 681-87 (1982) (discussing cases in which bundling is likely to be efficient).

<sup>8</sup> See, for example, Gabaix and Laibson, MIT Econ Working Paper No 05-18 (cited in note 1) (discussing sellers' frequent practice of shrouding information about their products when that information is not readily available to the public); Stefano DellaVigna and Ulrike Malmendier, *Paying Not to Go to the Gym* 2 (forthcoming), online at

recent contribution by Stefano DellaVigna and Ulrike Malmendier develops a model of optimal two-part tariff pricing with consumer misperception.<sup>9</sup> My analysis of how bundled components should optimally be priced builds on the DellaVigna and Malmendier model. Della Vigna and Malmendier also discuss many of the markets that feature in this Essay. DellaVigna and Malmendier, however, take the existence of the bundle as given.<sup>10</sup> The main contribution of this Essay is to endogenize bundling—to present bundling as an important strategic response to consumer misperception. I also discuss welfare and policy implications that are not identified in previous work.<sup>11</sup>

Finally, the potential role of bundling as a strategic response to consumers' imperfect rationality has been recognized in two important early articles by Richard Thaler and Richard Craswell. Pioneering the field of behavioral economics, Thaler's seminal contribution shows how mental accounting (by consumers), and specifically the framing and coding of multiple gains and losses, can lead sellers to adopt a bundling strategy.<sup>12</sup> Craswell, working at the intersection of antitrust law and consumer protection law, identifies the viability of misperception-driven bundling in competitive markets.<sup>13</sup> I generalize Thaler's and Craswell's insights and explore their welfare and policy implications.

## II. BUNDLING IN RESPONSE TO CONSUMER MISPERCEPTION

### A. Printers and Ink

When consumers misperceive the costs or benefits of one product, competition may force sellers to bundle this product with another product. I allow for separate pricing of the two products, but show that the competitive response to consumer misperception will often entail a single price. It is important to note that an effective bundle can exist even when two (or

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gsb.stanford.edu/malmendier/personal\_page/Papers/gymemp05-04-20.pdf (visited Nov 21, 2005) (studying consumer behavior regarding gym membership); Sharon M. Oster and Fiona M. Scott Morton, *Behavioral Decision-Making: An Application to the Setting of Magazine Subscription Prices*, SSRN Working Paper Series 5 (unpublished manuscript 2004), online at <http://ssrn.com/abstract=467222> (visited Nov 21, 2005).

<sup>9</sup> See Stefano DellaVigna and Ulrike Malmendier, *Contract Design and Self-Control: Theory and Evidence*, 119 Q J Econ 353, 357 (2004).

<sup>10</sup> An important exception is DellaVigna and Malmendier's analysis of endogenous switching costs. *Id.* at 385. Previous analyses of subscription contracts may also be interpreted as studying endogenous intertemporal bundling. See *id.* at 392 (collecting examples of intertemporal bundling from other industries); DellaVigna and Malmendier, *Paying Not to Go to the Gym* at 1 (cited in note 8) (modeling a choice between monthly and annual health club subscriptions); Oster and Morton, *Behavioral Decision-Making* (cited in note 8) (magazine subscriptions). Intertemporal bundling is discussed in Part IV.A.

<sup>11</sup> Specifically, DellaVigna and Malmendier ask how misperception affects welfare, while I ask how bundling affects welfare (taking misperception as given).

<sup>12</sup> See Richard Thaler, *Mental Accounting and Consumer Choice*, 4 Marketing Sci 199, 208–09 (1985).

<sup>13</sup> See Craswell, 62 BU L Rev at 671–81 (cited in note 7).

more) distinct products are separately priced. This bundle can be sustained through technology (i.e., compatibility constraints), law (i.e., contractual obligation), or simply economic or psychological switching/transaction costs.

Consider a competitive market for printers. Assume, however, that once a consumer buys a brand X printer she can buy ink cartridges only from X (as a matter of technological compatibility). How will sellers price their product? Or, more accurately, how will they price their two bundled products: printers and cartridges?<sup>14</sup>

Take a specific example. Let the cost of a printer be 1000 and the cost of an ink cartridge be 10. Assume that the seller knows that an average consumer will buy 100 cartridges over the life of the printer. (Inelastic demand is assumed for expositional simplicity. An elastic demand extension is developed in the appendix; the results are summarized in Part II.C.) The total per-consumer cost is thus 2000. If consumers are homogeneous in their printing practices,<sup>15</sup> and fully aware of their expected use of the printer, then a continuum of printer-ink price pairs is possible. To see this, let  $p_p$  and  $p_i$  denote the price of a printer and of an ink cartridge, respectively. The consumer thus expects to pay a total price of  $P = p_p + 100 \cdot p_i$ . Competition guarantees that the total price  $P$  equals the total cost to the seller, namely,  $P = p_p + 100 \cdot p_i = 2000$ . This competitive pricing condition is satisfied by per-product marginal cost pricing:  $p_p = 1000$  and  $p_i = 10$ . But it is also satisfied, for example, by  $p_p = 0$  and  $p_i = 20$  and by  $p_p = 2000$  and  $p_i = 0$ .

Consumer heterogeneity breaks the indifference between the infinity of possible price combinations. Consider two types of consumers: high use consumers who will buy 110 cartridges on average and low use consumers who will buy 90 cartridges on average. Assume an equal number of high and low use consumers. The  $p_p = 0$ ,  $p_i = 20$  price pair is unattractive to high use consumers. These consumers expect to pay 2200 under this pricing scheme, and will thus be quick to choose a seller offering a more balanced price combination. Specifically, high use consumers will prefer per-product marginal cost pricing, under which they expect to pay 2100. Conversely, the  $p_p = 2000$  and  $p_i = 0$  price pair is unattractive to low use consumers. These consumers expect to pay 2000 under this pricing scheme, and will thus prefer per-product marginal cost pricing, under which they expect to pay 1900. Heterogeneity will thus lead sellers to price both their printers

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<sup>14</sup> The analysis below directly applies to any market where a durable product is bundled with replacement parts or service. And, as explained below, it also applies more broadly to any misperception-based bundling of two goods, services or components.

<sup>15</sup> The homogeneous consumer case can be viewed as homogeneity within a class of consumers that has been segmented by sellers.

and their ink cartridges at marginal cost.<sup>16</sup> Perhaps more importantly, elastic demand also breaks the indifference between the possible price combinations and leads to marginal cost pricing (see Appendix).

#### B. Underestimation of Value/Use

Now assume that consumers are myopic and systematically underestimate the amount of printing they will do and thus the number of ink cartridges that they will buy. How does consumer misperception affect the above result that competition will lead to per-product marginal cost pricing?

For expositional clarity, I return to the unrealistic benchmark market where consumers are homogeneous with respect to their printing practices. Absent consumer misperception any price combination satisfying  $p_p + 100 \cdot p_i = 2000$  can persist in a competitive market. What if consumers mistakenly believe that they will need 50 ink cartridges, rather than 100 cartridges—the true number of cartridges that they will use? Compare the perceived attractiveness of the three price pairs considered above. With the  $p_p = 2000$ ,  $p_i = 0$  pricing scheme the consumer will perceive a total price of 2000. With the  $p_p = 1000$ ,  $p_i = 10$  pricing scheme the consumer will perceive a total price of 1500. And with the  $p_p = 0$ ,  $p_i = 20$  pricing scheme the consumer will perceive a total price of 1000. Since sellers get the same total price under the three pricing schemes, they will choose the  $p_p = 0$ ,  $p_i = 20$  scheme.<sup>17</sup>

This result is robust to the introduction of consumer heterogeneity. As before, assume that there are two types of consumers: high use consumers who will buy 110 cartridges on average and low use consumers who will buy 90 cartridges on average. Introducing consumer misperception, assume that the high use consumers think they will buy 60, rather than 110, ink cartridges, and that the low use consumers think they will buy 40, rather than 90, ink cartridges.

Compare the perceived attractiveness of the three price pairs considered above. With the  $p_p = 2000$ ,  $p_i = 0$  pricing scheme both high use and low use consumers will perceive a total price of 2000. With the  $p_p = 1000$ ,  $p_i = 10$  pricing scheme high use consumers will perceive a total price of 1600 and low use consumers will perceive a total price of 1400. And with the  $p_p = 0$ ,  $p_i = 20$  pricing scheme high use consumers will perceive a total price of 1200 and low use consumers will perceive a total price of 800.

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<sup>16</sup> Other equilibria where high use consumers are offered one contract/pricing scheme and low use consumers are offered another contract/pricing scheme are theoretically possible (if sellers can make low-price ink compatible only with high-price printers). In a competitive market, however, sellers have no incentive to deviate from per-product marginal cost pricing.

<sup>17</sup> In theory sellers might even set a negative printer price,  $p_p$ , and raise the ink price,  $p_i$ , above 20. In practice, however, negative prices pose too big a temptation for strategic behavior.

Since sellers get the same total price under the three pricing schemes, they will choose the  $p_p = 0$ ,  $p_i = 20$  scheme.<sup>18</sup>

The preceding analysis focused on the pricing of printers and ink, taking the existence of the printer-ink bundle as given. But the formation of bundles in itself is an endogenous deliberate strategy. A main theme of this Essay is that the bundling strategy is an effective, often inevitable, response to consumer misperception. The optimal pricing analysis demonstrated the dominance of the  $p_p = 0$ ,  $p_i = 20$  scheme. This pricing scheme cannot survive without effective bundling of printers and ink. Absent such bundling, a consumer who received a free printer under the  $p_p = 0$ ,  $p_i = 20$  scheme will buy ink at the marginal cost of  $p_i = 10$  from an independent ink seller. Foreseeing this dynamic no one will adopt the free printer-expensive ink tactic.

Making the  $p_p = 0$ ,  $p_i = 20$  scheme viable, however, is an attractive prospect. As shown above, if viable, this scheme dominates all other pricing schemes. Specifically, it dominates the pricing scheme that inevitably emerges absent bundling, the  $p_p = 1000$ ,  $p_i = 10$ , marginal-cost-pricing scheme. Sellers thus have a powerful incentive to bundle printers and ink. Indeed, sellers employ technological compatibility constraints coupled with intellectual property protection to secure effective bundling of printers and ink.<sup>19</sup>

What are the welfare implications of the bundling of printers and ink cartridges and specifically of the  $p_p = 0$ ,  $p_i = 20$  pricing scheme that such bundling entails? It may seem, at first blush, that there are no welfare implications. After all, under all three pricing schemes— $p_p = 2000$ ,  $p_i = 0$ ;  $p_p = 1000$ ,  $p_i = 10$ ; and  $p_p = 0$ ,  $p_i = 20$ —the average consumer ends up paying the exact same amount: 2000. But the three pricing schemes are not welfare-neutral.

First, while the *average* consumer will end up paying the same amount under the different schemes, some consumers will benefit and some consumers will lose. Table 1 lists the total (and per-use/cartridge) payments of high use and low use consumers under each of the three pricing schemes.

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<sup>18</sup> The analysis in the text considers only heterogeneity with respect to printer use. Another important dimension of heterogeneity, whose implications are not explored here, is heterogeneity with respect to the level of the bias/misperception (including, for example, the case where some consumers underestimate use and some overestimate use). For an analysis of this type of heterogeneity in related contexts, see generally DellaVigna and Malmendier, *Paying Not to Go to the Gym* (forthcoming) (cited in note 8); DellaVigna and Malmendier, 119 Q J Econ at 360 (cited in note 9) (setting a variable that represents a given consumer's estimate of his consumption of a product at a given time); see also John Haltiwanger and Michael Waldman, *Rational Expectations and the Limits of Rationality: An Analysis of Heterogeneity*, 75 Am Econ Rev 326, 328–33 (1985).

<sup>19</sup> Hall reports that printer manufacturers control over 90 percent of the ink market. See Robert E. Hall, *The Inkjet Aftermarket: An Economic Analysis* 23 (unpublished manuscript 1997) (on file with author). Also consistent with the above analysis, Hall suggests that ink cartridges are "hugely profitable." Id at 4.

Table 1: The differential effect of pricing distortions on the two consumer types

	High use consumers pay	Low use consumers pay
$p_p = 2000, p_i = 0$	Total: 2000 (Per use/cartridge: 18.2) Perceived total: 2000	Total: 2000 (Per use/cartridge: 22.2) Perceived total: 2000
$p_p = 1000, p_i = 10$	Total: 2100 (Per use/cartridge: 19.1) Perceived total: 1600	Total: 1900 (Per use/cartridge: 21.1) Perceived total: 1400
$p_p = 0, p_i = 20$	Total: 2200 (Per use/cartridge: 20) Perceived total: 1200	Total: 1800 (Per use/cartridge: 20) Perceived total: 800

Table 1 shows that low use consumers benefit from a move to the  $p_p = 0, p_i = 20$  pricing scheme, while high use consumers lose from such a move. This distributional effect can be seen as either good or bad, depending on the identity of the high use and low use consumers, but it is not welfare neutral.<sup>20</sup>

A second welfare implication derives from the distortion in the number of printers that consumers buy. Underestimation of value/use naturally leads to the purchase of too few printers, at least absent bundling. To see this let  $v$  denote the per-cartridge value of printing to the average consumer. The total value of printing to the average consumer is thus  $100v$ . Since the total cost of printing is 2000 (recall that the cost of a printer is 1000 and the cost of an ink cartridge is 10), it is efficient for a consumer to purchase a printer whenever  $100v > 2000$  or  $v > 20$ . With underestimation of value/use the perceived total value of printing is  $50v (< 100v)$ . Under the  $p_p = 1000, p_i = 10$ , marginal-cost-pricing scheme the average consumer perceives a total price of printing of 1500, and will thus purchase a printer whenever  $50v > 1500$  or  $v > 30$ . In particular, efficient purchases will not occur whenever  $20 < v < 30$ .

Bundling cures this problem. With bundling coupled with the  $p_p = 0, p_i = 20$  pricing scheme the average consumer perceives a total price of printing of 1000, and will thus purchase a printer whenever  $50v > 1000$  or  $v > 20$ . Efficiency is restored. The underestimation of value is perfectly

<sup>20</sup> In fact, even if the two buyer types are identical in every aspect other than their printing practices, still the distributional effect of the different pricing schemes will not be welfare neutral. With decreasing marginal utility of money, a loss to one individual is not perfectly balanced by a commensurate gain to another individual: Consider two identical individuals (with the same level of wealth), A and B. When a sum  $X$  is transferred from A to B, the reduction in A's utility is greater than the increase in B's utility. For a definition and discussion of the decreasing marginal utility assumption see Richard A. Posner, *Economic Analysis of Law* 10–11 (Aspen 6th ed 2003).

offset by the underestimation of total price. Bundling in response to underestimation is welfare enhancing.

### C. Overestimation of Value/Use

What would be the market response to the opposite kind of misperception—to overestimation, rather than underestimation, of use? While overestimation is less likely in the printer-ink context, I continue with this example for ease of exposition.

Again, I return to the unrealistic benchmark market where consumers are homogeneous with respect to their printing practices. Assume that consumers mistakenly believe that they will need 150 ink cartridges, rather than 100 cartridges—the true number of cartridges that they will use. Compare the perceived attractiveness of the three price pairs considered above. With the  $p_p = 2000$ ,  $p_i = 0$  pricing scheme the consumer will perceive a total price of 2000. With the  $p_p = 1000$ ,  $p_i = 10$  pricing scheme the consumer will perceive a total price of 2500. And with the  $p_p = 0$ ,  $p_i = 20$  pricing scheme the consumer will perceive a total price of 3000. Since sellers get the same total price under the three pricing schemes, they will choose the  $p_p = 2000$ ,  $p_i = 0$  scheme.<sup>21</sup>

The optimal pricing scheme with overestimation of use— $p_p = 2000$ ,  $p_i = 0$ —is diametrically opposite to the optimal pricing scheme with underestimation of use— $p_p = 0$ ,  $p_i = 20$ . The bundling of printers and ink, however, is equally necessary to support this very different pricing scheme. Absent such bundling, the consumer would purchase a printer at the marginal cost of  $p_p = 1000$  from an independent printer seller and then pick-up free ink from the seller offering the  $p_p = 2000$ ,  $p_i = 0$  scheme. Anticipating this dynamic, no one will adopt the expensive printer/free ink tactic. As with underestimation of use, here too sellers have a strong incentive to make the  $p_p = 2000$ ,  $p_i = 0$  scheme viable, by bundling printers and ink. Arguably, effective bundling with  $p_p = 2000$ ,  $p_i = 0$  pricing can be more easily achieved, as compared to effective bundling with  $p_p = 0$ ,  $p_i = 20$  pricing (as was needed with consumer underestimation of use). All sellers need to do is to price discriminate, in the sale of ink, between consumers who purchased their printer from the same seller and consumers who purchased their printer from a different seller. (Of course, ink arbitrage must also be prevented: a person who purchased a printer from an expensive printer/cheap ink seller must not be allowed to buy a million ink cartridges at the low price and then resell most of these cartridges to consumers who purchased their printer from another seller.)

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<sup>21</sup> As in the preceding subpart, this result is robust to the introduction of consumer heterogeneity.

What are the welfare implications of the bundling of printers and ink cartridges, this time with the  $p_p = 2000$ ,  $p_i = 0$  pricing scheme? As before, while the *average* consumer will end up paying the same amount under the different schemes, some consumers will benefit and some consumers will lose. The distributional implications, however, are the reverse of those resulting from the  $p_p = 0$ ,  $p_i = 20$  scheme adopted in response to underestimation of value/use. High-value/use consumers benefit from a move to the  $p_p = 2000$ ,  $p_i = 0$  pricing scheme, while low-value/use consumers lose from such a move.

Now to efficiency: while bundling increased efficiency when adopted in response to underestimation of value/use, the opposite is true when bundling responds to overestimation of value/use. To see this, let  $v$  denote the per-cartridge value of printing to the average consumer. The total value of printing to the average consumer is thus  $100v$ . Since the total cost of printing is 2000 (recall that the cost of a printer is 1000 and the cost of an ink cartridge is 10), it is efficient for a consumer to purchase a printer whenever  $100v > 2000$  or  $v > 20$ .

With overestimation of value/use the perceived total value of printing is  $150v$  ( $> 100v$ ). Overestimation of value/use naturally leads to the purchase of too many printers even under marginal cost pricing. Under the  $p_p = 1000$ ,  $p_i = 10$ , marginal-cost-pricing scheme the average consumer perceives a total price of printing of 2500, and will thus purchase a printer whenever  $150v > 2500$  or  $v > 16.6$ . In particular, inefficient purchases will occur whenever  $16.6 < v < 20$ . While overestimation produces inefficiency even absent bundling, bundling exacerbates this inefficiency. With bundling coupled with the  $p_p = 2000$ ,  $p_i = 0$  pricing scheme, the consumer will purchase a printer whenever  $150v > 2000$  or  $v > 13.3$ . Namely, the range of inefficient purchases increases from  $16.6 < v < 20$  without bundling to  $13.3 < v < 20$  with bundling.

Without bundling, marginal-cost pricing leads to overestimation of the total price in addition to the overestimation of value. And two overestimations are better than one: The overestimation of the total price partially offsets the overestimation of value, thus reducing the inefficiency.<sup>22</sup> With bundling, sellers frontload the entire cost of printing onto the price of the printer, preventing overestimation of total price by the consumer. By removing the beneficial offsetting effect of price overestimation, bundling exacerbates the excessive trade problem.

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<sup>22</sup> The overestimation of total price *completely* offsets the overestimation of value under the  $p_p = 0$ ,  $p_i = 20$  scheme. Under this pricing scheme the consumer will purchase a printer whenever  $150v > 3000$  or  $v > 20$ .

#### D. Elastic Demand

The preceding analysis assumed that the demand for ink is inelastic, namely that the number of ink cartridges that the consumer will purchase, as well as the number of ink cartridges that the consumer perceives that she will purchase, does not depend on the price of ink. This assumption, while useful for demonstrating the main implications of misperception-based bundling, is clearly unrealistic. In this section I describe the results of a more general elastic demand model, which is developed and analyzed in the appendix. These results confirm that the main features of misperception-based bundling, as developed in Parts II.B and II.C above, are robust to the introduction of elastic demand.

In the inelastic demand model the bundling seller chose extreme pricing schemes— $p_p = 0$ ,  $p_i = 20$  in the underestimation case and  $p_p = 2000$ ,  $p_i = 0$  in the overestimation case. Elastic demand introduces a new factor that might lead to less extreme pricing schemes. With elastic demand, increasing (decreasing) the price of ink above (below) marginal cost leads to distortions in the amount of ink that is actually purchased (affecting also the amount of ink that the consumer thinks she will purchase). In equilibrium this inefficiency will be balanced against the forces that push the price of ink away from marginal cost. Nevertheless, the main results developed in the preceding sections continue to hold: when consumers underestimate value/use, ink will be priced above marginal cost and printers will be priced below marginal cost; and when consumers overestimate value/use, ink will be priced below marginal cost and printers will be priced above marginal cost.

The elastic demand model also qualifies the welfare implications derived in the inelastic demand model. In the inelastic demand model, bundling in response to underestimation of value is unambiguously beneficial, since it improves the printer purchasing decision. In the elastic demand model, this improvement in the printer purchasing decision must be weighed against the distortion in the ink purchasing decision caused by the deviation from marginal cost pricing. The normative appeal of bundling is, therefore, reduced.

When consumers overestimate the value/use of printing, bundling was shown to be welfare-reducing in the inelastic demand model. This result is strengthened in the elastic demand model where distortions in the ink purchasing decision caused by the deviation from marginal cost pricing constitute an additional cost of bundling.

#### E. Bundling in Response to Price Misperception

Bundling is a strategic response to consumer misperception. This idea has been demonstrated above, focusing on consumer misperception about

the value of the product. Another type of misperception that can induce a bundling response is price misperception.

Pure price misperception is arguably rare. Price is usually the most salient feature of a product—the one thing consumers can be expected to perceive with reasonable accuracy. Still, consumers misperceive prices, especially when these prices are not immediately due. Returning to the printers and ink example, Robert Hall found that “people buy inkjet printers without information about [the cost of replacement ink].”<sup>23</sup> Credit purchases provide another example. Many consumers systematically underestimate the total price they will end up paying simply because they do not understand how fast interest accrues.

Consider two products (or two components) A and B that can be separately manufactured and sold at unit costs of  $c_A$  and  $c_B$ , respectively. The value to consumers of product A is  $v_A$ , and the value to consumers of product B is  $v_B$ . Consumers are assumed to be homogeneous. Absent bundling in a competitive market product A would be sold at a price of  $p_A = c_A$ , and product B would be sold at a price of  $p_B = c_B$ . Under reasonable assumptions this would be the market outcome regardless of consumer perception or misperception.

Now allow for bundling. Without loss of generality assume that consumers misperceive the price of product B to be  $\hat{p}_B = \delta \cdot p_B$ . I begin with underestimation of  $p_B$ , or  $\delta < 1$ . Absent bundling, the equilibrium will exhibit (per-product) marginal cost pricing, i.e.,  $(p_A, p_B) = (c_A, c_B)$ . This equilibrium cannot be sustained when bundling is feasible. Sellers offering such (per-product) marginal cost pricing would lose business to a competitor that sells the two products as a bundle A-B and sets  $p_A < c_A$  and  $p_B > c_B$ . In fact, at equilibrium  $(p_A, p_B) = (0, c_A + c_B)$ .

To see why, note that the perceived cost of the bundle is  $\hat{P} = p_A + \hat{p}_B = p_A + \delta \cdot p_B$ . Competition will force equilibrium prices  $(p_A, p_B)$  that minimize  $P$  subject to the constraint  $p_A + p_B \geq c_A + c_B$  (I assume non-negative prices,  $p_A, p_B \geq 0$ ). The  $(p_A, p_B) = (0, c_A + c_B)$  result follows. The intuition underlying this result is straightforward. Every dollar subtracted from the price of product A is perceived by consumers as a \$1 benefit; every dollar added to the price of product B is perceived by consumers as a  $\$ \delta (< \$1)$  cost. Sellers will thus transfer as much of the price as possible from product A to product B.

It bears emphasis that a seller who fails to adopt the bundling strategy will be driven out of the market. A seller who offers product A alone will have to charge  $p_A \geq c_A$ . Similarly, a seller who offers product B alone will

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<sup>23</sup> Hall, *Inkjet Aftermarket* at 22–23 (cited in note 19). This lack of information about price is independent of any misperception about use.

have to charge  $p_B \geq c_B$ . The bundled product would always appear more attractive to consumers.

Now assume that consumers overestimate the price of product B, or  $\delta > 1$ . Again, when bundling is feasible (per-product) marginal-cost pricing cannot be sustained in equilibrium. As before the perceived cost of the bundle is  $\hat{P} = p_A + \hat{p}_B = p_A + \delta \cdot p_B$ . And again competition will force equilibrium prices  $(p_A, p_B)$  that minimize  $\hat{P}$  subject to the constraint  $p_A + p_B \geq c_A + c_B$ . But now, with  $\delta > 1$ , this minimization implies  $(p_A, p_B) = (c_A + c_B, 0)$ . A parallel intuition explains this result. Every dollar subtracted from the price of product B is perceived by consumers as a  $\$ \delta (> \$1)$  benefit; every dollar added to the price of product A is perceived by consumers as a \$1 cost. Sellers will thus transfer as much of the price as possible from product B to product A.

The efficiency implications are straightforward. Bundling exacerbates the overconsumption problem created by underestimation of price. Overestimation of price leads to underconsumption absent bundling. This inefficiency is completely alleviated when bundling is feasible.

### III. THREE EXAMPLES

#### A. Subscription Services

One special type of bundling that directly responds to consumer misperception is the intertemporal bundling achieved through multi-period subscriptions. In intertemporal bundling the only difference between the bundled components is the timing. For example, a year-long subscription—to a magazine, a wireless or landline phone service, an ISP, or a health club—provides the same service every month throughout the year. Why are multi-period subscriptions so common? Why not sell only single-period products or services? Consumer misperception provides an answer.<sup>24</sup>

Consider a health club offering access to its facilities on a per-visit basis. In a competitive market this health club will have to set its admission fee equal to marginal cost, say \$10 per visit. Assume that the average consumer overestimates her future use of the health club: instead of ten visits per year the consumer anticipates that she will make twenty visits per year.<sup>25</sup> Under per-period marginal cost pricing the consumer expects a total cost of \$200. Now assume that a competitor offers—instead of or in addi-

<sup>24</sup> For important theoretical and empirical analyses of subscription markets and contracts from a behavioral perspective see DellaVigna and Malmendier, 119 Q J Econ 353 (cited in note 9) (setting forth a theoretical analysis supported by evidence from numerous markets); DellaVigna and Malmendier, *Paying Not to Go to the Gym* (cited in note 8) (studying health club membership contracts); Oster and Morton, *Behavioral Decision-Making* (cited in note 8) (analyzing magazine subscriptions).

<sup>25</sup> This is an assumption supported by casual observation as well as by more rigorous empirical analysis. See DellaVigna and Malmendier, *Paying Not to Go to the Gym* (cited in note 8).

tion to the per-visit fee—a yearlong subscription for a price of \$100. (I assume that health clubs know the number of visits made by an average consumer.) The consumer will clearly prefer the multi-period subscription over per-period admission.

Many subscription services charge a one-time subscription fee as described in the preceding health club example. Other subscription services charge a per-period fee, but follow a fee schedule very different from per-period marginal cost pricing. In particular, many subscription services charge different per-period prices for different periods within a multiperiod subscription. Particularly common is the practice of offering a low price, or even a zero price, for an introductory period.<sup>26</sup> One explanation for this practice is that sellers are exploiting consumer misperception—this time, consumer underestimation of future use. When signing on to a yearlong subscription service with a “two-month free” introductory offer, some consumers think that they will end the subscription after the first two months. Not all of these consumers actually end their subscription after two months. Put differently, sellers may be responding to consumers’ underestimation of the length of the period during which they would need or want a subscription with the specific seller. If consumers underestimate the effective subscription period, then sellers in a competitive market will backload their price as much as possible.

This too is an example of intertemporal bundling. The cement holding the bundle together is the cost of switching from one seller to another or simply the cost of terminating the subscription. It is consumers’ underestimation of these switching costs that explain the viability of a below marginal cost introductory fee. Since switching costs keep the bundle together, it is not surprising that sellers do not make a special effort to reduce these costs. Perhaps the notorious ten minute “please hold for the next available representative” wait that must be endured to cancel a subscription is not merely the result of a seller’s attempt to economize on the size of its customer service department. More direct measures designed to increase switching costs are lock-in clauses and termination fees. If consumers underestimate the cost of switching or, equivalently, underestimate the likely length of their subscription, sellers who fail to take advantage of switching cost-induced bundling and offer only per-period marginal cost pricing will not survive in a competitive market.<sup>27</sup>

The normative implications of intertemporal bundling depend on the misperception to which the bundling responds. Consider overestimation of future health club use due to overestimation of self control. Absent bundling

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<sup>26</sup> Examples include introductory offers by newspapers and magazines, credit card teaser rates, etc.

<sup>27</sup> For a formal analysis of the underestimation of switching costs and its implications see DellaVigna and Malmendier, 119 Q J Econ at 389 (cited in note 9).

such overestimation of value would lead to excessive initial visits to the health club by consumers who will not make sufficient return visits to secure any benefit. Bundling with a front-loaded subscription price will only exacerbate this inefficiency.

Next consider bundling in response to underestimation of use due to overestimation of termination/switching or underestimation of termination/switching costs. Absent bundling, that is, with zero termination/switching costs, the consumer would make efficient period-by-period decisions. Bundling will lead to excessive initiation of subscription contracts.

## B. CREDIT CARDS<sup>28</sup>

The credit card is a complex, multi-attribute product. In fact, the credit card is a bundle of different products and services. The credit card bundles together transacting and borrowing services. The credit card also implements intertemporal bundling, whereas borrowing now is bundled with borrowing later. The argument advanced in this Essay suggests that these forms of bundling are a strategic response to consumer misperception.<sup>29</sup>

Evidence suggests that consumers systematically underestimate their future credit card borrowing. They also underestimate the likelihood that they will need to consume various borrowing-related services. They underestimate the likelihood of late repayment. They underestimate the likelihood of requiring a special (and more expensive) loan beyond their specified credit limit.<sup>30</sup> Beyond underestimation of borrowing (and consequently of the likelihood that they will use borrowing-related services), consumers also underestimate the price of borrowing and borrowing-related services. They underestimate the speed with which interest accrues. They do not fully understand the implications of minimum payments and low (or even negative) amortization rates. And they are not aware of various computa-

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<sup>28</sup> This subsection is based on Oren Bar-Gill, *Seduction by Plastic*, 98 Nw U L Rev 1373 (2004). Economist Lawrence Ausubel was the first to suggest that credit card pricing responds to consumer misperception. See Lawrence M. Ausubel, *The Failure of Competition in the Credit Card Market*, 81 Am Econ Rev 50, 70–72 (1991); see also David Laibson, Andrea Repetto, and Jeremy Tobacman, *A Debt Puzzle*, in Philippe Aghion, et al, ed, *Knowledge, Information, and Expectations in Modern Macroeconomics: In Honor of Edmund S. Phelps* 228, 230–31 (Princeton 2003); Lawrence M. Ausubel, *Credit Card Defaults, Credit Card Profits, and Bankruptcy*, 71 Am Bankr L J 249, 261 (1997); Haiyan Shui and Lawrence Ausubel, *Consumer Time Inconsistency: Evidence from an Experiment in the Credit Card Market* 2–3 (unpublished manuscript 2004), online at <http://ssrn.com/abstract=586622> (visited Nov 21, 2005).

<sup>29</sup> I do not wish to preclude other explanations, for example cost-based explanations, for the bundling of transacting and borrowing services in the credit card.

<sup>30</sup> Consumers also underestimate their use of different transacting-related services, for example, currency exchange pursuant to foreign purchases.

tional techniques employed by issuers to increase the magnitude of interest (and related) payments.<sup>31</sup>

What are the implications of consumers' underestimation of borrowing and of the price of borrowing? In particular, what are the implications for the transacting service? Can the transacting service be offered independently? Imagine a card issuer who offers only transacting services—a debit card. In a competitive market this issuer would have to set a price equal to the marginal cost of the transacting service offered. Now consider a credit card issuer that bundles transacting and financing services. Given consumer underestimation of borrowing the credit card issuer would respond by setting a high price for the financing service and a low price for the transacting service. In fact, credit card issuers often offer a negative price for the transacting service: the transacting consumer receives bonus points and frequent flyer miles for every dollar spent. With underestimation of borrowing the bundle offered by the credit card issuer will be more attractive to consumers than transacting and borrowing services sold separately (and at per-service marginal cost).

Consistent with this analysis, debit cards, despite their increasing popularity, are finding it difficult to compete with the credit card bundle. Absent the back-end financing and fees revenues that credit card issuers enjoy, debit card issuers cannot match the attractive short-term perks that credit card issuers routinely offer.<sup>32</sup> Accordingly, debit cards are quickly replacing checks, but are not as successful in supplanting credit cards.<sup>33</sup>

Moving on to intertemporal bundling, consumers underestimate the cost of switching cards and thus overestimate the likelihood of switching. Issuers respond by offering short-term credit at low, even zero teaser rates.

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<sup>31</sup> For a description of these techniques see Mark Furletti, *Credit Card Pricing Developments and Their Disclosure*, Payment Cards Center Discussion Paper, Federal Reserve Bank of Philadelphia 1, 14–16 (2003), online at <http://www.phil.frb.org/pcc/discussion/discussion0103.pdf> (visited Nov 21, 2005) (discussing such techniques as payment allocation, compounded interest, and double-cycle interest, which help increase the size of interest payments).

<sup>32</sup> See Ronald J. Mann, *Global Credit Card Use and Debt: Policy Issues and Regulatory Responses*, U of Tex L and Econ Working Paper No. 49, 28–29 (2004), online at <http://ssrn.com/abstract=509063> (visited Nov 21, 2005) (describing the disadvantages of debit cards, specifically no float, no benefits, and fewer legal protections); Sujit Chakravorti and Alpa Shah, *A Study of the Interrelated Bilateral Transactions in Credit Card Networks*, Emerging Payments Occasional Paper Series (EPS-2001-2) 1, 23 (Federal Reserve Bank of Chicago July 2001) (showing that debit cards do not offer the benefit programs, extended warranties, and free credit until the end of the billing cycle that credit cards offer).

<sup>33</sup> See Mann, U of Tex L and Econ Research Paper No. 49 at 31–32 (cited in note 32) (showing that debit cards have surpassed check use, but that in the United States, debit cards have had trouble infiltrating the dominant network that credit cards have in place). This is not to say that debit cards are not replacing credit cards at all. They are. See Tom Brown and Lacey Plache, *Paying With Plastic: Maybe Not So Crazy*, 73 U Chi L Rev XX (2006). The success of the debit card is at least partially explained by its successful bundling with other banking services—the cost of which are underestimated by consumers.

Lenders offering equivalent short-term credit as a stand alone service must price the loan at cost, and thus cannot compete with an issuer that engages in intertemporal bundling.

What are the welfare consequences of the different forms of bundling observed in the credit card market? Absent bundling consumers would make accurate transacting and short-term borrowing decisions. Bundling, with its accompanying back-loaded prices, leads to excessive transacting and short-term borrowing.

The distributional consequences of credit card bundling are also troubling. Bundling of transacting and financing with prices backloaded onto the long-term financing component implies that borrowers, consumers that are more likely to use and pay for the financing services, will cross-subsidize transactors, consumers that use their cards mainly for transacting and enjoy free service plus frequent flyer miles and bonus points. As long as borrowing is positively correlated with weaker socioeconomic status bundling leads to regressive distributional consequences. Bundling is similarly unattractive if weaker consumers are more likely to extend their low-price short-term loans into the high-priced long-term.

### C. Cell Phones

As in the credit card market, common practices in the cell phone market suggest that providers of wireless communication services are responding to consumer misperception.<sup>34</sup> Consider the steep jump in per-minute charges when the consumer exceeds the plan limit. A recent study found that most contracts specify an increase of over 100 percent in the per-minute price, with some contracts specifying increases of 200 percent and beyond.<sup>35</sup> Clearly, these huge increases do not reflect a corresponding change in the provider's per-minute cost.

Arguably, the high prices set for minutes beyond the plan limit respond to consumers' underestimation of their future use of the cellular phone. Providers respond to consumer misperception by bundling airtime (i.e., talking minutes), handsets and other services such as voice mail. The high long-term prices subsidize the free phones, free voicemail, and lower short-

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<sup>34</sup> See DellaVigna and Malmendier, 119 Q J Econ at 380 (cited in note 9) ("Cellular phone companies can extract profits from naiveté by setting high marginal prices for minutes beyond the monthly allowance."); Bar-Gill, 98 Nw U L Rev at 1429-30 (cited in note 28) ("As in the credit card market, competition might be pressuring providers of wireless communication services to exploit consumers' imperfect perceptions of the future."); Barry Nalebuff & Ian Ayres, *Why Not?: How to Use Everyday Ingenuity to Solve Problems Big and Small* 178-79 (Harvard Bus Sch 2003) (discussing how cell phone carriers exploit consumer misperceptions).

<sup>35</sup> See DellaVigna and Malmendier, 119 Q J Econ at 380-81 (cited in note 9).

term prices.<sup>36</sup> A seller that offers handsets as a standalone item would have to price these handsets at their marginal cost. Such a seller would find it difficult to compete with cellular service providers who “give away” free handsets as part of their “handset plus service” bundle.

Wireless service contracts are also an important example of multi-period subscriptions. As discussed in Part III.A, providers employ various tactics designed to sustain this intertemporal bundling through increased switching costs. This bundling argument explains the common lock-in clause, which ties the consumer to the specific provider for as long as three years.<sup>37</sup> The lock-in clause targets consumers’ underestimation of the cost of lock-in. Specifically, consumers may underestimate the many contingencies that would induce them to end the contract earlier: the appearance of a more attractive offer from another provider; a change in their need for wireless services; or an unanticipated financial hardship that renders the monthly cellular phone bill too painful to bear.

As with high prices for minutes beyond the plan limit, it seems difficult to justify the lock-in clause on cost grounds. In some industries, fixed costs may justify a lock-in clause. It is unlikely, however, that per-consumer fixed costs alone can explain the lengthy lock-in clauses observed in the cell phone industry. Moreover, even if fixed costs are substantial, lock-in is not the obvious response. Why not simply charge an upfront fee? Lock-in clauses are common because consumers underestimate the cost of lock-in. In the cell phone market lock-in clauses do double duty. First, they sustain the intertemporal bundle. Second, they support the bundling of cellular service plans with handsets and other services. The revenues generated by these lock-in clauses, together with the revenues generated by high prices for minutes beyond the plan limit, pay for the free phones and other short-term perks offered by cell phone service providers.

What are the welfare implications of bundling in the cell phone market? If consumers overestimate the value of cellular communications (or at least overestimate the value of sticking to a specific provider), they will buy too many handsets even absent bundling. Bundling only exacerbates this problem.

The cell phone market exemplifies the dynamic interaction between consumer perceptions and seller/provider reactions. Recent innovations such as rollover minutes and flexible, no lock-in contracts suggest that at least some consumers have more accurate perceptions about the long-term

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<sup>36</sup> See Nalebuff and Ayres, *Why Not?: How to Use Everyday Ingenuity to Solve Problems Big and Small* at 179 (cited in note 34) (noting that competition in the cell phone market focuses on the short-term, free phone dimension).

<sup>37</sup> Providers offer different short-term perks to tempt consumers into choosing service plans with longer term commitments. See DellaVigna and Malmendier, 119 Q J Econ at 380–81 (cited in note 9); Bar-Gill, 98 Nw U L Rev at 1429–30 (cited in note 28).

costs of the wireless service. The evolution of consumer perception is driven by independent learning by consumers and by providers' advertisement campaigns. Understanding consumer perception may help predict market outcomes. Conversely, market outcomes can serve as indicators of consumer (mis)perception.

#### IV. POLICY IMPLICATIONS

The preceding analysis suggests that sellers often respond to consumer misperception by bundling the misperceived product (or component) with another, accurately perceived product (or component). The analysis further suggests that such bundling can be either welfare reducing or welfare enhancing. When bundling exacerbates the adverse effects of consumer misperception, regulation designed to discourage bundling may be desirable.<sup>38</sup>

In noncompetitive markets the antitrust prohibition on tying serves as a direct unbundling policy.<sup>39</sup> One possibility is to extend this prohibition against bundling to competitive markets. In at least two contexts such an extension may have already occurred. First, where a base-good seller operating in a competitive market (for the base good) attempts to bundle the base good with aftermarket parts or service, the Supreme Court has suggested that antitrust tying law may apply.<sup>40</sup> Second, The Magnuson-Moss warranty legislation of 1975 restricts sellers' ability to bundle warranted goods with other goods regardless of the level of competition in the relevant market.<sup>41</sup> Given the severity of this remedy, however, it should probably be used, if at all, only in extreme cases where the bundling practice is obviously harmful and where alternative policies are ineffective.

A less blunt unbundling policy is to promote competition on each component of the bundled product. If a consumer who bought a printer from seller A can buy ink cartridges from seller B, seller A would not be able to set low (below marginal cost) printer prices and high (above mar-

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<sup>38</sup> I focus explicitly on unbundling policies. Other policies may be equally effective. For example, regulators can directly target the misperception that gives rise to the bundling response.

<sup>39</sup> See, for example, the anti-tying provisions of the Sherman and Clayton Acts, 15 USC §§ 1, 14 (2000). For a recent analysis of tying in the printer market, see *Independent Ink, Inc v Illinois Tool Works, Inc*, 396 F3d 1342 (Fed Cir 2005), cert granted, 125 S Ct 2937 (2005) (discussing patent tying through a contract requiring the buyer to purchase toner cartridges only from the seller of the printer).

<sup>40</sup> See *Eastman Kodak Co v Image Technical Services, Inc*, 504 US 451, 479 (1992) (denying defendant's motion for summary judgment on the allegation that the defendant's practice of limiting independent service organizations' access to materials that were necessary to partake in the machine repair service market constituted an illegal tying arrangement in violation of the Sherman Act, even though the base good market was competitive); Carl Shapiro, *Aftermarkets and Consumer Welfare: Making Sense of Kodak*, 63 Antitrust L J 483 (1995) (summarizing and criticizing the *Kodak* rule). However, given the specific circumstances of the *Kodak* case and the way the *Kodak* rule has been interpreted in subsequent decisions, the Supreme Court's willingness to extend tying law to competitive markets should not be overstated.

<sup>41</sup> 15 USC § 2302(c) (2000). See Craswell, 62 BU L Rev at 662 (cited in note 7).

ginal cost) ink prices. This example suggests standardization as a potential solution to the bundling problem.<sup>42</sup>

Focusing on intertemporal bundling, the use of bundling tactics can be discouraged by reducing switching costs. The legal guarantee of cell phone number portability is an example of a policy aimed at increasing competition by reducing switching costs.<sup>43</sup> Limiting sellers' ability to use early termination penalties in subscription contracts is another example of a competition fostering, unbundling policy.

Disclosure regulation may also serve as an unbundling policy.<sup>44</sup> If sellers bundle printers and ink in response to consumer misperception about future use, regulation requiring sellers to provide "total cost of ownership" information may effectively prevent bundling.<sup>45</sup> If a seller must advertise, in addition to the printer's stand alone price, an inclusive price that adds the average cost of ink over the life of the printer, consumers will be less inclined to buy cheap printers that are bundled with expensive ink. If a mortgage lender or a credit card issuer is required to calculate for the consumer and explicitly state the total (or expected) interest and fee payments over the life of the loan, then consumers will be more likely to balance this total cost information against the short term perks offered by the lender or issuer on a bundled product.<sup>46</sup>

## V. CONCLUSION

Bundles are everywhere. Durables are bundled with parts and service. Diagnostic services are bundled with treatment services.<sup>47</sup> Products are bundled with selling services (e.g., showrooms and knowledgeable salespersons).<sup>48</sup> Michael Spence, in a seminal contribution, argued that almost every product "should be thought of as a bundle of characteristics."<sup>49</sup> In the

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<sup>42</sup> Of course, standardization is not without cost. In particular, it may hinder innovation.

<sup>43</sup> See 47 CFR § 52.23 (2005) (requiring carriers to allow for phone number portability).

<sup>44</sup> For an excellent discussion of disclosure regulation as a potential response to bundling see Craswell, 62 BU L Rev at 689–94 (cited in note 13).

<sup>45</sup> The EPA's "Energy Star" program is a leading example. On the benefits of "total cost of ownership" information see Nalebuff and Ayres, *Why Not?* at 177 (cited in note 34) (claiming the EPA's Energy Star program gives consumers total-cost-of-ownership information, which allows them to "add in the expected energy costs to the initial purchase price" of many products, and that "[c]onsequently, the program is said to save consumers \$5 billion annually"). The special disclosure required under Section 106 of the Magnuson-Moss Warranty—Federal Trade Commission Act when bundling durables and service is another case on point. See Pub L No 93-617, 88 Stat 2188 (1975), codified at 15 USC § 2306 (2004). Ideally such disclosure regulation can achieve the same results as direct price regulation—a much more obtrusive policy.

<sup>46</sup> See Bar-Gill, 98 Nw U L Rev at 1403–04 (cited in note 28). Bar-Gill also discusses the limits of disclosure. *Id.* at 1418.

<sup>47</sup> See Beales, Craswell, and Salop, 24 J L & Econ at 515 (cited in note 1).

<sup>48</sup> On resale price maintenance and the recovery of selling costs see, for example, Lester G. Telser, *Why Should Manufacturers Want Fair Trade?*, 3 J L & Econ 86, 104 (1960).

<sup>49</sup> Spence, 44 Rev Econ Studies at 561 (cited in note 1).

modern world economy these bundled characteristics should be broadly defined to include contractual provisions and potentially independent products.

The motivations for bundling are numerous: from leveraging of monopoly power, to product differentiation to simple cost saving. This Essay explored another motivation for bundling. It presented bundling as a strategic response to consumer misperception. The welfare and policy implications of bundling depend on the motivation for the observed bundling. Monopoly leveraging is bad. Cost saving is good. Bundling in response to consumer misperception can be either good or bad.

This Essay provided some tools for the policymaker to identify misperception-based bundling, and to ascertain when such bundling is welfare reducing. It then considered various regulatory responses and unbundling policies. The difficulty in identifying the motivation (or motivations) for an observed bundle, coupled with the difficulty in evaluating the welfare implications of bundling even when its underlying motivation is revealed suggests regulatory caution. For this reason the most attractive unbundling policies are those that facilitate the smooth operation of markets—through reduced switching costs and the provision of information—rather than the more heavy handed policies that directly prohibit bundling or attempt to fix the price of the bundle or its components.<sup>50</sup>

#### APPENDIX: ELASTIC DEMAND

This appendix extends the analysis in Part II of the article by introducing elastic demand.

##### A. Framework of Analysis

Returning to the printers and ink example, let  $i \geq 0$  denote the amount of ink (for example, the number of ink cartridges) to be used by the consumer, which also represents the amount of printing that the consumer will do. Let  $v(i) > 0$  denote the value of printing and assume decreasing marginal utility from printing:  $v'(i) > 0$  and  $v''(i) < 0$ . (To guarantee an internal maximum I also assume that  $v'(0) = \infty$  and  $\lim_{i \rightarrow \infty} v'(i) = 0$ .) Introducing consumer misperception, let the perceived value of printing be

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<sup>50</sup> See Colin Camerer, et al, *Regulation for Conservatives: Behavioral Economics and the Case for "Asymmetric Paternalism,"* 151 U Pa L Rev 1211, 1212 (2003) (proposing "an approach to evaluating paternalistic regulations and doctrines . . . [called] 'asymmetric paternalism' . . . [which] creates large benefits for those who make errors while imposing little or no harm on those who are fully rational"); Cass R. Sunstein and Richard H. Thaler, *Libertarian Paternalism Is Not an Oxymoron,* 70 U Chi L Rev 1159, 1160, 1162 (2003) (proposing "a form of paternalism, libertarian in spirit, that should be acceptable to those who are firmly committed to freedom of choice on grounds of either autonomy or welfare. . . . Libertarian paternalism is a relatively weak and nonintrusive type of paternalism, because choices are not blocked or fenced off.").

$\hat{v}(i) = \delta \cdot v(i)$ , where  $\delta < 1$  represents underestimation and  $\delta > 1$  represents overestimation. The per-unit costs of printers and ink are  $c_p$  and  $c_i$ , respectively. The per-unit prices of printers and ink are  $p_p$  and  $p_i$ , respectively.

I study a two-period model. At T=0 the consumer decides whether to purchase a printer. At T=1 the consumer decides how much to print, and accordingly how much ink to purchase. Misperception affects only the T=0 printer purchase decision, not the T=1 ink purchase decision. At T=1 the consumer learns her true value of printing,  $v(i)$ . The model is solved backwards, starting from the T=1 ink purchase decision.

If the consumer bought a printer at T=0, then at T=1 she will buy an amount of ink  $i^*(p_i)$  that solves  $\max \langle v(i) - p_i \cdot i \rangle$ . The First-Order Condition (FOC)  $v'(i^*(p_i)) = p_i$  implicitly defines  $i^*(p_i)$ .

I now examine the consumer's T=0 decision whether to purchase a printer. First note that due to misperception at T=0 the consumer *thinks* that at T=1 she will buy an amount of ink  $\hat{i}^*(p_i)$  that satisfies  $\hat{v}(\hat{i}^*(p_i)) = p_i$  or  $v'(\hat{i}^*(p_i)) = p_i/\delta$ . Comparing the FOCs that define  $i^*(p_i)$  and  $\hat{i}^*(p_i)$  leads to the following observation.

*Observation 1:*

- (1) If the consumer underestimates the value of printing, i.e., if  $\delta < 1$ , then at T=0 the consumer underestimates the amount of ink that she will buy at T=1:  $\hat{i}^*(p_i) < i^*(p_i)$ .
- (2) If the consumer overestimates the value of printing, i.e., if  $\delta > 1$ , then at T=0 the consumer overestimates the amount of ink that she will buy at T=1:  $\hat{i}^*(p_i) > i^*(p_i)$ .

If the consumer buys a printer, she will enjoy a surplus of  $w(p_p, p_i) = v(i^*(p_i)) - p_i \cdot i^*(p_i) - p_p$ . Therefore, the consumer *should* buy a printer at T=0 *if and only if*  $w(p_p, p_i) > 0$ . But rather than the true surplus, the consumer perceives  $\hat{w}(p_p, p_i) = \hat{v}(\hat{i}^*(p_i)) - p_i \cdot \hat{i}^*(p_i) - p_p$ . Therefore, the consumer *will* buy a printer at T=0 *if and only if*  $\hat{w}(p_p, p_i) > 0$ .

I begin by deriving the equilibrium behavior and welfare in the no-bundling case. I then compare this no-bundling benchmark to the case where bundling is feasible.

## B. The No-Bundling Case

Absent bundling in a competitive market sellers will adopt per-product marginal cost pricing, namely  $p_i = c_i$  and  $p_p = c_p$ . At T=1 the consumer will buy an amount of ink  $i^*(c_i)$  that satisfies  $v'(i^*(c_i)) = c_i$ . At T=0, the consumer surplus is  $w(p_p, p_i) = v(i^*(c_i)) - c_i \cdot i^*(c_i) - c_p$ , and the consumer *should* buy a printer *if and only if*  $w(c_p, c_i) > 0$ . But the con-

sumer perceives a surplus of  $\hat{w}(c_p, c_i) = \hat{v}(\hat{i}^*(c_i)) - c_i \cdot \hat{i}^*(c_i) - c_p$ , and will buy a printer at  $T=0$  if  $\hat{w}(c_p, c_i) > 0$ . This leads to the following observation.

*Observation 2:*

- (1) If the consumer underestimates the value of printing, i.e., if  $\delta < 1$ , then  $\hat{w}(c_p, c_i) < w(c_p, c_i)$  and the consumer might not buy a value-increasing printer.
- (2) If the consumer overestimates the value of printing, i.e., if  $\delta > 1$ , then  $\hat{w}(c_p, c_i) > w(c_p, c_i)$  and the consumer might buy a value-reducing printer.

Proof:

Rewriting the perceived welfare as a function of  $\delta$ ,  $\hat{w}(p_p, p_i; \delta) = \delta \cdot v(\hat{i}^*(p_i)) - p_i \cdot \hat{i}^*(p_i) - p_p$ , and applying the Envelope

Theorem, I obtain:  $\frac{\partial \hat{w}(p_p, p_i; \delta)}{\partial \delta} = v(\hat{i}^*(p_i)) > 0$ . Noting that

$w(p_p, p_i; \delta) = \hat{w}(p_p, p_i; \delta = 1)$ , the results stated in Observation 2 follow.

QED

### C. The Bundling Case

Bundling eliminates the  $p_p = c_p$  and  $p_i = c_i$  constraint, and replaces it with the more lax zero profit constraint,  $\pi(p_p, p_i) = 0$ , where  $\pi(p_p, p_i) = p_p + p_i \cdot i^*(p_i) - [c_p + c_i \cdot i^*(p_i)]$  is the seller's profit. The bundling seller chooses a pricing scheme  $(p_p, p_i)$  that solves:  $\max_{p_p, p_i} \langle \hat{w}(p_p, p_i) \rangle$  s.t.  $\pi(p_p, p_i) = 0$ .<sup>51</sup> FOCs reduce to:

$$(1) \quad \frac{\partial \hat{w}(p_p, p_i) / \partial p_p}{\partial \pi(p_p, p_i) / \partial p_p} = \frac{\partial \hat{w}(p_p, p_i) / \partial p_i}{\partial \pi(p_p, p_i) / \partial p_i}$$

The (absolute value of the) fraction on the left hand side of Equation (1) is the consumer welfare “bang” for each firm profit “buck” when  $p_p$  is lowered. The (absolute value of the) fraction on the right hand side of Equation (1) is the consumer welfare “bang” for each firm profit “buck” when  $p_i$  is lowered. These two ratios must be the same. Otherwise there is

<sup>51</sup> This formulation of the seller's maximization problem follows from an assumption of Bertrand competition among sellers. First, the seller's profit must equal zero; otherwise a competitor will offer a slightly lower price (on either dimension,  $p_p$  or  $p_i$ ) and attract all of the consumers. Second, given zero profit, the seller must choose a price combination that maximizes consumer welfare; otherwise a competitor will offer a welfare-increasing price combination and attract all of the consumers.

an “arbitrage” that can increase consumer welfare without reducing firm profits.

The fraction on the left hand side of Equation (1) simplifies (using the Envelope Theorem) to:  $\frac{\partial \hat{w}(p_p, p_i)/\partial p_p}{\partial \pi(p_p, p_i)/\partial p_p} = -1$ . The consumer welfare

bang for firm profit buck is always -1, since  $p_p$  is just a zero sum transfer.

The fraction on the right hand side of Equation (1) simplifies (using the Envelope Theorem) to:  $\frac{\partial \hat{w}(p_p, p_i)/\partial p_i}{\partial \pi(p_p, p_i)/\partial p_i} = \frac{-\hat{i}^*(p_i)}{i^*(p_i) + (p_i - c_i) \cdot \partial i^*(p_i)/\partial p_i}$ . A

\$1 increase in ink price reduces perceived consumer welfare by  $\hat{i}^*(p_i)$ , i.e., by the number of ink cartridges that the consumer expects to buy. The same \$1 increase in ink price raises the seller’s profit on infra-marginal cartridges by  $\hat{i}^*(p_i)$ , but costs the seller a profit of  $p_i - c_i$  on the marginal cartridges that will no longer be sold given the higher price.

Substituting into Equation (1), I obtain:

$$(2) \quad \frac{-\hat{i}^*(p_i)}{i^*(p_i) + (p_i - c_i) \cdot \partial i^*(p_i)/\partial p_i} = -1$$

When  $\delta = 1$ ,  $\hat{i}^*(p_i) = i^*(p_i)$  and Equation (2) implies  $p_i = c_i$ . When  $\delta < 1$ ,  $\hat{i}^*(p_i) < i^*(p_i)$  and Equation (2) implies  $p_i > c_i$  (given  $di^*(p_i)/dp_i < 0$ ). And when  $\delta > 1$ ,  $\hat{i}^*(p_i) > i^*(p_i)$  and Equation (2) implies  $p_i < c_i$  (given  $di^*(p_i)/dp_i < 0$ ). Intuitively, a larger  $\delta$  increases the number of ink cartridges that the consumer expects to purchase, and thus increases the consumer welfare bang for every firm profit buck attained by lowering the price of ink. Therefore, the price of ink is inversely related to  $\delta$ .<sup>52</sup>

The results obtained for ink price, when plugged into the zero profit constraint, produce the parallel results for the printer price. Rearranging the  $\pi(p_p, p_i) = 0$  constraint, I obtain:  $p_p - c_p = -(p_i - c_i) \cdot i^*(p_i)$ . Therefore, when  $\delta = 1$  implies  $p_i = c_i$ , it also implies  $p_p = c_p$ . When  $\delta < 1$  implies  $p_i > c_i$ , it also implies  $p_p < c_p$ . And, when  $\delta > 1$  implies  $p_i < c_i$ , it also implies  $p_p > c_p$ .

<sup>52</sup> The analysis thus far derives from the FOCs of the seller’s optimization problem that were reduced to Equation (1). Interestingly, the same FOCs, and thus the same results, obtain when competition is replaced by monopoly, and the monopolist solves the problem:  $\max_{p_p, p_i} \langle \pi(p_p, p_i) \rangle$  s.t.  $\hat{w}(p_p, p_i) = 0$ . Of course, while the ink price will remain unchanged, the printer price will necessarily increase.

Proposition 1 summarizes:

*Proposition 1:*

- (1) When consumers underestimate the value of printing, i.e., when  $\delta < 1$ , a bundling seller will set  $p_i > c_i$  and  $p_p < c_p$ .
- (2) When consumers overestimate the value of printing, i.e., when  $\delta > 1$ , a bundling seller will set  $p_i < c_i$  and  $p_p > c_p$ .

The welfare implications of bundling are summarized in the following proposition.

*Proposition 2:*

- (1) When consumers underestimate the value of printing, i.e., when  $\delta < 1$ ,
  - a. If a printer is purchased both with and without bundling, i.e., if  $0 < \hat{w}(c_p, c_i) < \hat{w}(p_p, p_i)$ , then bundling reduces welfare.
  - b. If a printer is *not* purchased both with and without bundling, i.e., if  $\hat{w}(c_p, c_i) < \hat{w}(p_p, p_i) \leq 0$ , then bundling has no effect on welfare.
  - c. If a printer is not purchased absent bundling but is purchased with bundling, i.e., if  $\hat{w}(c_p, c_i) \leq 0 < \hat{w}(p_p, p_i)$ , then bundling increases welfare.
- (2) When consumers overestimate the value of printing, i.e., when  $\delta > 1$ , bundling reduces welfare:
  - a. If a printer is purchased both with and without bundling, i.e., if  $0 < \hat{w}(c_p, c_i) < \hat{w}(p_p, p_i)$ , then bundling reduces welfare.
  - b. If a printer is *not* purchased both with and without bundling, i.e., if  $\hat{w}(c_p, c_i) < \hat{w}(p_p, p_i) \leq 0$ , then bundling has no effect on welfare.
  - c. If a printer is not purchased absent bundling but is purchased with bundling, i.e., if  $\hat{w}(c_p, c_i) \leq 0 < \hat{w}(p_p, p_i)$ , then bundling reduces welfare.

Proof:

When bundling is feasible prices are set to maximize  $\hat{w}(p_p, p_i)$ . Therefore,  $\hat{w}(p_p, p_i) > \hat{w}(c_p, c_i)$ .

(1) There are three possible scenarios:

Scenario 1— $0 < \hat{w}(c_p, c_i) < \hat{w}(p_p, p_i)$ : A printer is purchased both with and without bundling. In this scenario no bundling is better, since it optimizes the ink purchase decision. Formally, as shown in the

analysis preceding Proposition 1, when  $\delta = 1$   $\hat{w}(\cdot, \cdot)$ , which then equals  $w(\cdot, \cdot)$ , is maximized by  $p_i = c_i$  and  $p_p = c_p$ . Therefore, for any set of prices  $p_i \neq c_i$  and  $p_p \neq c_p$ :  $w(p_p, p_i) < w(c_p, c_i)$ . If a printer is purchased both with and without bundling, welfare is greater absent bundling.

Scenario 2— $\hat{w}(c_p, c_i) < \hat{w}(p_p, p_i) \leq 0$ : A printer is *not* purchased both with and without bundling. In this scenario bundling does not affect welfare.

Scenario 3— $\hat{w}(c_p, c_i) \leq 0 < \hat{w}(p_p, p_i)$ : A printer is not purchased without bundling, but a printer is purchased with bundling. In this scenario bundling increases welfare if  $w(p_p, p_i) > 0$ . I next show that  $w(p_p, p_i) > \hat{w}(p_p, p_i)$  (and since in Scenario 3  $\hat{w}(p_p, p_i) > 0$  this implies  $w(p_p, p_i) > 0$ ): Rewriting the perceived welfare as a function of  $\delta$ ,

$\hat{w}(p_p, p_i; \delta) = \delta \cdot v(\hat{i}^*(p_i)) - p_i \cdot \hat{i}^*(p_i) - p_p$ , and applying the Envelope

Theorem, I obtain:  $\frac{\partial \hat{w}(p_p, p_i; \delta)}{\partial \delta} = v(\hat{i}^*(p_i)) > 0$ . It follows that

$w(p_p, p_i; \delta) = \hat{w}(p_p, p_i; \delta = 1) > \hat{w}(p_p, p_i; \delta < 1)$ .

(2) There are three possible scenarios:

Scenario 1— $0 < \hat{w}(c_p, c_i) < \hat{w}(p_p, p_i)$ : A printer is purchased both with and without bundling. In this scenario no bundling is better, since it optimizes the ink purchase decision. (See part (1) of the proof for the formal derivation.)

Scenario 2— $\hat{w}(c_p, c_i) < \hat{w}(p_p, p_i) \leq 0$ : A printer is *not* purchased both with and without bundling. In this scenario bundling does not affect welfare.

Scenario 3— $\hat{w}(c_p, c_i) \leq 0 < \hat{w}(p_p, p_i)$ : A printer is not purchased without bundling, but a printer is purchased with bundling. In this scenario bundling reduces welfare, since this is an inefficient purchase:  $w(p_p, p_i) < \hat{w}(c_p, c_i)$  (and in Scenario 3  $\hat{w}(c_p, c_i) < 0$ ). To see that  $w(p_p, p_i) < \hat{w}(c_p, c_i)$ , recall that  $w(c_p, c_i) < \hat{w}(c_p, c_i)$  (from Observation 2) and  $w(p_p, p_i) < w(c_p, c_i)$  (proved in part (1), scenario 1).

QED