# ESSAYS ON THE PROVISION OF PUBLIC GOODS

A Dissertation

by

INKYUNG CHA

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2004

Major Subject: Economics

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# ABSTRACT

Essays on the Provision of Public Goods. (May 2004)

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In Chapter II, we present a model that allows us to study the effect of increased competition among charities for donations, and show that it will result in a lower provision of public goods. When charities get donations, they must pay two fundraising costs: a travel cost and an extra cost, a "premium" in our terminology. This premium arises from the extra time, effort, or incentives a charity must provide to garner a contribution from a donor who is solicited by other charities. Increased competition raises this premium, which leads to deadweight loss, so that revenue net of fundraising costs falls after a new firm enters into the market.

A problem with public goods markets is asymmetric information between charities and donors, such that donors do not know which charities will cheat. In Chapter III, we show that honest charities can get more donations than dishonest charities by investing in a capital stock. We study a two-period model under two assumptions, one where first-period investment does not affect the provision of public goods in the second period, and one where first-period investment does affect the provision of public goods in the second period. In the first case, we prove the existence of a separating equilibrium where honest charities make an investment and dishonest charities invest nothing. Thus, donors will donate more to charities that make investments, even if the investment is not used to produce public goods. In the second case, honest charities may invest the efficient amount, overinvest, or underinvest, depending on

the donors' beliefs.

In Chapter IV, we borrow parts of the models in the previous two chapters in order to see what effect the signaling cost has on the number of firms and average revenue. In our model, donor utility increases when they give to a charity that matches their ideology. We are interested in the long-run equilibrium, so unlike in Chapter II, we assume there is free entry in the market. The two important results are that the number of firms decreases and average revenue increases if the required signaling cost increases.

To my parents

## ACKNOWLEDGMENTS

While I was studying at Texas A&M, I met two important persons. One was my advisor, Dr. William Neilson, and the other one was my husband, Lance Bachmeier. Dr. Neilson introduced me to the world of economic theory. He helped me step-by-step as my mentor. Lance always supported me as a friend, colleague, and husband. Without these two people, I would not have finished my dissertation.

Dr. Hae-shin Hwang gave me comments and bits of wisdom that enabled me to solve many problems in my work. I appreciate his help very much. I wish to also acknowledge fellow students Pilsun Choi, Dokoan Kim, Jongho Kim, and Jill Stowe, who each helped me in different ways. Pastor Chong Kim and the Korean Mission Church supported me during my entire time in College Station. Many others also played a role, and I am eternally grateful to all of them.

Words cannot describe the gratitude I feel towards my parents, Byungkwon Cha and Youngae Choi, who gave me endless love and encouragement. My sister, Insoon Cha, was always willing to give me counsel whenever I had trouble during these years.

Finally, without God I would never have finished successfully. When I look at all of the obstacles I encountered, I am convinced that I would never have made it without His help. I love God not because I finished, but because of the deep friendship we built along the way.

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# CHAPTER I

## INTRODUCTION

This dissertation consists of three essays concerned with the provision of public goods in markets with imperfections. There is a well-developed theory of the provision of private goods, even in markets with various imperfections, such as monopolistic or oligopolistic market structure and asymmetric information (see for instance Varian (1992) and Mas-Colell, Whinston and Green (1995)). Unfortunately, this theory does not always apply to the provision of public goods, because public goods are nonexcludable and nonrivalrous.

The textbook theory of public goods begins with the observation that the nonexcludability property leads to a free rider problem and causes an underprovision of privately produced public goods. This led some authors to consider the possibility that the government could redistribute income to get an efficient outcome if the government knows individual preferences perfectly. Lindahl (1919) showed that if there exists a price which each person is willing to pay for public goods, efficiency can be achieved. Samuelson (1954, 1955) derives the efficiency condition for public goods, which is the summation of all individuals' marginal utilities equaling the marginal cost of provision of public goods. The problem is that individuals' preferences for public goods are not revealed truthfully; because of non-excludability, rational individuals will have an incentive to hide their true preferences. Several studies have dealt with this revelation problem. Clarke (1971), Groves (1973), and Groves and Ledyard (1977) design complicated mechanisms to induce truth-telling about preferences for public goods by individuals. They designed a two-part tax, which is similar

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This dissertation follows the style of the *American Economic Review.*

to Vickery (1961)'s auction theory, in that truth-telling is a dominant strategy for individuals. Bergstrom, Blume and Varian (1986) set up a non-cooperative provision of public goods model where each agent gives the optimal amount of contribution independent of the actions of others. Recently, Varian (1994) showed that when individuals contribute sequentially, that is, when they accept commitment, the provision of public goods is less than with simultaneous contributions.

In each of the models in this dissertation, we consider the behavior of non-profit firms which produce public goods, such as medical research, a community theater, soup kitchen and shelter, and so on. A key characteristic of non-profit firms is that they cannot distribute their revenue as profit, or more formally, they face a non-distribution constraint (Hansmann (1980)). They maximize the total of the public good that is provided instead of maximizing profit. So, the analysis of non-profit firms in various market structures and with information problems is different from that of the for-profit market. This differs from some authors (e.g., Burns and Walsh (1981)), where charities take advantage of market power in order to maximize profit. Charities exist in our models because some members of society get utility from public goods, either based on their own consumption or consumption by other people. It is optimal for a small number of people to specialize in the production of public goods. Those individuals that run charities then engage in fundraising activities to inform potential donors about their activities.

In Chapter II, we analyze the effect of competition between charities using Salop (1979)'s circle model. Potential donors solve a two-part problem. First, they choose whether to donate to any charity at all, and if so, then they have to choose which charity to donate to. This leads to two costs, a travel cost and a "premium" cost. The travel cost is a function of the difference of ideology between donors and charities, or alternatively can be interpreted literally as a geographical distance between the donors and the charity. The greater the distance between the charity and donor, the harder the charity will have to work to convince the donors that they provide good services. The premium cost is similar to a fundraising cost, and comes from the extra time, effort, or gifts due to increased competition. We assume that the donation is fixed, so increased competition will cause new charities to steal donations from the other charities. The main proposition is that increased competition will result in less provision of public goods. When charities get donations, they must pay a travel cost and a premium. Increased competition raises the premium, and causes deadweight loss, so that net revenue falls after a new firm enters into the market.

In related work, Bilodeau and Slivinski (1997) show that small charities produce more of the public good than large charities, because they will spend the money the way donors like without cheating. Large charities produce many goods, and they may therefore produce goods other than what the donor wanted. So then a single diversified charity will produce less public goods than two rival specialized firms. However, Bilodeau (1992) used a different approach to show that a single diversified charity like the United Way produces more public goods due to lower fundraising costs, when there is no asymmetric information problem. Probably the closest paper to chapter II is Rose-Ackerman (1982), which studies excess fundraising by nonprofit firms. In her paper, when a new nonprofit firm enters the market, whether the equilibrium fundraising share increases or decreases depends on the elasticity of giving. The elasticity of giving in her model is the elasticity of average expected gifts with respect to the solicited population.

In Chapter III, we consider an environment where donors do not know which charities are honest, that is, charities which will do what they claim with donations. Hence, we need to design a mechanism that encourages charities to tell the truth. In our model, the honest charity is concerned with the provision of public goods, whereas the bad type charity wants to misuse donations for their own perks, which are a luxury office, car, or expensive foreign vacations. A third institution or government can audit these charities at the end of each period, and the result is publicized. Donors using this information will not give donations to bad type charities. Hence, honest charities have a higher probability of continuing the game than the bad type charities in this environment. Honest charities are therefore willing to invest in capital as a signal to distinguish themselves from bad type charities. This is the same concept as Spence (1979)'s education signaling model, in which some workers choose to get an education, even though doing so does not affect the worker's productivity. We set up a two period model and look at two cases, one in which investment affects the provision of public goods, and one in which investment does not have value in the production of public goods. Donors' beliefs are important. Beliefs influence donors' gifts, so the two types of charities will consider future donations when they choose the level of investment. We prove that a separating equilibrium exists where the honest charity makes a capital investment and bad type charities invest zero. In the second case, we show that the optimal investment from high type charities depends on the donors' beliefs. The honest charity wants to distinguish itself from bad type charities. Hence, it sends a signal to donors because the charity wants to reveal that it will not cheat when given a donor's contribution.

Except for Vesterlund (2003) and Bilodeau and Slivinski (1997), the economics literature has not dealt with the quality of charities. In Spence's (1973) paper, education plays a role as a signal. The signal can reveal the high productivity worker, even if it does not influence the worker's productivity. So there is the possibility of overinvestment in education causing inefficiency. Spence (2002) explains how when the signal influences productivity, it is possible to achieve efficient investment. He emphasizes that the employer's belief will determine the wage of workers. Similarly, in our model, the donation depends on the donor's belief. So charities will make a decision to invest depending on the donor's belief. It is *possible* in Chapter III to get an efficient outcome, but there is no reason to expect that an efficient outcome will occur.

Some papers have considered asymmetric information among donors. Varian (1994) studies a sequential donation game, where donors take turns donating, and shows that there will be fewer private contributions than with a simultaneous game (i.e., the free rider problem is worse in a sequential game), as long as the first player contributes only one time. Other authors have discussed the case where charities publicize donations. This gives donors prestige (Harbaugh (1998)) or signals the donor's wealth (Glazer and Konrad (1996)). Bac and Bag (2003) adapt the model of Andreoni (1998) to find the conditions under which a charity will choose to make announcements about donations. Romano and Yildirim (2001) demonstrate that there will be more public goods produced in an announcement game than in the simultaneous game. They compare the traditional case - where donors are concerned about the total public good - to the warm glow case - where the donors care about their own donation. In a paper focused on the quality of charities, similar to Chapter III, Vesterlund (2003) emphasizes the fundraiser's role in the process of screening for high quality charities. The announcement of a donation by one individual is a signal of quality to other potential donors, and thus reveals the quality of the charity.

In chapter IV, we show that when charities invest in capital as a signal to reveal that they are honest, this signaling cost affects the number of firms, that is, the diversity of public goods. Many charities produce different public goods and each firm has no market power, so that they cannot influence the behavior other firms. Each firm chooses their giving price by choosing fundraising costs. Because there is free entry, in equilibrium there will be zero net benefit from entry. We show that if the signaling cost increases, it will cause a decrease in diversity.

Charities compete for donations like for-profit firms compete for sales. Competition does not always lead to higher social welfare. In the case of for-profit firms, Mankiw and Whinston (1986) show that free entry causes there to be an inefficient number of firms. Mankiw and Whinston (1986) explain that when a new firm enters into the market, the existing firms reduce their quantity sold, which they refer to as a business stealing effect. Dixit and Stiglitz (1977) point out the inefficiency of free entry when perfect price discrimination does not exist. In Spence (1976b), the inefficiency of equilibrium results from not catching revenue completely by selling differentiated goods. When we allow for large fixed costs, as with increasing returns to scale in production, the number of firms is not optimal. Lancaster (1975) and Spence (1976a) show that fixed costs cause there to be less product diversity. The results from Chapter IV show that fixed costs have a similar impact in not-for-profit markets.

# CHAPTER II

# IS COMPETITION AMONG CHARITIES BAD?

## A. Introduction

This paper analyzes the effects of increased competition among charities for donations, and the dead weight loss which results. As motivation for our interest in this topic, consider the following recent headline:

> The AIDS Walk In Washington, D.C., usually attracts close to 25,000 people and raises up to $1 million for AIDS services in the city. This year, just 5,000 people showed up for the walk and only raised about $400,000.[1]

After the September 11 attacks, many new charities began providing public services, and this has led them to compete with existing charities for donations. The concern of this paper is on the effects this additional competition has on the fundraising, and what will be the impact on the total provision of public good.

The papers closest to the present are Rose-Ackerman (1980, 1982). Rose-Ackerman (1980) presented empirical evidence that "United Fund", which in some ways monopolize fundraising markets, operating inefficiently. Rose-Ackerman (1982) showed that competition for donations can cause "excessive" fundraising in the sense that, with unlimited entry, the cost of the marginal donation exactly equals the amount of that donation. In her model, charities solicited donations by sending a brochure, which has a fixed cost. Competition reduces the expected number and size of the positive responses to the brochures, and therefore on the amount of funds raised by a given

[1] Rose Palazzo, abcnews.com, October 29, 2001, "Feeling the Pinch - Nonprofits Reeling Since Sept. 11".

charity. Our paper takes a different approach. Whereas in Rose-Ackerman's work the cost of soliciting a donation from a single individual is fixed and the yield is variable, in our model the yield is fixed but the cost of raising the funds is variable. This approach reflects the fact that when more charities attempt to raise funds from the same pool of donors, the charities must work harder to get a given individual's donation.

We employ a spatial model with a fixed pool of donors, each of whom has the same indivisible amount to contribute. To garner a contribution, the fundraiser must visit the potential donor, resulting in a travel cost. If another charity is soliciting funds from the same donor, the fundraiser must pay a "premium" to the donor to garner the contribution. This premium could take the form of a physical good, like a coffee mug or a T-shirt, but is best thought of as the fundraiser spending more time and effort with the donor. The donor makes the contribution to the charity that pays the higher premium for the donation. Both travel costs and the fundraising premia paid to donors come out of the funds raised by the charity.

Competition in this setting has two effects. First, it reduces travel costs because any entering charity will be located closer to some donors than incumbent charities were. Second, competition increases fundraising costs by increasing the premium. Since funds raised also pay the travel and fundraising costs, it is possible that increased competition results in a reduced net amount of funds. Our results show that the fundraising costs rise by more than the travel costs fall, so that increased competition actually reduces the net amount of funds available for charitable works.

This result can be thought of as a crowding out effect. Several authors have studied the crowding out effect on donations following government grants. Warr (1983) presented a model in which if the government gives a grant to individuals in an effort to redistribute income, it is neutralized by a change in contributions to charitable goods. Robert (1984) also showed a dollar-for-dollar crowding out effect in his model. Bergstrom, Blume, and Varian (1984) have shown that in Nash equilibrium, a small redistribution of wealth will not change the equilibrium allocation of charitable goods under certain conditions. All of these authors present neutrality theorems. Andreoni (1998) showed that when giving is based on impure altruism, the crowing out effect is incomplete. Straub (2000) estimated the crowding out effect for noncommercial radio stations and his results showed that there is zero crowding out.

In our model, we study a different crowding out effect, that is, with no change in government grants, we analyze the effect of an increase in the number of firms on funds raised by existing firms. The theoretical results show that there exists a super-crowding out effect. New charities "steal" donations from existing ones, so that the total amount of funds raised stays the same. However, increased competition pushes up the cost of raising funds, resulting in a decrease in the total amount of funds available for charitable services across charities.

In Section 2, we describe the model. Section 3 shows the main result, and section 4 provides the conclusion. This paper is the first to analyze competition in the fundraising market, so we recognize at the outset that additional work is needed.

## B. Model

Firms are non-profit charities that raise funds in order to provide services. Funds raised are used for two purposes. If the firm raises an amount $F_i$, it must expend an amount $C_i$ to do so. The remaining funds, termed available funds and denoted by $\phi_i$ $= F_i - C_i$ can be used to provide services. There is a production function, $U(\phi_i)$ which governs the transformation of available funds into charitable services, and is assumed to be strictly increasing. The charity's objective is to maximize services produced, which, since the production function is strictly increasing, implies that it maximizes available funds.

Firms and donors are located on a circle of unit circumference. Donors are distributed continuously and uniformly around the circle. Each donor has a fixed amount $f$ to donate to charity. Donors will not give to a charity unless a representative of the charity visits them to ask for the money, though, and so the charity must pay a travel cost for the donation. If a donor is visited by only one charity, he gives the entire amount $f$ to that charity. Suppose that the charity is located at point $a$ and that the donor is located at point $x$. Then the charity must pay a travel cost of $|x-a|$ to solicit the donation of $f$. Obviously, the charity will only solicit donations from people who are located sufficiently near the charity; that is, a charity located at point a never solicits donations from an individual whose location $x$ satisfies $|x-a|>f$, because then the travel cost is more than the solicited donation and the net benefit to the charity is negative. Accordingly, charity $i$ located at point $a_i$ has a set of *feasible donors* who are located at points in the set $D_i = \{x : |x-a_i| \leq f\}$. Each set of feasible donors has length $2f$.

If two adjacent firms are located farther than $2f$ apart, they do not compete with each other for donors because their feasible donor sets do not intersect. If, however, the two sets do intersect, the charities must compete for donors. Charities can expend effort in addition to travel costs in an attempt to get donations. If charity $i$ expends effort $e_i$ on a donor, and charity $j$ expends effort $e_j$ on the same donor, the donor gives $f$ to charity $i$ if $e_i > e_j$, he gives $f$ to charity $j$ if $e_j > e_i$. If $e_i = e_j$, the donor gives $f$ to the closer of the two charities, and if $e_i = e_j$ and the donor is equidistant from both $i$ and $j$, he gives to neither.[2]

Now suppose that a donor located at point $x$ is in the feasible donor sets of two charities, located at $a_1$ and $a_2$, but that charity 1 is closer than charity $2 : |x - a_1| < |x - a_2|$. As stated above, the donor gives $f$ to charity 1 if $e_1 \geq e_2$ and gives $f$ to charity 2 if $e_2 > e_1$. In equilibrium, it must be the case that at the level of effort expended by the close firm, charity 1, it is unprofitable for charity 2 to secure the donation. In other words, $e_1 = f - |x - a_2|$, so that if a firm is the closest charity to a donor, it exerts an amount of effort equal to the donation less the distance of the donor from the second-closest charity. The net benefit to charity 1 from the donor located at $x$, then, is $f - |x - a_1| - (f - |x - a_2|) = |x - a_1| - |x - a_2|$, which is the difference between the distances between the donor and the two charities.

It is now possible to describe the equilibrium behavior of donors and charities. Suppose that there are $n$ charities located sequentially at $a_1, ..., a_n$ around the circle, with $a_i$ between $a_{i-1}$and $a_{i+1}$ for $i = 2, ..., n-1$, and $a_n$ between $a_{n-1}$and $a_1$. The feasible donor sets are $D_1, ..., D_n$, respectively. Consider a donor located at point $x$. Then there exists $i \in \{1, ..., n\}$ such that $a_i \leq x \leq a_{i+1}$. Donor $x$ gives $f$ to firm $i$ if $|x - a_i| < |x - a_{i+1}|$ and gives $f$ to firm $i+1$ if $|x - a_i| > |x - a_{i+1}|$. Charity $i$ receives donations from donors in the interval $(a_i - min\{f, (a_i - a_{i-1})/2\},\ a_i + min\{f, (a_{i+1} - a_i)/2\})$, using the conventions that $a_{n+1} = a_1$ and $a_{1-1} = a_n$.

[2]This last assumption does not matter, because we are not interested in total contribution, and donors equidistant from two charities represent a set of measure zero.

C. Increased competition

Suppose that $n$ charities are located sequentially around the circle, as above. Let us restrict attention to two charities, 1 and 2, located at $a_1 < a_2$. Assume, for the purposes of this exercise, that for any donor in $[a_1, a_2]$, the two closest charities are charities 1 and 2; that is, for any $x \in [a_1, a_2]$, $|x - a_2| < |x - a_n|$ and $|x - a_1| < |x - a_3|$. This assumption implies that the competition for funds from donor $x \in [a_1, a_2]$ is between charities 1 and 2, and that the premium is based on their relative distances. Further assume that $|a_2 - a_1| < f$, so that every donor in $[a_1, a_2]$ is subject to competition for funds. Other cases are possible, and we say more about these later.

Now suppose that a new charity enters at $a_0$ between $a_1$ and $a_2$. This new charity competes for funds with its two closest competitors. Figure 1 shows how the charities allocate the donors in the new equilibrium. The segment in contention is $[a_1, a_2]$. Charity 1 keeps donors in the interval $\left[a_1, \frac{a_1 + a_0}{2}\right)$, charity 2 keeps donors in $\left(\frac{a_0 + a_2}{2}, a_2\right]$, and charity 0 receives donations from donors in $\left(\frac{a_1 + a_0}{2}, \frac{a_0 + a_2}{2}\right)$. Since donors in this last interval are served by a closer charity than before, travel costs for these donations fall. However, since the second-closest charity is closer for all donors in the interval $[a_1, a_2]$, fundraising premia rise for all donors.

More detail on the change in fundraising costs is provided by Figure 2. The top, solid curve represents the fundraising premia after the new charity enters at $a_0$. These costs peak at the midpoints between the charities. The dashed curve that is second from the top represents the fundraising premia before the new charity enters. Since there is less competition before entry, the premia are lower. The area between these two lines is the additional fundraising cost due to the increasing premia. The dashed curve at the bottom of the figure represents travel costs before entry. These costs are zero at the locations of the existing charities and peak at the point midway between

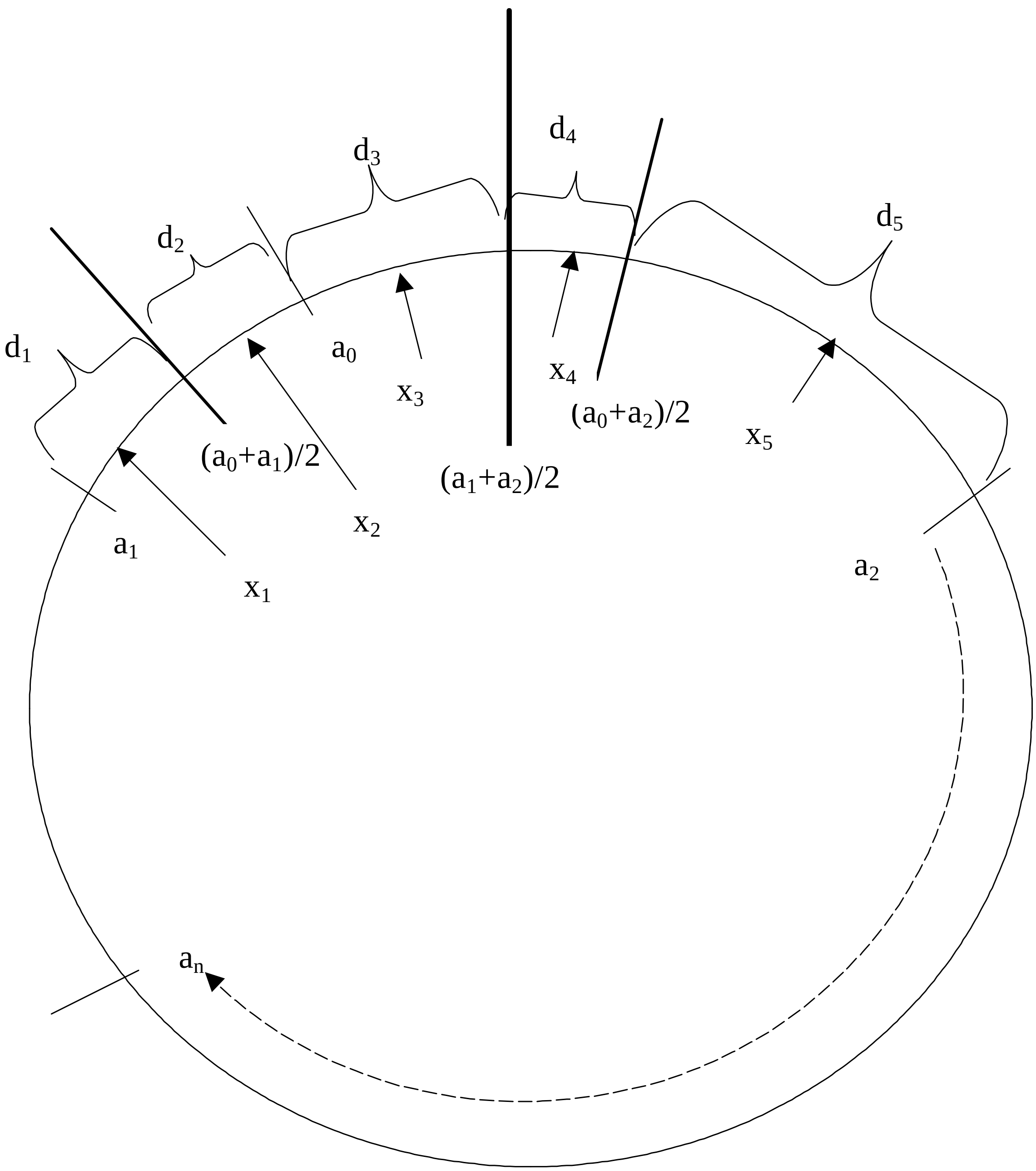


Fig. 1. Entry of a New Charity

them. Finally, the bottom, solid curve represents the travel costs after entry. The area between the two bottom curves represents the savings in travel costs caused by entry. Note that all of the line segments in the figure have slopes of magnitude one, either positive or negative.

As is apparent from Figure 2, in region $d_1$, between $a_1$ and $(a_0+a_1)/2$, entry leads to an increase in fundraising costs. Donors in this region do not change who they donate to, so there is no change in travel cost, but they require a larger premium to attract their donations. In region $d_2$, between $(a_0+a_1)/2$ and $a_0$, there is an increase in the required premium but a decrease in travel cost. However, the area $A$ shown in the figure exactly offsets the area $A'$, and so there is a net increase in fundraising costs in this region. In region $d_3$, between $a_0$ and $(a_1+a_2)/2$, there is again an increase in premium costs but a decrease in travel costs. The region $B$ is exactly offset by the region $B'$, though, leaving a net reduction in costs for this region. In region $d_4$, between $(a_1+a_2)/2$ and $(a_0+a_2)/2$, the increase in the premia (area $C$) and the decrease in travel costs (area $C'$), exactly offset each other, and entry has no net effect on fundraising costs for this region. Finally, in region $d_5$, between $(a_0+a_2)/2$ and $a_2$, the donors do not change who they donate to, so the only change is an increase in the premia required to obtain these donations.

As the figure shows, entry leads to two (shaded) regions where fundraising costs increase and one where the costs decrease. As our main result shows, the cost increases outweigh the cost reductions, so that entry leads to a net increase in fundraising costs. Since every donor on the interval $[a_1, a_2]$ was already contributing before entry, entry does not increase the total amount contributed, but increases the amount spent on fundraising, and therefore the amount of funds available for charitable services decreases as a result of entry.

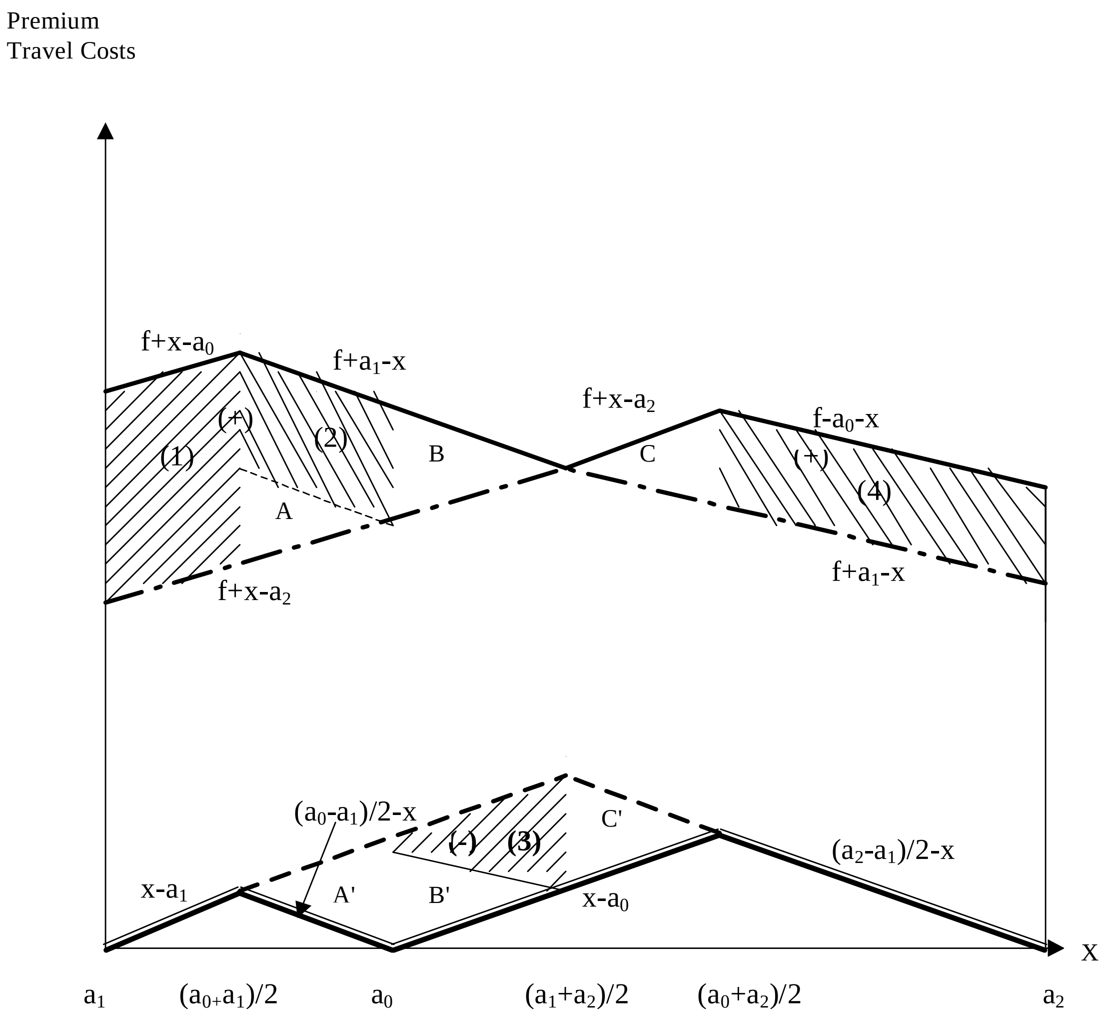


Fig. 2. Change in Costs After Entry

**Proposition 1** *Suppose that* $|a_{i+1} - a_i| < f$ *and* $|a_{i+1} - a_i| < min\{|a_i + 2 - a_i + 1|, |a_i - a_{i-1}|\}$*. If a new charity enters at point* $a_0 \in (a_i, a_{i+1})$*, the net funds raised from donors in* $[a_i, a_{i+1}]$ *decreases.*

Proof. For notational ease, let $i = 1$, and assume without loss of generality that $a_0 < (a_1 + a_2)/2$. Divide $[a_1, a_2]$ into five segments, as shown in Figure 1, with the segments denoted $d_1, ..., d_5$. The calculations of the change in total costs corresponding to each segment, while straightforward, are somewhat messy, and therefore are included in Appendix A.

Integrating and canceling out several of the terms yields $\Delta = (a_0 - a_1)^2 + (a_1 + a_2 - 2a_0)\left(\frac{1}{2}a_0 - \frac{3}{4}a_1 + \frac{1}{4}a_2\right)$, where $\Delta$ denotes the total fundraising cost after entry minus the total fundraising cost before entry. The first term is obviously positive, and the term $a_1 + a_2 - 2a_0$ is positive by the assumption that $a_0 < (a_1 + a_2)/2$. Finally, note that

$$\frac{1}{4}\left[2a_0 - 3a_1 + a_2\right] = \frac{1}{4}\left[2\left(a_0 - a_1\right) + \left(a_2 - a_1\right)\right] > 0,$$

since $a_1 < a_0 < a_2$. Consequently, $\Delta > 0$. There is no increase in the total (gross) amount of funds raised, so net funds available from donors in $[a_1, a_2]$ decreases by $\Delta$.

Our result shows that when there are already enough charities so that all donors are already solicited by at least two charities (the market is saturated), the addition of new charities increases the costs of fundraising for existing charities by more than enough to offset the savings in travel costs, and therefore entry reduces the amount of funds available for charitable works. If the market is not yet saturated, so that there are some donors who are not yet solicited or are only solicited by one charity, this result may not hold. Still, though, if entry eventually leads to saturation, further entry leads to a decrease in charitable services.

## D. Conclusion

We have demonstrated that increased competition among nonprofit firms can lead to less provision of the public good, resulting in social inefficiency. Specifically, we defined an additional cost resulting from competition between nonprofit firms. This cost comes in the form of a gift, such as a T-shirt, book or mug, given to donors, or in the form of increased time and effort spent by the fundraising staff. Using a location model, we calculated the total cost (travel cost and the extra cost which comes from competition) before a new firm enters into the market, and after it enters. Our main result shows that when there are sufficiently many charities already in the market, total cost increases after the entrant enters into the market, so that the provision of public goods decreases when there is a fixed amount of total funds.

Many authors have studied the crowding out effect when government gives a subsidy to charities or a tax break to donors. Little research has studied the crowding out effect caused by competition between charities. In practice, nonprofit firms expend large amounts of time and effort raising funds, and even expend large amounts of time and effort on specific individuals. If there were no competition, firms would not need to make these expenditures, and therefore these expenditures can be considered a dead weight loss. Also, because this cost depends on the location of the second closest firm, it is independent of the firm's own location.

Economists are interested in the objective function of nonprofit firms, whether it is net revenue maximization or total revenue maximization. A few empirical studies show that some industries maximize net revenue; the other industries maximize total revenue. Khanna, Posnett and Sandler (1995) analyzed fundraising effects on donations. They found that the health and overseas sectors maximize net revenue, and the social welfare sector does not, using panel data for the U.K. Okten and Weisbrod (2000) demonstrated that fundraising has both a positive and a negative effect on donations. The positive effect is similar to an advertising effect with for profit firms. The negative effect on donations emanates from the increased price of giving.[3] They found that charities do not maximize net benefit from fundraising, using IRS data, because they either under-fundraise or over-fundraise. In our paper, competition among charities leads to excessive fundraising expenses.

[3] In Okten and Weisbrod (2000), PRICE equals $1/(1-F-A)$, $F$ is the share of fundraising expenditures in donations and $A$ is the share of administrative expenditures in the donation. Employing the same method, Rose-Ackerman (1986) defined the price of giving as $c_t/(1-w_{t-1})$, where $c_t$ is marginal cost and $w_{t-1}$ is the fundraising share in the previous period.

# CHAPTER III

# INVESTMENT AS A SIGNALING DEVICE FOR CHARITIES

## A. Introduction

All else equal, donors prefer to give their donations to honest charities that will use the funds for charitable works rather than frivolous expenditures. Unfortunately, donors do not know how charities will use their donations, and determining a charity's intentions can be expensive or even impossible. If donors have a complete history of all previous actions taken by the management of a charity, they may be able to infer the management's preferences. Of course, such extensive information is seldom available. It would be useful if there were a signal available that revealed the charity's preferences. The donors need a system that reveals which charities will use their donations for the intended purpose. We argue that a charity's investment can serve as that signal.

There is a large literature on signaling as a way to deal with information problems (see Spence (2002)). The seminal paper by Spence (1973) showed that investment in education plays a role as a signal that high productivity workers can use to distinguish themselves from low productivity workers. A very interesting feature of that model is that high productivity workers will get an education, and firms will pay workers more if they have an education, even though education has no effect on productivity. Efficiency of the education investment has also been analyzed when education affects productivity.[1] Spence (1974) proved the existence of an efficient competitive

[1]Spence (1976c) defines "efficient" to mean maximized output net of signaling cost.

equilibrium when individual productivity is monotonically increasing with education. Spence (2002) shows that there exists a fully efficient separating equilibrium as long as the high productivity worker's education level (in the case where education influences productivity) is larger than the level of education when the low productivity worker mimics to get the same wage as the high-type worker. The feature common to all of these papers is that the informed person sends a signal to the uninformed person in order to get a higher payoff. The signaling model is the basis for this paper, as we analyze the problem of imperfect information between charities and donors.

Information problems are very important for the provision of public goods, and this paper is not the first to have considered the importance of asymmetric information in this context. Several papers have discussed strategies for charities to get more donations in the presence of asymmetric information. Vesterlund (2003) showed that under imperfect information about the quality of public goods, when the fundraiser announces contributions, it can reveal the charity's type and avoid the free rider problem. The initial donor learns information about the quality of the charity, and the fundraiser make this information common knowledge and announces the first contribution. This announcement generates more donations compared with no announcement. Romano and Yildirim (2001) showed that the announcement strategy has an effect on donations as long as the followers increase their utility based on their own contribution (the warm glow model). Bac and Bag (2003) show that the fundraiser's decision to reveal the number of donors depends on the public goods production function. To provide the public good, it requires a minimum quality threshold, such as a large building for a homeless shelter or equipment for a broadcasting group. Such threshold investment is made by large contributors. Andreoni (1998) shows that "leadership giving" generates additional donations and eliminates corner solutions. He also shows that such "leadership giving" can signal to donors that the charity is high quality, because the "leader" can guess the real quality of the charity by directly interviewing the managers or hiring somebody to evaluate the charity (Andreoni (2003)).

In our model, the investment capital, whether it relates to productivity or not, plays a role as a signal of whether the charity is good or bad. Good charities produce public goods using the donation, while bad charities use the donation for perks such as a luxury car, foreign vacation, nice office, etc. We show that the high-type has a larger discount factor than the low type. The low-type has a possibility of being audited after it cheats, and this will be revealed to donors. By these mechanisms, we find a separating equilibrium in which high-types invest to signal their quality, and low-type charities choose zero investment. But in this equilibrium, we cannot find efficient investment, which is maximum public goods net of signaling costs. When the investment has an effect on the provision of public goods, we do find efficient investment. But there still exists overinvestment for high-type charities in some cases. The reason is that the donor's belief requires too much initial investment, and high-type charities choose an investment that is greater than its optimal investment.

This paper is organized as follows. In section 2, we set up the basic model and explain why the discount factor depends on the charity's preferences. In section 3, we study signaling when investment is just an expense, adding nothing to the provision of public goods. In section 4, we show how things change when signaling has an effect on productivity, and how the firm's decision of how much to invest as a signal is different. In the last section is the conclusion.

## B. Model

Charities exist for the purpose of providing public goods for society, and donors give their donation to charities in order to maximize their utility. If a charity conforms to this goal without cheating, the provision of the public good may be efficient under perfect information. If donors know that the charity will misuse a portion of their donation, then they will not give anything to that charity. Unfortunately, donors do not know whether charities will provide the public good or do other things with the money. Honest charities want to reveal their intentions to donors in order to get more donations, but the dishonest charities have an incentive to mimic the honest charities. Therefore, the honest charities need a mechanism to distinguish themselves from dishonest ones.

We begin by analyzing a simple two-period model. The utility of charity $i$ depends on the provision of the public good in the first period, $G_1^i$, the amount of public good provided in the second period, $Z_2^i$, and perks, $P_t^i$ for $i = H, L$. The utility function for type $H$ charities is

$$U_H = G_1^H + \beta^H Z_2^H, \tag{3.1}$$

and for type $L$ charities is

$$U_L = P_1^L + \beta^L P_2^L. \tag{3.2}$$

The high-type charity is only concerned with providing the public good, whereas the low-type charity prefers to misuse the donations for their own perks.

Each charity can be audited by a third institution or government with positive probability after the first period. After the audit, if the charity is found to have misused any donations, this is revealed to the public, and donors will not give any more donations to that charity. For type $i$ the continuation probability (which can also be thought of as a discount factor) is $\beta^i = 1 - \gamma^i$, where $\gamma^i$ is the probability that charity $i$ is caught cheating. For high-type charities, the discount factor, $\beta^H = 1/(1+r)$, where $r$ is the interest rate, equals one, because they never cheat their donors, meaning $\gamma^H = 0$. When the low-type charity spends some donations on perks, that fact is observed by an audit with probability $\gamma^L > 0$, and therefore the low-type charity's discount factor is $\beta^L = \gamma^L/(1+r) < \beta^H$. Hence, the high-type and low-type charities have different probabilities of remaining in the market if the low-type charity spends any of its contributions on perks.

In the first period, each charity gets a donation, $D_1$, that is distributed among the provision of the public good, $G_1^i$, perks, $P_1^i$, and investment, $I_1^i$. After donors observe the charity's investment choice, they make a donation. In the second period, the donation, if any, is used for the provision of the public good, $G_s^i$, and perks, $P_2^i$. Investment is not necessary in the second period, because the game ends after the second period is over.

Donors give donations if they believe the charity is high-type, and the charities will invest if they expect to get sufficiently large donations. We specify the donor's beliefs about the charity, because their beliefs determine their giving. Donors have beliefs such that if charity $i$'s first period capital investment, $I_1^i$, is bigger than a threshold $\overline{I}$, donors believe with probability one that the charity is high-type. Formally:

$$\Pr(type = H | \ I_1^i \geq \overline{I}) = 1$$

and

$$\Pr(type = H | \ I_1^i < \overline{I}) = 0.$$

This belief affects the donor's gift. If $I_1^i \geq \overline{I}$ the donor contributes $D_2^H$ to the charity, and if $I_1^i < \overline{I}$ the donor contributes $D_2^L < D_2^H$. The two types of charities consider future donations when they decide the level of investment to signal. If the low-type charity wants to get donations in the second period, it will have to make the same investment as the high types. But if the charity with a low continuation probability wants to get donations, it will have to pay a higher opportunity cost of investment than the high-type charity, which is the sacrifice of perks.

The charity's budget constraints are as follows. In the first period the donation is the same for all charities and the budget constraint is

$$G_1^i + I_1^i + P_1^i = D_1.$$

The donation can be spent on some combination of the public good, perks, and investment. In the second period investment is no longer an option, and donations depend on first-period investment. Let the function $D_2(I_1)$ denote the second-period donation when the first-period investment is $I_1$. It is given by

$$D_2(I_1) = \begin{cases} D_2^H & \quad I_1 \geq \overline{I} \\ & \text{if} \\ D_2^L & \quad I_1 < \overline{I} \end{cases}$$

In addition, the capital accumulated through first period investment may or may not be productive. More explicitly, the first-period investment may allow the charity to produce more of the public good with the same amount of donation. If the charity devotes $G_2^i$ to the public good, output of the public good is

$$Z_2 = G_2 \cdot (1 + f(I_1)),$$

where $f(I) \geq 0$ for all $I \geq 0$. If $f(I) = 0$ for all $I \geq 0$ the investment is said to be unproductive, and if $f(I) > 0$ for all $I > 0$ the investment is said to be productive. We refer to $f(\cdot)$ as the public good technology function. The second-period budget constraint is

$$G_2^i + P_2^i = D_2(I_1).$$

C. Equilibrium without productivity of capital

The previous section described the game that is played between honest charities, dishonest charities, and donors. This section studies the game when investment in the first period has no effect on second period public goods production. The donors' beliefs affect their gifts, and the two types of charities consider future donations when they decide the level of investment to signal. Because donors do not know a charity's type, the high-type charity must reveal its type through investment, so we need an incentive for charities to tell the truth. The two types require different conditions for truth-telling. Since the high-type gets no utility from either perks or investment, it spends nothing on perks and spends either $I_1 = \overline{I}$ or $I_1 = 0$ on investment. Consequently, its utility is either $D_1 - \overline{I} + \beta^H D_2^H$ in the case that it invests $\overline{I}$ or $D_1 + \beta^H D_2^L$ if it invests nothing. It chooses investment $I_1 = \overline{I}$ if the following condition is satisfied:

$$D_1 - \overline{I} + \beta^H D_2^H \geq D_1 + \beta^H D_2^L$$

which reduces to the condition $\overline{I} \leq \beta^H (D_2^H - D_2^L)$.

The low-type charity has three choices. It can choose not to invest, in which case it spends its entire first-period donation on perks since the public good generates no utility. If it survives to the second period it receives the low donation $D_2^L$ and spends it all on perks. Its discounted utility from investing nothing is $D_1 + \beta^L D_2^L$. Its second option is invest $\overline{I}$ so that it can receive the high donation in the second period. Its discounted utility is then $D_1 - \overline{I} + \beta^L D_2^H$. Finally, it can choose to behave honestly, in which case it has no chance of being caught and shut down, so that its discount factor is $\beta^H$ instead of $\beta^L$. To behave honestly it invests $\overline{I}$ so that it gets the high donation in the second period and it spends the remaining $D_1 - \overline{I}$ on the public good. Its discounted utility is $\beta^H D_2^H$.

If

$$D_1 + \beta^L D_2^L \geq \beta^H D_2^H$$

the low-type charity is better off investing nothing than behaving honestly to eliminate the possibility of being caught cheating. If

$$D_1 + \beta^L D_2^L \geq D_1 - \overline{I} + \beta^L D_2^H$$

the low-type charity is better off investing nothing than investing $\overline{I}$ and consuming the rest as perks. This reduces to the condition $\overline{I} \geq \beta^L(D_2^H - D_2^L)$.

**Proposition 2** *Consider any combination* $(\beta^H, \beta^L, D_2^H, D_2^L)$ *with* $\beta^H > \beta^L$ *and* $D_1 + \beta^L D_2^L \geq \beta^H D_2^H$. *Then for any beliefs* $\overline{I} \in [\beta^L(D_2^H - D_2^L), \beta^H(D_2^H - D_2^L)]$, *there exists a separating equilibrium where high-type charities make the threshold capital investment,* $\overline{I}$, *and low-type charities invest zero.*

**Proof.** See above. ■

In this case, the high-type charity overinvests to distinguish itself from the low-type charity. With full information, the charities choose zero investment, which is socially optimal. Since investment is just an expense, and is not used for producing public goods, it always leads to a waste of resources when capital is unproductive.

### D. Equilibrium with productivity of capital

We have shown that even if capital is not useful for producing public goods, investment will lead to the existence of at least one separating equilibrium. There will in general be many separating equilibria, depending on preferences and the first and second period donations. We now show what happens if investment affects the second-period provision of the public good.

We know that the utility function is given in equation (1) for the high-type charity. We maximize (1) subject to the budget constraint and public good technology function. Substitute the constraints into the public good $G_1$ and $Z_2$ to get the charity's problem:

$$max\ D_1 - I_1^H + \beta^H D_2(I_1^H)(1 + f\left(I_1^H\right)).$$

Substituting for $D_2(I)$, we rewrite this problem,

$$max \begin{cases} D_1 - I_1^H + \beta^H \cdot D_2^H \cdot (1 + f\left(I_1^H\right)) & I_1^H \geq \overline{I} \\ & \text{if} \\ D_1 - I_1^H + \beta^H \cdot D_2^L \cdot (1 + f\left(I_1^H\right)) & I_1^H < \overline{I} \end{cases}$$

Let $I_1^*$ maximize $D_1 - I_1 + \beta^H \cdot D_2^H \cdot (1 + f\left(I_1\right))$, so that $f'(I_1^*) = 1/\beta^H \cdot D_2^H$, and let $\widehat{I}_1$ maximize $D_1 - I_1 + \beta^H \cdot D_2^L \cdot (1 + f\left(I_1\right))$, so that $f'(\widehat{I}_1) = 1/\beta^H \cdot D_2^L$. Since $D_2^L < D_2^H$ and $f$ is increasing, it follows that $I_1^* > \widehat{I}_1$. Define $\widetilde{I}_1$ to be the value of

$I_1 > I_1^*$ such that

$$D_1 - \widetilde{I}_1 + \beta^H \cdot D_2^H \cdot (1 + f\left(\widetilde{I}_1\right)) = D_1 - \widehat{I}_1 + \beta^H \cdot D_2^L \cdot (1 + f\left(\widehat{I}_1\right)).$$

The relationship between $I_1^*$, $\widehat{I}_1$, and $\widetilde{I}_1$ is shown in Figure 1.

It is now possible to describe the solution to the high-type charity's maximization problem. If $\overline{I} \leq I_1^*$ the charity invests $I_1^*$. Since the constraint that $I_1 \geq \overline{I}$ in the objective function is non-binding, it has no impact on the solution. If $\overline{I} > I_1^*$ two cases emerge. First, if $\overline{I} > \widetilde{I}_1$ the charity does worse investing enough to get the higher donations than it does by investing $\widehat{I}_1$. Second, if $I_1^* < \overline{I} \leq \widetilde{I}_1$ the charity does best by investing $\overline{I}$. Consequently, the high-type charity's optimal investment is given by the function

$$I_1^H(\overline{I}) = \begin{cases} I_1^* & \overline{I} \leq I_1^* \\ \overline{I} \quad \text{if} & I_1^* < \overline{I} \leq \widetilde{I}_1 \\ \widehat{I}_1 & \overline{I} > \widetilde{I}_1 \end{cases} . \tag{3.3}$$

The low-type charity's investment decision is simpler. Investment plays two roles: it enables the charity to transform second-period donations into a larger amount of the public good and, if it is sufficiently high to make donors believe the charity is high-type, it increases second-period donations. Since the low-type charity does not value provision of the public good, the productivity aspect of investment is irrelevant and the investment decision matches that of the unproductive investment case. Assuming that $D_1 + \beta^L D_2^L \geq \beta^H D_2^H$ so that the charity always prefers investing nothing to behaving honestly, the low-type charity's investment function is

$$I_1^L(\overline{I}) = \begin{cases} \overline{I} & \overline{I} < \beta^L(D_2^H - D_2^L) \\ & \text{if} \\ 0 & \overline{I} \geq \beta^L(D_2^H - D_2^L) \end{cases} . \tag{3.4}$$

**Proposition 3** *Consider any combination* $(\beta^H, \beta^L, D_2^H, D_2^L)$ *with* $\beta^H > \beta^L$ *and* $D_1 + \beta^L D_2^L \geq \beta^H D_2^H$*. Then the investment functions for the two types of charities are given by* (3.3) *and* (3.4)*. If* $\beta^L(D_2^H - D_2^L) \leq \overline{I} \leq I_1^*$ *then there exists a separating equilibrium in which high-type charities invest the efficient amount and low-type charities invest zero. Furthermore, if* $\max(\beta^L(D_2^H - D_2^L), I_1^*) < \overline{I} \leq \widetilde{I}_1$ *then there exists a separating equilibrium in which high-type charities overinvest and low-type charities invest zero.*

**Proof.** See above. ■

Spence (2002) shows that there exists a fully efficient separating equilibrium as long as the high productivity worker's education level (in the case where education influences productivity) is larger than the level of education when the low productivity worker mimics to get the same wage as the high-type worker. Otherwise, there exists overinvestment, so the equilibrium is inefficient. Here we have shown the existence of a fully separating equilibrium for our model when investment affects productivity, although there may or may not be overinvestment. When the threshold value $\overline{I}$ determined by the donor's belief is smaller than the efficient level of investment, the separating equilibrium has efficient investment by the high-type charity. When the threshold value is higher than the efficient level of investment, though, there is overinvestment in the separating equilibrium.

Figure 3 shows the range for which there is overinvestment. In the interval A, the high-type firm chooses the optimal investment $I_1^*$, so this is efficient. In interval C, it

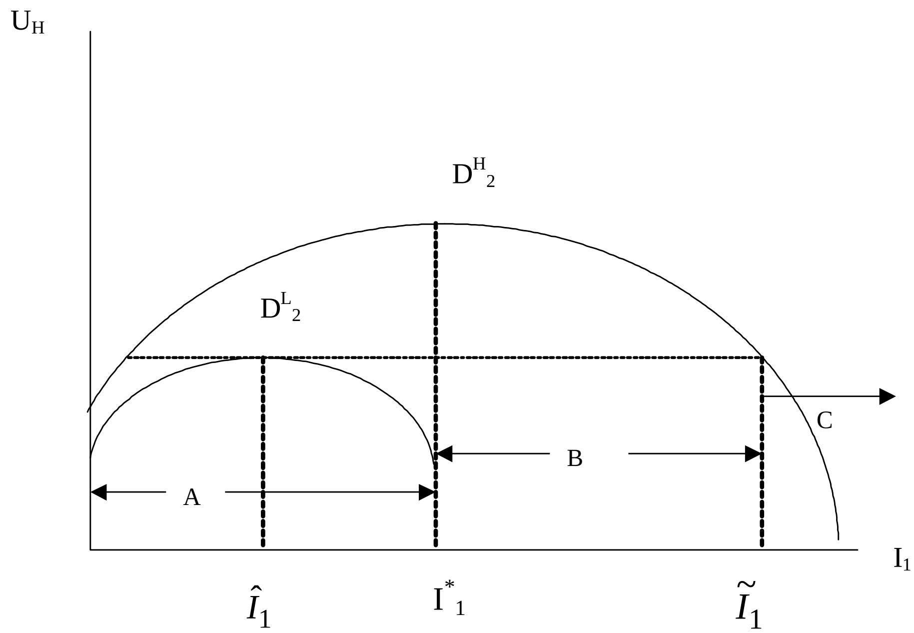


Fig. 3. High-type Charity Investment Choices

wants less investment, so it chooses $\widehat{I}_1$, because signaling is so expensive that doing so lowers utility. In interval B, it chooses the threshold investment $\overline{I}$, because then it gets the high donation and is better off. This investment is more than the optimal investment with full information, $I_1^*$, so there exits overinvestment and interval B is the set of inefficient allocations. Which one is seen in practice depends on the donors' beliefs.

## E. Conclusion

We have studied a model where donors do not know which charity will cheat them after they donate money. In this model, we show how investment can serve as a signal for honest charities. When investment has no effect on the provision of public goods, that is, it is only a device to distinguish honest from dishonest charities, many separating equilibria exist. If investment affects the provision of public goods, then we find that there can be efficient investment even in a separating equilibrium. Because of imperfect information, investment as just a signaling device is inefficient compared with full information, but when investment increases public goods production, we can get efficient investment. The charity's choice depends on the donor's beliefs. If the donor's belief is too conservative, it is not worthwhile for the firm to invest, even if it looks like a dishonest charity. It results from a concave investment function. In contrast, if the donor's required investment is less than the charity's maximized optimal investment, the charity chooses the optimal investment, and it is efficient. If the donor's requirement is larger than the maximized optimal investment, but not too much larger, the charity will invest the threshold amount in order to get the large donation. This results in overinvestment and it causes an inefficient market outcome. In our paper, an interesting result is that if investment affects the provision of the public good, we can get the same equilibrium as with full information, but depending on donor's beliefs, there may also exist overinvestment in the market.

# CHAPTER IV

# SIGNALING COSTS AND THE OPTIMAL NUMBER OF CHARITIES

## A. Introduction

In the previous chapter, we saw that imperfect information is very important for the provision of public goods. When donors don't have information about which charities are good, high quality charities (ones that don't cheat) want to reveal their preferences so that they can be distinguished from low quality charities. This chapter studies the equilibrium where charities signal and receive a donation, and if they don't signal, they get no donations. As in the previous chapter, charities must expend investment on a signal such as a big building, equipment, or hiring famous people for fundraising, whether it helps to produce public goods or not. We study the effects of this signaling cost, which can be thought of as an entry tax or license fee, on the number of firms and the price of giving in a monopolistically competitive public goods market.

Study of the relationship between entry and product diversity in for-profit industries has a long history. Mankiw and Whinston (1986) demonstrate that free entry results in an inefficient number of firms compared to the social optimum, that is, there exists excessive entry. When new firms enter into the market, the incumbent firm will decrease its quantity in response to the new firm's entry. This means that new firms steal quantity from existing firms. New firms have an incentive to enter into the market to capture that revenue. Such a business stealing effect happens in a homogenous market. But this excessive entry does not hold anymore when we consider a heterogeneous production market. When the entrant produces new production, it will improve social welfare, because firms can't capture all surplus from consumer without perfect price discrimination. So a lower number of firms enter into the market compared with the socially optimal number. This point has also been discussed in Spence (1976b). He demonstrates that product selection will decline with entry because total surplus which after new firms enter the market doesn't equal to summation of products' marginal contribution. Fixed costs are another cause of insufficient product diversity. Lancaster (1975) and Spence (1976a) show that the fixed cost causes less product diversity. Berry and Waldfogel (1996) demonstrate in an empirical paper that the difference between the socially optimum welfare and welfare under free entry results in inefficiency in the radio broadcasting.

As demonstrated by the authors cited above, there are many studies of welfare and product diversity in private markets. In nonprofit markets, some characteristics are similar to the monopolistic competition market, even though the firms may not maximize profit. Non-profit firms can maximize their net revenue and choose their fundraising cost. Rose-Ackerman (1982) points out that donors want to give their gifts to charities which are close to their ideology. This is modeled as the distance between the charity and the donor in our model. Her study shows that the competition for donations leads to a big fundraising share, defined as fundraising cost/donations, but she assumes that charities can rank donors by donations and calculate the expected donation. Charities send the brochures first to high ranking donors whom charities guess are closest to their preferences. Hence, donors' behavior is actually passive, in that the donor giving more donations depends on the charities' best guesses. She mentions also that free entry might decrease the fundraising share in equilibrium if entry makes for less elasticity of giving with respect to the proportion of the population who is solicited by charities. The solicited population decreases with an increased number of firms and lowers the elasticity of giving according to extra fundraising. Hence, the equilibrium fundraising share falls. But when there exist a very large number of charities in the market, the fundraising share will rise. As the number of firms approaches infinity, then the number of solicited donors goes to one. This means that the fundraising expense equals expected donations.

We adapt Salop (1979)'s circle model, so that donors' utility depends on diversity, and charities maximize net revenue. The signaling cost, used to overcome problems with imperfect information, is a fixed cost and it plays a role as an entry barrier. Under free entry, the number of firms is less than the social optimum due to signaling costs. This paper proceeds as follows. Section 2 is the basic model, section 3 studies the case where the price of giving is constant, and the last section is the conclusion.

## B. Basic Model

We briefly summarize the model from chapter II here. Donors are located on a circle of circumference 1. The location of a donor represents her ideology along the lines of Rose-Ackerman (1982). Donors never change their location, but charities produce a single public good and choose their location on the circle endogenously as described below. Charities are free to change their location costlessly. They reevaluate their location each time a new firm enters the market and decide whether or not to move, and if so, where to move.

Charities face three different costs if they want to produce public goods. The *signaling cost* is paid by good quality charities (those that don't cheat) because they want to distinguish themselves from low quality charities. For instance, that could be a big building or equipment, and can be thought of as an entry tax or license fee. The *travel cost* is the physical distance between donors and charities, or differences in preferences between them, and whether it is the former or latter case doesn't matter.

The *premium cost* comes from free gifts such as books, mugs and t-shirts given to donors, but is also more time and effort spent on donors due to increased competition.

Charities maximize total net revenue. In the circle model, donors are distributed continuously and uniformly. The charities try to get donations from the closest donors (those with the lowest travel cost). Hence, the utility of charities, $V$, is as follows.

$$V = 2\int_{0}^{\frac{1}{2n}} (d^{*} - z)\, dz - S \tag{4.1}$$

where $z = |x - a|$ is the distance between donor $x$ and charity $a$, $d^{*}$ is the donation chosen by the donor, $n$ is the total number of charities, and $s$ is the signaling cost. Net revenue is equal to the optimal donation minus the travel cost. One thing that stands out in equation (1) is that there is only a travel and signaling cost. So, unlike in chapter II, we first assume the premium cost is equal to zero, meaning the charity gives no gifts or special attention to donors even if a new charity enters the market. The premium cost is important, but this chapter focuses on the effect of the signaling cost. By ignoring the premium cost, we can study a simple model that shows the effect of the signaling cost on the diversity of public goods. We leave the extension to the case of endogenous premium cost for future work.

Donor's utility increases with a smaller distance, $z$, because small $z$ means that the donor's preferences are close to the charity's characteristics. When donations increase for a given income, private consumption will decline. Hence, private consumption depends on the distance only indirectly. The donor's utility function can then be rewritten as

$$U = U(c(z), d(1 - z)), \tag{4.2}$$

where $c$ is private consumption and $d$ is the donation. Even though the consumption of private goods is not related to the distance $z$ directly, we can make a monotonic transformation and get donors' utility function as in the equation (2), subject to the constraint

$$y = c + d,$$

where $y$ is income. The utility function is concave with $U_c > 0, U_d > 0, U_{cc} < 0, U_{dd} < 0$ and $U_{cd} < 0$. As explained above, $c_z > 0$ and $d_z < 0$.

C. Equilibrium without premium cost

In this section, we assume donors maximize a Cobb-Douglas utility function:

$$\max U = c^z d^{1-z}$$

$$s.t. \quad c + d = y.$$

Each price equals one. The premium cost affects the price of giving and it affects the donor's decision indirectly. The price of giving means the value of the public good provided by charities after the fundraising cost and administration cost is subtracted from the total donation, that is, $1/(1 - F - A)$, where $F$ is the fundraising cost and $A$ is the administration cost. It is impossible to calculate the administration cost, so in practice economists have used fundraising costs to calculate the price of giving. Steinberg (1986) finds that the price of giving doesn't affect donations in his empirical paper, but Rose-Ackerman (1982) points out that donors are sensitive to the price of giving, and Okten and Weisbrod (2000) show that fundraising expenditures cause donations to increase due to better information from advertisements. They also have a negative effect on donations indirectly, because the price of giving is higher than for the case without fundraising. In our model, the premium share is used to measure fundraising share. In this section we consider the price of giving as exogenous and premium share is equal to zero.

The optimal private consumption and donation given price can be found using the first order conditions:

$$\begin{aligned} c^* &= zy \\ d^* &= (1-z)y. \end{aligned}$$

Charities maximize utility, $V$, which is equal to net revenue. In equilibrium, the donors are located at $x \in (1, 1/n)$ and each charity can get donations inside that range. When the charity considers the closest donor, it maintains a possible area where it can induce donations from the right side and left side of firm, $1/2n$ from the charity's location on either side. Given the optimal donation, charities can calculate total net revenue without signaling cost, $V$:

$$V = 2\int_0^{\frac{1}{2n}} ((1-z)y - z)\,dz = \frac{1}{4}\frac{-y-1+4yn}{n^2}. \tag{4.3}$$

Under imperfect information, good charities want to send a signal to donors as to their real type in order to get more donations than the bad charities. This is a necessary condition for charities to show that they have no incentive to cheat donors and will produce the public good when they receive a donation. Chapter III studied this cost in more detail and showed that an equilibrium exists with good charities signaling an amount $S$, and receiving a positive donation, and bad charities not signaling and receiving no donation. What is important here is that this signaling cost is a fixed cost, and when the new charities want to enter the market, they have to pay it. Therefore, to decide whether to enter this market or not, the decision rule is to enter if net revenue, $V_0$, is at least equal to zero when the signaling cost is $S$:

$$V_0 = V - S = \frac{1}{4}\frac{-y - 1 + 4yn}{n^2} - S \geq 0. \tag{4.4}$$

In equation (4), if $V_0 < 0$, charities have no incentive to enter the market. We assume free entry, which allows us to state the following proposition.

**Proposition 4** *When the required signaling cost increases, the number of charities decreases if n is sufficiently large.*

**Proof.** To find $dn/dS$, we take the total derivative of equation (4) with respect to the number of firms and signaling cost, and get $V'(n) \cdot dn = dS$, so that

$$V'(n) = \frac{d(\frac{1}{4}\frac{-y-1+4yn}{n^2})}{dn} = -\frac{1}{2}\frac{2yn - y - 1}{n^3}. \tag{4.5}$$

Therefore $dn/dS = 1/V'(n)$. Substitute this result for $V_0'(n)$ into $dn/dS = 1/V_0'(n)$ :

$$\frac{dn}{dS} = \frac{-2n^3}{2yn - y - 1} < 0 \quad if \quad n > \frac{1 + 1/y}{2}. \tag{4.6}$$

■

This result explains two things. The first is that charities' net revenues decrease with the number of firms if $n$ is large enough in equation (5). Even though increased competition leads to less travel cost (closer ideology), the territory, 1/n, where a charity is able to get donations decreases in equilibrium. If the territory decreases more than the decrease in travel cost, then net revenue will shrink. Secondly, the signaling cost makes for less product diversity according to equation (6). We assume that each firm produces one public good. The signaling cost is a barrier to entry for potential firms. Hence, because of this fixed cost, the equilibrium number of firms will fall. If $n$ is a large number, $n > (1 + 1/y)/2$, the total net revenue falls, so when they spend on signaling, charities' revenue may be negative in equilibrium.

The condition for product diversity to fall with a higher signaling cost is potentially very restrictive. Furthermore, it is difficult to understand the intuition behind a higher signaling cost leading to greater diversity of charity. The following lemma clarifies the issue: anytime there are already charities in the market, the equilibrium amount of diversity will fall. In practice, this may not be observed due to the integer problem, of course.

**Lemma 5** *If $n$ is at least equal to one (i.e., if it is optimal for some charities to exist in the market), then $\frac{dn}{dS} < 0$ (integer problem ignored).*

**Proof.** The condition for entry is that $V_0 = V - S = \frac{1}{4}\left(\frac{-y - 1 + 4yn}{n^2}\right) - S \geq 0$. If $V_0 = \frac{1}{4}\left(\frac{-y - 1 + 4yn}{n^2}\right) - S = 0$, then solving for the optimal number of charities for arbitrary $y$ and $S$, we find $n^* = \frac{2y \pm \sqrt{4\left(y^2 - Sy - 1\right)}}{4S}$. But $y^2 - Sy - 1 \geq 0$ requires $y > 1$. Thus, to have a real optimal number of charities, a necessary (but not sufficient) condition is that $y > 1$. From above, $\frac{dn}{dS} = -\frac{2n^3}{2yn - y - 1}$. If $y > 1$ and $n \geq 1$, then $\frac{dn}{dS} < 0$. ■

D. Conclusion

We used a simple circle location model and analyzed the effect of signaling costs on the number of firms, that is, the diversity of production and premium share. When the signaling cost is fixed, it is a barrier to entering into the market. The charities are willing to invest in this signaling, because they want to reveal their quality to get more donations, otherwise they will lose donors. Announcement of donations may be signaling, but in this case the cost is trivial. In our model, signaling requires incurring a cost like in Spence (1973)'s education model. The diversity of public goods decreases with signaling cost. An interesting future research project would be to make the choice of the premium cost endogenous for each charity. If charities choose three kinds of costs, travel cost, premium cost and signaling cost, even though it would be a very complicated model, requiring a general equilibrium analysis, it would be more realistic. Whether it would cause a change in our results cannot be determined without actually setting up and solving the model.

# CHAPTER V

## CONCLUSION

This dissertation has explored the implications of two types of market imperfections in public goods markets, imperfect competition and asymmetric information. The effects of these two imperfections has been studied in a large number of papers for the case of private goods, but only a few economists have studied information problems and imperfect competition as they relate to the provision of public goods. The important difference between the two types of markets is the different optimization problems solved by consumers and firms. In private goods markets, firms sell products to consumers. Consumers make purchases so as to maximize their own utility from consumption. In public goods markets, firms solicit donations from their "consumers" and then provide services to other people. The objective of non-profit firms is to maximize the provision of public goods.

In chapter II, we demonstrated the effect of changes in competition among charities using a circle model. There exists two types of costs, a travel cost and a premium cost due to fundraising. When one firm enters between two existing firms, the new firm steals donations from incumbents. Hence, the existing firms have an incentive to increase fundraising expenditures in order to not lose the donor. Under the assumption that donations are fixed, we showed that donors give that amount of money to the closest firm. We then proved that increased competition leads to a higher premium cost (fundraising expenditure), but less travel cost, with the increase in premium cost always dominating.

This is interesting, because it is not *a priori* clear which effect will be larger. If a new charity enters into the market, then that will lead to lower travel costs. Intuitively, one way to interpret the travel cost is that charities need to invest some time and money to convince donors that they provide a useful service. If a new charity enters with a new ideology, that ideology will appeal to many donors. It will then be easier for the new charity to get money from those donors than it was for the old charities. The new charity therefore has to expend less effort to get donations, and the expenditures are basically wasted money. Yet in all cases, the entry leads to greater competition and thus higher total fundraising expenditures because old charities will fight to keep their donors. Our result may be changed if increased competition leads to an increase in donations, but that is really a different issue. We are interested in the effects of competition for existing donors. The key proposition in this essay proved the result that increased competition always makes for less provision of public goods. In private goods markets, on the other hand, it is usually thought that more competition is a good thing.

In chapter III, we considered a different problem, that of imperfect information between donors and the charity. The question we asked is, "What happens if the donors do not know how the charity will spend their donations?" Under some assumptions, such as knowledge of the management of the charity's utility function, or all previous actions taken by the management of the charity, the donors might be able to solve a complicated signal-extraction problem and figure out how donations will be spent. However, we are interested in the case where donors have limited information about the charity's management. We assume instead that the donor can only observe the charity's capital stock (such as office building, statue, etc.). There is a possibility of being audited each period and found to have cheated. If they ever cheat, that becomes public information and the charity does not get anymore donations.

Under these simple assumptions, we analyze the possibility that the charity can use investment in capital to help solve the imperfect information problem. Donors' beliefs about the honesty of the charity conditional on the charity's capital stock determines their donation. Charities will choose their investment in capital in order to reveal their true type. In the benchmark case, we assume that the capital stock has no value in production of the public good. The capital stock only serves as a signal and provides no other service. When this investment does not influence the provision of public good, we proved the existence of a separating equilibrium where the high type invests in capital and the low type invests zero. If the provision of public goods is increased by greater investment, then we get optimal investment as long as meeting the donor's belief is not too expensive. If the donor's belief is such that a very large capital stock is necessary to be seen as an honest charity, charities will not choose investment because the cost is too expensive. If the threshold capital stock is sufficiently small, honest charities will always invest to distinguish themselves from the dishonest charities.

The signaling cost is a fixed cost. This fixed cost is an entry barrier for new firms to enter into the market. This leads to a connection between the models in the chapters II and III. In chapter IV, we study a circle model and show that the signaling cost from chapter III influences the diversity of production. We show that the existence of a fixed cost causes the number of firms to decrease.

There are at least two ways to extend the research. First, we could apply numerical methods and simulations of the monopolistic competition and asymmetric information models of public goods. Dixit (2002) suggests that this is a very fruitful way to attack models of the sort in this dissertation because of their complicated features. Dixit (2002) discusses setting up a new model of the public sector using a location model joint with a representative consumer model of monopolistic competition and solving by numerical methods. Second, we have not allowed for the existence of a government sector. Further study of the effects of government behavior in public goods markets with imperfections may potentially be fruitful. These topics are interesting, but are left for future research.

REFERENCES

**Andreoni, James.** "Toward a Theory of Charitable Fund-Raising." *Journal of Political Economy*, December 1998, 106(6), pp. 1186-1213.

**Andreoni, James.** "Leadership Giving in Charitable Fund-Raising." Working Paper, University of Wisconsin-Madison, 2003.

**Bac, Mehmet and Bag, Parimal Kanti.** "Strategic Information Revelation in Fundraising." *Journal of Public Economics*, March 2003, 87(3-4), pp. 659-679.

**Bergstrom, Theodore; Blume, Lawrence and Varian, Hal.** "On the Private Provision of Public Goods." *Journal of Public Economics*, February 1986, 29(1), pp. 25-49.

**Berry, Steven and Waldfogel, Joel.** "Free Entry and Social Inefficiency in Radio Broadcasting." *RAND Journal of Economics*, Autumn 1999, 30(3), pp. 397-420.

**Bilodeau, Marc.** "Voluntary Contributions to United Charities." *Journal of Public Economics*, June 1992, 48(1), pp 119-133.

**Bilodeau, Marc and Slivinski, Al.** "Rival Charities." *Journal of Public Economics*, December 1997, 66(3), pp. 449-467.

**Burns, Michael E. and Walsh, Cliff.** "Market Provision of Price-excludable Public Goods: A General Analysis." *Journal of Political Economy*, February 1981, 89(1), pp. 166-191.

**Clarke, E.H.** "Multipart Pricing of Public Goods." *Public Choice*, 1971, 11, pp. 17-33.

**Dixit, Avinash.** "Some Reflections on Theories and Applications of Monopolistic Competition." Working Paper, Princeton University, 2000.

**Dixit, Avinash and Stiglitz, Joseph E.** "Monopolistic Competition and Optimum

Product Diversity." *American Economic Review*, June 1977, 67(3), pp. 297-308.

**Glazer, A. and Konrad, K.A.** "A Signaling Explanation for Charity." *American Economic Review*, September 1996, 86(4), pp. 1019-1028.

**Groves, T.** "Incentives in Teams." *Econometrica*, July 1973, 41(4), pp. 617-663.

**Groves, T. and Ledyard, J.** "Optimal Allocation of Public Goods: A Solution to the 'Free Rider' Problem." *Econometrica*, May 1977, 45(4), pp. 783-809.

**Hansmann, Henry B.** "The Role of Nonprofit Enterprise." *Yale Law Journal*, April 1980, 89(5), pp. 835-901.

**Harbaugh, William T.** "What Do Donations Buy? A Model of Philanthropy Based on Prestige and Warm Glow." *Journal of Public Economics*, February 1998, 67(2), pp. 269-284.

**Khanna, Jyoti; Posnett, John and Sandler, Todd.** "Charity Donations in the U.K: New Evidence Based on Panel Data." *Journal of Public Economics*, February 1995, 56(2) pp. 257-272.

**Kingma, Bruce Robert.** "An Accurate Measurement of the Crowd-out Effect, Income Effect, and Price Effect for Charitable Contributions." *Journal of Political Economy*, October 1989, 97(5), pp. 1197-1207.

**Lancaster, Kelvin.** "Socially Optimal Product Differentiation." *American Economic Review*, September 1975, 65(4), pp. 567-585.

**Leffler, Keith; Long, John B., Jr. and Thomas, Russell.** "Signaling: Efficiency and Equilibrium." *Economics Letters*, 1979, 4(3), pp. 215-220.

**Lindahl, E.** "Just Taxation-A Positive Solution," in R. Musgrave & A. Peacock, eds., *Classics in the Theory of Public Finance*, London: Macmillan, 1919.

**Mankiw, N. Gregory and Whinston, Michael D.** "Free Entry and Social Inefficiency." *RAND Journal of Economics*, Spring 1986, 17(1), pp 48-58.

**Mas-Colell, Andreu; Whinston, Michael D. and Green, Jerry R.** *Microeconomic Theory.* New York: Oxford University Press, 1995.

**Oken, Cagla and Weisbrod, A. Burton.** "Determinants of Donations in Private Nonprofit Markets." *Journal of Public Economics*, February 2000, 75(2), pp. 255-272.

**Romano, Richard and Yildirim, Huseyin.** "Why Charities Announce Donations: A Positive Perspective." *Journal of Public Economics*, September 2001, 81(3), pp. 423-447.

**Rose-Ackerman, Susan.** "Charitable Giving and Excessive Fundraising." *Quarterly Journal of Economics*, May 1982, 97(2), pp. 193-212.

**Rose-Ackerman, Susan.** "United Charities: An Economic Analysis." *Public Policy*, Summer 1980, 28(3), pp. 321-350.

**Salop, Steven C.** "Monopolistic Competition with Outside Goods." *Bell Journal of Economics*, Spring 1979, 10(1), pp. 141-156.

**Samuelson, Paul A.** "The Pure Theory of Public Expenditure." *Review of Economics and Statistics*, November 1954, 36(4), pp. 387-389.

**Samuelson, Paul A.** "Diagrammatic Exposition of a Pure Theory of Public Expenditure." *Review of Economics and Statistics*, November 1955, 37(1), pp. 350-356.

**Spence, Michael.** "Job Market Signaling." *Quarterly Journal of Economics*, August 1973, 87(3), pp 355-374.

**Spence, Michael.** "Competitive and Optimal Responses to Signals: An Analysis of Efficiency and Distribution." *Journal of Economic Theory*, March 1974, 7(3), pp. 296-332.

**Spence, Michael.** "Product Selection, Fixed Costs, and Monopolistic Competition." *Review of Economic Studies*, June 1976a, 43(2), pp. 217-235.

**Spence, Michael.** "Product Differentiation and Welfare." *American Economic Review*, May 1976b, 66(2), pp. 407-414.

**Spence, Michael.** "Competition in Salaries, Credentials, and Signaling Prerequisites for Jobs." *Quarterly Journal of Economics*, February 1976c, 90(1), pp. 51-74.

**Spence, Michael.** "Signaling in Retrospect and the Informational Structure of Markets." *American Economic Review*, June 2002, 92(3), pp. 434-459.

**Steinberg, Richard.** "The Revealed Objective Function of Nonprofit Firms." *RAND Journal of Economics*, Winter 1986, 17(4), pp. 508-526.

**Steinberg, Richard.** "Should Donors Care about Fundraising?" in Rose-Ackerman, Susan, ed., *The Economics of Nonprofit Institutions: Studies in Structure and Policy*, New York: Oxford University Press, 1986.

**Straub, John D.** "Fundraising and Government Crowd-out of Private Contributions to Public Radio: An Empirical Study." Working Paper, University of Wisconsin, 2000.

**Varian, Hal R.** *Microeconomic Analysis.* New York: W.W. Norton & Company, Inc., 1992.

**Varian, Hal R.** "Sequential Contributions to Public Goods." *Journal of Public Economics*, February 1994, 53(2), pp. 165-186.

**Vesterlund, Lise.** "The Informational Value of Sequential Fundraising." *Journal of Public Economics*, March 2003, 87(3-4), pp. 627-657.

**Vickery W.** "Counterspeculation, Auctions and Competitive Sealed Tenders." *Journal of Finance*, March, 1961, 16(1), pp. 8-37.

**Warr, Peter G.** "Pareto Optimal Redistribution and Private Charity." *Journal of Public Economics*, October 1982, 19(1), pp. 131-138.

# APPENDIX A

## CHAPTER II SUPPLEMENTARY MATERIAL

This appendix presents the change in total cost for all five areas following entry. For area $d_1$, the total cost was originally

$$\int_{a_1}^{\frac{a_1+a_0}{2}} \left[|x_1 - a_1| + f - |a_2 - x_1|\right] dx_1.$$

After entry, it becomes

$$\int_{a_1}^{\frac{a_1+a_0}{2}} \left[|x_1 - a_1| + f - |a_0 - x_1|\right] dx_1.$$

For area $d_2$, the total cost was originally

$$\int_{\frac{a_1+a_0}{2}}^{a_0} \left[|x_2 - a_1| + f - |a_2 - x_2|\right] dx_2.$$

After entry, it becomes

$$\int_{\frac{a_1+a_0}{2}}^{a_0} \left[|a_0 - x_2| + f - |x_2 - a_1|\right] dx_2.$$

For area $d_3$, the total cost was originally

$$\int_{a_0}^{\frac{a_1+a_2}{2}} \left[|x_3 - a_1| + f - |a_2 - x_3|\right] dx_3.$$

After entry, it becomes

$$\int_{a_0}^{\frac{a_1+a_2}{2}} \left[|x_3 - a_0| + f - |x_3 - a_1|\right] dx_3.$$

For area $d_4$, the total cost was originally

$$\int_{\frac{a_1+a_2}{2}}^{\frac{a_2+a_0}{2}} \left[|a_2 - x_4| + f - |x_4 - a_1|\right] dx_4.$$

After entry, it becomes

$$\int_{\frac{a_1+a_2}{2}}^{\frac{a_2+a_0}{2}} \left[|x_4 - a_0| + f - |a_2 - x_4|\right] dx_4.$$

For area $d_5$, the total cost was originally

$$\int_{\frac{a_2+a_0}{2}}^{a_2} \left[|a_2 - x_5| + f - |x_5 - a_1|\right] dx_5.$$

After entry, it becomes

$$\int_{\frac{a_2+a_0}{2}}^{a_2} \left[|a_2 - x_5| + f - |x_5 - a_0|\right] dx_5.$$

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