NBER WORKING PAPER SERIES

THE BUSINESS OF BUSINESS IS BUSINESS: WHY (SOME) FIRMS SHOULD PROVIDE PUBLIC GOODS WHEN THEY SELL PRIVATE GOODS

Chien-Yu Lai
Andreas Lange
John A. List
Michael K. Price

Working Paper 23105
http://www.nber.org/papers/w23105

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2017

The Business of Business is Business: Why (Some) Firms Should Provide Public Goods when they Sell Private Goods
Chien-Yu Lai, Andreas Lange, John A. List, and Michael K. Price
NBER Working Paper No. 23105
January 2017
JEL No. D4,H4,L1

ABSTRACT

This note links the commodity bundling literature with the literature on the private provision of public goods. We discuss the potential profitability of bundling strategies for both private firms and charitable organizations. Even in the absence of consumption complementarities, we show important cases when private and public goods should be bundled. For example, both a monopolist and a charity can profit from bundling the goods they provide. Linking sales to charitable contributions can also be beneficial for for-profit firms as it alleviates price-competition. Beyond providing a theoretical framework for understanding the incentive properties of bundling private and public goods, the study lends insights into the debate on the efficacy of corporate social responsibility.

Chien-Yu Lai
The Department of Economics
University of Chicago
E. 59th Street
Chicago, IL 60637
cylai@uchicago.edu

Andreas Lange
University of Hamburg
Department of Economics
Von Melle Park 5
20146 Hamburg
Germany
andreas.lange@wiso.uni-hamburg.de

John A. List
Department of Economics
University of Chicago
1126 East 59th
Chicago, IL 60637
and NBER
jlist@uchicago.edu

Michael K. Price
Experimental Economics Center
Andrew Young School of Policy Studies
Georgia State University
P.O. Box 3992
Atlanta, GA 30302-3992
and NBER
mprice25@gsu.edu

1 Introduction

Milton Friedman (1970) set off a firestorm when he likened corporate social responsibility to "pure and unadulterated socialism." From this came the mantra from Friedmanites that "the business of business is business." In the four decades since, the debate over the nature and extent of the social responsibilities of business has become heated and complex. Within academic circles, several areas of study have been launched in response to Friedman's arguments, including a vast literature that explores the relationship between corporate social performance and financial performance. By and large, the empirical results emanating from this line of research are far from conclusive. While some studies find a positive relationship between social and financial performance (e.g., Waddock and Graves, 1997), others report no or even a negative relationship (e.g., Wright and Ferris, 1997; McWilliams and Siegel, 2001).[1]

At roughly the same time, a vibrant literature in industrial organization was emerging that examined the properties of commodity bundling. An early contribution was due to Friedman's colleague, George Stigler (1962), who showed that it is potentially profitable for a monopolist selling two goods to bundle them by requiring a buyer to purchase both in order to get either. This line of research has proliferated with several seminal advances, showing the rationale for tying arrangements. For example, Adams and Yellen (1976) formally examine the multiproduct monopoly decision with independent demands.[2] Schmalensee (1982) considers the decision of a single-product monopolist who can bundle its product with a competitive produced good. In both of these settings, bundling enhances the profitability of the monopolist as it allows them to engage in price discrimination. Nalebuff (2004) examines the effect of bundling in an oligopolistic setting and shows an alternate reason for such strategies - bundling is a particularly effective strategy for deterring entry.

Although Friedman and Stigler were noted close friends going as far back as their graduate school days at the University of Chicago, the literature has yet to marry these two lines of

[1]For a good overview of this literature we refer the interested reader to McWilliams et al. (2006) who summarize the results from more than a dozen papers exploring the link between CSR and firm performance.

[2]Adams and Yellen (1976) rely upon a series of examples to show that bundling can enhance the profitability of a multi-product monopolist. They do not, however, provide a general characterization of conditions under which bundling is an optimal strategy. Schmalensee (1984) extends the Adams and Yellen model to examine the optimality of bundling under the assumption that reservation values follow a bivariate normal distribution. McAfee et al. (1989) further extend this line of work and show that bundling is an optimal strategy whenever reservation values for the various goods are independently distributed.

scholarship.[3] This gap in the literature is surprising as it is not difficult to find examples of consumption goods that are bundled with charitable donations. Of course, it is not difficult to find examples of consumption goods that are bundled with charitable donations. For example, profits from certain iPods, T-shirts, and other items with the (RED) label go to the Global Fund to Fight AIDS, TB and malaria. Products with the pink breast cancer awareness logo are widespread and reach from products like t-shirts and other visible and durable goods, to fruit juices. Alternately, many firms elect to adopt "green" production processes or fair-trade practices that raise costs but provide external benefits in the form of improved air quality or living standards for farmers in developing countries.

Yet it is not only for profit firms that engage in such practices. Many non-profit organizations sell products to augment charitable revenues or offer potential donors gifts for contributions exceeding some pre-determined threshold. For example, the World Wildlife Fund sells items ranging from duffel bags and day packs to t-shirts, hats, and jackets on its website. And other organizations such as the Public Broadcast System offer products such as coffee mugs and CD collections during on-air fundraising efforts as a "gift" to donors who contribute more than some pre-determined amount.

In this note, we explore the potential profitability of bundling strategies for both private firms and charitable organizations. We begin by modeling the decision problem of a single-good monopolist who can link with a charity to offer a bundled product for which revenues are split between the two parties. Following the existing literature on bundling, we assume that values for the public and private goods are independently distributed. Consonant with prior work (see, e.g., Adams and Yellen, 1976; Schmalensee, 1984; McAfee et al., 1989), we first show that a profit-maximizing monopolist will either (i) sell only a single (unbundled) good only or (ii) simultaneously offer both the unbundled good and a second variety of their product which bundles the good with a charitable contribution. As in prior work, the intuition underlying the decision to bundle with a charity is straightforward. Linking purchases with charitable donations allows the monopolist to attract new customers and engage in price discrimination by offering differentiated products.

We next derive conditions under which it is optimal for the monopolist to offer both the

[3] "...there is no one anywhere I would rather have as a colleague than you." (George Stigler to Milton Friedman, October 19, 1954, p.133). Citation Craig Freedman, "Review of J. Daniel Hammond and Claire H. Hammond (editors), Making Chicago Price Theory: Friedman-Stigler Correspondence, 1945-1957." EH.Net Economic History Services, Sep 27 2006. URL: http://eh.net/bookreviews/library/1118.

unbundled and bundled varieties of their product. Specifically, we show that bundling can increase the monopolist's profits whenever the elasticity of demand for consumers with a high value for the public good is more than twice the average price elasticity at the standard monopoly price. The intuition underlying this result can be gleaned from the following stylized example. Consider a market with only two types of consumers: some with high value of the private good and no valuation for the public good and others with a sufficiently smaller value for the private good and a positive valuation for the public good. If the composition of types is such that the standard monopolist would serve only those with a high value for the private good, it is possible for the monopolist to attract the low type consumers by offering a bundled good that sells for a higher price - a portion of which is designated for charity.

We then extend the model to consider the effect of bundling on price competition amongst two firms. Within this context, we first demonstrate that any equilibrium of the pricing game yields positive profits for both firms provided that they each designate a different share of total proceeds for charity. Intuitively, bundling serves to differentiate the firms' products and therefore relaxes price competition. We then endogenize the bundling decision and examine the share of proceeds each firm will designate for charity. In doing so, we show that there exists a subgame perfect equilibrium in which one firm provides only the private good while the other elects to bundle their good with charity.

In some regards, our study is similar in spirit to Besley and Ghatak (2007) who explore the feasibility and desirability of corporate social responsibility and show that such strategies are consistent with profit-maximization in competitive markets. However, our study differs from Besley and Ghatak (2007) along a number of important dimensions. First, Besley and Ghatak (2007) focus solely on the bundling decision of firms engaged in price competition. Our study examines this decision for both a single-good monopolist and firms engaged in price competition. Second, Besley and Ghatak (2007) model firms as simultaneously announcing prices and an associated level of public good provision (or mission strategy). In our framework, we consider a sequential game whereby firms first select what share of proceeds will be designated for charity and then, based upon the observed shares, a price to charge for their product. Finally, Besley and Ghatak (2007) consider only two types of consumers - those who are caring and value the public good and those who are neutral and have zero value for the public good. Our model allows for the more general case of a continuum of types and assumes that continuous distributions of values for both the public and private goods.[4]

Beyond providing a theoretical framework for understanding the incentive properties of bundling private and public goods, our study lends insights into the debate on the efficacy of corporate social responsibility. Importantly, our study can be used to reconcile the disparate empirical results regarding the profitability of corporate social responsibility and highlights that not all actions driven by a desire to provide a 'social good.' For example, while many would consider a Whole Foods donation of 5% of a store's total sales to a non-profit organization as corporate social responsibility, our model suggests that such an activity is necessary for rather than at odds with profit maximization.[5]

Moreover, our study advances a growing literature exploring the response of consumers to charity-linked products (see, e.g., Popkowski Leszczyc and Rothkopf, 2010; Elfenbein and McManus, 2010; McManus and Bennet, 2011) or products produced using fair-trade standards and/or "green" technologies (see, e.g., Loureiro and Lotade, 2005; Kotchen, 2006; Kotchen and Moore, 2007; Hiscox and Smyth, 2011). Although this literature is ubiquitous in showing that consumers are willing to pay more for such products, it provides little guidance as to why a profit-maximizing firm would elect to offer such goods. Our study explicitly addresses this issue and suggests a new rationale for the proliferation of charity-linked and/or "green" products in the marketplace.

2 Theory of Bundling

We follow the basic setup by Adams and Yellen (1976). A private good is produced at constant marginal costs c. Potential buyers are interested in at most one unit of the product,

[4] More closely related to our study, Pecorino (2016) investigates motivations of linking charitable donations to firms profits. Differently from our setting, he models a portion of profits not revenues going to charity. For positive fixed costs of production, he shows that it may be profitable for a firm to choose to sell the bundle instead of the pure private good. Our approach differs from his by not relying on positive fixed costs and instead demonstrating that product differentiation provides a motive for bundling.

[5] One need look no further than the following comment from CEO John Mackey to see that such motives are a key driver of Whole Foods actions. "While our stores select worthwhile organizations to support, they also tend to focus on groups that have large membership lists, which are contacted and encouraged to shop our store that day to support the organization. This usually brings hundreds of new or lapsed customers into our stores, many of whom then become regular shoppers. So a 5% Day not only allows us to support worthwhile causes, but is an excellent marketing strategy that has benefited Whole Foods investors immensely," (Mackey, 2005).

the reservation price being denoted by v. Additionally, agents as having a value for a public good, the (constant) marginal value being denoted by $h \in [0,1)$. Throughout the paper we assume that the budget constraint of the consumers is not binding. We can therefore describe each consumer as a pair (v,h).

It serves beneficial to denote the distribution of h by $F(h)$, where we assume that its density $F'(h) > 0$. For any given h, we can characterize the distribution of private values by defining a demand function $D(p|h)$ as only consumers with $v \geq p$ will purchase a standard private good. We assume that that for all h, $D'(p|h)+pD''(p|h) < 0$. As $F'(h)$ captures the number of consumers for a given h, $D(0|h)$ is normalized to 1.

To set up the subsequent discussion, it is useful to analyze individuals decisions when two varieties are offered, described by (p_0, d_0) and (p_1, d_1), where p_i is the price demanded for the private good and d_i is the amount per sold unit going to charity. Without loss of generality, we assume that $d_1 \geq d_0 \geq 0$.

In this case, a consumer of type (v,h) has three options: (i) to buy bundle (p_0, d_0), (ii) to buy bundle (p_1, d_1), or (iii) to buy none of them. Consumers will consider buying bundle 1 instead of bundle 0 if and only if

$$p_1 - hd_1 \leq p_0 - hd_0 \quad \Leftrightarrow \quad h \geq \hat{h} = \frac{p_1 - p_0}{d_1 - d_0}$$

We immediately obtain that no consumer buys product 1 if $p_1 - p_0 \geq d_1 - d_0$, and that no demand for product 0 results if $p_1 < p_0$. That is, the high-price bundle must be linked with a larger donation, with the difference in donations $(d_1 - d_0)$ being larger than the price difference $(p_1 - p_0)$.

Consumers with $h > \hat{h}$ $(h \leq \hat{h})$ will buy the bundle $i = 1$ $(i = 0)$ if

$$v - p_t + hd_t \geq 0 \quad \Leftrightarrow \quad v \geq p_t - hd_t$$

Essentially, the link with charitable donations reduces the effective price to the consumers the more, the larger their valuation of the public good is. Demand for the respective bundles is therefore given by:

$$D_1 = \int_{\hat{h}}^{1} D(p_1 - hd_1|h)dF(h)$$

and

$$D_0 = \int_0^{\hat{h}} D(p_0 - hd_0|h)dF(h)$$

where $\hat{h} = (p_1 - p_0)/(d_1 - d_0)$. The consumption decisions are illustrated in Figure 1.

2.1 Monopolist linking up with charity

We first study a profit-motivated monopolist who considers linking up with a charity. We restrict the bundling decision to a binary choice $d \in \{0, d\}$ with $d > 0$. That is, besides offering a product without charitable contributions at p_0 with revenues p_0 going to the monopolist ($d_0 = 0$), a bundle with $d_1 = d > 0$ might be offered at p_1 with revenues split between charity (d) and monopolist ($p_1 - d$).

As a baseline, we consider the standard monopolist's setting without bundling. Here, the monopolist chooses the price p by maximizing

$$\Pi^M = \max_p (p - c) \int_0^1 D(p|h)dF(h)$$

such that the first order condition is given by

$$\int_0^1 D(p|h)dF(h) + (p - c) \int_0^1 D'(p|h)dF(h) = 0 \quad (1)$$

We denote the optimal monopoly price by p^M and the corresponding profit by Π^M.

As a first step, we show that the monopolist will always provide one variety of the good *without* bundling with charity, i.e. $d_0 = 0$.

Proposition 1 *A profit-oriented monopolist will always provide one variety of the good that is not bundled with charitable donations.*

Proof: Assume to the contrary, that the monopolist offers his product only as a bundle $(p, d) = (p_1, d_1)$. Then consider an additional variety of the good at a price $p_0 = p_1 - \hat{h}d$ ($0 < \hat{h} < 1$) that is not linked to charity ($d_0 = 0$). With this, the demand for the (p_1, d_1) bundle would be unaffected for $h > \hat{h}$, while the demand for the good at price $\hat{p}_0$ would replace the demand for the bundle for all $h \leq \hat{h}$. The profits would thereby increase as

$$(p_1 - d - c) \int_0^{\hat{h}} D(p_1 - hd|h) dF(h) < (p_1 - d - c) \int_0^{\hat{h}} D(p_0|h) dF(h) < (p_0 - c) D(\hat{p}) F(\hat{h})$$

□

We now explore when introducing a bundle that links the private good with charitable donations is indeed profitable. When introducing the bundle (in addition to selling the product alone), the profit to the monopolist is given by

$$\begin{aligned}
\Pi(p_0, p_1, d_1) =& (p_0 - c) D_0 + (p_1 - d - c) D_1 \\
=& (p_0 - c) \int_0^{\hat{h}} D(p_0|h) dF(h) \\
&+ (p_1 - d - c) \int_{\hat{h}}^1 D(p_1 - hd|h) dF(h)
\end{aligned}$$

In order to derive a sufficient condition for profit increases due to bundling, we assume that the monopolist offers the good at $p_0 = p^M$ and additionally provides a bundle at price $p_1 = p_0 + \hat{h}d$ $(0 < \hat{h} \leq 1)$. This bundle is constructed such that demand for $h < \hat{h}$ still goes to the unbundled variety at price $p_0 = p^M$ whereas consumers with $h > \hat{h}$ consume the bundled variety. We consider the resulting profit as a function of $\hat{h}$, denoted by $\hat{\Pi}(\hat{h})$. Obviously $\hat{\Pi}(1) = \Pi^M$. We now consider the profit change for a marginal decrease in $\hat{h}$ from $\hat{h} = 1$. The profit change is given by

$$\begin{aligned}
&\hat{\Pi}(\hat{h}) - \hat{\Pi}(1) \\
=& (p^M + \hat{h}d - d - c) \int_{\hat{h}}^1 D(p^M + \hat{h}d - hd|h) dF(h) - (p_0^M - c) \int_{\hat{h}}^1 D(p_0^M|h) dF(h)
\end{aligned}$$

We therefore obtain:

$$\begin{aligned}
\hat{\Pi}'(\hat{h}) =& d \int_{\hat{h}}^1 D(p^M + \hat{h}d - hd|h) dF(h) \\
&+ d(p^M + \hat{h}d - d - c) \int_{\hat{h}}^1 D'(p^M + \hat{h}d - hd|h) dF(h) \\
&+ d(1 - \hat{h}) D'(p^M|\hat{h}) F'(\hat{h})
\end{aligned}$$

with $\hat{\Pi}'(1) = 0$ and

$$\hat{\Pi}''(1) = -\,2dD(p^M|1)F'(1) - d(p^M - c)D'(p^M|1)F'(1) \tag{2}$$

It is therefore obvious that profits increase above the (unbundled) monopolist's profit Π^M if $\hat{\Pi}''(1) > 0$.

Rearranging (2) and using the first order condition (1), we see that $\hat{\Pi}''(1) > 0$ is equivalent to:

$$\frac{-D'(p^M|1)}{2D(p^M|1)} > \frac{1}{p^M - c} = \frac{-\int D'(p^M|h)dF(h)}{\int D(p^M|h)dF(h)} \tag{3}$$

This condition states that the introduction of a bundle is beneficial if the price elasticity of demand for agents with large h (at $h = 1$) is sufficiently larger than the price elasticity of demand across all consumers:

$$p^M \frac{-D'(p^M|1)}{2D(p^M|1)} = \frac{\eta_{h=1}}{2} > \eta = p^M \frac{-\int D'(p^M|h)dF(h)}{\int D(p^M|h)dF(h)}$$

where η is the overall price elasticity of demand and $\eta_{h=1}$ is the price elasticity at $h = 1$. If the price elasticity of demand for agents with large h is more than twice as large than the overall price elasticity of demand, a monopolist can therefore benefit from bundling. Intuitively, for highly elastic demand for high h-consumers, the monopolist would want to choose a smaller price to gain additional consumers. By introducing the bundle, the monopolist can differentiate prices such that low h-consumers still face a large price and consumers with $h > \hat{h}$ effectively face a smaller price as they consume the bundle.

In this case, both charity and monopolists benefit from introducing a second variety of the product which links consumption with charitable donations. The former benefits from increasing revenues, the latter from increasing donations.

We summarize these results in the following proposition:

Proposition 2 *Bundling with a charity can be beneficial to a monopolist. In particular, offering a bundle in addition to selling the good increases profits if the elasticity of demand from high h consumers is more than twice than the average price elasticity at the standard monopolist's price.*

The monopolist can therefore potentially increase revenues beyond only selling the product additionally offering a product/charity bundle. The charity also benefits from these bundles as they gain revenues that (due to the linear structure of the public good) would not result in a voluntary giving setting. Such benefits cannot occur, however, if demand is independent of h. In this case, the monopolist would not desire to differentiate prices between consumers with different preferences h towards the public good. Instead, the monopolist's price p^M proves optimal.

2.2 Price competition in a Duopoly

While the previous section dealt with the case of a monopolistic provider of the private good, we now turn to a situation in which there is price competition for selling the private good. For simplicity, we consider the case of the duopoly. Here, it is well-known that Bertrand competition leads to prices being set at marginal cost (which in our case of constant marginal costs leads to zero profit). We now demonstrate another reason why bundling a private with public good can be beneficial for for-profit firms: it generally relaxes the price competition.

We use the same model as above, but consider two simplifying settings. In the first, we assume that private demand does not depend on h, i.e. $D(p|h) = D(p)$ for all h and, additionally a uniform distribution of h types. Second, we allow the demand to be correlated with h, but assume $h \in \{0, \bar{h}\}$, that is, consumers either do not care for the public good or their marginal utility is at one specific positive level.

We assume that two firms A and B offer bundles (p_A, d_A) and (p_B, d_B), respectively; where again $d_i \in \{0, d\}$. We assume the following sequence of the game:

1. Firms choose the extent of bundling (d_A and d_B).
2. Firms engage in price competition (p_A and p_B).

A few words are in order to discuss this timeline. An alternative would be to have firms choose the amount of charitable donations and the price simultaneously (e.g., Besley and Ghatak, 2007). However, many firms that provide some charitable donations or provide public goods with parts of their revenues, first have to establish their brand (i.e., d_i) and then later engage in price competition.[6]

2.2.1 Case 1: Private demand uncorrelated with preferences for public good

We first consider the case in which demand is independent of the valuation of the public good, i.e., $D(p|h) = D(p)$ for all h and assume h to be uniform, i.e. $F(h) = h$. In this case, bundling could not be optimal for a monopolist (see above). We will see that bundling still persists in the market.

The case of $d_A = d_B = 0$ corresponds to the standard Bertrand competition case and yields the wellknown result of $p_A = p_B = c$ with both firms earning zero profits. Similarly, if $d_A = d_B = d$, each firm can secure all the demand by slightly underpricing its competitor. Both firms would do so as long as prices cover the costs plus donations, i.e. if $p_i > c + d$. The equilibrium is therefore given by $p_A = p_B = c + d$.

Positive profits therefore can only prevail if $d_A \neq d_B$. We now consider this case and define $d_1 = d$ and $d_0 = 0$. As before, we denote the corresponding prices by p_0 and p_1 and let $\hat{h} = (p_1 - p_0)/d$ if $p_1 > p_0$ and $p_1 - d \leq p_0$, $\hat{h} = 0$ if $p_1 \leq p_0$ and $\hat{h} = 1$ if $p_1 - d > p_0 - d$.

The respective profits are given by

$$\Pi_0 = (p_0 - c) \int_0^{\hat{h}} D(p_0) dF(h) \tag{4}$$

$$\Pi_1 = (p_1 - d - c) \int_{\hat{h}}^1 D(p_1 - hd) dF(h) \tag{5}$$

such that demand and profits change continuously with price changes.

This leads to the following (necessary) first order conditions:

$$0 = \frac{\partial \Pi_0}{\partial p_0} = \int_0^{\hat{h}} D(p_0) dF(h) + (p_0 - c) \int_0^{\hat{h}} D'(p_0) dF(h) - (p_0 - c) \frac{1}{d} D(p_0) F'(\hat{h}) \tag{6}$$

[6] An alternative assumption would be that bundling firms promise to give a *percentage* of their proceeds to charity. While this would slightly complicate the exposition, the qualitative results are not affected by this assumption.

$$0 = \frac{\partial \Pi_1}{\partial p_1} = \int_{\hat{h}}^{1} D(p_1 - hd) dF(h) + (p_1 - d - c) \int_{\hat{h}}^{1} D'(p_1 - hd) dF(h) - (p_1 - d - c) \frac{1}{d} D(p_1 - \hat{h}d) F'(\hat{h}) \tag{7}$$

The first two terms in (6) and (7) reflect the pricing decisions for monopolists who serve potential consumers with $h < \hat{h}$ or $h > \hat{h}$, respectively. In addition, both firms take into account that an increase in the price loses consumers along the h-margin. This third term therefore reflects the price competition between the two firms.

Note that, for the assumed uniform distribution of h, the second order condition is automatically satisfied when the first order condition holds with equality.[7]

Maximization of (4) and (5) directly leads to the existence of a price-equilibrium in which both firms make positive profits:

Proposition 3 *If firms have chosen to bundle their products with charitable contributions, there is a unique price equilibrium. It yields positive profits for both of firms as long as* $d_A \neq d_B$*. If* $d_A = d_B$*, the only equilibrium is given at* $p_A = p_B = d_A + c = d_B + c$ *and gives zero profits to both firms.*

The proof is given in the Appendix. Proposition 3 shows that differentiating products by linking them to a different extent to charitable contributions alleviates the price competition such that positive payoffs result in duopoly. We therefore immediately arrive at the following result:

Proposition 4 *Any subgame perfect equilibrium is characterized by one firm in the first stage choosing only to provide the private good* $\min[d_A, d_B] = 0$*, while the other chooses to bundle at a level* $d = \max[d_A, d_B]$*, before both firms engage in price competition that yields positive profits for both.*

The proof is again given in the Appendix. Proposition 4 shows that it is optimal for firms to alleviate price competition by bundling with a charity. However, for the case of two

[7] For more general distributions, the first-order condition may not be sufficient. In equilibrium, however, interior solutions $0 < \hat{h} < 1$ are also guaranteed: firms cannot compete down to zero profits ($p_0 = p_1 - d = c$) as firm 0 could then increase its price without losing all consumers. However, if $p_0 > c$, firm 1 can also set a price to make positive profit. However, the assumption of a uniform distribution simplifies the further explorations of equilibria as it guarantees the reaction functions given by (6) and (7) to be continuous. In fact, relaxing the assumption of uniformly distributed h not problematic as long as reaction functions stay continuous.

competing firms, only one will bundle such that our theory predicts that not all firms will provide charitable contributions.

It is interesting to see what firm will arrive at larger profits in equilibrium. We show that:

Proposition 5 *The firm which does bundle at a level d makes less profits than the firm which does not link sales to charitable donations.*

Given Proposition 5 it becomes obvious that a firm will particularly benefit if its competitor bundles with the charity. As such, we predict from our model that (i) firms can be expected to bundle with charity, but (ii) firms providing such a bundle will make less profits than those selling solely the private good.

2.2.2 Case 2: Discrete h types

The derivations so far relied on a continuous distribution the public good valuation by consumers ($F'(h) > 0$ for all h). However, it may seem reasonable that clusters in such valuations exist. We therefore finally turn to a case where h can only take discrete values: some consumers do not care for the public good ($h = 0$) while others have a positive valuation ($h = \bar{h}$) with $0 < \bar{h} < 1$, i.e. consumer types are given by $h \in \{0, \bar{h}\}$. Again we allow firms to bundle either at level d or not to bundle at all. To simplify notation, we denote the demand functions for $h = 0$ consumers by $D_0(p) = D(p|0)$ and or $h = \bar{h}$ types by $D_1(p) = D(p|\bar{h})$, again normalized to $D_0(0) = D_1(0) = 1$. The number of of potential consumers with $h = 0$ is denoted by α_0, the number of $h = \bar{h}$ consumers by α_1.

Similar to the last section, if both firms choose not to connect to charitable donation ($d_A = d_B = 0$), both will sell the product at $p = p_A = p_B = c$ by Bertrand competition. By the same argument, if both firms choose to connect to $d > 0$, both will sell the bundle at $p_A = p_B = c + d$. In this section, we therefore focus on deriving conditions under which a separating equilibrium exists. As before, we denote firm 0 as the firm selling the product without any donation ($d_0 = 0$) and firm 1 as the firm selling the product with $d_1 = d > 0$, prices denoted by p_0 and p_1 respectively.

The difference to the last section is that a marginal price change does not only marginally change the consumer base of a firm by marginally affecting the cutoff value $\hat{h}$; rather it may lead to a discrete change. This happens at $p_1 - p_0 = \bar{h}d$, where consumers of type $h = \bar{h}$ switch between both firms, as well as at $p_1 - p_0$ where consumers of type $h = 0$ switch. In the separating equilibrium outcome, obviously, firm 0 only serves consumers type $h = 0$, while firm 1 serves consumers of type $h = \bar{h} > 0$. With this notation, it proves beneficial to define

$$P_0^* = \arg\max_p (p - c) D_0(p) \tag{8}$$

$$P_1^* = \arg\max_p (p - c - d) D_1(p - hd) \tag{9}$$

as the monopoly prices for firm 0 (P_0^*) selling only to consumers who don't care for the public good, and for firm 1 selling only to consumers who care (P_1^*). Note that this immediately implies that $P_0^* \geq c$ and $P_1^* \geq c + d$. To avoid trivial cases, we assume that $P_0^* > c$ and $P_1^* > c + d$.

With these preliminaries, we arrive at the following proposition:

Proposition 6 *A separating equilibrium exists if and only if all of the following conditions are satisfied:*

(i) $P_1^* - \bar{h}d < P_0^* < P_1^*$,

(ii) $\alpha_0 (P_0^* - c) D_0(P_0^*) \geq \max_{p_0 \leq P_1^* - \bar{h}d} (p_0 - c)(\alpha_0 D_0(p_0) + \alpha_1 D_1(p_0))$,

(iii) $\alpha_1 (P_1^* - c - d) D_1(P_1^* - \bar{h}d) \geq \max_{p_1 \leq P_0^*} (p_1 - c - d)(\alpha_0 D_0(p_1) + \alpha_1 D_1(p_1 - \bar{h}d))$

It is given by one firm choosing not to bundle and to offer the product at $p_0 = P_0^*$*, and the other firm bundling and pricing at* $p_1 = P_1^*$*.*

One can show that – as long as condition (i) in Proposition 6 is satisfied – optimization in (iii) yields $p_1 = P_0^*$.[8]

The formal proof of Proposition 6 is given in the Appendix. The intuition, however, is straightforward. In a separating equilibrium, for both firms a *marginal* change of price must

[8] For this consider the first-order conditions for maximizing the right-hand side (iii) in $p_1 = P_0^* < P_1^*$: $\alpha_0((P_0^* - d - c)D_0'(P_0^*) + D_0(P_0^*))\alpha_1((P_0^* - d - c)D_1'(P_0^* - \bar{h}d)) + D_1(P_0^* - \bar{h}d)) = -\alpha_0 d D_0'(P_0^*) + \alpha_1((P_0^* - d - c)D_1'(P_0^* - \bar{h}d)) + D_1(P_0^* - \bar{h}d)) > 0$, where we used the first-order condition for maximization of profits of firm 0, and the concavity of the profit function of firm 1.

not improve profits. This implies pricing at monopoly prices and that $0 < p_1 - p_0 < \bar{h}d$ as otherwise a marginal change would discretely increase the sales of one charity by stealing consumers from the other firm. Additionally, no charity can have an incentive to *discretely* change its price to a level to steal (all) consumers from the other firm. To steal the market share from its competitor, a firm would need to lower its price and thereby give up some profits from its original consumer base. This loss of profits must be larger than the profit gain from the new consumers. This immediately leads to conditions (ii) and (iii).

For example, condition (iii) is automatically satisfied if $P_0^* - d < c$, i.e. if firm one would run into losses if trying to attract consumers of $h = 0$ type. In this case, condition (ii) essentially boils down to having a sufficiently small consumer base at $h = \bar{h}$, i.e. α_1/α_0 needs to be sufficiently small. In general, however, if $P_0^* - d > c$, condition (iii) generates a lower bound for α_1/α_0.

Also note that – with Proposition 6 – we also obtain the following result:

Proposition 7 *When $D_0(p) = D_1(p)$, no separating equilibrium can exist.*

That is, private demand cannot be uncorrelated with preference for public good. The separation result in Section 2.2.1 was therefore driven by the assumption of a continuous h-type distribution.

In order to further illustrate the conditions for a separating equilibrium, we consider linear demand functions: let $D_0(p) = 1 - \beta_0 p$, $D_1(p) = 1 - \beta_1 p$. It is straightforward to derive the monopoly prices:

$$P_0^* = \frac{1 + \beta_0 c}{2\beta_0} \tag{10}$$

$$P_1^* = \frac{1 + \beta_1 c + \beta_1 d(1 + \bar{h})}{2\beta_1} \tag{11}$$

such that

$$P_1^* - \bar{h}d = \frac{1 + \beta_1 c + \beta_1 d(1 - \bar{h})}{2\beta_1}$$

Simple algebra shows that condition (i) of Proposition 6 is equivalent to

$$\frac{\beta_1 - \beta_0}{\beta_0 \beta_1 (1 + \bar{h})} < d < \frac{\beta_1 - \beta_0}{\beta_0 \beta_1 (1 - \bar{h})} \tag{12}$$

which puts a lower and upper bound on d. Note that this condition can only be satisfied if $\beta_1 > \beta_0$ which corresponds to Proposition 7. We first derive a sufficient condition for condition (ii) of Proposition 6: the right hand-side of condition (ii) is maximized in $p_0 = P_1^* - \bar{h}d$ if[9]

$$\frac{\alpha_1}{\alpha_0} \leq \hat{\gamma}_1 := \frac{1 + \beta_0 c - 2\beta_0(P_1^* - \bar{h}d)}{(1 - \bar{h})d\beta_1}.$$

Then, evaluated at $p_0 = P_1^* - \bar{h}d$, condition (ii) holds if

$$\alpha_0(P_0^* - c)(1 - \beta_0 P_0^*) \geq (P_1^* - \bar{h}d - c)(\alpha_0(1 - \beta_0(P_1^* - \bar{h}d)) + \alpha_1(1 - \beta_1(P_1^* - \bar{h}d)))$$

which is equivalent to

$$\frac{\alpha_1}{\alpha_0} \leq \hat{\gamma}_2 := \frac{(P_0^* - c)(1 - \beta_0 P_0^*) - (P_1^* - \bar{h}d - c)(1 - \beta_0(P_1^* - \bar{h}d))}{(P_1^* - \bar{h}d - c)(1 - \beta_1(P_1^* - \bar{h}d))}. \tag{13}$$

As such, a sufficient condition for (ii) to hold is given by:

$$\frac{\alpha_1}{\alpha_0} \leq \hat{\gamma} = \min\{\hat{\gamma}_1, \hat{\gamma}_2\}$$

Similarly, condition (iii) is equivalent to:

$$\frac{\alpha_1}{\alpha_0} \geq \tilde{\gamma} := \frac{\max\{0, P_0^* - d - c\} \max\{0, 1 - \beta_1 P_0^*\}}{(P_1^* - d - c)(1 - \beta_1(P_1^* - \bar{h}d)) - (P_0^* - d - c)(1 - \beta_1(P_0^* - \bar{h}d))}. \tag{14}$$

Note that condition (14) is automatically satisfied if $\beta_1 P_0^* \geq 1$, i.e. when demand from $\bar{h}$ consumers at price P_0^* is zero, and if $P_0^* - d - c \leq 0$ in which case losses would result. Using the latter case, we obtain that for

$$\max\left\{\frac{1 - \beta_0 c}{2\beta_0}, \frac{\beta_1 - \beta_0}{\beta_0\beta_1(1 + \bar{h})}\right\} \leq d \leq \frac{\beta_1 - \beta_0}{\beta_0\beta_1(1 - \bar{h})}$$

separating equilibria will exist if α_1/α_0 is sufficiently small and therefore satisfies condition (ii).

To further illustrate the conditions for existence of separating equilibria, we consider a specific parameter setting.

[9]Consider the first-order condition at $p_0 = P_1^* - \bar{h}d$. It is positive if $(P_1^* - \bar{h}d - c)(\alpha_0 D_0'(P_1^* - \bar{h}d) + \alpha_1 D_1'(P_1^* - \bar{h}d)) + (\alpha_0 D_0(P_1^* - \bar{h}d) + \alpha_1 D_1(P_1^* - \bar{h}d)) = \alpha_0[(P_1^* - \bar{h}d - c)D_0'(P_1^* - \bar{h}d) + D_0(P_1^* - \bar{h}d)] + \alpha_1[(1 - \bar{h})dD_1'(P_1^* - \bar{h}d))] \geq 0$.

Example 1 *Let $\beta_0 = 1$, $\beta_1 = 2$, $c = 0$. We further fix $\bar{h}$ and $\alpha_1/\alpha_0 = \gamma$ and derive conditions on d which support separating equilibria.*

Condition (i) is equivalent to

$$\frac{1}{2(1+\bar{h})} < d < \frac{1}{2(1-\bar{h})} \tag{15}$$

Condition (iii) is automatically satisfied as $D_1(P_0^*) = 0$. Simple algebra shows that $\hat{\gamma}_1 > \hat{\gamma}_2$ and that $\gamma < \hat{\gamma}_2$ is sufficient for condition (ii) to hold. This is equivalent to

$$d \leq \frac{1-2\gamma}{2(1-\hat{h})(1+2\gamma)} \tag{16}$$

Intuitively, a smaller d means that firm 0 has to reduce its price more in order to gain access to type $\bar{h}$ consumers. Hence, if d is sufficiently small, this reduction is not worthwhile as it substantially reduces the profits from its original $h = 0$ consumer base.

Combining (15) and (16), we obtain the following range for d in which bundling leads to a separating equilibrium:

$$\frac{1}{2(1+\bar{h})} < d < \frac{1}{2(1-\bar{h})} \frac{1-2\gamma}{(1+2\gamma)} \tag{17}$$

For separating equilibria to exist, it is therefore necessary that

$$2\gamma < \bar{h}.$$

That is, the less $\bar{h}$ consumers are interested in the public good (i.e. the smaller $\bar{h}$), the less they are differentiated from $h = 0$ consumers. Thus, the firm that does not bundle would have a larger incentive to reduce the price to also obtain those $\bar{h}$ consumers, unless their number is also very small. Conversely, if $\bar{h}$ is large, it is more likely that a bundling level d exists for which separation occurs. However, the existence of separating equilibrium always requires $\gamma < 1/2$.

3 Conclusions

This note links the commodity bundling literature with the literature on the private provision of public goods. We have developed a model in the spirit of Adams of Yellen (1976) to explore the potential profitability of bundling strategies for both private firms and charitable organizations. We begin by showing that under certain conditions, a single-good monopolist can increase profits by selling both unbundled and bundled versions of their product. Intuitively, the ability to link purchases with charitable contributions allows the monopolist to differentiate their product and attract new customers.

Our analysis also considers the effect of bundling on price competition amongst two firms. Here we show that any equilibrium of the pricing game yields positive profits for both firms provided they bundle at different levels. Intuitively, bundling provides a way for firms to differentiate their product and therefore relaxes price competition. Moreover, we show that, in such cases, there exists a subgame-perfect equilibrium in which only one of the two firms elects to bundle.

In doing so, our study sheds new light light on the debate regarding the efficacy of corporate social responsibility. Importantly, our study highlights that not all such actions are driven by a desire to provide a "social good". Rather our model suggests a profit motive for such actions. In this regard, we view CSR as a strategy perfectly consonant with the mantra of Friedmanites that "the business of business is business." In many instances, bundling with charities are necessary for rather than at odds with profit maximization.

We can envision several distinct directions for future work. First, theoretically we have focused on the demand side but one could add important insights by focusing on the supply side, and modeling how selection of workers and worker effort correlate with firms' use of CSR. A second branch of related work could tie such a model to a field experiment that identifies the key parameters using randomization in a manner that permits a counterfactual analysis of the welfare effects of CSR. Whole outside of the scope of our study, we hope to use another occasion for such an exercise.

References

Adams, William J. and Janet L. Yellen, 1976, "Commodity Bundling and the Burden of Monopoly," *Quarterly Journal of Economics* 90, 475-498.

Besley, Timothy and Maitreesh Ghatak (2007), "Retailing public goods: The economics of corporate social responsibility," *Journal of Public Economics* 91, 16451663.

Elfenbein, Daniel W. and Brian P. McManus, 2010, "Last Minute Bidding in eBay Charity Auctions," *Economic Letters*, 107, 42-52.

Friedman, Milton, 1970, "The Social Responsibility of Business Is to Increase Its Profits," The New York Times Magazine, September 13, 1970: 32-33, 122, 126

Hammond, J. Daniel and Claire H. Hammond, editors, 2006, "Making Chicago Price Theory: Friedman-Stigler Correspondence, 1945-1957," London: Routledge.

Hiscox, Michael J. and Nicholas F. B. Smyth, 2011, "Is There Consumer Demand for Improved Labor Standards? Evidence from Field Experiments in Social Labeling," Working Paper.

Kotchen, Matthew J. 2006, "Green Markets and Private Provision of Public Goods," *Journal of Political Economy* 114, 816-834.

Kotchen, Matthew and Michael R. Moore, 2007, "Private provision of environmental public goods: Household participation in green-electricity programs," *Journal of Environmental Economics and Management* 53, 116

Loureiro, Maria L. and Justus Lotade, 2005, "Interviewer Effects on the Valuation of Goods with Ethical and Environmental Attributes," *Environmental and Resource Economics* 30, 49 - 72.

Mackey, John, 2005, "Putting Customers Ahead of Investors." *Reason.*
http://reason.com/archives/2005/10/01/rethinking-the-social-responsi/singlepage

McAfee, R. Preston, John McMillan, Michael D. Whinston, 1989, "Multiproduct Monopoly, Commodity Bundling, and Correlation of Values", *Quarterly Journal of Economics* 104, 371-383.

McManus, Brian and Richard Bennet, 2011, "The demand for products linked to public goods: Evidence from an online field experiment," *Journal of Public Economics* 95, 403-415.

McWilliams, Abigail and Donald Siegel, 2001, "Corporate social responsibility: a theory of the firm perspective," *Academy of Management Review* 26, 117-127.

McWilliams, Abigail, Donald S. Siegel, and Patrick M. Wright, 2006, “Corporate Social Responsibility: Strategic Implications,” *Journal of Management Studies* 43, 1-18.

Nalebuff, Barry, 2004.“Bundling as an Entry Barrier,” *The Quarterly Journal of Economics* 119(1), 159-187.

Pecorino, Paul, 2016. “A Portion of Profits to Charity: Corporate Social Responsibility and Firm Profitability,” *Southern Economic Journal* 83, 380-398.

Popkowski Leszczyc, Peter T.L. and Michael H. Rothkopf, 2010, “Charitable Motives and Bidding in Charity Auctions,” *Management Science* 56, 399-413.

Schmalensee, Richard, 1982, “Commodity Bundling by Single-Product Monopolies”, *Journal of Law and Economics* 25, 67-71.

Schmalensee, Richard, 1984, “Gaussian Demand and Commodity Bundling”, *Journal of Business* 57, 211-230.

Stigler, George J., 1963, “United States v. Loew’s, Inc.: A Note on Block Booking,” *Supreme Court Review* 152.

Waddock, Sandra A., and Samuel B. Graves, 1997, “The corporate social performance - financial performance link,” *Strategic Management Journal* 18, 303-319.

Wright, Peter and Stephen P. Ferris, 1997, “Agency Conflict and Corporate Strategy: The Effect of Divestment on Corporate Value,” *Strategic Management Journal* 18, 77-83.

A Appendix

Proof of Proposition 3

Maximization of (4) and (5) directly give the reaction functions of the two firms, i.e. $p_0 = P_0(p_1)$ and $p_1 = P_1(p_0)$. It is obvious that $c < P_0(p_1) < p_1$ for $p_1 - d > c$ and $c < P_1(p_0) - d < p_0$ for $p_0 > c$, since otherwise zero profits would occur for firm 0 and 1, respectively. As a consequence, we have $\lim_{p_1 \downarrow c} P_0(p_1) = c$ and $\lim_{p_0 \downarrow c} P_1(p_0) = c + d$. For $p_0 \downarrow c$, we therefore obtain $\lim_{p_0 \downarrow c} P_0(P_1(p_0)) - p_0 = P_0(c+d) - c > 0$. Here, $P_0(c+d) - c$ follows as firm 0 can make a profit with a fraction of consumers by choosing $p_0 > c$. For sufficiently large p_0, however, we obtain $P_1(p_0) < p_0$ as then firm 1 would serve the whole market. Here, $P_0(P_1(p_0)) - p_0 < 0$. Continuity of the profit and reaction functions therefore immediately imply the existence of a p_0^D with $P_0(P_1(p_0^D)) = p_0^D$ which, together with $p_1^D = P_1(p_0^D)$, forms a price equilibrium. Since $c < P_0(p_1) < p_1$ and $c + d < P_1(p_0) < p_0 + d$, both firms face positive demand and profits ($0 < \hat{h} < 1$).

We now prove the uniqueness of the price equilibrium. For this, we first show that for each fixed $\hat{h}$, there exist unique p_0 and p_1 that satisfy the first order conditions (6) and (7), respectively. For this, we partially differentiate (6) with respect to p_0, while keeping $\hat{h}$ constant to obtain

$$\begin{aligned} & 2\int_0^{\hat{h}} D'(p_0)dF(h) + (p_0 - c)\int_0^{\hat{h}} D''(p_0)dF(h) \\ & - \underbrace{[D(p_0) + (p_0 - c)D'(p_0)]}_{>0} \frac{1}{d} F'(\hat{h}) \\ & < 0 \end{aligned}$$

which shows that for a given $\hat{h}$ there can be only one p_0 satisfying (6). Hereby, $D(p_0) + (p_0 - c)D'(p_0) > 0$ follows from (6). It follows that $(p_1 - P_0(p_1))/d$ must be monotonic in p_1: if not, two different p_1 would exist that lead to the same $\hat{h}$ (and the same $P_0(p_1)$) in contradiction to the shown uniqueness. In fact, $(p_1 - P_0(p_1))/d$ is increasing since it takes value $(p_1 - P_0(p_1))/d = 0$ at $p_1 = c$.

Similarly, we differentiate (7) with respect to p_1, while keeping $\hat{h}$ constant to obtain

$$
\begin{aligned}
&2\int_{\hat{h}}^{1} D'(p_1-hd)dF(h)+(p_1-d-c)\int_{\hat{h}}^{1} D''(p_1-hd)dF(h)\\
&-\underbrace{[D(p_1-\hat{h}d)+(p_1-d-c)D'(p_1-\hat{h}d)]}_{>[D(\hat{p})+(p_0-c)D'(\hat{p})]>0}\frac{1}{d}F'(\hat{h})\\
&<0
\end{aligned}
$$

where $\hat{p}=p_0=p_1-\hat{h}d$. Therefore, for any given $\hat{h}$ there can be only one p_1 satisfying (7). In fact, $(P_1(p_0)-p_0)/d$ must be monotonic in p_0: if not, then two different p_0 would lead to the same $\hat{h}$ in contradiction to the proven uniqueness. Furthermore, $(P_1(p_0)-p_0)/d$ is decreasing in p_0 as it takes value $(P_1(p_0)-p_0)/d=1$ at $p_0=c$.

Now consider an intersection of the reaction functions $P_1(p_0)$ and $P_0(p_1)$, say in (p_0^D,p_1^D), leading to $\hat{h}^D$. From above, we know that $P_1(p_0)-p_0$ is strictly decreasing in p_0 while $p_1-P_0(p_1)$ strictly increases in p_1. As a consequence the reaction functions are separated by the iso-$\hat{h}$-line through (p_0^D,p_1^D) such that no other intersection can exist. □

Proof of Proposition 4:

Follows immediately from Proposition 3□

Proof of Proposition 5: We show that $\Pi_0(0,d)>\Pi_1(0,d)$, i.e. the firm who links with public good provision to a larger extent generates less profits.

Using the first-order conditions (6) and (7), we know that

$$
\begin{aligned}
&\Pi_0(0,d)-\Pi_1(0,d)\\
&=-(p_0-c)^2\int_{0}^{\hat{h}} D'(p_0)dF(h)+(p_1-d-c)^2\int_{\hat{h}}^{1} D'(p_1-hd)dF(h)\\
&\quad+\frac{1}{d}\underbrace{[(p_0-c)^2D(\hat{p})-(p_1-d-c)^2D(\hat{p})]}_{>0}F'(\hat{h})\\
&>(p_0-c)^2[\int_{\hat{h}}^{1} D'(p_1-hd)dF(h)-\int_{0}^{\hat{h}} D'(p_0)dF(h)\\
&>(p_0-c)^2D'(\hat{p})F'(\hat{h})[1-2F(\hat{h})]
\end{aligned}
$$

where in the last line we used the assumption $D''<0$. We therefore have to show that

$F(\hat{h}) \geq 0.5$. For this we again use the first order conditions to obtain

$$
\begin{aligned}
&[D(p_0-) + (p_0 - c)D'(p_0)]F(\hat{h}) \\
&= \int_0^{\hat{h}} D(p_0)dF(h) + (p_0 - c)\int_0^{\hat{h}} D'(p_0)dF(h) \\
&= (p_0 - c)\frac{1}{d}D(\hat{p})F'(\hat{h}) \\
&> (p_1 - d - c)\frac{1}{d}D(\hat{p})F'(\hat{h}) \\
&= \int_{\hat{h}}^1 D(p_1 - hd)dF(h) + (p_1 - d - c)\int_{\hat{h}}^1 D'(p_1 - hd)dF(h) \\
&\geq \int_{\hat{h}}^1 D(p_1 - hd)dF(h) + (p_0 - c)\int_{\hat{h}}^1 D'(p_1 - hd)dF(h) \\
&\geq [D(p_1 - \hat{h}d) + (p_0 - c)D'(p_1 - \hat{h}d)][1 - F(\hat{h})] \\
&= [D(\hat{p}) + (p_0 - c)D'(\hat{p})][1 - F(\hat{h})]
\end{aligned}
$$

which with $[D(\hat{p}) + (p_0 - d_0 - c)D'(\hat{p})] > 0$ immediately implies $F(\hat{h}) \geq 0.5$ and therefore completes the proof. □

Proof of Proposition 6:

If we condition conditions (i), (ii), and (iii) hold, a separating outcome results as no incentives to deviate are possible. They are therefore sufficient.

To show that conditions (ii) and (iii) are necessary for the existence a separating equilibrium, assume that prices p_0 and p_1 form a separating equilibrium. If $p_i \neq P_i^*$, firms could deviate to optimize profits from their own consumers. If (ii) would not hold, firm 0 would have an incentive to deviate from its price to attract $\bar{h}$ type consumers. Similarly, (iii) is necessary to prevent firm 1 from deviating from its monopoly price in order to attract consumers of type $h = 0$. Furthermore, (ii) immediately implies $P_1^* - \bar{h}d < P_0^*$ and (iii) immediately implies $P_1^* > P_0^*$ such that condition (i) is also a necessary condition. □

Proof of Proposition 7: Suppose $D_0(p) = D_1(p) = D(p)$. Then, P_0^* and P_1^* are given by following two first order conditions:

$$D(P_0^*) + (P_0^* - c)D'(P_0^*) = 0 \tag{18}$$

$$D(P_1^* - \bar{h}d) + (P_1^* - c - d)D'(P_1^* - \bar{h}d) = 0 \qquad (19)$$

We rewrite 19 as follows

$$D(P_1^* - \bar{h}d) + (P_1^* - \bar{h}d - c)D'(P_1^* - \bar{h}d) - (1 - \bar{h})dD'(P_1^* - \bar{h}d) = 0. \qquad (20)$$

Replacing $P_1^* - hd$ by p_0 in 20, we obtain:

$$D(p_0) + (p_0 - c)D'(p_0) = (1 - \bar{h})dD'(p_0) < 0 \qquad (21)$$

and therefore $p_0 = P_1^* - \bar{h}d > P_0^*$. This contradicts the necessary condition (i) for the existence of an separating outcome. □

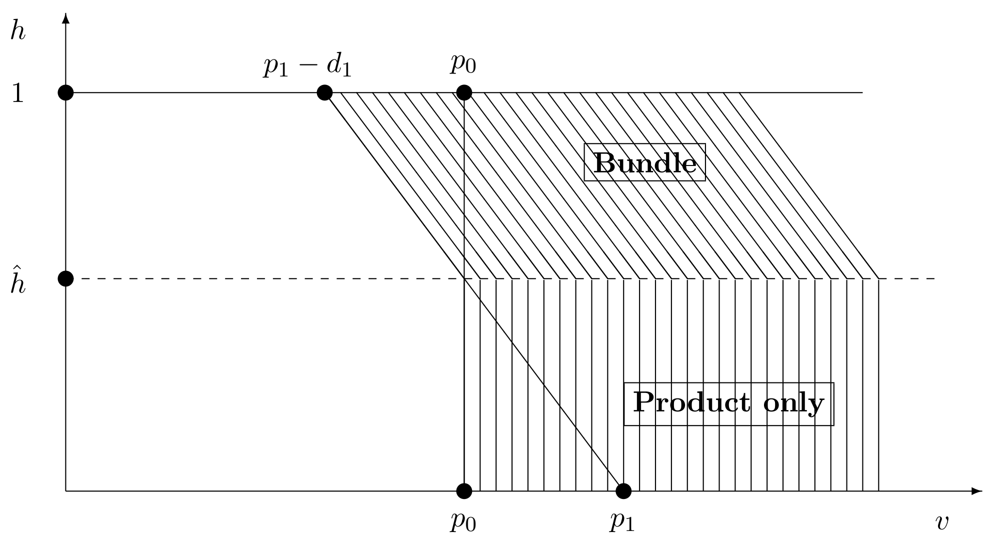

Figure 1: Consumption of one bundled and one unbundled variety, $(p_0, 0)$ and (p_1, d).