Essays on Financing Decisions of Not-for-Profit Organisations

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Abstract

Chapter 1. – This paper novelly examines the nature of the interaction between private donors and not-for-profit organisations (NPOs) when NPOs can invest endowment funds in a two-asset risky portfolio and donors can contribute to both the endowment fund and the annual campaign.

I study a three-stage non-cooperative game with two types of economic agents: a cohort of heterogeneous donors and one representative NPO. In equilibrium, donors always contribute to the endowment fund; however, they may not contribute to the annual campaign. The proportion of the NPO's endowment fund invested in the risky asset is a discontinuous function of the endowment; donors contribute less to an aggressive NPO and more to a cautious one. When the NPO can solicit donors to contribute only once, this increases the expected level of the contribution in equilibrium, but this may not generate higher expected utility for donors.

Chapter 2. – This paper presents a dynamic model of charitable giving. At each period, donors contribute to an NPO's endowment; the NPO provides a charitable good and invests in the financial market. Investments are made in a risky asset and a risk-free asset. I introduce two types of shocks to account for uncertainty: donors' income shock and financial market fluctuations.

I show that the optimal share of disposable endowment invested in risky asset is constant.

Donors' strategy, whether to contribute or free-ride on the NPO's investments, depends on donors' shadow prices. Donors contribute when NPO's endowment is relatively low. Large contribution levels encourage the NPO to participate in the capital market at the expense of providing charitable good. I show that the NPO prefers an environment with a lower rate of return on risk-free assets. NPO's risk exposure to the financial market affects both NPO's and donors' decisions. However, risk exposures on donors' side do not impact parties' decisions. Regulation analysis suggests that portfolio ceiling and provision floor are achievable.

Chapter 3. – The existing literature on NPOs' risky investments is sparse. This paper links two data sources: the National Center for Charitable Statistics (NCCS) data over the period of 1987-2014 and the U.S. presidential elections data. I develop a dynamic model to examine how the national-level political incumbent shapes the NPOs' risky investment portfolio selection, adjusting for a set of NPOs' intrinsic characteristics and real interest rate.

I find that right-leaning Republicans act as a rein on NPOs' risky investments, i.e., a Republican administration is associated with a reduction in NPOs' holdings of corporation stocks and a 16.28% reduction in equity share relative to a Democratic administration. It is attributed to the impact of the Republican administration by more facilitating NPOs' accessibility to borrowing than having a Democratic president. I argue that NPOs behave as backward-looking investors or are reluctant to change their portfolio due to the significant portfolio adjustment cost, using past performance as an indicator to make their current risky investment decisions.

Heckman two-step estimation indicates that NPOs' investment is an endogenous sample selection instead of a random choice. I show that NPOs have a less extensive equity share with more severe agency costs; foundation size plays a different role when NPOs decide whether to invest in risky assets compared with investing NPOs. Moreover, for investing NPOs, the equity share is expected to decrease by 12.0% if there is a 1% increase in the real interest rate; NPOs are more inclined to invest in risky assets when the real interest rate increases, in the sense of riding with the rational bubble.

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General Introduction

The philanthropic giving market is increasingly more significant in the modern economy than ever before; e.g., in the United States in 2018, individual giving amounted to 292 billion dollars. The mission of not-for-profit organisations (NPOs) is to maximize their social impact, and making more revenue means better fulfilling their mandate. As for all other institutional investors, NPOs need to hedge potential investment losses and liquidity risks by employing a portfolio strategy, which comprises the security screening and optimal allocation of the disposable endowment along the portfolio frontier. In this thesis, I investigate the NPOs' investment decisions in static and dynamic settings and analyze the impact of political regimes' alternation on these decisions.

Chapter 1 studies philanthropic decision-making in two institutional settings. Compared to other multi-stage models of the voluntary provision of public goods, the critical difference in this paper is that NPO is not simply treated as a conduit for funneling contributions into the provision of the public good. Instead, the NPO is a strategic player, and the control over its investment with the endowment funds is of critical importance when the donors determine how much to contribute to the endowment and to the thereafter annual campaign. Although the model considered here is simple, it generates new insights into some key elements of the interaction between charities and donors.

In particular, I show that charities that can go back to donors for annual campaign funds choose a less conservative investment strategy than do charities that cannot do so. Whereas wealthier individuals are typically expected to be more willing to bear the risk, the opposite is found to be true of charities that have an annual campaign fund: when a charity has a larger endowment (that is, it is wealthier), it becomes a more cautious investor. Not surprisingly, there is less variation in the public good level of provision when charities can solicit contributions to both the endowment and the annual campaign. However, the expected level of provision of the public good is typically higher when the provision of the public good is financed exclusively by the endowment, but not necessarily generates higher expected utility for donors, which complement the findings of Kamdar et al. (2015) and provides a novel explanation of the success of fundraising when the NPO expresses the willingness to stop soliciting in the future.

Chapter 2 models a charitable market consisting of an NPO and donors as a dynamic non-cooperative stochastic differential game. It is natural to examine macroeconomic shocks (Imbs, 2007; Ramey and Ramey, 1994). However, to account for income disturbances and financial market volatility, I uniquely consider fluctuations of the rate of return of the risky asset and donors' incomes generated by the Itô diffusions. The NPO allocates its resources between a charitable good and investment in risk-free (e.g., T-bills) and risky assets. Donors dispatch their incomes between consumption and charitable giving.

The results show that the NPO chooses a constant share of the risky asset. Donors' contributions are discontinuous; they either hit the upper bound of giving or free-ride the NPO, which leads to the jump in the provision of charitable good by NPOs. The NPO always provides public good when donors do not contribute, but this does not necessarily apply if donors contribute with a higher contribution ratio. I also show that the environment with a lower rate of return on T-bill is favorable to the NPO's expected endowment. NPO's investment risk affects both NPO's and donors' decision problems; however, donors' income and passive investment risk exposures keep silent, which complements the experimental evidence by Cettolin et al. (2017). Regulation analysis suggests that portfolio ceiling and provision floor must be binding but are achievable.

The third chapter contributes to the existing literature by empirically examining NPOs' investment decisions under different political administrations. As governments require, NPOs are becoming more market-driven and have adopted for-profit organisation strategies to be more efficient (Wellens and Jegers, 2014; Eikenberry and Kluver, 2004). In particular, the distinct ideological partisanship to spur economic growth (Quinn and Shapiro, 1991) and to deliver social benefits (Faricy, 2011) by the Democratic administration and the Republican government inevitably leads the public to react differently. NPOs are expected to reduce corporation stock investment and scale down risky investment proportion in the Republican government. I implement a panel data analysis to investigate the determinants of the equity share of U.S. private foundations by merging the National Center for Charitable Statistics (NCCS) data throughout 1987-2014 and the U.S. presidential elections. I uniquely establish the channels through which political incumbent alternation influences NPOs' risky investment, adjusting for a set of NPOs' intrinsic traits and real interest rate.

The interaction of political incumbents and both contribution and leverage ratio is significant. I provide the evidence that right-leaning Republicans act as a rein to NPOs' risky investments, i.e., NPOs in the Republican government, relative to the Democratic administration, have 16.28% less equity share. I argue that NPOs are backward-looking investors since their previous performances are positively correlated to current investment decisions. Furthermore, I crystallize that the more severe interest conflict between board members and management or other staff, who serve as decision-makers, is generally associated with a less extensive equity share. This study also presents the likelihood of NPOs getting involved in a risky investment, e.g., NPOs with larger foundation size are more likely to take the risky investment vehicle; NPOs incline to invest in stocks when the real interest rate increases in the sense of riding with the rational bubble.

Implementing Heckman two-step estimation, I explain the change of NPOs to purchase stock conditional on participation, i.e., for those NPOs that have invested in the stock market when the political administration alternates. As noted, larger NPOs tend to purchase corporation stocks due to the economies of scale and greater willingness to take risks, but, for investing NPOs, opposite results are observed. Moreover, less extensive equity share is associated with more severe agency costs whether NPOs are involved in the financial market. It is also noted that NPOs are inclined to invest in stocks when the real interest rate increases in the sense of riding with the rational bubble, consistent with the findings by Gala and Julio (2016).

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Chapter 1

Giving to the Endowment vs. Annual Campaign–A Sequential Game Theoretic Analysis

1.1 Introduction

In December 2017, the United States Congress enacted a bill which applied a 1.4% excise tax to the endowment income of American universities, serving 500 students or more, with endowment funds in excess of $500,000 per student. Although only a small number of universities were expected to be affected by this tax in the initial year of implementation (Kreigbaum, 2017), officials of the institutions targeted by the new policy stressed the impact of the reduction in the income from their endowment funds on their capacity to provide support for students and research (Reif, 2017; Faust, 2017; Martin, 2017). Harvard economist John Campbell was quick to point out that the new bill was likely to distort decision-making by universities. In particular, those with small numbers of students, but large per-student endowments, could avoid the tax if they continued limiting the number of student places rather than potentially expanding enrolment (Powell, 2017).

Although this particular tax measure applies only to the endowment funds attached to tertiary learning institutions, endowment funds play a crucial role in supporting the work of many other non-profit organisations (NPOs).[1] In the US, this includes cultural institutions such as the Metropolitan Museum in New York, the Getty Museum in Los Angeles, and the Art Institute of Chicago; medical not-for-profits such as the Mayo Clinic, St. Jude Children's Research Hospital and American Cancer Society; and environmental groups such as the Nature Conservancy and World Wildlife Fund. All of these organisations rely to a significant extent on income from their endowment to fund their ongoing activities. Similarly, in the UK, the assets of heavy-hitters such as Trinity College Cambridge, the National Trust (with its extensive inventory of historic properties), Guys' and St. Thomas' Charity and the Royal Society play a crucial role in enabling these charities to carry out their respective missions.

Given the critical role of endowment funds in supporting the work of many major NPOs, it is therefore somewhat surprising that the literature on the voluntary provision of public goods has essentially neglected the analysis of the decision of donors to contribute to an NPO's endowment fund as distinct from the annual campaign. Whereas there has been considerable thoughtful attention directed to issues such as how the impact of sequential giving, and to the use of matching gifts, leadership givers, etc, (Potters et al., 2005, 2007; Bracha et al., 2011), influence donor decision-making, researchers have not thought particularly hard about why donors choose to give today - rather than tomorrow - to fund the provision of public goods.

One obvious potential motivation for giving to a charity's endowment fund rather than

[1] Revenue diversification is one of the strategies by NPOs to alleviate the financial balance pressure due to the expanding of NPOs, eg., Fischer et al. (2011); Carroll and Stater (2008). In this chapter, for the purpose of examining the impact of agents' risk preference on equilibrium, NPO is solely financed by the donors' voluntary contributions and its thereafter risky investment, providing desired public good on a non-profit basis.

to its annual campaign is the tax wedge between the return to funds invested by the donor in the charity's endowment versus funds that the donor invests personally to fund future contributions to the charity. However, once funds are handed over to the charity, the donor can no longer control the charity's investment strategy: it may invest its endowment funds more aggressively than would the donor, creating a greater risk of a future cash crunch if the investment returns are poor, and therefore additional pressure on the donor to make larger future contributions to the charity. In effect, this creates a "Samaritan's Dilemma" (Buchanan, 1975), which raises interesting questions regarding both the design of fundraising campaigns and, potentially, the regulation of charities. In particular, it might be interesting to ask whether charities should commit not to solicit funds for the annual campaign if a donor has already contributed to the endowment - this would be consistent with the empirical evidence (Kamdar et al., 2015) that finds that donors give more when they are given the option of taking themselves off the solicitation list for future fundraising campaigns.[2]

Although the model considered here is simple, it generates new insights into some key elements of the interaction between charities and donors. In particular, I show that charities that can go back to donors for annual campaign funds choose a less conservative investment strategy than do charities that cannot do so. Whereas wealthier individuals are typically expected to be more willing to bear the risk, the opposite is found to be true of charities that have an annual campaign fund: when a charity has a larger endowment (that is, it is wealthier) it becomes a more cautious investor. Not surprisingly, there is less variation in the level of provision of the public good when charities can solicit contributions to both the endowment and the annual campaign. However, the expected level of provision of the public good is typically higher when the provision of the public good is financed exclusively by the

[2]Kamdar et al. (2015) establish that altruism and warm-glow cannot explain this unexpected fundraising success, and therefore attribute it to the fact that incentives change behavior, e.g., the charity's willingness to stop future soliciting for money leads donors to be generous in the short run; and social pressure avoidance.

endowment, but not necessarily generates higher expected utility for donors.

This paper proceeds as follows. In section 1.2, I briefly review the literature on the voluntary provision of public goods, focusing particularly on giving decisions in an intertemporal setting. Subsequently, in section 1.3, I describe the model of donor-NPO interaction, which is formalized as a three-stage non-cooperative game. In sections 1.4, I study donor and NPO behavior along the equilibrium path, and contrast outcomes when the charity relies exclusively on endowment funds to finance the provision of the public good versus outcomes when it solicits funds both for the endowment and for the annual campaign. The conclusions and suggestions for future work are presented in section 1.5. All proofs are relegated to the Appendix.

1.2 Literature Review

There is rich theoretical and empirical literature that examines the voluntary provision of public goods. Excellent surveys include Andreoni (2006a) and List (2011a). The conceptual foundations of this literature are found in Olson (1974) and Kolm et al. (1969), but the seminal theoretical model is Bergstrom et al. (1986), which models donor behavior as a one-shot non-cooperative game. The literature on public good provision in multi-stage settings is relevant to the model studied in this paper. Key early contributions are Fershtman and Nitzan (1991), who examine an infinite game in which contributions accumulate over time, and Varian (1994), who examines a two-stage Stackelberg-style game. Whereas the infinite horizon setting accentuates the free-riding problem,[3] the Stackelberg framework generates a less amount of the public good than in the alternative Cournot-Nash game setting; this is even

[3]"...in a dynamic content an individual has the opportunity to learn the response of other players to his and others, à la Becker (1974) that this can increase the severity of the free-riding problem, might eventually choke off voluntary participation in the collective action," Fershtman and Nitzan (1991).

aggravated in the asymmetric information or unfavorable contribution sequence environment.

More recent papers characterize the impact of environment at uncertainty on the efficiency of the public good supply. In the discrete public good setting,[4] McBride (2006) shows that an increase in uncertainty about the provision threshold will increase contributions if the public good is sufficiently valuable. Wang and Ewald (2010a) study a stochastic differential game model setting, where volatility comes either from the current level of the public good or from the rate of the provision to the public good by donors. Lohse et al. (2012) point out that more risk-averse donors require a higher efficient level of the public good,[5] and establish the strategic substitution between the market insurance and efficient provision of the public good.

Various alternative approaches have been studied to resolve free-riding in the dynamic setting. When the level of provision of the public good is not variable, Bagnoli and Lipman (1989) and Bagnoli and McKee (1991) show that it is possible to fully implement the core of the public goods game if donors contributions are returned whenever total pledges are insufficient to cover the cost of provision. Marx and Matthews (2000) study the funding of a public project in a continuous time model, in which there is a discrete jump in benefits once the project is completed, and show that in some settings an efficient level of the public good will be provided. Yildrim (2006) can also generate efficient provision of a public project when agents have idiosyncratic, time variant costs of contributing to the provision of the public good, and these costs are private information. In these papers, there is no explicit modeling of an endowment fund; instead, the focus is either on the interaction between donors or the reduction of the free-rider problem.

In studying the interaction between NPOs and donors, the attention of researchers has

[4]The discrete public good is defined as a threshold production function, which is provided only if the required contribution threshold is satisfied.

[5]Many public goods have the properties of self-insurance (SI) or self-protection (SP), e.g., fire department, national defense, to mitigate the size or probability of loss to the society.

focussed principally on how the use of professional fundraisers and the design of the fundraising campaign influence donor behavior (Bekkers and Crutzen, 2007; Waters, 2008; Rondeau and List, 2008; Kumru and Vesterlund, 2010). It is also noticed that there is growing theoretical and empirical literature on scandal shocks and their subsequent impacts, e.g., too much money spent in fundraising and administration rather than going to charitable works (Donovan, 2002); The Catholic sex abuse scandal merely has the substitution effect for religious participation (Hungerman, 2013); the contradictory result suggests that this negative shock leads to a decline in people's religious participation and long-lasting charitable giving, but no evidence of a decline in pro-social behavior and religious belief (Bottan and Perez-Truglia, 2015). As should be obvious, all these papers point to the fact that the interaction between the economic agents would crucially determine the equilibrium outcome, but again have not addressed the decision to give to an endowment fund as opposed to an annual campaign.

1.3 Model

I study philanthropic decision-making in two institutional settings. As compared to other multi-stage models of the voluntary provision of public goods, the important difference in this paper is that NPO is not simply treated as a conduit for funneling contributions into the provision of the public good. Rather, the NPO is a strategic player, and the control over its investment with the endowment funds is of critical importance when the donors determine how much to contribute to the endowment and to the thereafter annual campaign.

The more general model is a three-stage game, where donors first determine how much to contribute to the charity's endowment, after which the NPO determines what proportion of the endowment funds is to be invested in the risky asset. Finally, the donor can, after observing the outcome of the NPO's investment decision, determine how much to top-up the

NPO's resources by contributing to the annual campaign. This setting is contrasted with a two-stage game, where donors again have to determine how much to contribute to the endowment, and the NPO then chooses how much to invest in the risky asset, but there is no subsequent opportunity for contributing to the annual campaign.

1.3.1 Donors Program

The framework in this paper extends the canonical model of the voluntary provision of public goods. There are N heterogeneous individuals in the economy. Each individual is indexed by $i \in \mathcal{I} = \{1, ..., N\}$, and endowed with income ω_i to consumes two commodities: a private consumption good, x_i, and a public good, G. It is also required that both the private and public goods are normal goods and that they are substitutes in consumption.

To develop a sharp understanding of the key features of the interaction between donors and the NPOs, it is instructive to start with a simple scenario. Assume that there is no asymmetric information about the NPO's investment technology, that is funds invested in the risky asset earn a positive rate of return r with probability π, or are entirely lost with probability $1 - \pi$; the residual endowment funds invested in the risk-free asset maintain their value with certainty. Furthermore, donor i's utility function is quasilinear in the private good x_i, and with constant relative risk aversion (CRRA) for the public good G, that is,

$$U_i(x_i, G) = x_i + u_i(G) = x_i + \frac{G^{\gamma_i}}{\gamma_i}, \tag{1}$$

where $\gamma_i \sim U(0, 1)$, and $1 - \gamma_i \in (0, 1)$ measures the relative risk aversion of the donor i to variation in the level of provision of the public good.[6]

[6]In contrast with the constant marginal utility of private goods, donor i has a declining marginal utility of public good in this model setting. The rationale is contributed by the facts that the real market, either financial or philanthropic, cannot provide donors with perfectly substitutes for the public good as a return on their contributions, and socially responsible investment (SRI) requirements or predetermined charitable

Donor i's decision about how much to contribute to the annual campaign is *ex-post*, which is taken odds all uncertainty is resolved. It can be written as,

$$\max_{g_{is}\geq 0} U_{is}\left(x_{is}, G_s\right) = \omega_i - d_{is} - g_{is} + \frac{\left(R_s + \sum g_{is}\right)^{\gamma_i}}{\gamma_i}, \tag{2}$$

where $s \in \{1, 2\}$, representing the good and bad states of nature, respectively; R_s is the state contingent endowment proceeds generated by the NPO's investment portfolio.

In contrast, donor i's decision to give to the endowment fund is *ex-ante*. She must anticipate the NPO's decision regarding the proportion of its funds to invest in the risky asset, and before nature determines the outcomes of the investment and her following giving to the annual campaign. As a result, donor i's decision-making of contribution to the endowment fund can be expressed as

$$\max_{d_i\geq 0} \mathbb{E}U_i\left(x_i, G\right) = \pi(\omega_i - d_i - g^*_{i1} + {G_1^{\gamma_i}}/{\gamma_i}) + (1-\pi)(\omega_i - d_i - g^*_{i2} + {G_2^{\gamma_i}}/{\gamma_i}), \tag{3}$$

$$s.t. \quad \begin{cases} \beta^* \text{ solves NPO's problem, Eq.(5),} \\ g^*_{is} \text{ solves Eq.(2),} \end{cases}$$

where G_s denotes the state contingent level of the public good, depending on NPO's decision on the optimal portfolio selection, β^*.

1.3.2 NPOs Program

Consistent with the notion of impact philanthropy (Duncan, 2004), assume that NPOs (or the managers who operate them) are fully motivated by social impact instead of being the

risky investment has narrowed the investment domain, which leads the investment project to have a declining marginal utility.

imperfect agents of donors, and its utility, $V(G)$, depends only on the total amount of the public good G it produces. Suppose that the NPO has a utility function exhibiting constant relative risk aversion(CRRA). Specifically, let

$$V(G) = \frac{G^{\alpha}}{\alpha}, \tag{4}$$

where $0 < \alpha < 1$. Note that $1 - \alpha \in (0, 1)$ measures the relative risk aversion of the charity to variation in the level of provision of the public good.

Definition 1.1. (Investment portfolio) *The NPO's investment portfolio comprises two assets, one risky asset and one risk-free asset. Assume $\beta \in \Omega$, which is a compact and convex set defined in $[0, 1]$, the NPO strategically allocates β proportion of its endowment fund to the risky asset and the rest to the risk-free asset.*

After donors have contributed to the endowment fund, the NPO has the opportunity to invest a proportion, β, of the endowment funds to a risky asset, leaving the remaining funds in the safe asset. The risky asset is assumed to have a positive expected rate of return, that is $\mathbb{E}(r) = \pi r - (1 - \pi) > 0$.

Noting that the state of nature is fully realized for donors when the uncertainty of the NPO's risky investment resolves *ex-post* by strategically choosing β. For a given level of endowment fund, D, function $\Omega : \beta \to \mathbb{E}U$, Ω maps onto $\mathbb{R}^{+}$. Define the NPO's expected utility, $\mathbb{E}U$, as a convex combination of these polar cases, either success or failure in the risky invetsment. The NPO's problem is:

$$\max_{0 \leq \beta \leq 1} \mathbb{E}V\left(G\right) = \pi \frac{\left(\left(1 + r\beta\right) D + \sum g_{i1}\right)^{\alpha}}{\alpha} + \left(1 - \pi\right) \frac{\left(\left(1 - \beta\right) D + \sum g_{i2}\right)^{\alpha}}{\alpha}, \tag{5}$$

$$s.t. \qquad D \in (0, +\infty).$$

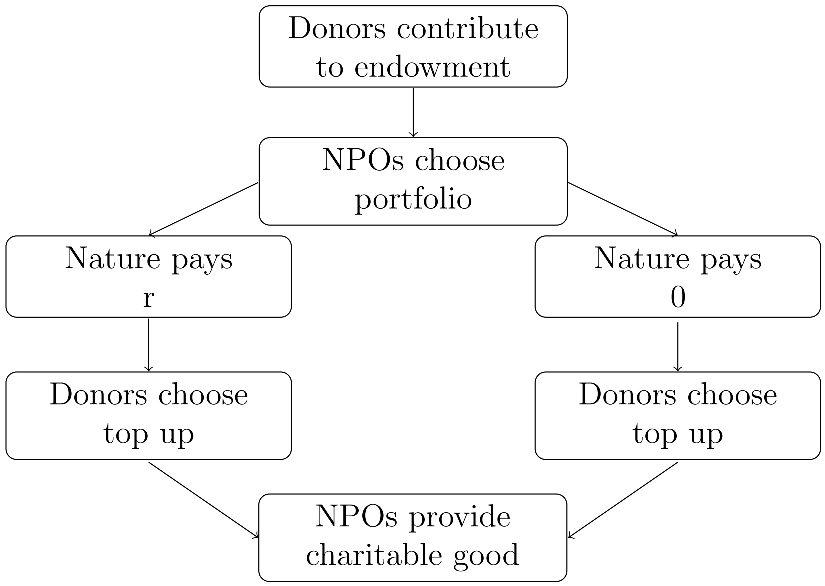


Figure 1.1: Structure of the Three -Stage Game

1.3.3 Timing

I study two different games in this paper. The two-stage game is identical to the three-stage model, except that there is no opportunity for donors to contribute to the annual campaign. Therefore, only the net endowment funds are used to produce the public good. The more general game has three stages. The sequence of events unfolds as follows.

1. In stage 1, anticipating the NPO's behavior in stage 2 and the subsequent opportunity for the annual campaign in stage 3, each individual i strategically decides how much to contribute to the NPO's endowment fund, i.e., D.

2. In stage 2, the NPO decides on the proportion, β, of the endowment fund to invest in the desired risky asset. Nature then determines whether the risky asset pays r, or whether it pays 0;

3. Subsequently, in stage 3, after nature determines the return on the risky asset, donors

can choose to contribute to an annual campaign; the net endowment funds plus annual campaign contributions determine the level of provision of the public good. The game then ends.

This is summarized in Figure 1.1. It is worthwhile to stress that the timing design reflects that donors control the fundraising process to get the desired risky portfolio and expected utility. Nevertheless, the designed applicability of giving to the annual campaign ensures that the NPO behaves unselfishly in the spirit of Bruce and Waldman (1990),[7] especially in the absence of central authority to enforce the commitment.

1.4 Equilibrium Analysis

I solve both games backwards, and so seek to characterize subgame perfect Nash equilibrium outcomes. It is simplest to begin by examining donors and the NPO's behavior in the two-stage model when there is no opportunity for donors to top-up their initial gift to the endowment by contributing subsequently to an annual campaign.

1.4.1 Equilibrium with Only an Endowment Drive

To characterize the equilibrium, I first examine the behavior of the NPO in stage 2 when it must choose, for a given level of endowment, D, how to allocate its resources between the risky and the risk-free asset. In this specific setting, where the NPO's utility function is characterized by constant relative risk aversion, it is straightforward to show that the charity always invests a constant proportion of its endowment funds in the risky asset.[8]

[7]Becker (1974) establishes that if the transfer by altruistic family members is operative in a "*tit for tat*" strategy, the rotten kid will act unselfishly to maximize the whole family's income. "we extended Becker's rotten-kid theorem by showing that the child will undertake actions which maximize family income in (*both*) periods as long as the parent makes an operative transfer in the last period", Bruce and Waldman (1990).

[8]Given donors' contributions to the endowment fund in stage 1, in stage 2 of the two-stage model, the NPO's decision-making of β^* is essentially the application of Merton (1969) and Samuelson (1969), except

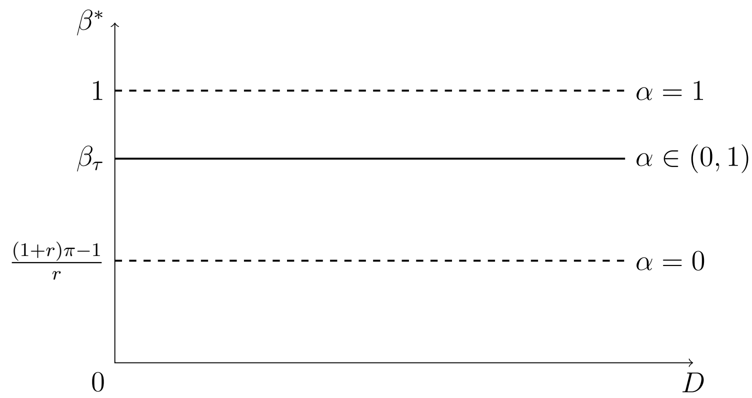


Figure 1.2: NPO optimal portfolio selection β^* in the setting with only an endowment drive.

Proposition 1.1. *The optimal proportion β^*, of the NPO's endowment fund, which is optimally invested in the risky asset, is independent of the level of the endowment fund and increases in the NPO's risk preference parameter, α. The NPO's expected utility is strictly concave in β.*

Proof: See Appendix 1.6.

Proposition 1.1 shows that, in the two-stage model setting, a constant proportion of the endowment is invested in the risky asset, and this proportion depends only on the charity's aversion to risk, and not on any characteristic of the donor. As the NPO becomes less risk averse, it invests a higher proportion of its endowment in the risky asset, with a lower bound of $\frac{(1+r)\pi-1}{r}$ and an upper bound of 1, respectively. Figure 1.2 illustrates this.

Remark 1.1. *In equilibrium, the level of the endowment fund, D^*, satisfies*

$$D^* = \max_{\gamma_i} \left\{\pi(1+r\beta^*)^{\gamma_i} + (1-\pi)\left(1-\beta^*\right)^{\gamma_i}\right\}^{\frac{1}{1-\gamma_i}} > 1,$$

which is increasing in donors' risk preference parameter γ_i with a lower bound of 1 at $\gamma_i = \underline{\gamma}$

that the model studied here is not simply a one agent life time optimal portfolio selection problem, but a sequential game between the NPO and donors.

and an upper bound of $+\infty$ at $\gamma_i = 1$. Only the least risk-averse donor contributes; others free-ride.

Proof: See Appendix 1.6.

It is no surprise that only the donor i with the greatest γ_i contributes to the endowment fund; this is entirely an artifact of donor i's quasi-linear form of the utility function. However, this property is important for establishing the next results.

Corollary 1.1. *When the provision of the public good is financed only by the proceeds of the endowment fund, then the equilibrium size of the endowment and the expected level of provision of the public good both increase as the charity becomes less risk averse. As the NPO becomes less risk averse, thus donor(s) also increase their expected utility.*

Proof: See Appendix 1.6.

The notion that, in equilibrium, a risk-averse donor prefers to contribute to a less risk-averse NPO rather than to a NPO which has a risk preference similar to his or her own is somewhat surprising. In particular, a risk-neutral NPO invests the entire endowment in the risky asset, leaving the risk-averse donor with zero consumption of the public good in the bad state. If the donor were to directly control the NPO's investment decision, the donor would always choose $\beta_d^* = \frac{\zeta - 1}{\zeta + r}$, where $\zeta = (\frac{\pi r}{1-\pi})^{1/(1\,-\,\gamma_i)}$ (see Appendix proof of Remark 1), so that the donor would choose a more cautious investment strategy than a risk-neutral charity.

So why is there associated with a Pareto improvement of donors' expected utility when the NPO becomes less risk-averse? An increase in β^* raises the donor i's expected marginal utility of giving an additional dollar to the endowment, since the donor i's marginal utility of the public good in the good state increases more than it decreases in the bad state, which therefore shifts the $\mathbb{E}MB_i$ curve rightwards. Since the expected marginal benefit of contributing an additional dollar to the endowment must equal the marginal cost, which

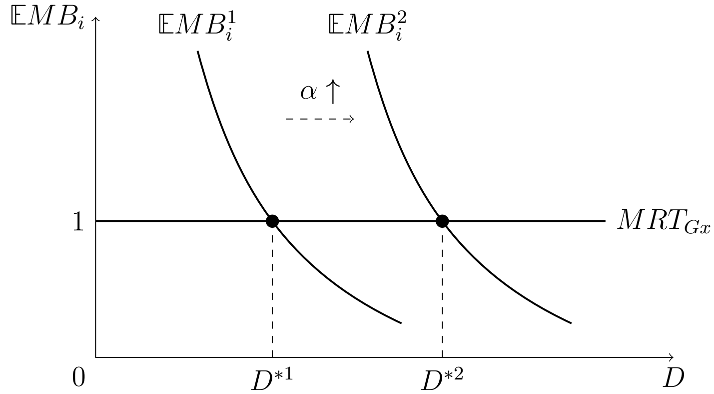


Figure 1.3: The impact of NPO's risk parameter α on the endowment level D^* in the setting with only an endowment drive.

is constant and equal to one, this condition can only be satisfied if there is an increased equilibrium donation. In effect, the equilibrium level of the endowment, D^*, increases if the NPO becomes less risk-averse, which is the driving force to explain the results in Corollary 1.1. This is illustrated in Figure 1.3.

1.4.2 Equilibrium with an Endowment Drive and Annual Campaign

The aim here is to characterize the subgame-perfect Nash equilibrium of the game when, in stage 3, donors can contribute to an annual campaign. As I use backwards induction to characterize equilibrium outcomes, it is first necessary to study donors' behavior in the annual campaign subgame. This, however, is essentially the classic voluntary provision game (Bergstrom et al., 1986), except that the proceeds of the endowment fund provide a floor on the level of funding for the public good.

Lemma 1.1. *In stage 3, the donors' contribution to the annual campaign depends only on the level of endowment fund proceeds. In any state in which the proceeds of the endowment*

fund exceed 1 unit, the annual campaign contribution is zero. Otherwise, the endowment proceeds will be topped up to 1 unit.
Proof: See Appendix 1.6.

Knowing how donors behave in the annual campaign phase, the next step is to examine the investment decision of the charity in stage 2. The charity's investment decision requires it to trade off the benefits to the charity of a more aggressive investment strategy, which leads to a higher level of provision of the public good in the good state and less in the bad state; or, in contrast, a more conservative investment strategy, which would result in a lower level but also less variation in the expected provision of the public good.

Definition 1.2. (Cautious investor). *For a risk-averse NPO, define the threshold risk parameter α_τ such that $\alpha_\tau = \frac{1}{1+r}$. A NPO is defined as a cautious investor if $\alpha < \alpha_\tau$ and as an aggressive investor if $\alpha > \alpha_\tau$.*

Proposition 1.2. *If the NPO is a cautious investor($\alpha < \alpha_\tau$) then there exists a critical level of the endowment fund D_τ, possibly very large, such that $\beta^* = 1$ in any subgame-perfect Nash equilibrium when $D < D_\tau$. If $D > D_\tau > 1$, then the NPO will choose a conservative investment strategy, $\beta^* = \beta_\tau < 1$ such that the endowment proceeds exceed 1 in both states of nature. In contrast, if the NPO is an aggressive investor($\alpha > \alpha_\tau$), then $\beta^* = 1$ in any subgame-perfect Nash equilibrium.*
Proof: See Appendix 1.6.

The proof of Proposition 1.2 establishes that when the initial endowment $D < D_\tau$, the dominant strategy for the charity is to choose $\beta^* = 1$. It is interesting to note that for $D \leq \frac{1}{1+r}$, the charity's expected payoff is independent of β^*, whereas for $\frac{1}{1+r} < D < D_\tau$, the charity's expected utility is monotonically increasing in β. The threshold D_τ depends on the risk parameter for the charity, α, as well as the inestment technology, r and π, which

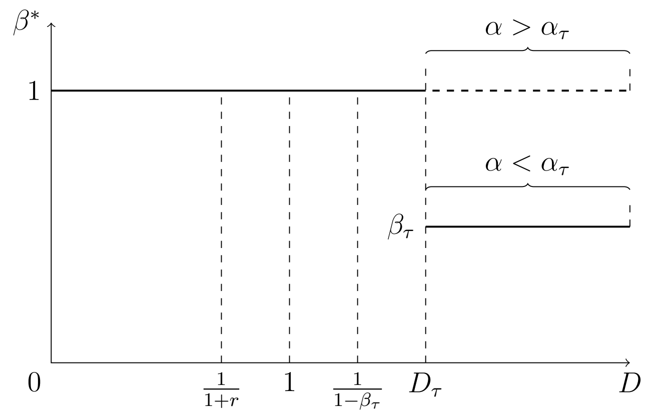


Figure 1.4: The discontinuity of NPO optimal portfolio selection β^* in the setting with endowment drive and an annual campaign.

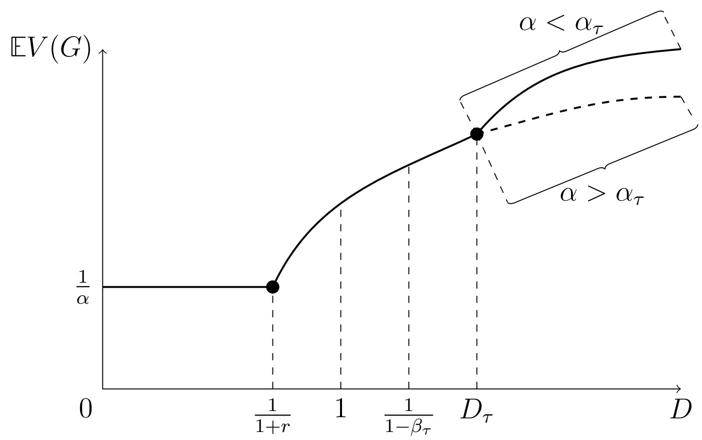


Figure 1.5: NPO expected utility $\mathbb{E}V(G)$ in the setting with endowment drive and an annual campaign.

determines the expected return on the risky asset. When D is relatively modest, a choice of $\beta^* = 1$ by the charity means that the endowment proceeds are less than 1 in the bad state, and greater than 1 in the good state. The donors, therefore, contribute to the annual campaign in the bad state, but not in the good state, and the charity prefers to invest aggressively to have a higher average level of the public good, although this means there is more variance in the level of its provision.

However, for a large enough level of D, which must exceed one unit, and when the charity is a cautious investor such that $\alpha < \alpha_\tau$, the benefit to the charity of a marginal increase in the level of provision is less valuable than a reduction in the variance in the level of provision of the public good. For $D > D_\tau$, the charity chooses a conservative investment strategy, which results in endowment proceeds exceeding 1 unit in both states of the world, and there is no annual campaign contribution by the donors. Figures 1.4 and 1.5 illustrate this property. Note that Figure 1.4 reveals the discontinuity in the NPO's optimal choice of β^* that arises when the NPO is a cautious investor. For $D < D_\tau$, the charity always chooses $\beta^* = 1$, otherwise, at D_τ, it jumps down to choose $\beta^* = \beta_\tau$, which is less than 1.

Having characterized the NPO's behavior in stage 2, I turn to the analysis of the decisions taken by donors regarding their contribution to the endowment fund in stage 1. Whereas donors do not always contribute to the annual campaign, I show below, in Proposition 1.3, that they always contribute to the endowment fund. If donors prefer stability in the level of the public good to stability in the consumption of the private good, then the unique equilibrium path is one in which they contribute to both the endowment fund and to the annual campaign. However, if the charity is sufficiently risk-averse, and donors are sufficiently risk-tolerant regarding variation in the consumption of the public good, then the equilibrium path involves donors making a large contribution to the endowment fund in stage 1, the charity choosing a conservative investment strategy in stage 2, and donors making a zero contribution to the annual campaign in stage 3.

Definition 1.3. (Endowment demand function $\Psi : \gamma_i \to D^*$) *By Remark 1.1, if the provision of the public good is financed only by the proceeds of the endowment fund, the donor i with the largest risk parameter γ_i contributes, and her demand for the level of the endowment fund, D^*, is monotonically increasing in γ_i when $\gamma_i > \underline{\gamma}$. Define the demand function $\Psi : \gamma_i \to D^*$, then Ψ maps onto $(1, +\infty)$, and its inverse function $\gamma_i = \Psi^{-1}(D^*)$.*

Proposition 1.3. *When donors have the option of contributing both to an endowment fund*

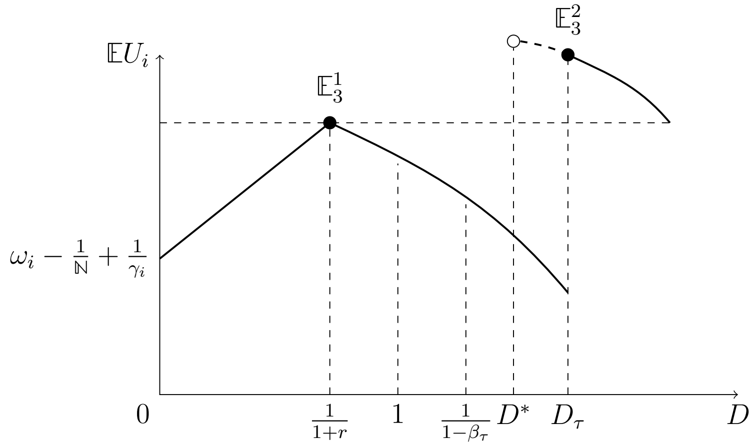


Figure 1.6: Donor i optimal expected utility $\mathbb{E}U_i$ when $\alpha < \alpha_\tau$ and $\gamma_i > \hat{\gamma}$

$\mathbb{E}_3^1$ and $\mathbb{E}_3^2$ consist of the potential equilibriums in the institutional framework with endowment drive and annual campaign.

and to an annual campaign, there is a unique subgame-perfect Nash equilibrium path. If the charity is an aggressive investor, such that $\alpha > \frac{1}{1+r}$*, then in equilibrium donors contribute* $\frac{1}{1+r}$ *to the endowment fund, the charity chooses* $\beta^* = 1$*, and endowment funds are topped up to* 1 *when the risky investment fails. In contrast, if the charity is a cautious investor, that is* $\alpha < \frac{1}{1+r}$*, then there exists a threshold level of donor i's risk parameter* $\hat{\gamma}$*, such that if* $\gamma_i > \hat{\gamma}$*, then donor* i *contributes* $D \geq D_\tau > 1$ *to the endowment fund, the charity chooses* $\beta_\tau < 1$*, and there is no top-up giving in stage* 3*; otherwise, if* $\gamma_i < \hat{\gamma}$*, the unique subgame-perfect Nash equilibrium is the same as when* $\alpha > \frac{1}{1+r}$.

Proof: See Appendix 1.6.

Proposition 1.3 establishes that, for any given risk parameter and investment technology set $\Theta = \{\alpha, \gamma_i; r, \pi\}$, there is a unique subgame perfect Nash equilibrium. To understand why this is true, it is useful to refer back to Figure 1.4. Observe that if $D \leq D_\tau$, or $D > D_\tau$ but the NPO is an aggressive investor, then the NPO always chooses $\beta^* = 1$. This means that the endowment proceeds in the bad state are always zero, and donors then make a contribution to the annual campaign, ending up with one unit of the public good. It is straightforward to check that donor i's expected utility is maximized when the initial endowment is $\frac{1}{1+r}$, which ensures the donors will obtain one unit of the public good without uncertainty.

In contrast, when the NPO is a cautious investor, i.e., $\alpha < \alpha_\tau$, there must be an endowment level, D_τ, such that when $D > D_\tau$, the NPO chooses $\beta^* = \beta_\tau$ as its dominant investment strategy. If the risky investment generates a higher enough expected return as compared to $\mathbb{E}_3^1$ (Figure 1.6), the donor may contribute a considerably large amount in the initial endowment, which the charity invests conservatively. In this equilibrium $\mathbb{E}_3^2$ (Figure 1.6), donors do not contribute to the annual campaign.

Figure 1.6 also illustrates the relationship between the size of the endowment fund and donor i's expected utility, which is discontinuous at D_τ. When $\mathbb{E}U_i(D \geq D_\tau) < \mathbb{E}U_i(D = \frac{1}{1+r})$, then the subgame perfect Nash equilibrium will have donors giving both to the endowment fund and to the annual campaign. When the reverse condition holds, then the subgame perfect Nash equilibrium involves giving only to the endowment fund.

Remark 1.2. *In equilibrium, donor may not contribute to the annual campaign, but always gives to the endowment drive.*
Proof: See Appendix 1.6.

Remark 1.2 crystallizes that the strategy profile with no one donating anything in the first period, but giving only in the second period can not be the subgame perfect equilibrium. The rationale is that strategy profile with a contribution to the endowment drive will be a profitable deviation.

1.4.3 Model Comparison

Having studied the equilibrium behavior of donors and the charity when fundraising is conducted with and without an annual campaign, it is interesting to ask whether donors and the charity can agree about the institutional rules under which fundraising should be conducted to finance the provision of the public good. What this requires is a comparison of the donor and charity's equilibrium payoffs in the two games (see Figure 1.7). Importantly, in both settings, the equilibrium is inefficient: there is underprovision of the public good as compared to what is prescribed by the Samuelson rule. Below, what I show is that the interests of donors and the charity generally disagree, and the donor may prefer the inefficient outcome with a lower level of the public good to the alternative, also inefficient, outcome that would prevail in the alternative fundraising environment.

Proposition 1.4. *Donors and the NPO generally disagree about whether the charity should run an annual campaign.*
Proof: See Appendix 1.6.

The proof of Proposition 1.4 establishes that the ranking of the institutional framework by the donors and NPO is contingent on the degree of risk-aversion and the investment technology. When $\alpha > \frac{1}{1+r}$, or when $\alpha < \frac{1}{1+r}$ and $\gamma_i < \hat{\gamma}$, the NPO prefers an institutional setting where it is limited to raising funds for the endowment, but cannot run an annual campaign. In the specific subcase of $\alpha > \frac{1}{1+r}$, when $\gamma_i > \hat{\gamma}$, this is also the preferred outcome for the donors; otherwise, the donor prefers the outcome when the NPO solicits both for the endowment and annual campaign, even though this results in a lower level of the public good. However, when $\alpha < \frac{1}{1+r}$ and $\gamma_i > \hat{\gamma}$, the preferences of the donor and the charity are reversed: it is the charity which prefers the institutional setting with an annual campaign, and donors who prefer fundraising to be limited to the endowment drive.

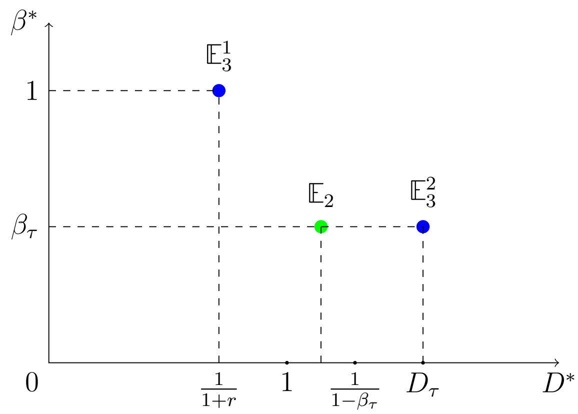


Figure 1.7: The impact of model selection on the equilibrium path

The green point $\mathbb{E}_2$ represents the equilibrium in the model setting with only an endowment drive. The blue points $\mathbb{E}_3^1$ and $\mathbb{E}_3^2$ comprise the potential equilibriums in the institutional framework with endowment drive and annual campaign.

This conflict stems from the different objectives of the NPO and donors. The NPO cares about the expected level of provision of public goods; the α parameter determines its aversion to variance in the level of provision. In contrast, donors care about the level (and variance) in the provision of public goods but also about the level (and variance) in the consumption of private good. As illustrated in Figures 1.2 and 1.4, for any given combination of risk parameters and investment technology, $\Theta = \{\alpha, \gamma_i; r, \pi\}$, the NPO chooses a weakly less aggressive portfolio when it is limited to raising funds only for its endowment as compared to the setting with an annual campaign. Nevertheless, in the framework of fundraising with an annual campaign, the discontinuity in the selected risky portfolio results in the jump of donors' expected utility (see Figures 1.4 and 1.6) and a much larger contribution to the endowment when the NPO is a cautious investor. In the setting with an annual campaign, this induces the donors to give less to the aggressive NPO, and more to the conservative one, than in the alternative fundraising framework. Importantly, an outcome with more public goods is not necessarily better for donors although this is closer to the level of provision of the public good which is required to satisfy the Samuelson rule.

It is essential to stress that in this paper, I compare two inefficient outcomes, not a comparison with the first-best outcome. Nevertheless, the results in Propositions 1.3 and 1.4 complement the findings of Kamdar et al. (2015), and provides a novel explanation of the success of fundraising when the NPO expresses the willingness to stop soliciting in the future. It must be emphasized that this fundraising success is conditional on $\Theta = \{\alpha, \gamma_i; r, \pi\}$, and may not actually make the donors better off.

1.5 Conclusions and Future Applications

In the present paper, I design the voluntary supply of public goods in a non-cooperative sequential game setting. Importantly, I do not simply treat the charity as a conduit for transforming donations into the desired public good, instead, the charity behaves strategically, because it must decide how to invest its endowment funds.

I study donors and NPO behavior in two different settings. In the first setting, donors contribute to an endowment fund, and the NPO decides on the proportion of this fund to invest in a risky asset. Net endowment proceeds are used to finance the provision of the public good. In the second setting, donors are also allowed to contribute to an annual campaign after observing the results of the investment decision.

In the three-stage game, when the NPO is risk tolerant, or both the NPO and donors are sufficiently risk averse, the donors provide an endowment fund of $\frac{1}{1+r}$, the NPO invests the entire endowment in the risky asset, and donors contribute to the annual campaign when the investment fails, one unit of the public good is provided in both states of the world. In contrast, when the NPO is a cautious investor and donors are risk tolerant, the discontinuity in the NPO portfolio selection results in the jump of donors' expected utility. As compared to the two-stage game where there only has an endowment drive, donors tender to give less to the aggressive NPO and more to the conservative one. However, an outcome with more public goods is not necessarily better for donors, which ultimately leads to the conflict of ranking of the alternative institutional framework by donors and the NPO.

This paper's findings suggest several opportunities for future work. For instance, extending this model to the case of a stochastic differential game model to investigate how external shocks, i.e., the rate of return and income shocks, would propagate and affect the equilibrium outcomes. It would also be interesting to test the theoretical findings in this paper, e.g., the discontinuity in the charity portfolio selection, and the conflict of ranking of the alternative institutional framework by donors and the NPO, by using trustable *NCCS* data.[9]

[9] NCCS established in 1982 and dedicated to develop uniform standards for reporting on the activities of charitable organisations and build the compatible national, state, and regional databases, is the national repository of data on the nonprofit sector in the United States.

1.6 Appendix

1.6.1 Proof of Proposition 1.1

Proof. For the sake of simplicity, denote $\sum d_i$ and $\sum_{j \neq i} d_j$, respectively, as D and D_{-i} in future use of the proofs.

Recall that NPO's utility function takes the form of CRRA, $V(G) = \frac{G^\alpha}{\alpha}$. Given an initial endowment D, the NPO's investment decision is to strategically choose β to solve,

$$\beta^*(D) = \arg\max_{0 \leq \beta \leq 1} \mathbb{E}V(G) = \pi V\big\{(1 + r\beta) D\big\} + (1 - \pi) V\big\{(1 - \beta) D\big\}.$$

It is easy to verify that the second-order derivative, $\frac{\mathrm{d}^2 \mathbb{E}V(G)}{\mathrm{d}^2 \beta}$, is negative, but first-order derivatives, $\frac{\mathrm{d}\mathbb{E}V(G)}{\mathrm{d}\beta}$, at $\beta = 0$ and 1 are positive and negative, respectively. Therefore, the NPO's expected utility must be strictly concave on β. At an interior solution, first-order condition for the charity's problem is $\pi V_1' r D - (1 - \pi) V_2' D = 0$, and therefore β^* equals

$$\beta^* = \frac{\zeta - 1}{\zeta + r}, \qquad \text{where} \quad \zeta = \Big(\frac{\pi r}{1 - \pi}\Big)^{\frac{1}{1-\alpha}}. \tag{A.1}$$

Notice that β^* is independent of D, which implies that the NPO invests a constant proportion of its endowment in the risky asset. Observe also that ${}^{\mathrm{d}\beta^*}/_{\mathrm{d}\alpha} > 0$, which implies that as the NPO becomes less risk averse, it invests a higher proportion of its endowment in the risky asset. One can verify that $\beta^* \in [\frac{(1+r)\pi - 1}{r}, 1]$. □

1.6.2 Proof of Remark 1.1

Proof. Recall that donor i's utility function takes the form

$$U_i(x_i, G) = x_i + u_i(G) = x_i + {}^{G^{\gamma_i}}/_{\gamma_i}. \tag{A.2}$$

Donor i chooses initial contribution d_i to maximize expected utility anticipating the choice of β^* by the NPO

$$\max_{d_i \geq 0} \mathbb{E}U_i\left(x_i, G\right) = \pi\Big(\omega_i - d_i + \frac{\left(\left(1 + r\beta^*\right) D\right)^{\gamma_i}}{\gamma_i}\Big) + (1-\pi)\Big(\omega_i - d_i + \frac{\left(\left(1 - \beta^*\right) D\right)^{\gamma_i}}{\gamma_i}\Big),$$

where $\beta^* = {}^{\zeta\,-\,1}/_{\zeta\,+\,r}$, as shown in Proposition 1.1. By the first order condition with respect to β, one can easily verify that if the donor i were to control the charity's investment decision, she would choose $\beta_d^* = \frac{\zeta - 1}{\zeta + r}$, where $\zeta = (\frac{\pi r}{1-\pi})^{1/(1\,-\,\gamma_i)}$. As should be obvious, there always exists a conflict over risky portfolio selection between donor i and the charity except that donor i's risk parameter γ_i is exactly equal to the charity's risk parameter α.

Given the optimal initial contributions of others, the first order condition for the donor i's problem requires that for any donor i for whom $d_i^* > 0$ it must be true that

$$\pi\Big((1 + r\beta^*)D\Big)^{\gamma_i - 1}\left(1 + r\beta^*\right) + (1-\pi)\,\Big(\left(1 - \beta^*\right) D\Big)^{\gamma_i - 1}\left(1 - \beta^*\right) = 1. \qquad \text{(A.3)}$$

The LHS of Eq.(A.3) reflects the expected marginal benefit of an additional unit of endowment, D, measured in the units of forgone private consumption (in this case, the marginal utility of private consumption is equal to 1). The RHS is the marginal rate of transformation, MRT_{Gx}, which is assumed to be equal to 1. Therefore, donor i's demand for the endowment fund, D^*, becomes

$$D^* = \Big(\pi(1 + r\beta^*)^{\gamma_i} + (1-\pi)\left(1 - \beta^*\right)^{\gamma_i}\Big)^{\frac{1}{1-\gamma_i}}.$$

Note that if the charity is risk neutral, then $D = \max\limits_{\gamma_i}\left\{\pi\left(1 + r\right)^{\gamma_i}\right\}$, which is governed by the donor's risk-aversion parameter γ_i only. Define $f(\gamma_i) = \pi\left(1 + r\beta^*\right)^{\gamma_i} + (1-\pi)\left(1 - \beta^*\right)^{\gamma_i}$. Straightforward calculations establish that the second order derivative, f'', is positive, and

$\lim_{\gamma_i \to 0^+} f(\gamma_i) = 1 < \lim_{\gamma_i \to 1^-} f(1) = 1 + (\pi r - (1-\pi))\beta$, which implies that there must exist a $\underline{\gamma}$, such that $f(\gamma_i)$ is strictly increasing and convex on γ_i when $\gamma_i > \underline{\gamma}$. Consequently, the demand for public good, D^*, is strictly increasing in γ_i with the lower bound 1 at $\gamma_i = \underline{\gamma}$ and upper bound $+\infty$ at $\gamma_i = 1$.

As established by Bergstrom et al. (1986), when donors have a quasi-linear utility function, the contributor set consists only of those donors with the greatest demand for the public good. As should be obvious, in this case only the donor with highest risk parameter, say donor i with γ_i, contributes to the endowment fund, the rest free ride. That is,

$$d_j^* = \begin{cases} D^* = \left(\pi(1+r\beta^*)^{\gamma_i} + (1-\pi)\left(1-\beta^*\right)^{\gamma_i}\right)^{\frac{1}{1-\gamma_i}} & j = i, \\ 0 & j \neq i \end{cases} \tag{A.4}$$

The level of expected public good $\mathbb{E}(G)$ therefore equals $\left(1 + (\pi r - (1-\pi))\beta^*\right)D^*$. It must be true that $\mathbb{E}(G) > D > 1$ since $\pi r - (1-\pi) > 0$. This proves Remark 1.1. □

1.6.3 Proof of Corollary 1.1

Proof. Recall from Remark 1.1 that $\mathbb{E}(G) = \left[1 + (\pi r - (1-\pi))\beta^*\right]D^*$. Thus:

$$\begin{aligned} \frac{\mathrm{d}\mathbb{E}\left(G\right)}{\mathrm{d}\beta^*} &= \frac{\partial\mathbb{E}\left(G\right)}{\partial\beta^*} + \frac{\partial\mathbb{E}\left(G\right)}{\partial D^*}\frac{\mathrm{d}D^*}{\mathrm{d}\beta^*}, \\ &= \left(\pi r - (1-\pi)\right)D^* + \left(1 + (\pi r - (1-\pi))\beta^*\right)\frac{\mathrm{d}D^*}{\mathrm{d}\beta^*}. \end{aligned} \tag{A.5}$$

Rewrite Eq.(A.3) as

$$D^{*1-\gamma_i} = \pi\left(1 + r\beta^*\right)^{\gamma_i} + (1-\pi)\left(1-\beta^*\right)^{\gamma_i}.$$

Differentiating, I obtain

$$(1-\gamma_i)D^{*-\gamma_i}\frac{\mathrm{d}D^*}{\mathrm{d}\beta^*}=\gamma_i\left[\pi r\left(1+r\beta^*\right)^{\gamma_i-1}-\left(1-\pi\right)\left(1-\beta^*\right)^{\gamma_i-1}\right]. \tag{A.6}$$

It is easy to see that the RHS of Eq.(A.6) is decreasing in β^* and it is positive at $\beta^*=1$. Therefore, $\frac{\mathrm{d}D^*}{\mathrm{d}\beta^*}>0$. From Eq.(A.5) I have $\frac{\mathrm{d}\mathbb{E}(G)}{\mathrm{d}\beta^*}>0$. This finishes the proof of first part of Corollary 1.1.

Note that along the equilibrium path, the expected utility of the donor i who contributes to finance the NPO can be expressed as:

$$\begin{aligned}\mathbb{E}U_i\left(x_i,G\right)&=\omega_i-D^*+\pi\frac{\left(\left(1+r\beta^*\right)D^*\right)^{\gamma_i}}{\gamma_i}+\left(1-\pi\right)\frac{\left(\left(1-\beta^*\right)D^*\right)^{\gamma_i}}{\gamma_i},\\&=\omega_i+\big(\frac{1}{\gamma_i}-1\big)D^*.\end{aligned} \tag{A.7}$$

Alternatively, for donors $j\neq i$ who free ride, her expected utility equals

$$\begin{aligned}\mathbb{E}U_j\left(x_j,G\right)&=\omega_j+\pi\frac{\left(\left(1+r\beta^*\right)D^*\right)^{\gamma_j}}{\gamma_j}+\left(1-\pi\right)\frac{\left(\left(1-\beta^*\right)D^*\right)^{\gamma_j}}{\gamma_j},\\&=\omega_j+\frac{D_j^{*1-\gamma_j}}{\gamma_j}D^{*\gamma_j},\end{aligned} \tag{A.8}$$

where D_j^* is donor j's demand for the public good, which is less than D^*. It is direct that all the individuals' expected utility will increase when the charity becomes less risk-averse. This completes the prove of Corollary 1.1. □

1.6.4 Proof of Lemma 1.1

Proof. As in Bergstrom et al. (1986), in stage 3, donor i chooses her *ex-post* state contingent contribution to the annual campaign, g_{is}, to maximize her utility.

$$\max_{g_{is}\geq 0} U_{is}\left(x_{is}, G_s\right) = \omega_i - d_{is} - g_{is} + \frac{\left(R_s + \sum g_{is}\right)^{\gamma_i}}{\gamma_i}, \tag{A.9}$$

where $s \in \{1, 2\}$ represents the good and bad states of nature, respectively; R_s is the realized state contingent endowment proceeds.

The first-order condition for the donor i's problem must follow that if $g_{is} > 0$ then

$$G_s \equiv R_s + \sum g_{is} = 1. \tag{A.10}$$

Eq.(A.10) indicates that giving to the annual campaign always leads to the provision of one unit of the public good, which is independent of the donors' characteristics. Donors will no longer contribute to annual campaign when the realized endowment proceeds exceed 1 unit. Donor i's reaction function becomes

$$g_{is}^{*} \equiv 1 - (R_s + \sum_{j\neq i} g_{js}^{*}) \qquad \forall\ i \in \mathbb{N}. \tag{A.11}$$

Notice that gifts to the annual campaign are perfect substitutes. Although the level of the provision of public good is uniquely determined, whenever there is a positive giving to the annual campaign there is an infinite number of combination of gifts that can support the equilibrium outcome. In the context of equally cost sharing mechanism, Eq.(A.11) can be simply written as $g_{is}^{*} \equiv {}^{(1-R_s)}/_{\mathbb{N}}$. This finishes the prove of Lemma 1.1. $\square$

1.6.5 Proof of Proposition 1.2

Proof. To establish the claim of Proposition 1.2, it is useful to first address several intermediate results that enable us to characterize charity behavior along the equilibrium path.

Lemma 1.2. *If the endowment fund $D \in (0, \frac{1}{1+r}]$, the charity's expected payoff is independent of β, and therefore $\beta^* = 1$ is an optimal choice for the charity.*

Proof. If $D \in (0, \frac{1}{1+r}]$, then $\forall\beta \in (0, 1]$ the possible investment proceeds must be $R_1 = (1 + r\beta)D \leq 1$ and $R_2 = (1 - \beta)D < 1$. By Lemma 1.1, in stage 3, the donor will always top-up the endowment proceeds to 1 unit. This implies that the charity's expected utility is independent of β^* since $\forall\beta \in (0, 1]$ the charity obtains utility, $^1/_\alpha$, in both states of nature. Therefore, $\beta^* = 1$ is an optimal choice for the charity. □

Lemma 1.3. *If the endowment fund $D \in (\frac{1}{1+r}, 1]$, the charity's expected payoff is monotonically increasing in β. Therefore, the charity always chooses $\beta^* = 1$.*

Proof. For $D \in (\frac{1}{1+r}, 1]$, there are two cases to consider.

If $\beta < (\frac{1}{D} - 1)/r$, the endowment proceeds must be less than one unit in both states of nature. By Lemma 1.1, donors will top up the endowment proceeds to 1 unit, and the charity obtains utility, $\frac{1}{\alpha}$, which is independent of the charity's choice of $\beta \in [0, (\frac{1}{D} - 1)/r]$.

If $\beta > (\frac{1}{D} - 1)/r$, then $R_1 > 1$ and $R_2 < 1$. By Lemma 1.1, donors contribute to the annual campaign only when the investment is unsuccessful. Therefore, the charity's decision-making problem in stage 2 becomes:

$$\max_{(^1/_D - 1)/r < \beta \leq 1} \mathbb{E}V(G) = \pi \frac{[(1 + r\beta)D]^\alpha}{\alpha} + (1 - \pi)\frac{1^\alpha}{\alpha}.$$

At a solution to the charity's utility maximization problem

$$\frac{\mathrm{d}\mathbb{E}V(G)}{\mathrm{d}\beta} = \pi \left[(1 + r\beta)\, D\right]^{\alpha-1} rD > 0,$$

which implies that the charity will always choose $\beta^* = 1$. Therefore, the charity reaps investment proceeds in the good state which totally crowd out the annual campaign contribution, and null investment proceeds in the bad state which leads the donors to contribute 1 unit to the annual campaign. Its optimal expected utility can be expressed as:

$$\mathbb{E}^*V(G) = \pi \frac{\left[(1 + r)\, D\right]^{\alpha}}{\alpha} + (1 - \pi)\, \frac{1}{\alpha} > \frac{1}{\alpha}.$$

As a result, for any $D \in (\frac{1}{1+r}, 1]$, the charity prefers the more aggressive investment strategy $\beta^* = 1$. □

The following Lemma provides more intuition for characterizing the impact of the charity's risk parameter α on the selection of β.

Lemma 1.4. *Let $D \in (1, +\infty)$. Then for a given $\alpha < \frac{1}{1+r}$ and investment technology, there must exist a unique critical level of endowment, D_τ such that if $1 < D < D_\tau$ the charity chooses $\beta^* = 1$; whereas if $D > D_\tau$, it chooses β_τ.*

Proof. If $D \in (1, +\infty)$ then $\forall \beta \in (0, 1]$, investment proceeds are greater than 1 in the good state of nature. However, if $\beta < 1 - \frac{1}{D}$, then investment proceeds exceed 1 also in the bad state; otherwise, they are less than 1 in the bad state.

By Lemma 1.1, if investment proceeds exceed 1, then donors do not contribute to the annual campaign; if proceeds are less than 1, they will contribute to the annual campaign, and 1 unit of the public good is provided. By Lemma 1.3, the expected utility of the charity is increasing on the interval $\beta \in [1 - \frac{1}{D}, 1]$, so that it is optimal for the charity to choose

$\beta^* = 1$. Its expected utility, $\mathbb{E}V(\beta^* = 1)$, is then expressed as

$$\mathbb{E}V(\beta^* = 1) = \pi \frac{[(1+r)\,D]^{\alpha}}{\alpha} + (1-\pi)\,\frac{1}{\alpha}. \tag{A.12}$$

Recall, from Proposition 1.1, that if investment proceeds exceed 1 in both the states of nature, then the expected utility of the charity is strictly concave in β, and the optimal portfolio β_τ is

$$\beta_\tau = \frac{\zeta - 1}{\zeta + r}, \qquad \textit{where} \quad \zeta = \left(\frac{\pi r}{1-\pi}\right)^{\frac{1}{1-\alpha}}. \tag{A.13}$$

Consequently, over the range of values for β which generates endowment proceeds exceeding 1 in both states of nature, $\beta \in [0, 1 - \frac{1}{D}]$. If $\beta_\tau < 1 - \frac{1}{D}$, then the expected utility of the charity attains an interior maximum, which is

$$\mathbb{E}V(\beta^* = \beta_\tau) = \pi \frac{[(1+r\beta_\tau)\,D]^{\alpha}}{\alpha} + (1-\pi)\,\frac{[(1-\beta_\tau)\,D]^{\alpha}}{\alpha}. \tag{A.14}$$

Alternatively, if $\beta_\tau > 1 - \frac{1}{D}$, then the charity's expected utility is increasing in β over the entire range $\beta \in [0, 1 - \frac{1}{D}]$, and it can be checked that

$$\mathbb{E}V(\beta^* = 1 - \frac{1}{D}) = \pi \frac{[(1+r\beta^*)\,D]^{\alpha}}{\alpha} + (1-\pi)\,\frac{1}{\alpha}. \tag{A.15}$$

Figure 1.8 illustrates. Comparing Eq.(A.12) to Eq.(A.15), one can easily verify that for $1 < D < \frac{1}{1-\beta_\tau}$, $\mathbb{E}V(\beta^* = 1 - \frac{1}{D}) < \mathbb{E}V(\beta^* = 1)$: there cannot be a subgame-perfect Nash equilibrium in which the charity invests the endowment cautiously with $\beta^* = 1 - \frac{1}{D}$.

It remains to show that there exists an endowment level, D_τ, such that if $D > D_\tau$, the charity will choose a cautious strategy. First, consider the threshold endowment level,

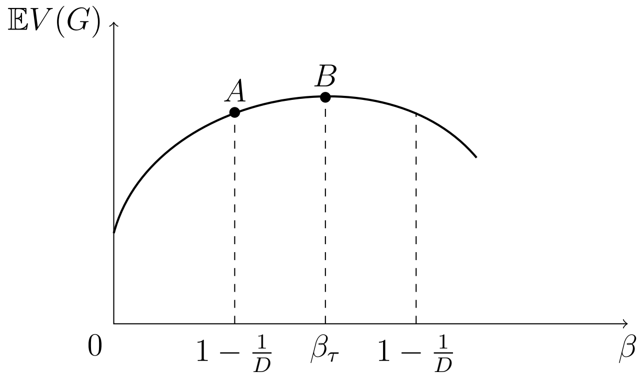


Figure 1.8: NPO expected utility $\mathbb{E}V(G)$ of β in the setting with only an endowment drive

For a given $D \in (1, +\infty)$, β must be less than $1 - {}^1\!/_D$ to ensure the investment proceeds are greater than 1 in the bad state of nature. Therefore, the local maximization is achieved at point A or B, which depends on whether $\beta_\tau > 1 - \frac{1}{D}$ or not.

$\underline{D} = \frac{1}{1-\beta_\tau}$. Observe that at $\underline{D}$,

$$\mathbb{E}V(D = \underline{D}) = \begin{cases} \pi \frac{[(1+r)\underline{D}]^\alpha}{\alpha} + (1-\pi)\frac{1}{\alpha} & \text{if } \beta^* = 1, \\ \\ \pi \frac{[(1+r\beta_\tau)\underline{D}]^\alpha}{\alpha} + (1-\pi)\frac{1}{\alpha} & \text{if } \beta^* = \beta_\tau. \end{cases} \tag{A.16}$$

As should be obvious, at threshold $\underline{D} = \frac{1}{1-\beta_\tau}$, the charity's expected utility follows

$$\mathbb{E}V(\beta^* = 1, D = \underline{D}) > \mathbb{E}V(\beta^* = \beta_\tau, D = \underline{D}).$$

Next, note that both expressions for expected utility, Eqs.(A.12) and (A.14), are continuous in D, and strictly increasing and concave in $D \in [\underline{D}, \infty)$. Therefore, if and only if $\frac{\partial \mathbb{E}V(\beta^*=\beta_\tau)}{\partial D} > \frac{\partial \mathbb{E}V(\beta^*=1)}{\partial D}$, then it must be true that $\exists D$ for which $\mathbb{E}V(\beta^* = \beta_\tau) = \mathbb{E}V(\beta^* = 1)$(see Figure 1.9).

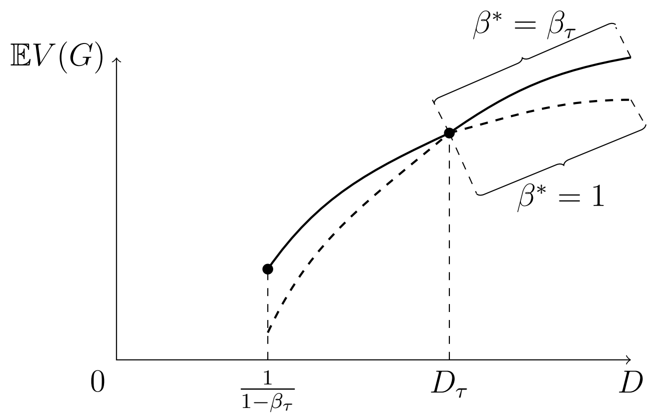


Figure 1.9: The impact of β on NPO expected utility $\mathbb{E}V(G)$ of D when $D > \frac{1}{1-\beta_\tau}$

There must exist a threshold D_τ, such that for $D > D_\tau$, $\mathbb{E}V(\beta^* = \beta_\tau) > \mathbb{E}V(\beta^* = 1)$ holds, *iff* $\frac{\partial \mathbb{E}V(\beta^*=\beta_\tau)}{\partial D} > \frac{\partial \mathbb{E}V(\beta^*=1)}{\partial D}$. Therefore, the charity will choose $\beta^* = \beta_\tau$ instead of $\beta^* = 1$.

Notice that

$$\frac{\partial \mathbb{E}V}{\partial D} = \begin{cases} \left[\pi(1+r\beta_\tau)^\alpha + (1-\pi)(1-\beta_\tau)^\alpha\right] D^{\alpha-1} & \textit{if } \beta^* = \beta_\tau, \\ \pi(1+r)^\alpha D^{\alpha-1} & \textit{if } \beta^* = 1. \end{cases} \tag{A.17}$$

Therefore, to establish the existence of D_τ it is necessary to show that

$$\pi(1+r\beta_\tau)^\alpha + (1-\pi)(1-\beta_\tau)^\alpha > \pi(1+r)^\alpha. \tag{A.18}$$

If the NPO is a cautious investor, that is, $\alpha < \frac{1}{1+r}$, then it follows that

$$\alpha < \frac{\frac{1-\pi}{\pi r}\left[(\frac{\pi r}{1-\pi})^{\frac{1}{1-\alpha}} + r\right]^{1-\alpha}}{1+r}, \tag{A.19}$$

because

$$\frac{1-\pi}{\pi r}\left[(\frac{\pi r}{1-\pi})^{\frac{1}{1-\alpha}} + r\right]^{1-\alpha} > \frac{1-\pi}{\pi r}\left[(\frac{\pi r}{1-\pi})^{\frac{1}{1-\alpha}}\right]^{1-\alpha} = 1.$$

Since $1+r > (1+r)^{1-\alpha}$, α must be less than $\frac{\frac{1-\pi}{\pi r}[(\frac{\pi r}{1-\pi})^{\frac{1}{1-\alpha}}+r]^{1-\alpha}}{(1+r)^{1-\alpha}}$, which implies that

$$\alpha < \left(\frac{1-\pi}{\pi r}\right)\left[\frac{1+r}{(\frac{\pi r}{1-\pi})^{\frac{1}{1-\alpha}}+r}\right]^{\alpha-1}. \tag{A.20}$$

Next, using the expression for β_τ (see Eq.A.1), inequality (A.20) can be safely rewritten as

$$\pi r\alpha(1-\beta_\tau) < (1-\pi)(1-\beta_\tau)^{\alpha}. \tag{A.21}$$

Now, using the Taylor expansion around $r=0$, $(1+r)^\alpha$ and $(1+r\beta_\tau)^\alpha$ can be simply expressed as $1+\alpha r$ and $1+\alpha\beta_\tau r$, respectively. From this, inequality (A.21) is exactly as what I claimed in Eq.(A.18), which establishes the existence of D_τ.

One can easily verify that if Eq.(A.18) holds, α must be less than $\frac{1}{1+r}$. Therefore, it is clear that iff $\alpha < \frac{1}{1+r}$, then $\forall D > \underline{D}$, such that $\mathbb{E}V(\beta^* = \beta_\tau) > \mathbb{E}V(\beta^* = 1)$. This completes the proof of Lemma 1.4; the result is illustrated in Figure 1.9. □

Lemma 1.5. *Let $D \in (1,\infty)$ and $\alpha > \frac{1}{1+r}$. Then the charity chooses $\beta^* = 1$.*

Proof. As noted in the proof of Lemma 1.4, if $\alpha > \frac{1}{1+r}$, Eq.(A.18) does not hold. Consequently, the expected utility of the charity when it invests aggressively always exceeds its expected utility from choosing $\beta^* = \beta_\tau$, that is $\beta^* = 1$. □

Proposition 1.2 now follows straightforwardly from the proceeding Lemmas. If $\alpha < \frac{1}{1+r}$, for $D < D_\tau$, in any subgame-perfect Nash equilibrium, the charity chooses $\beta^* = 1$. For $D > D\tau > 1$, it will choose $\beta^* = \beta_\tau$, the endowment proceeds will exceed 1 in both states of nature, and there will no contribution to the annual campaign. However, if $\alpha > \frac{1}{1+r}$, then $\forall D \in (0,\infty)$, the charity chooses $\beta^* = 1$, and donors top-up in the bad state, that is, when the risky investment fails. The charity's investment behavior is illustrated in Figures 1.4 and 1.5. □

1.6.6 Proof of Proposition 1.3

Proof. In stage 1, anticipating the NPO's behavior in stage 2 and the subsequent opportunity for the annual campaign in stage 3, donor i's decision-making problem can be expressed as

$$\max_{d_i \geq 0} \mathbb{E}U_i\left(x_i, G\right) = \pi(\omega_i - d_i - g_{i1}^* + {G_1^{\gamma_i}}/{\gamma_i}) + (1-\pi)(\omega_i - d_i - g_{i2}^* + {G_2^{\gamma_i}}/{\gamma_i}), \quad \text{(A.22)}$$

$$s.t. \begin{cases} d_i \geq 0, \\ \beta^* \text{ solves NPO's expected utility maximization for } D = \Sigma d_i, \\ g_{is}^* \text{ solves Eq.(A.9)}, \end{cases}$$

where $G_s, s \in \{1, 2\}$, is the state contingent level of the public good.

To solve the donors' stage 1 decision, it is useful to separate the subgame-perfect Nash equilibrium paths based on the size of the initial endowment resulting from this decision. Consider, initially, the subgames which follow $\forall D \leq \frac{1}{1+r}$.

Recall, from Lemma 1.2, that for $D \in (0, \frac{1}{1+r}]$, the charity's expected utility is independent of the charity's portfolio selection β^* (see Figure 1.4). The charity is therefore willing to respect the donors' preference when selecting β^* if for all D which belong to this interval. As shown in Lemma 1.1, it is reasonable to assume equally cost sharing mechanism in stage 3, and then donor i's decision problem can be expressed as

$$\max_{d_i,\,\beta} \mathbb{E}U_i\,(x_i, G) = \pi(\omega_i - d_i - g_{i1}^* + {G_1^{\gamma_i}}/{\gamma_i}) + (1-\pi)(\omega_i - d_i - g_{i2}^* + {G_2^{\gamma_i}}/{\gamma_i}), \tag{A.23}$$

$s.t.$

$$\begin{cases} 0 \leq d_i \leq \frac{1}{1+r} - D_{-i}, \\ \beta^* \in [0,1], \\ g_{is}^* = \frac{1}{\mathbb{N}}(1-(1+r\beta)D), \;\; g_{i2}^* = \frac{1}{\mathbb{N}}(1-(1-\beta)D), \\ G_1 = G_2 = 1, \end{cases}$$

where D_{-i} denoted the contributions of players other than player i. It is first useful to study the relationship between donor i's expected utility and the proportion of the charity's endowment that is invested in the risky asset. The first-order condition with respect to β, $\frac{\partial \mathbb{E}(U_i)}{\partial \beta}$, is $[\pi r - (1-\pi)]\,\frac{D}{\mathbb{N}} > 0$, because the expected rate of return on the risky asset is positive. Therefore, $\forall D \in [0, \frac{1}{1+r}]$, the expected utility of donor i is maximized when β^* is equal to 1.

Next, observe that $\frac{\partial \mathbb{E}(U_i)}{\partial d_i}$ equals $[\pi r - (1-\pi)]\frac{\beta}{\mathbb{N}} > 0$, whenever, as assumed, the expected rate of return on the risky investment is positive. Consequently, constraint $0 \leq d_i \leq \frac{1}{1+r} - D_{-i}$ is binding at the right side, which implies that the required total contribution to the endowment fund equals $\frac{1}{1+r}$ for donor i, $i = 1, ..., n$. Observe that if costs are shared equally,[10] donor i contributes $\frac{1}{1+r} \cdot \frac{1}{\mathbb{N}}$ and $\frac{1}{\mathbb{N}}$ to the endowment fund and the annual campaign respectively, with

[10]à la Bergstrom et al. (1986), in the context of quasilinear utility, same demand for public good leads to the infinity combinations of contribution in equilibrium. Although, in this paper, donors are heterogeneous in risk parameter γ_i, the demand for the endowment fund is $\frac{1}{1+r}$ in the range $D \in [0, \frac{1}{1+r}]$. As shown in Lemma 1.1, the donor i's demand for the public good equals 1 in both stages of nature, which is independent of the risk parameter γ_i. Therefore, the assumption of equally cost sharing mechanism applies, which also makes the problem tractable.

optimal expected utility

$$\mathbb{E}^* \, U_i\,(x_i, G) = \omega_i - \big(\frac{1}{1+r} + 1 - \pi\big)\frac{1}{\mathbb{N}} + \frac{1}{\gamma_i}, \tag{A.24}$$

where $\mathbb{N}$ is the set of total individuals.

Next, consider the donors' decisions in stage 1, which lead to an endowment $D \in (\frac{1}{1+r}, 1]$. The donor i's stage 1 decision-making problem becomes,

$$\max_{d_i \geq 0} \mathbb{E}U_i\,(x_i, G) = \pi(\omega_i - d_i - g^*_{i1} + {G_1^{\gamma_i}}/{\gamma_i}) + (1-\pi)(\omega_i - d_i - g^*_{i2} + {G_2^{\gamma_i}}/{\gamma_i}), \tag{A.25}$$

$s.t.$

$$\begin{cases} \frac{1}{1+r} - D_{-i} \leq d_i \leq 1 - D_{-i}, \\ \beta^* = 1, \\ g^*_{i1} = 0, \quad g^*_{i2} = {1}/{\mathbb{N}}, \\ G_1 = (1+r)D, \quad G_2 = 1. \end{cases}$$

The first-order condition with respect to d_i is

$$\frac{d\mathbb{E}\,(U_i)}{dd_i} = \pi\big(-1 + ((1+r)D)^{\gamma_i - 1}\big) + (1-\pi)(-1). \tag{A.26}$$

Observe that $\frac{d\mathbb{E}(U_i)}{dd_i} = 0$ requires that the demand for the optimal level of endowment $D^* = \frac{\pi^{1/(1-\gamma_i)}}{1+r}$, which is less than $\frac{1}{1+r}$, thus violating the restriction that $\frac{1}{1+r} - D_{-i} \leq d_i$. Observe next that $\frac{d^2\mathbb{E}(U_i)}{dd_i^2} = \pi(\gamma_i - 1)\,[(1+r)D]^{\gamma_i - 2} < 0$ over the entire range, which implies that $\mathbb{E}(U_i)$ attains a local maximum at $d_i^* = \frac{1}{1+r} - D_{-i}$ (see Figure 1.6).

Now consider $d_i > 1 - D_{-i}$, so that $D \in (1, +\infty)$. Assume that $\alpha > \frac{1}{1+r}$ which, by Proposition 1.2, implies that $\beta^* = 1$. Donor i's stage 1 decision problem is again described as Eq.(A.25), but the constraint becomes $d_i > 1 - D_{-i}$. The first-order condition Eq.(A.26) still applies. By the same reasoning as above, donor i's expected utility is decreasing on this range, and therefore achieves a local maximum at $d_i = 1 - D_{-i}$, which once again is less than expected utility when $D = \frac{1}{1+r}$, and $\beta^* = 1$ (see figure 1.6). As a consequence, the subgame-perfect Nash equilibrium path must be $\{D^* = \frac{1}{1+r}, \beta^* = 1\}$. This proves the first part of Proposition 1.3.

In contrast, if the charity is sufficiently risk averse ($\alpha < \alpha_\tau = \frac{1}{1+r}$), then for a given $\alpha < \alpha_\tau$, there exists an unique endowment level, D_τ, such that the charity chooses $\beta^* = 1$ for $D < D_\tau$. By the proof above, $\{D \in (1, +\infty),\ \beta^* = 1\}$ cannot be the optimal path; for $D > D_\tau$, the charity switches to choose $\beta^* = \beta_\tau$. Recall that when $\beta^* = \beta_\tau$ for $D > D_\tau$, the endowment proceeds always exceed one unit, and there is no annual campaign giving in both states of nature. Therefore, donor i's decision-making problem becomes

$$\max_{d_i \geq 0} \mathbb{E}U_i\left(x_i, G\right) = \pi(\omega_i - d_i - g_{i1}^* + {G_1^{\gamma_i}}/{\gamma_i}) + (1-\pi)(\omega_i - d_i - g_{i2}^* + {G_2^{\gamma_i}}/{\gamma_i}), \tag{A.27}$$

$$s.t. \quad \begin{cases} d_i > D_\tau - D_{-i}, \\ \beta^* = \beta_\tau, \\ g_{i1}^* = g_{i2}^* = 0, \\ G_1 = (1 + r\beta_\tau)D, \quad G_2 = (1 - \beta_\tau)D. \end{cases}$$

By Remark 1.1 and Corollary 1.1, only the donor i with the largest risk parameter γ_i contributes to financing the provision of the public good. Therefore, without endowment constraint donor i's optimal expected utility can be expressed as

$$\mathbb{E}^*\, U_i\left(x_i, G\right) = \omega_i + \left({1}/{\gamma_i} - 1\right) D^*, \tag{A.28}$$

where $D^* = [\pi(1+r\beta_\tau)^{\gamma_i} + (1-\pi)(1-\beta_\tau)^{\gamma_i}]^{\frac{1}{1-\gamma_i}}$. The second-order condition for donor i's problem, $\frac{d^2\mathbb{E}(U_i)}{dd_i^2}$, is $(\gamma_i - 1)[\pi(1+r\beta_\tau)^{\gamma_i-1} + (1-\pi)(1-\beta_\tau)^{\gamma_i-1}] D^{\gamma_i-2}$, which is negative. Therefore, $\mathbb{E}(U_i)$ is strictly concave in d_i.

Case 1. $D^* < D_\tau$

By Definition 1.3, assume donor i has the largest risk parameter, her demand for the endowment fund in the scenario without annual campaign can be expressed by the function $\Psi : \gamma_i \to D^*$, and Ψ maps onto $(1, +\infty)$, and its inverse function $\gamma_i = \Psi^{-1}(D^*)$. Therefore, if $D^* = \Psi(\gamma_i) < D_\tau$, then donor i overly contributes to the endowment and achieves her local maximum at D_τ (see Figure 1.6), which can be denoted as

$$\begin{aligned}\mathbb{E}U_i(x_i, G)|_{D_\tau} &= \omega_i - D_\tau + [\pi(1+r\beta_\tau)^{\gamma_i} + (1-\pi)(1-\beta_\tau)^{\gamma_i}]\frac{D_\tau^{\gamma_i}}{\gamma_i} \\ &= \omega_i - D_\tau + (D^*)^{1-\gamma_i}\frac{D_\tau^{\gamma_i}}{\gamma_i}.\end{aligned} \tag{A.29}$$

As all individuals $j \neq i$ will free ride, their expected utility becomes

$$\mathbb{E}U_j(x_j, G) = \omega_j + (D^*)^{1-\gamma_i}\frac{D_\tau^{\gamma_j}}{\gamma_j}. \tag{A.30}$$

By Eqs.(A.24), (A.29), the difference in the expected utility of the donor with the largest risk parameter, $\delta\mathbb{E}(U_i)$, between the paths $\{D = \frac{1}{1+r}, \beta = 1\}$ and $\{D = D_\tau, \beta = \beta_\tau\}$ is equal to

$$\delta\mathbb{E}(U_i) = \left[\omega_i - \left(\frac{1}{1+r} + 1 - \pi\right)\frac{1}{\mathbb{N}} + \frac{1}{\gamma_i}\right] - \left[\omega_i - D_\tau + (D^*)^{1-\gamma_i}\frac{D_\tau^{\gamma_i}}{\gamma_i}\right]. \tag{A.31}$$

Observe that D^* must follow

$$D^* < \left[\frac{1-\gamma_i(\frac{1}{1+r}+1-\pi)\frac{1}{\mathbb{N}}+D_\tau\gamma_i}{D_\tau^{\gamma_i}}\right]^{\frac{1}{1-\gamma_i}} \iff \delta\mathbb{E}(U_i) > 0.$$

Denote $\hat{\gamma} = \Psi^{-1}(\left[\frac{1-\gamma_i(\frac{1}{1+r}+1-\pi)\frac{1}{\mathbb{N}}+D_\tau\gamma_i}{D_\tau^{\gamma_i}}\right]^{\frac{1}{1-\gamma_i}})$. Consequently, $\{D = \frac{1}{1+r}, \beta = 1\}$ is the equilibrium path if and only if $\gamma_i < \hat{\gamma}$ and $\alpha < \alpha_\tau$; otherwise, if $\gamma_i > \hat{\gamma}$ and $\alpha < \alpha_\tau$, then, $\delta\mathbb{E}(U_i) < 0$. The equilibrium path is then $\{D = D_\tau, \beta = \beta_\tau\}$. Figure 1.6 illustrates.

Case 2. $D^* > D_\tau$

If $D^* = \Psi(\gamma_i) > D_\tau$, the difference in donor i's expected utility between the paths $\{D = \frac{1}{1+r}, \beta = 1\}$ and $\{D = D^*, \beta = \beta_\tau\}$ can be expressed as

$$\delta\mathbb{E}(U_i) = \left[\omega_i - \left(\frac{1}{1+r}+1-\pi\right)\frac{1}{\mathbb{N}}+\frac{1}{\gamma_i}\right] - \left[\omega_i + \left(\frac{1}{\gamma_i}-1\right)D^*\right]. \tag{A.32}$$

Same reasoning as above, one can verify that if and only if $\gamma_i < \hat{\gamma}$ and $\alpha < \alpha_\tau$, where $\hat{\gamma} = \Psi^{-1}(\frac{1-\gamma_i\left(\frac{1}{1+r}+1-\pi\right)\frac{1}{\mathbb{N}}}{1-\gamma_i})$, then $\{D = \frac{1}{1+r}, \beta = 1\}$ is the equilibrium path; in contrast, if $\gamma_i > \hat{\gamma}$ and $\alpha < \alpha_\tau$, $\delta\mathbb{E}(U_i) < 0$. Therefore, the equilibrium path will be $\{D = D^* > D_\tau, \beta = \beta_\tau\}$, where the annual campaign is completely crowded out in both states of nature. More particularly, if $\gamma_i = \hat{\gamma}$ and $\alpha < \alpha_\tau$ then, for donor i, path $\{D = \frac{1}{1+r}, \beta = 1\}$ or $\{D = D^*, \beta = \beta_\tau\}$ renders the same expected utility.

As a result, it is established that no matter $D^* < D_\tau$ or $D^* > D_\tau$ the claims in the Proposition 1.3 always hold. □

1.6.7 Proof of Remark 1.2

Proof. Suppose that donor only contributes to the annual campaign. By Lemma 1.1, she will top up to the annual campaign by $1/\mathbb{N}$, and ends up with the expected utility

$$\mathbb{E}^* \, U_i \left(x_i, G\right) = \omega_i - \frac{1}{\mathbb{N}} + \frac{1}{\gamma_i},$$

which is lower than the expected utility with contribution to the endowment drive at equilibrium $\mathbb{E}_3^1$ or $\mathbb{E}_3^2$ (See Figure 1.6). This completes the proof of Remark 1.2. □

1.6.8 Proof of Proposition 1.4

Proof. In the model with only an endowment drive, only the donor i with the largest risk parameter, γ_i, contributes to finance the provision of public good, By Eq.(A.14), the NPO's expected utility can be expressed as

$$\mathbb{E}V\left(\beta^* = \beta_\tau\right) = \left[\pi\left(1 + r\beta_\tau\right)^\alpha + \left(1 - \pi\right)\left(1 - \beta_\tau\right)^\alpha\right] \frac{\left(D^*\right)^\alpha}{\alpha}. \tag{A.33}$$

Using Taylor expansion around $\beta_\tau = 0$, $\left(1 + r\beta_\tau\right)^\alpha$ and $\left(1 - \beta_\tau\right)^\alpha$ can be simply written as $1 + \alpha r \beta_\tau$ and $1 - \alpha\beta_\tau$ respectively. It turns out,

$$\pi\left(1 + r\beta_\tau\right)^\alpha + \left(1 - \pi\right)\left(1 - \beta_\tau\right)^\alpha > 1. \tag{A.34}$$

By Eq.(A.5), donors' optimal expected utility becomes,

$$\mathbb{E}^* U_j \left(x_j, G\right) = \begin{cases} \omega_i + \left(\frac{1}{\gamma_i} - 1\right) D^* & \textit{for } j = i, \\ \omega_j + \frac{D_j^{*1-\gamma_j}}{\gamma_j} D^{*\gamma_j} & \textit{for } j \neq i, \end{cases} \tag{A.35}$$

where $D^* = [\pi(1+r\beta_\tau)^{\gamma_i} + (1-\pi)(1-\beta_\tau)^{\gamma_i}]^{\frac{1}{1-\gamma_i}}$, which maps γ_i to $(1, +\infty)$; and donor j's demand for the endowment level, D_j^*, equals $[\pi(1+r\beta_\tau)^{\gamma_j} + (1-\pi)(1-\beta_\tau)^{\gamma_j}]^{\frac{1}{1-\gamma_j}}$, which is greater than 1, but less than D^*.

Alternatively, in the model with permitted annual campaign, there are two possible equilibrium, $\mathbb{E}_3^1$ or $\mathbb{E}_3^2$. Figure 1.7 illustrates.

If $\alpha > \frac{1}{1+r}$, or $\alpha < \frac{1}{1+r}$ and $\gamma_i < \hat{\gamma}$, then the equilibrium goes to $\mathbb{E}_3^1$, where the subgame-perfect Nash equilibrium path is $\{D^* = \frac{1}{1+r}, \beta^* = 1\}$, and one unit of the public good is provided in both states of nature. Therefore, the charity's expected utility turns out to be

$$\mathbb{E}^* V(\beta^* = 1) = \frac{1}{\alpha}. \tag{A.36}$$

Donor i's expected utility in equilibrium is

$$\mathbb{E}^* \, U_i \left(x_i, G\right) = \omega_i - \left(\frac{1}{1+r} + 1 - \pi\right) \frac{1}{\mathbb{N}} + \frac{1}{\gamma_i}, \tag{A.37}$$

where $\mathbb{N}$ is the number of total individuals set.

By Eqs.(A.35), (A.36), (A.37), the NPO prefers the institutional setting with refrained annual campaign than the one with permitted annual campaign when $\alpha > \frac{1}{1+r}$, or $\alpha < \frac{1}{1+r}$ and $\gamma_i < \hat{\gamma}$. It is also clear that the donor i, who is the only contributor in the model with refrained annual campaign,

1. if $\alpha < \frac{1}{1+r}$ and $\gamma_i < \hat{\gamma}$

   Recall from the proof of Proposition 1.3, donor i is worse off than the donors in the designed 3-stage model. However, for the free-rider $j \neq i$ in the 2-stage model, by Eq.(A.35) her expected utility $\mathbb{E}^* U_j \left(x_j, G\right) = \omega_j + \frac{D_j^{*1-\gamma_j}}{\gamma_j} D^{*\gamma_j} > \omega_j + \frac{1}{\gamma_j}$, which is obviously greater than the donor's expected utility in the 3-stage model setting, where

$\mathbb{E}^* U_j(x_j, G) = \omega_j + \frac{1}{\gamma_j} - \left(\frac{1}{1+r} + 1 - \pi\right) \frac{1}{\mathbb{N}}$.

2. if $\alpha > \frac{1}{1+r}$

   Same reasoning as above, the free-rider $j \neq i$ in the 2-stage model still achieves higher expected utility than otherwise in the 3-stage model setting. However, the contributor i in the 2-stage model may get worse since her higher expected utility from the consumption of public good is associated with a large contributon to the endowment fund. However, by Eqs.(A.35) and (A.37), if and only if $\gamma_i > \tilde{\gamma}$, where $\tilde{\gamma} = \Psi^{-1}(\frac{1-(\frac{1}{1+r}+1-\pi)\frac{\gamma_i}{\mathbb{N}}}{1-\gamma_i})$, then the contributor i will prefer the 2-stage model.

Next, compare the equilibrium $\mathbb{E}_2$ with $\mathbb{E}_3^2$.

1. if donor i's demand for the public good, D^*, is less than D_τ

   By Figure 1.6 and Eq.(A.33), it is direct that the NPO's expected utility in the equilibrium $\mathbb{E}_2$ is less than in $\mathbb{E}_3^2$. Notice also, by Figure 1.6, that in the 3-stage model, contributor i's expected utility is lower than in the 2-stage model; by Eq.(A.30), the expected utility of free-rider $j \neq i$ is

$$\mathbb{E}U_j(x_j, G) = \omega_j + (D^*)^{1-\gamma_i} \frac{D_\tau^{\gamma_j}}{\gamma_j}. \tag{A.38}$$

   Compared with Eq.(A.35), which is the expected utility of free-rider $j \neq i$ in the 2-stage model, one can verify that the former is larger.

2. if donor i's demand for the public good, D^*, is more than D_τ

   As shown above, in this case, the designed model with permitted annual campaign generates exactly the same results as in the model with only an endowment drive. This completes the proof of Proposition 1.4.

□

Chapter 2

Charitable Giving and NPOs Investment Decision in a Stochastic Dynamic Economy

2.1 Introduction

The philanthropic giving market plays an increasingly more significant role in the modern economy than ever before. Particularly, there is a positive dynamics in charitable giving in the USA, which has doubled since 1995 (List, 2011b). Charitable individual givings by Americans to non-profit organisations (NPOs) now exceed 2 percent of GDP. In 2018 individual givings amounted to 292 billion dollars. From the supply side, research on NPOs' strategies mainly focus on fundraising activities that include direct mailing, telemarketing, face-to-face solicitations, staffing (Kamdar et al., 2015; Andreoni and Payne, 2011, 2003). Meanwhile, investment income contributes to a sizable proportion of the revenue of NPOs. Figure 2.1 shows that in 2005 in the USA around 7 percent of the total revenue of NPOs came from investment income. Investment activity allows for a more stable provision of charitable goods (Sherlock and Gravelle, 2009; Weisbrod, 2009; Song et al., 2008; Scott, 2006). However, an important role that NPOs play in capital markets and the impact on the charitable giving market are mostly neglected (Jegers and Verschueren, 2006; Bowman, 2002; Wedig, 1994).

To address the role of NPOs investments in the charitable market I need to emphasize the dynamic and uncertain environment in which NPOs and financial markets operate. Charitable and financial markets evolve over time. Donors and NPOs observe the history of giving, charitable good provision and investment strategies over time. Also, charitable givings are sensitive to economic fluctuations. Individual givings are affected by these permutations (List, 2011b). Other conventional funding sources, such as private payments for services, government grants, and other revenues, are also affected by these fluctuations (Sherlock and Gravelle, 2009). These revenue fluctuations motivate NPOs to invest in financial markets to reduce the risk associated with reliance on conventional funding sources. Such investments create a certain degree of volatility, which will, in turn, affects the market for charitable giving (Cettolin et al., 2017; Lohse et al., 2012).

This paper contributes to the literature by considering NPOs' investment activity to finance their philanthropic requirements. I model a charitable market consisting of an NPO and donors as a dynamic non-cooperative stochastic differential game. It is natural to examine macroeconomic shocks (Imbs, 2007; Ramey and Ramey, 1994). However, to account for income disturbances and financial market volatility, I uniquely consider fluctuations of the rate of return of the risky asset and donors' incomes generated by the Itô diffusions. The NPO allocates its resources between a charitable good and investment in risk-free (for example, T-bills) and risky assets. Donors dispatch their incomes between consumption and charitable giving.

The results show that the NPO invests a constant share of disposable endowment in the

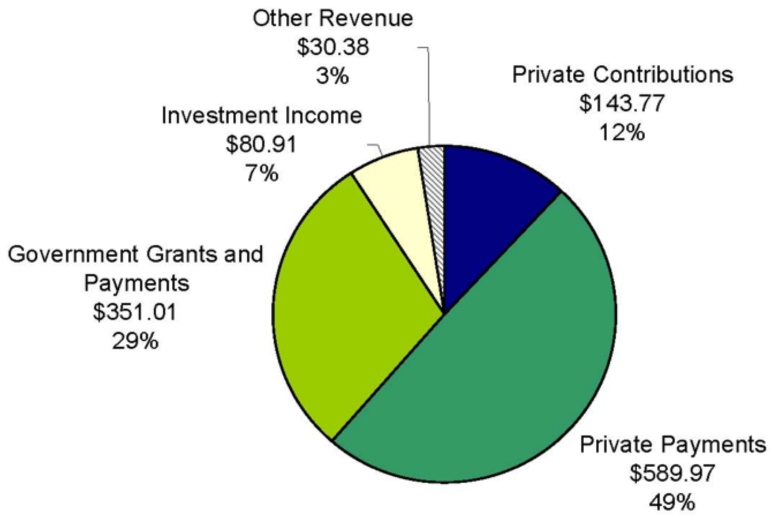


Figure 2.1: NPO Revenue by Source, 2005 (billions of dollars).

Source: Wing, Pollak, and Blackwood, The Nonprofit Almanac, 2008, and CRS calculations.

risky asset. This share depends on the return on the risk free asset. If the return on risk-free asset is high, the NPO does not need to bear the risk in the financial market and it invests all disposable endowment in the risk-free asset. For the medium range of the return on the risk-free asset, the NPO invests a proper proportion to the risky asset. The impact of the rate of return of the risk-free asset on the NPO's public good provision is non-monotonic. A low rate of return on T-bills encourages the NPO to invest all of its disposable endowment in the risky asset thereby increasing its expected endowment. Donors contribute to the NPO if it does not have a sufficiently high level of endowment. An accumulation of endowment may discourage donors to contribute further. The givings by donors are discontinuous, leading to a jump of the NPO's provision of charitable goods when its endowment level exceeds the critical point. A higher contribution level by donors encourages the NPO to participate in the financial market at the expense of providing the public good. It is interesting to note that while the investment shock affects both NPOs' and donors' decisions, income shock does not affect their decisions. I also show that the NPO exhibits risk-averse behavior, i.e., a more extensive portfolio selection requires a higher risk premium to compensate for the possible investment loss.

The remainder of the paper is organized as follows: Section 2.2 presents a literature review. Sections 2.3 describes the model of two types of interacting agents. I solve the model and derive a feedback Nash-equilibrium using the Hamilton-Jacobi-Bellman approach in Section 2.4. An empirical test is in Section 2.5. Section 2.6 summarizes the primary conclusions. All the proofs are relegated to Appendix 2.7.

2.2 Literature Review

There are two main strands in the literature on charitable giving. In the first strand, giving is considered as an individual economic decision, where donations are determined by maximizing donors' utility subject to a budget constraint. NPOs are treated as a conduit to channel funds to the desired public projects. Once NPOs receive donations, the provision of public goods is instantaneous (Varian, 1994; Andreoni, 1988; Bergstrom et al., 1986). The second strand of literature defines giving as the result of strategic interactions. NPOs choose fundraising efforts and mechanisms (Andreoni, 2006b). Both strands of literature do not consider the role of NPOs in the financial market.

Recent papers focus on the free-riding problem (Yildrim, 2006; Marx and Matthews, 2000) and the design of the efficient fundraising campaign to influence donors' contribution behaviors (Kamdar et al., 2015; Kumru and Vesterlund, 2010; Waters, 2008; Rondeau and List, 2008). Efficiency is attainable in the limit if contributors punish past free riders by not contributing to the public project (Marx and Matthews, 2000).

In a dynamic setting, contributions accumulating over time accentuate the free-riding problem (Fershtman and Nitzan, 1991).[1] Uncertainty makes individual donors less motivated to contribute, and the free-rider problem is exacerbated (Wang and Ewald, 2010a). Marsiliani and Renstroem (2010) establish that donors' capital stocks will converge due to saving, which eventually leads donors to contribute the same amount of public good. This novel finding contrasts with the static model, where only rich people contribute (Bergstrom et al., 1986).

The existing literature on NPOs' investment decisions is sparse. To my knowledge, a few papers consider NPOs as active investors in financial markets. An exception is my chapter 1, examining the interaction between donors' giving decisions and the NPO's investment strategy in a static and deterministic model. Donors contribute to the endowment but may not contribute to the annual campaign. Agents' behavior differs when annual campaigns are permitted or not. With the permitted annual campaign, the NPO's portfolio selection is a discontinuous, decreasing function of the endowment; donors contribute less to an aggressive NPO and more to a cautious one. Surprisingly, donors and the NPO generally disagree about whether the charity should run an annual campaign. This result complements Kamdar et al. (2015). However, this paper does not incorporate random shocks in the financial market and donors saving behavior to hedge against the income shocks.

There is a line of theoretical and empirical literature related to risky investment by firms. The mean-variance approach is a fundamental framework for optimal portfolio selection (Markowitz, 1952). Investors can reduce their exposure to individual asset risk by constructing a combination of instruments that are not perfectly positively correlated (Xing et al., 2010; Tobin, 1958; Markowitz, 1952). These papers do not consider strategic relations between NPOs' investment behavior and donors' willingness to contribute. Recent empirical papers establish the impact of the risky environment on either donors' contribution (Cettolin et al.,

[1] "...in dynamic content, an individual has the opportunity to learn the response of other players to his and others, à la Becker (1974) that this can increase the severity of the free-riding problem, might eventually choke off voluntary participation in the collective action," Fershtman and Nitzan (1991).

2017) or NPOs borrowing and investing behavior (Rosen and Sappington, 2016; Song et al., 2008).

2.3 Model Setting

There are two players in the model: a NPO and a cohort of homogeneous donors. The NPO's strategy consists of a pair (G_t, β_t), where G_t is the provision of the public (charitable) good and β_t refers to the proportion of funds invested in a risky asset at time t. Donors select consumption, C_t, and contribution level, D_t.

2.3.1 NPO's Payoff and Program

To reduce the risk associated with the fluctuation of returns on risky asset, the NPO determines the optimal allocation of the disposable endowment in the portfolio frontier. The disposable endowment refers to the NPO's endowment fund after the provision of the charitable good. Suppose that the efficient portfolio consists of a risky asset and a risk-free asset (T-bills).

Definition 2.1. (NPO's investment strategy) *An investment strategy at time t consists of allocating β_t proportion of its disposable endowment fund to the risky asset and $1 - \beta_t$ proportion to the risk-free asset. Assume $\beta_t \in \mathscr{S}$, which is a compact and convex set defined in $[0, 1]$.*

The NPO does not render all of its endowment as the public good but instead invests a proportion of the disposable endowment to participate in the financial market. The remaining proportion is held as an additional fund balance to hedge against the risk of possible financial downturns and ensure there is adequate liquidity available for future operations.

Formally, the NPO chooses a pair (G_t, β_t) at each time t to maximize its present value of expected lifetime utility, $U^n = \int_0^\infty e^{-\rho_c t} u^n(G_t)dt$, where ρ_c is the NPO's discount rate and U_t^n is instantaneous utility given by,

$$U_t^n = u^n(G_t) \quad u_{G_t}^n(G_t) > 0,\; u_{G_t,G_t}^n(G_t) < 0, \tag{1}$$

where $u_{G_t}^n(G_t)$ and $u_{G_t,G_t}^n(G_t)$ denote NPO's first and second-order derivatives, respectively.

I introduce the following notations:

s_t = a state variable, representing NPO's total financial endowment at time t,
G_t = NPO's provision of the public good at time t,
β_t = proportion invested in the risky asset at time t,
σ_r = volatility of the risky asset,
r = rate of return on the risk-free asset (T-bills),
$\bar{r}$ = long-term mean of the rate of return on the risky asset,
r_t = rate of return on the risky asset at time t,
D_t = donors' contribution to the NPO at time t.

I assume that the NPO takes the exogenous rate of return of risky asset as given. The NPO's investment portfolio at time t consists of two assets, risk and risk-free assets, with proportions β_t and $1 - \beta_t$ respectively. Assume futher that the rate of return on T-bill is a constant r and the rate of return on the risky asset, r_t, is generated by the Itô process in the form of Ornstein−Uhlenbeck.[2] At time interval $[\,t,\, t + \Delta t\,]$, its discrete form is,

$$r_t \Delta t = \theta\,(\bar{r} - r_t)\,\Delta t + \sigma_r \varepsilon_t \sqrt{\Delta t}, \tag{2}$$

where the parameter $\theta > 0$ represents how "strongly" the random rate of return generates system's reaction to perturbations, $\varepsilon_t \sim \mathcal{N}(0,1)$.

[2]Ornstein-Uhlenbeck process is the continuous-time analog of the discrete-time $AR(1)$ process. It has stationary, Gaussian, and Markovian properties and approaches its long-term mean $\bar{r}$ with the degree of volatility σ_r. The stationary (long-term) variance is given by $var(r_t) = \sigma_r^2/2\theta$.

Denote by W_{tr} the standard Wiener process and by w_t donors' wealth. Donors' contribution function, $D_t(w_t, s_t) : (w_t, s_t) \to D_t$, and $D_t(w_t, s_t)$ maps onto $[0, +\infty)$. I have the following:

Proposition 2.1. *Given donors' consumption and contribution strategy (C_t, D_t), NPOs' best-response problem consists in choosing the path of the optimal bundle, (G_t^*, β_t^*), such that the present value of expected lifetime utility is maximized,*

$$\max_{G_t, \beta_t} \mathbb{E}(U^n) = \mathbb{E}\left\{ \int_0^\infty e^{-\rho_c t} u^n(G_t) dt \right\}, \tag{3}$$

s.t.

$$ds_t = \Big(\big(\beta_t (\frac{\theta}{1+\theta} \bar{r} - r) + r\big) s_t - \big(G_t - D_t(w_t, s_t)\big) \Big) dt + \beta_t s_t \sigma_r dW_{tr}. \tag{4}$$

Proof: See Appendix 2.7

Note that given donors' choice (C_t, D_t), the NPO's strategy only affects its endowment. Hence, the NPO's problem is constrained only by its endowment equation (4). Also, note that the variance of the NPO's endowment, $\beta_t^2 s_t^2 \sigma_r^2$, depends on not only the variance of the risky asset, but also on the portfolio selection and the endowment level. For instance, a higher level of endowment and a larger proportion invested in the risky asset generate more fluctuations than smaller ones..

2.3.2 Donors' Payoff and Program

Consider a cohort of homogeneous donors with mass 1. An instantaneous utility of a representative donor is quasi-linear in the private consumption C_t and is given by

$$U_t^d = C_t + u^d(G_t), \tag{5}$$

where $u^d(G_t)$ is an increasing and concave function of argument G_t.

Parameters and variables of donor's program are defined as:

C_t = donors' consumption at time t,

D_t = donors' contribution to the endowment at time t,

$\bar{I}$ = donors' average income,

I_t = donors' income at time t,

σ_I = the volatility of income I_t around average income $\bar{I}$ caused by shocks,

w_t = a state variable, representing donors' total wealth level at time t.

Assume that $C_t \in (0, \eta_c w_t)$, where parameter $\eta_c \in (0, 1)$. Donors consume consumptions at any time t and the upper bound $\eta_c w_t$ is a fixed proportion of wealth level. Donors' contribution, D_t, is set within $[0, \eta_d s_t]$, where parameter $\eta_d \in [0, 1)$. The upper bound $\eta_d s_t$ represents donors' required level of the charitable good.

Donors' per unit time income evolves at time interval $[\,t,\, t + \Delta t\,]$ following the process,

$$I_t \Delta t = \bar{I} \Delta t + \sigma_I \varepsilon_t \sqrt{\Delta t}, \tag{6}$$

where $\varepsilon_t \sim \mathcal{N}(0, 1)$. When donors' decision (C_t, D_t) is realized, the corresponding endowment residue receives a risk-free rate of return, r.

For simplicity, assume that both the NPO and donors have the same discount rate, which is equal to the rate of return on T-bill: $\rho_c = \rho_d = r$. Suppose further that Wiener processes W_{tI} and W_{tr} are not correlated. I have the following:

Proposition 2.2. *Given the NPO's strategy (G_t, β_t), the donor's best-response problem* *consists in maximizing the present value of expected lifetime utility,*

$$\max_{\substack{C_t \in (0,\, \eta_c w_t] \\ D_t \in [0,\, \eta_d s_t]}} \mathbb{E}(U^d) = \mathbb{E}\left\{ \int_0^{\infty} e^{-\rho_d t} \big(u^d(G_t) + C_t \big) dt \right\}, \tag{7}$$

s.t.

$$ds_t = \Big(\big(\beta_t (\frac{\theta}{1+\theta} \bar{r} - r) + r \big) s_t - \big(G_t - D_t(s_t) \big) \Big) dt + \beta_t s_t \sigma_r dW_{tr}, \tag{8}$$

and

$$dw_t = \big(r w_t + \bar{I} - D_t - C_t \big)\, dt + \sigma_I dW_{tI}. \tag{9}$$

Proof: See Appendix 2.7

It is important to note that the donors' problem is constrained by two differential equations (8) and (9) because given the NPO's strategy (G_t, β_t), donors' decision (C_t, D_t) affects both NPO's endowment and donors' wealth evolvements. Note also that donor's wealth fluctuations depend only on income volatility.

2.4 Equilibrium Analysis

2.4.1 Resolving Model

To solve the model I use the Feedback Nash equilibrium concept.[3] In this equilibrium concept, players' strategies are contingent to the state of the game, S_t. The solution satisfies the Hamilton-Jacobi-Bellman (HJB) equations, which incorporate players' conditional behavior

[3]The choice of equilibrium concept, for example, open-loop Nash or Feedback Nash, is dictated by the assumptions regarding pre-commitment of actions, and information structure. Without a central authority, commitments are not enforceable, making Feedback Nash more realistic to solve the dynamic differential game. In this concept agents adjust their strategies contingent on the system's current state, in the sense of a stationary Markovian Nash equilibrium (Wang and Ewald, 2010b,a; Kossioris et al., 2008; Wedig, 1994; Fershtman and Nitzan, 1991; Yeung and Petrosjan, 2006).

in the Nash equilibrium.

The NPO's best response problem is to choose the (G_t^*, β_t^*), given the donors' choice, (C_t^*, D_t^*), at each time t. The same procedure applies to donors' best-response problem. I have the following:

Definition 2.2. *Denote by $\Gamma(S_0, \infty - 0)$ the non-cooperative stochastic differential game with equations (3), (4), (7), (8), (9), and initial state $S_0 = \{s_0, w_0\}$. Denote by $\Gamma(S_\tau, \infty - \tau)$ the game with the initial state $S_\tau = \{s_\tau, w_\tau\} \in S$ and $\tau \in [0, \infty)$. The NPO's and donors' value functions, which are the current value of the expected payoffs from $t \to \infty$, can be written as,*

$$\Phi^{(\tau)}(t, s_t) = \mathbb{E}\left\{ \int_t^\infty e^{-r(y-\tau)} u^n(G_y) dy \right\}, \tag{10}$$

and

$$\Psi^{(\tau)}(t, s_t, \omega_t) = \mathbb{E}\left\{ \int_t^\infty e^{-r(y-\tau)} \big(u^d(G_y) + C_y\big) dy \right\}, \tag{11}$$

for $\tau \in [0, \infty)$, and $t \in [\tau, \infty)$ respectively.

It can be concluded that, using equations $\Phi^{(\tau)}(t, s_t) = e^{-(t-\tau)}\Phi^{(t)}(t, s_t)$, and $\Psi^{(\tau)}(t, s_t, w_t) = e^{-(t-\tau)}\Psi^{(t)}(t, s_t, w_t)$, the game, $\Gamma(S_\tau, \infty - \tau)$, has the property that the discounted value of any subgame value function from $t \in [t, \infty)$ is equal to the current value of the value function at time $t \in [t, \infty)$.

Definition 2.3. (Shadow prices of the NPO and donors) *Donors' shadow prices refer to the partial derivatives of the value function, $\Psi(s_t, w_t)$, with respect to their wealth level and the NPO's endowment, denoted by Ψ_{s_t} and Ψ_{w_t} correspondigly. The NPO's shadow price is the derivative of its value function, $\Phi(s_t)$, with respect to endowment s_t, denoted by Φ_{s_t}.*

Note that value functions $\Psi(s_t, w_t)$ and $\Phi(s_t)$ are increasing and strictly concave in arguments s_t and w_t. Therefore, shadow prices are positive and decreasing.

To solve for the equilibrium of the game, I need the following:

Proposition 2.3. *A strategy profile* $\{(G_t^*, \beta_t^*), (C_t^*, D_t^*)\}$ *is the equilibrium of the game* $\Gamma(S_0, \infty - 0)$ *if there exist two times differentiable functions* $\Phi(s_t)$ *and* $\Psi(s_t, w_t)$ *satisfying the following Hamilton-Jacobi-Bellman equations,*

$$r\Phi(s_t) = \max_{G_t, \beta_t} \Big\{ u^n(G_t) + \Phi_{s_t}\Big(\big(\beta_t(\frac{\theta}{1+\theta}\bar{r} - r) + r\big)s_t - (G_t - D_t^*)\Big) + \frac{1}{2}\Phi_{s_t,s_t}\beta_t^2 s_t^2 \sigma_r^2 \Big\}, \tag{12}$$

and

$$r\Psi(s_t, w_t) = \max_{\substack{C_t \in (0,\, \eta_c w_t] \\ D_t \in [0,\, \eta_d s_t]}} \Big\{ u^d(G_t^*) + C_t + \Psi_{s_t}\Big(\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r} - r) + r\big)s_t - (G_t^* - D_t)\Big) + \Psi_{w_t}\big(rw_t + \bar{I} - D_t - C_t\big) + \frac{1}{2}\Psi_{s_t,s_t}\beta_t^{*2} s_t^2 \sigma_r^2 + \frac{1}{2}\Psi_{w_t,w_t}\sigma_I^2 \Big\}. \tag{13}$$

Proof: See Appendix 2.7.

Given donors' strategy, (C_t^*, D_t^*), the NPO chooses (G_t^*, β_t^*) such that the right side of the HJB equation is maximized. Hence, I obtain the first-order conditions for the NPO's problem,

$$u^n_{G_t}(G_t^*) - \Phi_{s_t} = 0, \tag{14}$$

$$\Phi_{s_t}\big((\frac{\theta}{1+\theta}\bar{r} - r)s_t\big) + \Phi_{s_t,s_t}\beta_t^* s_t^2 \sigma_r^2 = 0. \tag{15}$$

These equations characterize the NPO's best-response. Similarly, donors' first-order conditions with respect to C_t and D_t are,

$$1 - \Psi_{w_t} > 0 \; or \; < 0, \tag{16}$$

$$\Psi_{s_t} - \Psi_{w_t} > 0 \, or \; < 0. \tag{17}$$

These inequalities describe donors' best-response (C_t^*, D_t^*). Thus, donors' private consumption, C_t^*, and contrtibution, D_t^*, must take corner values. By inequality (16), I obtain $\Psi_{w_t} < 1$ to ensure that donors have private consumption at time t. Since the value function $\Psi(s_t, w_t)$ is increasing and strictly concave in its arguments, the following properties are satisfied: $\lim_{w_t \to 0} \Psi_{w_t} = 1$ and $\lim_{w_t \to +\infty} \Psi_{w_t} = 0$. For the shadow price Ψ_{s_t}, it must be true that $\lim_{s_t \to 0} \Psi_{s_t} = \infty$ and $\lim_{s_t \to +\infty} \Psi_{s_t} = 0$. There exists a threshold, $\bar{s}$, which is uniquely determined by the condition: $\Psi_{s_t} = 1$, such that $\Psi_{s_t} > \Psi_{w_t}$ when $s_t < \bar{s}$, as shown in Figure 2.2.

To proceed further, define the set of rate of returns on T-bills.

Definition 2.4. (Effective space of the return rate on T-bills) *The effective space, $\mathscr{R}_e$, is a compact and convex set in $\mathbb{R}^+$. $\mathscr{R}_e$ is a set of rates of return on T-bill, r. $\forall r \in \mathscr{R}_e$, the NPO chooses an interior optimal portfolio; otherwise, the corner solution, $\beta_t^* = 0$ or 1 applies. Figure 2.4 illustrates.*

The next proposition describes the equilbirium of the game.

Proposition 2.4. *There exists a unique threshold, $\bar{s}$, such that*

a) the NPO provides a constant proportion of its current endowment as public good, G_t^*, given

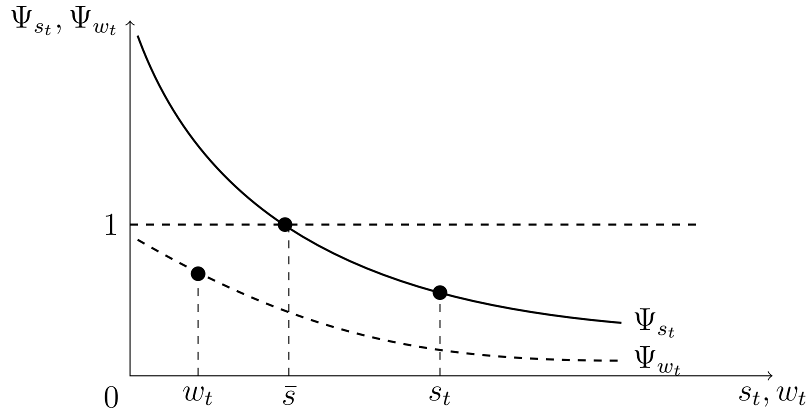


Figure 2.2: Donors Shadow Price Curves Ψ_{s_t} and Ψ_{w_t}

Note: the solid curve represents donors' shadow price of NPO's endowment, whereas the dashed one is donors' shadow price of their wealth level. $\Psi_{s_t} > \Psi_{w_t}$ if $s_t < \bar{s}$; when $s_t > \bar{s}$, for a arbitrary pair of (s_t, w_t), $\Psi_{s_t} >< \Psi_{w_t}$.

by

$$G_t^* = \begin{cases} \left(r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)s_t & \textit{if } s_t < \bar{s}, \\ \left(r - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)s_t & \textit{if } s_t > \bar{s}, \textit{ and } \Psi_{s_t} < \Psi_{w_t}, \\ \left(r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)s_t & \textit{if } s_t > \bar{s} \textit{ and } \Psi_{s_t} > \Psi_{w_t}. \end{cases} \tag{18}$$

b) the NPO exhibits risk-aversion: a higher proportion of the disposable endowment invested in the risky asset requires a larger risk premium. The proportion, β_t^**, is fixed and given by*

$$\beta_t^* = \begin{cases} \frac{\frac{\theta}{1+\theta}\bar{r}-r}{(1-\alpha)\sigma_r^2} & \textit{if } r \in \mathscr{R}_e, \\ 0, 1 & \textit{if } r \notin \mathscr{R}_e. \end{cases} \tag{19}$$

c) donors' contributions, D_t^*, are given by

$$D_t^* = \begin{cases} \eta_d s_t & \textit{if } s_t < \bar{s}, \\ 0 & \textit{if } s_t > \bar{s} \textit{ and } \Psi_{s_t} < \Psi_{w_t}, \\ \eta_d s_t & \textit{if } s_t > \bar{s} \textit{ and } \Psi_{s_t} > \Psi_{w_t}. \end{cases} \tag{20}$$

d) finally, donors consume a fixed proportion of their wealth, $C_t^* : C_t^* = \eta_c w_t$.

Proof: See Appendix 2.7

Proposition 2.4 establishes that the NPO provides a higher proportion of its present endowment as public good if donors do not contribute. The intuition is that more public good provided by NPOs will shrink its endowment, which therefore increases donors' *shadow price*, Ψ_{s_t},[4] and incentivizes donors to give in the future. Figure 2.3 illustrates this property. Donors may free ride on the NPO's investment when $s_t > \bar{s}$. In this case, donors' shadow price from w_t exceeds the shadow price from s_t.

The NPO's optimal portfolio selection does not depend on donors' contribution. This result is consistent with Samuelson (1975) and Merton (1971), who show that for CRRA utility, the portfolio-selection decision is independent of the consumption in discrete and continuous-time models. Note also that a sufficiently low rate of return on T-bill will encourage the NPO to invest all its disposable endowment in the risky portfolio. Alternatively, a higher enough rate of return on T-bill will discourage the NPO not to participate in any risky financial activities. For any rate of return on T-bills, $r \in \mathscr{R}$, the NPO chooses either the interior solution, $\beta_t^* = (\frac{\theta}{1+\theta}\bar{r} - r) / ((1-\alpha)\sigma_r^2)$, or the corner solution, $\beta_t^* = 0$, or 1, as shown in Figure **??**. It is worth noting that the expected rate of return on the risky asset is an increasing function

[4]Note that donors' first-order condition with respect to contribution equals the difference of shadow price, $\Psi_{s_t} - \Psi_{w_t}$. The properties of decreasing Ψ_{s_t} and Ψ_{w_t} directly lead to the result that lower NPO's endowment encourages donors to contribute.

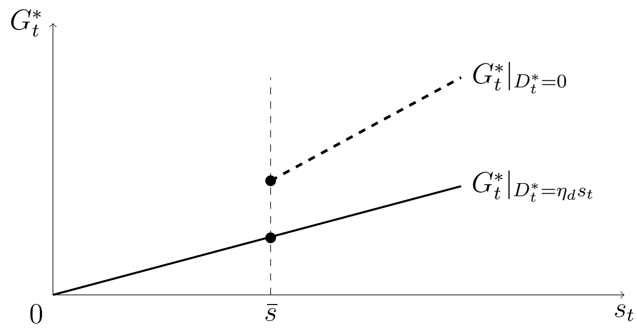


Figure 2.3: NPO Optimal Provision of Public Good, G_t^*, Conditional on Donors' Optimal Contribution, D_t^*.

The solid bold line represents the NPO's optimal provision of public good when donors contribute; the dashed line represents the provision of public good when donors do not contribute. s_t is the NPO's endowment level at time t, D_t^* is donors' optimal contribution, which equals $\eta_d s_t$ or 0.

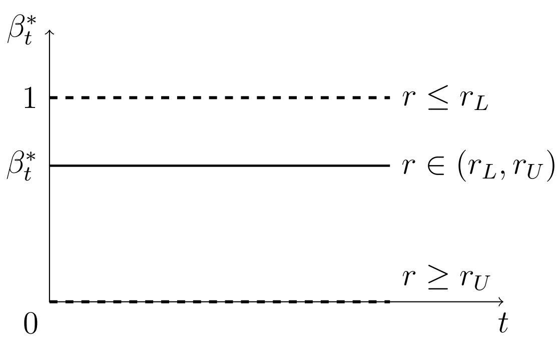


Figure 2.4 - I

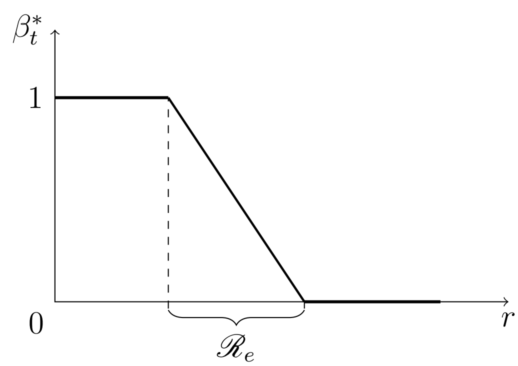


Figure 2.4 - II

Figure 2.4: NPO Optimal Portfolio Selection β_t^*

Note that $\beta_t^* = \min\{\max\{\frac{\frac{\theta}{1+\theta}\bar{r}-r}{(1-\alpha)\sigma_r^2}, 0\}, 1\}$. The effective space $\mathscr{R}_e = \{r \in \mathbb{R}^+ \mid r_L < r < r_U\}$, where $r_L = \frac{\theta}{1+\theta}\bar{r} - (1-\alpha)\sigma_r^2$, $r_U = \frac{\theta}{1+\theta}\bar{r}$.

of β_t^*, which shows that the NPO is risk-averse.

Figure 2.5 shows that donors' contribution decision depends on whether the shadow price from NPO's endowment, Ψ_{s_t}, exceeds the one from their income, Ψ_{w_t}. Otherwise, donors prefer to free ride on the NPO instead of giving. Therefore, donors contribute $D_t^* = \eta_d s_t$ if $s < \bar{s}$. When $s > \bar{s}$, the optimal contribution would be either $D_t^* = \eta_d s_t$ or $D_t^* = 0$.

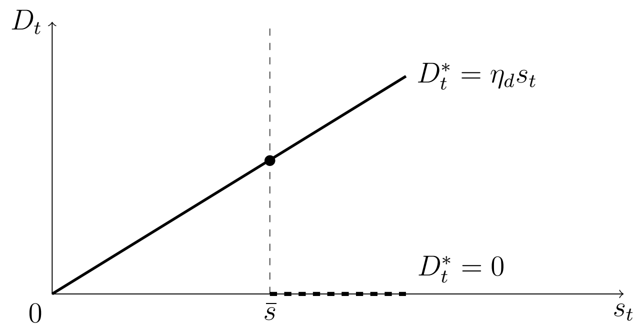


Figure 2.5: Donors' Optimal Contribution D_t^*

Note that if donors' shadow price from the NPO's endowment, s_t, is greater than the one from their income, ω_t, donors contribute $D_t^* = \eta_d s_t$; otherwise, $D_t^* = 0$. The solid line represents that donors contribute $D_t^* = \eta_d s_t$; the dashed one indicates that donors free ride the NPO.

Remark 2.1. *The optimal strategy* $\{(G_t^*, \beta_t^*), (C_t^*, D_t^*)\}$ *depends only on the present state; therefore, it satisfies the Markov property.*

Proof: See Appendix 2.7

Denote by $f(r) = r - \frac{\alpha}{1-\alpha}\eta_d - \alpha\left(\frac{\theta}{1+\theta}\bar{r} - r\right)^2/(2(1-\alpha)^2\sigma_r^2)$ the gap between the rate of return on T-bills, r, and the adjusted risk premium, $\alpha\left(\frac{\theta}{1+\theta}\bar{r} - r\right)^2/(2(1-\alpha)^2\sigma_r^2)$, plus donors' contribution factor, $\frac{\alpha}{1-\alpha}\eta_d$.

Corollary 2.1. *a) The interior solution for the provision of the public good,* G_t^**, exists if and only if the subspace of the rate of return on T-bill,* $\mathscr{R}_s = \{r \in \mathbb{R}^+ \mid f(r) > 0\}$ *is non-empty. b) The NPO is always willing to provide the public good when donors do not contribute. c) The higher contribution proportion,* η_d*, leads the NPO to provide less public good.*

Proof: See Appendix 2.7

Providing the public good adds a positive value to NPO's value function, $\Phi(s_t)$, which requires that $\mathscr{R}_s = \{r \in \mathbb{R}^+ \mid f(r) > 0\}$ is non-empty. Corollary 2.1 establishes that the NPO always provides the public good when donors do not contribute; in this case, the subspace $\mathscr{R}_s(\eta_d = 0) \neq \varnothing$. The higher contribution proportion, η_d, decreases $f(r)$ and monotonically

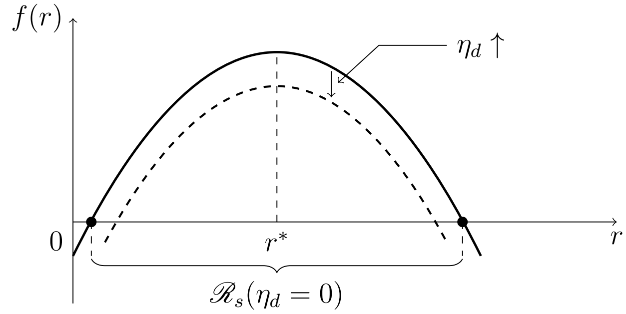


Figure 2.6: The Subspace of Rate of Return on T-bill, $\mathscr{R}_s(\eta_d)$

Note: The subspace, $\mathscr{R}_s(\eta_d = 0)$, equals $\{r \in \mathbb{R}^+ \mid f(r) > 0 \cap \eta_d = 0\} \neq \varnothing$, where $f(r) = r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha\left(\frac{\theta}{1+\theta}\bar{r}-r\right)^2}{2(1-\alpha)^2\sigma_r^2}$. $r^* = \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha}$. The dashed parabola is the case when η_d is increasing.

shrinks the subspace, $\mathscr{R}_s$. Therefore, the NPO is more willing to get involved in the financial market instead of providing the public good. There exists a threshold of the contribution proportion, $\hat{\eta}_d$, such that the NPO will allocate all its endowment to the financial market and will not provide the public good: $G_t^* = 0$ when $\eta_d \geq \hat{\eta}_d$. Figure 2.6 illustrates.

Corollary 2.2. *The subspace of the rate of return on T-bill, $\mathscr{R}_s = \{r \in \mathbb{R}^+ \mid f(r) > 0\}$, increases with parameters σ_r, $\bar{r}$, θ and decreases with NPO's risk parameter α.*

Proof: See Appendix 2.7

This property is attributed to the fact that the change of parameters $\{\alpha, \theta, \bar{r}, \sigma_r\}$ leads the $f(r)$ curve to shift not only vertically but also horizontally. For example, as the NPO's risk parameter α increases from α_1 to α_2, the critical point $(r^*, f(r^*))$ shifts lower left, and the subspace, $\mathscr{R}_s$, shrinks, which is different from the impact of the contribution ratio η_d (See Figures 2.6 and 2.7).

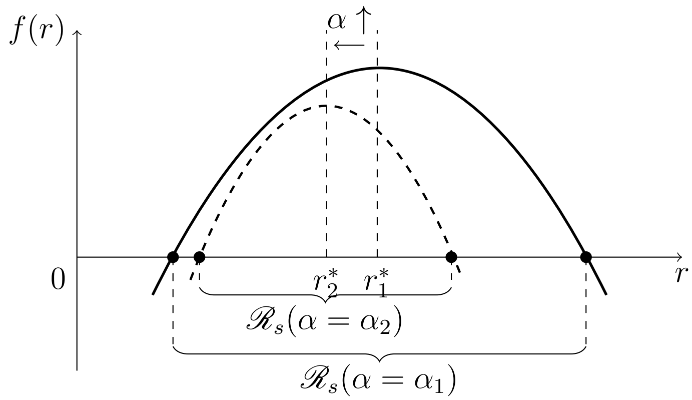


Figure 2.7: The Impact of Risk Parameter, α, on Dominance of Function $f(r)$

Note: The subspace, $\mathscr{R}_s$, equals $\{r \in \mathbb{R}^+ \mid f(r) > 0 \cap \eta_d \geq 0\} \neq \varnothing$, where $f(r) = r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha\left(\frac{\theta}{1+\theta}\bar{r}-r\right)^2}{2(1-\alpha)^2\sigma_r^2}$, $r^* = \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha}$, and $f(r^*) = \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{2\alpha} - \frac{\alpha}{1-\alpha}\eta_d$. The dashed parabola is the case when NPO's risk parameter, α, increases from α_1 to α_2.

2.4.2 Risk Exposure

It is natural to ask whether NPO's risk exposure impact differs from the donors'. It requires examining how the variance of risky investment and income influences the strategy profile.

2.4.2.1 Benchmark

In the benchmark, defined in Sections (2.3.1), (2.3.2), NPOs can actively choose the risky portfolio to diversify a certain degree of the investment risk; donors expose to the income risk and accoumulate the residual wealth by investing in the risk-free asset. It follows,

Proposition 2.5. *Investments risk affects both the NPO and donors' decisions. The increased risk exposure of NPOs encourages public goods provision, reduces the proportion of disposable endowment invested in the risky asset, and incentivizes donors to contribute less. Donors' income risk exposure does not have any effect on parties' decisions.*

Proof: See Appendix 2.7

Proposition 2.5 establishes that the NPO's or donors' risk exposure plays a different role in determining decision profiles. A more volatile risky investment forces the NPO to lower its portfolio selection and provide more charitable goods, which decreases its endowment level. By Proposition 2.4, donors, therefore, cut down contributions. On the other hand, donors' wealth variation equals income variation σ_I^2 and is not correlated to donors' decisions $\{C_t^*, D_t^*\}$ (See Proposition 2.2). The negative variance impact $\frac{1}{2}\Psi_{w_t,w_t}\sigma_I^2$ on donors' value function $\Psi(s_t, w_t)$ is irrelevant to donors' first-order conditions (16, 17). Therefore, the donors' income risk exposure does not affect the equilibrium of the game.

The rationale behind this contrasting difference is attributed to the fact that donors put wealth residual in the risk-free asset passively instead of actively diversifying the residual such that the variance of wealth level is relevant to donors' decisions.

2.4.2.2 Extended Risk Exposure

It is also interesting to examine donors' risk exposure impact when donors can apply the wealth residual to the risky investment instead of the risk-free asset. Suppose that the rate of return on the risky asset, r_t, is generated by the Itô process in the form of Ornstein−Uhlenbeck,

$$dr_t = \vartheta(\tilde{r} - r_t)dt + \tilde{\sigma}dW_t. \tag{21}$$

where $\tilde{r}$ represents the mean value of the rate of return on the risky asset. $\tilde{\sigma}$ is the standard deviation, and W_t is the standard Wiener process.

Corollary 2.3. *Suppose that donors expose to the income risk and the residual wealth is invested in the risky asset. Donors risk exposures do not influence agents' optimal decisions. Proof: See Appendix 2.7*

Donors invest the entire residual wealth in the risky asset. Without actively diversifying, the variance of wealth level is not relevant to the donors' decisions such that the optimal choices by donors do not affect the negative variance impact on the value function $\Psi(s_t, w_t)$. The findings by Proposition 2.5 and Corollary 2.3 are consistent with the experimental evidence by Cettolin et al. (2017), who show that the increased risk exposure of givers keeps silent, but a rise in beneficiaries' risk exposure discourages giving.

2.4.3 The Expected Stock of Endowment and Its Limitation

Proposition 2.6. *The NPO's expected stock of endowment is contingent on the rate of return on T-bill. It converges either to infinity or to a level $\bar{s}_\tau \in (\bar{s}_L, \bar{s}_U]$.*[5]

$$\mathbb{E}\{s_t\} = \begin{cases} s_0 e^{\left(\frac{\theta}{1+\theta}\bar{r} - r + \frac{\eta_d}{1-\alpha} + \frac{\alpha}{2}\sigma_r^2\right)t} & \textit{if } r \leq r_L, \\ s_0 e^{\left(\frac{\eta_d}{1-\alpha} + \frac{(2-\alpha)(\frac{\theta}{1+\theta}\bar{r} - r)^2}{2(1-\alpha)^2\sigma_r^2}\right)t} & \textit{if } r \in \mathscr{R}_e, \\ s_0 e^{\frac{\eta_d}{1-\alpha}t} & \textit{if } r \geq r_U, \end{cases}$$

$$\lim_{t \to +\infty} \mathbb{E}\{s_t\} = \begin{cases} \infty & \textit{if } r < r_U, \\ \bar{s}_\tau & \textit{if } r \geq r_U. \end{cases}$$

Proof: See Appendix 2.7

Proposition 2.6 shows that given the risky investment project, the NPO's risk parameter α, and donors' contributions proportion η_d, the rate of return on T-bill r plays an important role in determinating $\mathbb{E}\{s_t\}$ and $\lim_{t \to +\infty} \mathbb{E}\{s_t\}$. A not sufficiently large value of r ensures that the NPO will participate in the risky investment activities and provide partial investment

[5] Thresholds $\bar{s}_L$ and $\bar{s}_U$ are uniquely determined by $\Psi_{s_t} = 1$ and $\Psi_{s_t} = \Psi_{w_t}$ respectively. Donors contribute when $s_t \leq \bar{s}_L$ and free ride the NPO when $s_t \geq \bar{s}_U$. Donors either contribute or free ride when $\bar{s}_L < s_t < \bar{s}_U$ depending on the sign of $\Psi_{s_t} - \Psi_{w_t}$. Note: $\bar{s}_\tau \in (\bar{s}_1, \bar{s}_2]$ is the minimum level of the NPO's endowment such that donors do not contribute $\forall s_t > \bar{s}_\tau$.

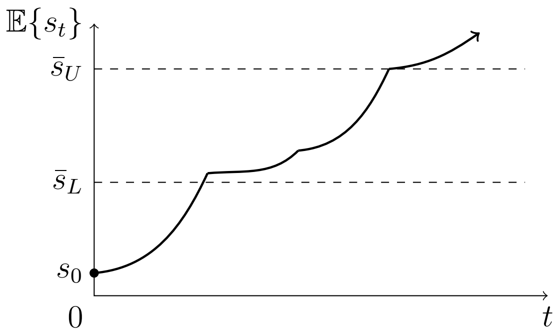


Figure 2.8 - I

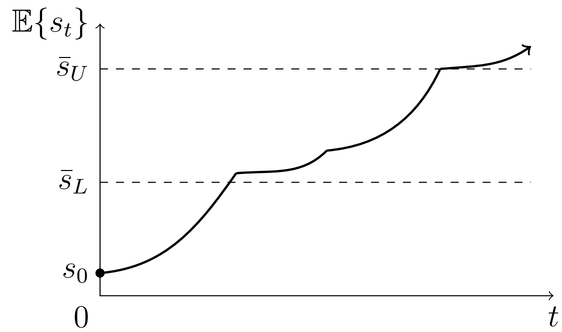


Figure 2.8 - II

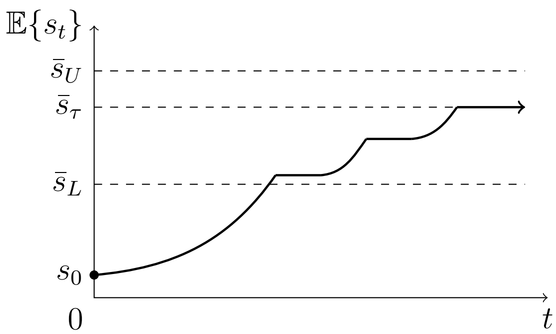


Figure 2.8 - III

Figure 2.8: NPO's Expected Endowment $\mathbb{E}\{s_t\}$ and its Limitation

Note: s_0 is the NPO's initial endowment. Figures 2.8 - I, II, III are cases when $r \leq r_L$, $r \in \mathscr{R}_e$ and $r \geq r_U$, respectively.

proceeds as the public good, which eventually leads the expected endowment, $\mathbb{E}\{s_t\}$, to accumulate continuously, as shown in Figures 2.8 - I, II. Alternatively, for a sufficiently large value, the NPO prefers to invest all its disposable endowment to the T-bill. As the endowment accumulates, donors stop contributing, and the NPO provides all of the net proceeds generated from T-bill as the public good until donors contribute again. This cycle continues until the NPO's endowment s_t reaches the level, $\bar{s}_\tau \in (\bar{s}_L, \bar{s}_U]$. This property helps to explain that $\mathbb{E}\{s_t\}$ increases from the initial level, s_0, and converges to $\bar{s}_\tau \in (\bar{s}_L, \bar{s}_U]$ (See Figure 2.8 - III).

Note that for a relatively lower rate of return on the T-bill, the NPO's expected endowment,

$\mathbb{E}\{s_t\}$, reaches the threshold level, $\bar{s}_L$, faster due to allocating a higher proportion of disposable endowment to the risky asset. The $\mathbb{E}\{s_t\}$ curve becomes flat after that, where donors' contributions cease. Recall by Corollary 2.1 that the lower the contribution ratio, η_d, the higher the NPO's willingness to provide the public good is going to be. Therefore, a sufficiently small η_d leads the NPO to invest less. Thus, the surplus of investment proceeds after the provision of public good accumulates less, which eventually flattens the NPO's expected endowment curve. Figures 2.8- I, II, and III illustrate.

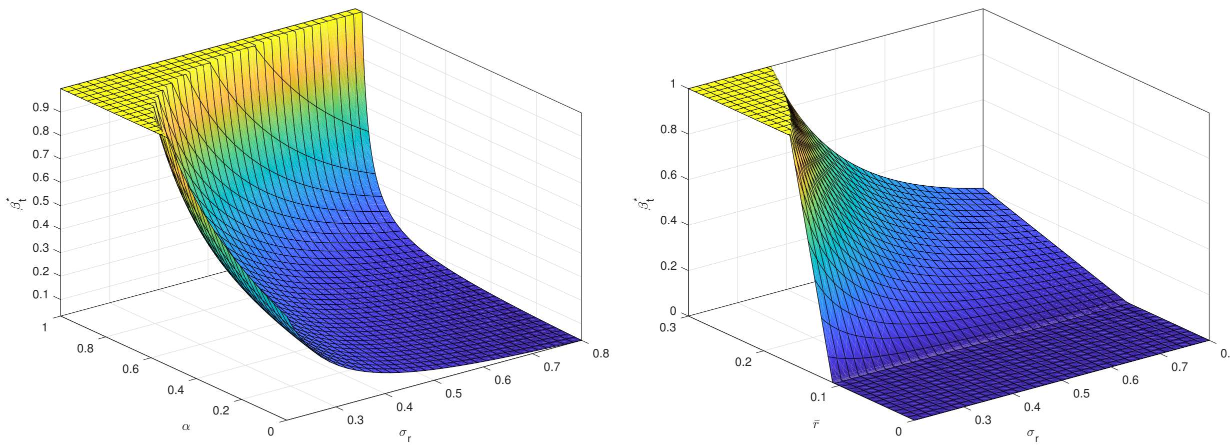
2.4.4 Numerical Simulations

Let $\bar{r} = 0.15, r = 0.05, \theta = 0.85, \alpha = 0.35, \sigma_r = \sigma_I = 0.5,\ s_0 = 0.2$, and $\bar{s} = 0.6$. Note that qualitatively similar figures are obtained when using other sets of parameters. By Proposition 2.4, the NPO chooses a constant fraction,

$$\beta_t^* = \min\left\{ \max\left\{ \frac{\frac{\theta}{1+\theta}\bar{r} - r}{(1-\alpha)\sigma_r^2}, 0 \right\}, 1 \right\}. \tag{23}$$

Figure 2.9-(a) shows that given the parameters $\bar{r}$, r, and θ, the NPO's optimal portfolio selection, β_t^*, increases with its risk parameter, α, but decreases with the standard deviation of the investment project, σ_r. Note that a sufficiently large risk parameter, α, and a small standard deviation, σ_r, lead the NPO to invest all its disposable endowment in the risky asset.

Figure 2.9-(b) illustrates that given the rate of return on T-bill, r, and the NPO's risk parameter, α, the optimal β_t^* increases in the long-term mean of the rate of return on risky tangency portfolio, $\bar{r}$, and decreases with σ_r. Nevertheless, a high enough long-term mean, $\bar{r}$, motivates the NPO to choose $\beta_t^* = 1$, and, therefore, to allocate all its disposable endowment in the risky asset. A low enough $\bar{r}$ drives the NPO to choose $\beta_t^* = 0$.



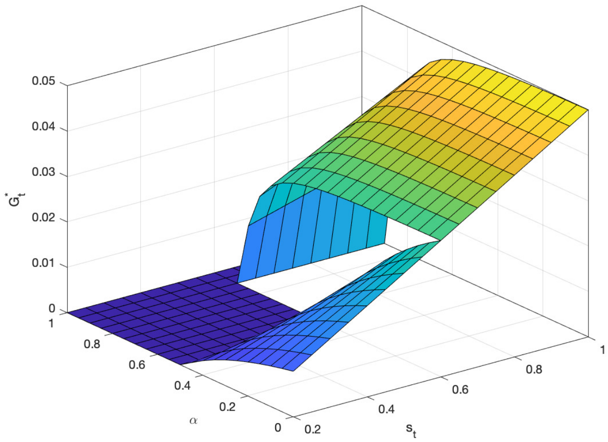
2.9-(a) β_t^* vs. α and σ_r

2.9-(b) β_t^* vs. $\bar{r}$ and σ_r

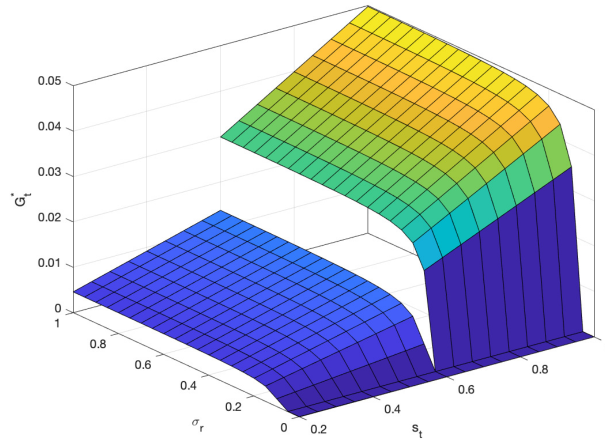
Figure 2.9: Simulation of NPOs' Optimal Portfolio Selection, β_t^*

Noting that the interior solution of β_t^* requires the rate of return on T-bill, $r \in \mathscr{R}_e = \{r \in \mathbb{R}^+ \mid r_L < r < r_U\}$, where $r_L = \frac{\theta}{1+\theta}\bar{r} - (1-\alpha)\sigma_r^2$, and $r_U = \frac{\theta}{1+\theta}\bar{r}$; otherwise, the NPO chooses corner solution, $\beta_t^* = 0$ or 1.

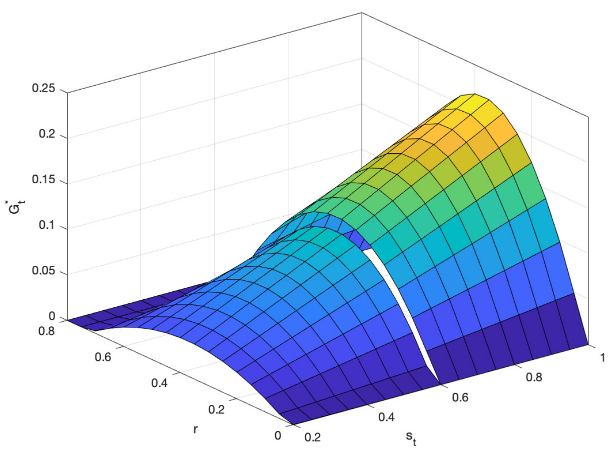
Figures 2.10-(a), (b) show that the NPO provides less public good when it becomes less risk-averse, but is willing to provide more when the financial investment is more volatile. The intuition is that the NPO with a higher risk parameter, α, prefers to participate in the financial market and to allocate more of its endowment to the risky portfolio. Hence, it chooses a lower level of the public good, G_t^*. Investments with higher volatility drive the NPO to provide more public good and to allocate less endowment to risky assets. Note that a large enough risk parameter, α, or low enough volatility, σ_r, force the NPO not to provide the public good at all. Figure 2.10-(c) shows that the impact of the rate of return on T-bill, r, is not monotonic. A sufficiently low or a sufficiently high rate of return on T-bills, r, increases the investment risk premium. This encourages the NPO to participate in the financial market, and to provide less public good. Figure 2.10-(d) shows that the NPO will decrease the public good provision when donors increase the contributions proportion, η_d. Note that the results depicted in Figure 2.10-(c), (d) are consistent with Corollary 2.1 (See Figure 2.6). I have the following comparative statics,



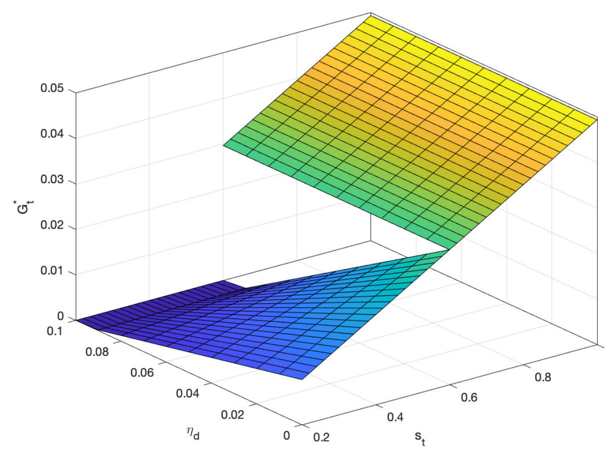
2.10-(a) G_t^* vs. α and s_t



2.10-(b) G_t^* vs. σ_r and s_t



2.10-(c) G_t^* vs. r and s_t



2.10-(d) G_t^* vs. η_d and s_t

Figure 2.10: Simulation of NPOs' Optimal Provision of the Public Good, G_t^*.

Noting that $G_t^* = f(r)s_t$. There is an interior solution for the provision of the public good, G_t^*, iff the subspace of the rate of return on T-bill, $\mathscr{R}_s = \{r \in \mathbb{R}^+ \mid f(r) > 0\} \neq \varnothing$, where function, $f(r)$, represents the gap between the rate of return on T-bill, r, and the adjusted risk premium, $\frac{\alpha\left(\frac{\theta}{1+\theta}\bar{r}-r\right)^2}{2(1-\alpha)^2\sigma_r^2}$ plus donors' contribution factor, $\frac{\alpha}{1-\alpha}\eta_d$.

Proposition 2.7. *Parameters, $\{\alpha, \eta_d, \theta, \bar{r}, \sigma_r\}$, affect monotonically public good provision. The impact of the T-bill return rate on the provision of the public good is non-monotonic.*

Proof: See Appendix 2.7

Equation (A17) indicates that the function $f(r)$ has the quadratic form in the rate of return on T-bill, r (See Figure 2.6). Hence, the impact of the rate of retun on T-bill is non-monotonic. The change of other parameters shifts the function $f(r)$ curve (See Figure 2.7). However, the dominance of function $f(r)$ in its domain, $\mathscr{R}_s$, is consistent. Thus, the impact of parameters, except r, is monotonic, as illustrated in Figure 2.9.

2.5 Regulations

To maximize the present value of expected payoff, it is likely that NPOs invest a large proportion of endowment in the risky asset and therefore incur an unexpected investment loss *ex post*. Meanwhile, NPOs may provide charitable goods insufficiently, and fewer philanthropic activities are financed. In order for NPOs to face meaningful regulations, e.g., portfolio ceiling $\tilde{\beta}_t$ and provision floor $\tilde{G}_t$ must be binding.

2.5.1 Portfolio Ceiling

Proposition 2.8. *With portfolio ceiling $\tilde{\beta}_t$, NPO chooses $\tilde{\beta}_t$ as its suboptimal portfolio selection. The effective space $\mathscr{R}_e$ shrinks to $\tilde{\mathscr{R}}_e$.*

Proof: See Appendix 2.7

Proposition 2.8 shows, as required by the regulation, NPOs apply the portfolio ceiling proportion of disposable endowment to the risky asset. It is helpful to stress that NPOs' portfolio selection is a kinked piecewise function of the rate of return on the risk-free asset (See Figure 2.11), which suggests that to manage the potential investment loss effectively, the setting of portfolio ceiling needs to take account of the impact of the rate of return on portfolio selection. e.g., NPO lowers its optimal risky portfolio when the rate of return on the risk-free asset goes up, which requires the portfolio ceiling to be set lower for binding.

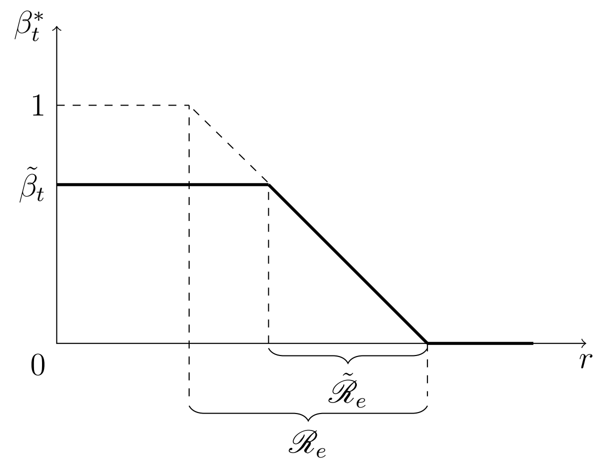


Figure 2.11: NPO Optimal Portfolio Selection β_t^* with Portfolio Ceiling $\tilde{\beta}_t$

Note that $\beta_t^* = \min\big\{\max\{\frac{\frac{\theta}{1+\theta}\bar{r}-r}{(1-\alpha)\sigma_r^2}, 0\}, 1\big\}$ without portfolio ceiling. The effective space $\mathscr{R}_e = \{r \in \mathbb{R}^+ \mid r_L < r < r_U\}$, where $r_L = \frac{\theta}{1+\theta}\bar{r} - (1-\alpha)\sigma_r^2$, $r_U = \frac{\theta}{1+\theta}\bar{r}$. The solid kinked line represents the optimal portfolio selection with portfolio ceiling $\tilde{\beta}_t$, where $\tilde{\mathscr{R}}_e = \{r \in \mathbb{R}^+ \mid \tilde{r}_L < r < r_U\}$ and $\tilde{r}_L = \frac{\theta}{1+\theta}\bar{r} - (1-\alpha)\sigma_r^2\tilde{\beta}_t^{\,2}$, $r_U = \frac{\theta}{1+\theta}\bar{r}$.

2.5.2 Provision Floor

Recall from Proposition 2.7 and discussions in section 2.4.1, without provision floor, NPOs may undersupply charitable goods at equilibrium when parameters, $\{\alpha, \eta_d, \theta, \bar{r}, \sigma_r\}$, satisfy certain conditions. It is essential to regulate NPOs to provide charitable goods to a higher level than the equilibrium level. It follows,

Proposition 2.9. *With provision floor $\tilde{G}_t$, NPOs deliver the charitable good at the level not less than $\tilde{G}_t$ instead of the optimal level G_t^*. Subspace $\mathscr{R}_s$ expands.*

Proof: See Appendix 2.7

Since the provision floor is binding, i.e., $\tilde{G}_t > G_t^*$, leading the corresponding endowment level $\tilde{s}_t < s_t^*$, thus, the NPO is to choose the second best, ie., the provision floor, $\tilde{G}_t$, instead of the optimal solution, G_t^*.

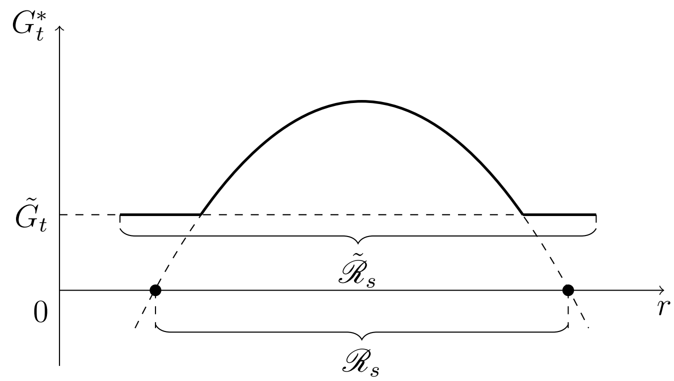


Figure 2.12: NPOs Provision of Charitable Good with Provision Floor $\tilde{G}_t$

Note that without the regulation of provision floor, the subspace $\mathscr{R}_s$ equals $\{r \in \mathbb{R}^+ \mid f(r) > 0 \cap \eta_d \geq 0\} \neq \varnothing$, where $G_t^* = (r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha\left(\frac{\theta}{1+\theta}\bar{r}-r\right)^2}{2(1-\alpha)^2\sigma_r^2})s_t$. The solid piecewise curve is the case where provision floor $\tilde{G}_t$ is applied.

2.6 Conclusion

I consider a dynamic charitable market with two types of random shocks: fluctuations of the investment rate of return and income shock. Donors contribute to an NPO's endowment, and the NPO provides the charitable good, which is financed by donors' contributions and investment proceeds. The results show that the NPO chooses a constant share of the risky asset. Donors' contributions are discontinuous; they either hit the upper bound of giving or free-ride the NPO, which leads to the jump in the provision of charitable good by NPOs. The NPO always provides public good when donors do not contribute, but this does not necessarily apply if donors contribute with a higher contribution ratio.

I also show that the environment with a lower rate of return on T-bill is favorable to the NPO's expected endowment. NPO's investment risk affects both NPO's and donors' decision profiles; however, donors' income and passive investment risk exposures keep silent, which complements the experimental evidence by Cettolin et al. (2017).

In future extensions, it would be interesting to examine the causal impact of political ‘type’ of incumbents on NPOs’ behaviors, e.g., the level of risky investment, contribution received and paid, the required risk premium. One can also consider how a NPO designs its investment portfolio policy in the context of competition for donor base, which not only allows the NPO to put its risk attitude on the risk portflio policy, but also requires the investment to be committed with social responsibilities (Sparkes, 2008; Rodgers, 1995).

2.7 Appendix

2.7.1 Proof of Proposition 2.1

Proof. Rewrite equation (2) as:

$$r_t \Delta t = \frac{\theta}{1+\theta}\bar{r}\Delta t + \frac{\sigma_r}{1+\theta}\varepsilon_t\sqrt{\Delta t}. \tag{A1}$$

The total change of NPO's endowment at the time interval $[\,t,\, t+\Delta t\,]$ can be rewritten as:

$$\begin{aligned} s_{t+\Delta t} - s_t &= \sum_{j=1}^{m} \beta_{tj}(e^{r_j \Delta t} - 1)\left(s_t + D_t\Delta t - G_t\Delta t\right) - \left(G_t - D_t\right)\Delta t \\ &= \big(\beta_t(e^{\frac{\theta}{1+\theta}\bar{r}\Delta t + \frac{\sigma_r}{1+\theta}\varepsilon_t\sqrt{\Delta t}} - 1) + (1-\beta_t)\left(e^{r\Delta t} - 1\right)\big)\big(s_t - \left(G_t - D_t\right)\Delta t\big) \\ &\quad - \left(G_t - D_t\right)\Delta t. \end{aligned} \tag{A2}$$

Using the Taylor expansion, $e^x = 1 + x$, and the fact that the mean of $\varepsilon_t\sqrt{\Delta t}$ is zero, I have two implications of equation (A2):

$$\begin{aligned} \mathbb{E}_t\big\{s_{t+\Delta t} - s_t\big\} &= \Big(\big(\beta_t(\frac{\theta}{1+\theta}\bar{r} - r) + r\big)s_t - \left(G_t - D_t\right)\Big)\Delta t + O\big((\Delta t)^2\big)\,; \\ \mathbb{E}_t\big\{\,(s_{t+\Delta t} - s_t)^2\,\big\} &= \beta_t^2 s_t^2 \sigma_r^2 \Delta t + O\big((\Delta t)^2\big)\,, \end{aligned}$$

where $O(\cdot)$ is the asymptotic order symbol representing "the same order as", and $\mathbb{E}_t$ is the expectation operator conditional on the information at time t. The stochastic differential equation of NPO's total financial endowment at time t can be written as:

$$ds_t = \Big(\big(\beta_t(\frac{\theta}{1+\theta}\bar{r} - r) + r\big)s_t - \left(G_t - D_t\right)\Big)dt + \beta_t s_t \sigma_r dW_{tr}, \tag{A3}$$

where W_t is the standard Wiener process.[6] This completes the proof of Proposition **??**. □

2.7.2 Proof of Proposition 2.2

Proof. From equation (6), it follows that the change of the wealth level, Δw_t, can be written as:

$$w_{t+\Delta t} - w_t = (e^{r\Delta t} - 1)(w_t + (I_t - D_t - C_t)\Delta t) - (D_t + C_t - I_t)\Delta t. \tag{A4}$$

Inserting equation (6) into equation (A4), the conditional expectations of $w_{t+\Delta t} - w_t$ and $(w_{t+\Delta t} - w_t)^2$ at time t can be written as:

$$\begin{aligned} &\mathbb{E}_t\{w_{t+\Delta t} - w_t\} = \left(rw_t + \bar{I} - D_t - C_t\right)\Delta t + O((\Delta t)^2), \\ &\mathbb{E}_t\left\{ \left(w_{t+\Delta t} - w_t\right)^2 \right\} = \sigma_I^2 \Delta t + O((\Delta t)^2). \end{aligned}$$

The corresponding stochastic differential equation of the state variable w_t is, therefore,

$$dw_t = \left(rw_t + \bar{I} - D_t - C_t\right) dt + \sigma_I dW_{tI}. \tag{A5}$$

This proves Proposition 2.2. □

2.7.3 Proof of Proposition 2.3

Proof. The proof follows from equations (3, 6) and the theorem from Yeung and Petrosjan (2006). □

[6] The Wiener process follows a normal distribution $\mathcal{N}(0, t)$, and is a continuous-time Markovian stochastic process; its increment satisfies $dW_t \equiv \lim_{\Delta t \to 0} \varepsilon_t \sqrt{\Delta t}$ with the analog of a discrete-time random walk $W_{t+1} - W_t = \varepsilon_t$, where $\varepsilon_t \sim \mathcal{N}(0, 1)$, and $W(0) = 0$.

2.7.4 Proof of Proposition 2.4

Proof. Consider the donors' first-order conditions with respect to C_t and D_t. By donors' *Hamilton-Jacobi-Bellman* equation (13), the optimal choice pair (C_t^*, D_t^*) satisfies the following inequalities

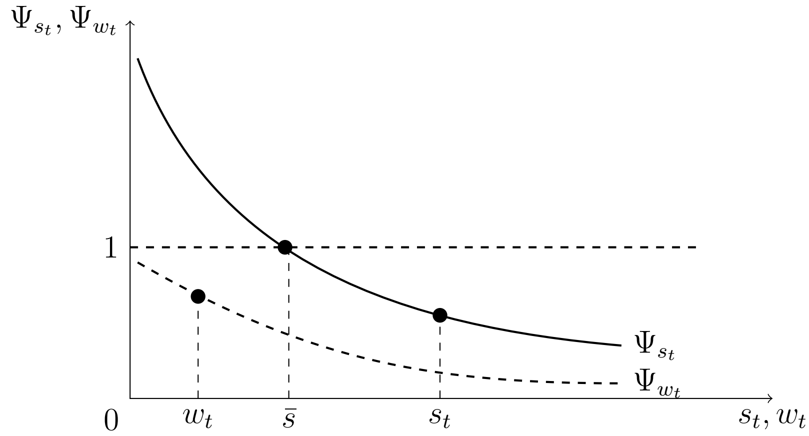
$$1 - \Psi_{w_t} > 0 \ or \ < 0, \tag{A6}$$

$$\Psi_{s_t} - \Psi_{w_t} > 0 \ or \ < 0. \tag{A7}$$

which indicates that donors' private consumption, C_t^*, and contrtibutions, D_t^*, must take the corner solutions instead of interior ones.

Assume that donors' value function, $\Psi(s_t, w_t)$, is increasing and strictly concave in both arguments s_t and w_t. Note that the donors' first-order conditions with respect to consumption, C_t, must be positive to ensure private consumptions at time t with any level of wealth, w_t. That is Ψ_{w_t} is monotonically decreasing and set within $(0, 1)$. Besides, Ψ_{w_t} follows the properties: $\lim_{w_t \to 0} \Psi_{w_t} = 1$ and $\lim_{w_t \to +\infty} \Psi_{w_t} = 0$. By equation (A6), the optimal private consumption, C_t^*, would hit the upper bound level, $\eta_c w_t$, where the parameter $\eta_c \in (0, 1)$ represents donors' propensity for consumption.

Donors' value function $\Psi(w_t, s_t)$ is concave in s_t and, therefore, Ψ_{s_t} is a monotonically decreasing function in s_t. It follows that $\lim_{s_t \to 0} \Psi_{s_t} = +\infty$ and $\lim_{s_t \to +\infty} \Psi_{s_t} = 0$, as shown in the Figure above. Consequently, there must exist a unique level of NPO's endowment, $\bar{s}$, such that $\Psi_{s_t} = 1$, which is greater than Ψ_{w_t}. Thus, $\Psi_{s_t} - \Psi_{w_t} > 0$ when $s_t < \bar{s}$. That is the donors' first-order condition with respect to contribution, D_t, is positive, which motivates donors to contribute to the upper bound, $D_t^* = \eta_d s_t$, where parameter $\eta_d \in (0, 1)$ represents the donors' desired level of public good. On the other hand, $\Psi_{s_t} - \Psi_{w_t} >< 0$ when $s_t > \bar{s}$. Thus, donors do not contribute if $\Psi_{s_t} < \Psi_{w_t}$, whereas donors contribute $\eta_d s_t$ if $\Psi_{s_t} > \Psi_{w_t}$.



Donors Shadow Price Curves Ψ_{s_t} and Ψ_{w_t}

Note: the solid curve represents donors' shadow price of NPO's endowment, whereas the dashed one is donors' shadow price of their wealth level. $\Psi_{s_t} > \Psi_{w_t}$ if $s_t < \bar{s}$; when $s_t > \bar{s}$, for a arbitrary pair of (s_t, w_t), $\Psi_{s_t} >< \Psi_{w_t}$.

$$C_t^* = \eta_c w_t, \tag{A8}$$

$$D_t^* = \begin{cases} \eta_d s_t & \textit{if } s_t < \bar{s} \\ 0 & \textit{if } s_t > \bar{s} \textit{ and } \Psi_{s_t} < \Psi_{w_t} \\ \eta_d s_t & \textit{if } s_t > \bar{s} \textit{ and } \Psi_{s_t} > \Psi_{w_t}. \end{cases} \tag{A9}$$

Next, consider the NPO's optimal problem. Following Merton (1971) I assume that the NPO's instaneous utility function takes the form of CRRA: $u^n(G_t) = {G_t^\alpha}/{\alpha}$, where $\alpha \in (0, 1)$. By the NPO's first-order conditions equations (14, 15), G_t^* and β_t^* can be expressed as,

$$G_t^* = \Phi_{s_t}^{1/(\alpha\,-\,1)}, \tag{A10}$$

$$\beta_t^* = -\frac{\Phi_{s_t}\left(\frac{\theta}{1+\theta}\bar{r} - r\right)}{\Phi_{s_t,s_t} s_t \sigma_r^2}. \tag{A11}$$

Inserting equations (A10, A11) into the NPO's *HJB* equation (12), yields,

$$r\Phi(s_t) = \begin{cases} \frac{1-\alpha}{\alpha}\Phi_{s_t}^{\overline{(\alpha-1)}^{\alpha}} + \Phi_{s_t} r s_t - \frac{1}{2}\left(\frac{\theta}{1+\theta}\bar{r} - r\right)^2 \frac{\Phi_{s_t}^2}{\Phi_{s_t,s_t}\sigma_r^2} & \textit{if } D_t^* = 0, \\ \frac{1-\alpha}{\alpha}\Phi_{s_t}^{\overline{(\alpha-1)}^{\alpha}} + \Phi_{s_t}\left(r + \eta_d\right) s_t - \frac{1}{2}\left(\frac{\theta}{1+\theta}\bar{r} - r\right)^2 \frac{\Phi_{s_t}^2}{\Phi_{s_t,s_t}\sigma_r^2} & \textit{if } D_t^* = \eta_d s_t. \end{cases} \tag{A12}$$

Assume that the NPO's *BJH* equation, equation (A12), has the explicit solution, which takes the form of $\Phi(s_t) = \Lambda s_t^{\alpha}$ (See Merton (1971)). The function, $\Phi(s_t) = \Lambda s_t^{\alpha}$, will be the solution of equation (A12) if the parameter Λ satisfies the following conditions

$$\Lambda = \begin{cases} \frac{1}{\alpha}\left(r - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)^{\alpha-1} & \textit{if } D_t^* = 0, \\ \frac{1}{\alpha}\left(r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)^{\alpha-1} & \textit{if } D_t^* = \eta_d s_t. \end{cases} \tag{A13}$$

Hence, by equations (A10, A11, A13), I obtain

$$G_t^* = \begin{cases} \left(r - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)s_t & \textit{if } D_t^* = 0 \\ \left(r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha(\frac{\theta}{1+\theta}\bar{r}-r)^2}{2(1-\alpha)^2\sigma_r^2}\right)s_t & \textit{if } D_t^* = \eta_d s_t, \end{cases} \tag{A14}$$

$$\beta_t^* = \min\left\{\max\left\{\frac{\frac{\theta}{1+\theta}\bar{r} - r}{(1-\alpha)\sigma_r^2}, 0\right\}, 1\right\} \qquad \textit{if } D_t^* \geq 0. \tag{A15}$$

This proves Proposition 2.4. □

2.7.5 Proof of Remark 2.1

Proof. According to equations (A8, A9, A14, A15), both the donors' and the NPO's strategies only depend on the state variables s_t, and w_t, representing the Markov property of memoryless, which completes the proof of Remark 2.1. □

2.7.6 Proof of Corollary 2.1

Proof. Define the function of the rate of return on T-bill, r,

$$f(r) = r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha\left(\frac{\theta}{1+\theta}\bar{r} - r\right)^2}{2(1-\alpha)^2\sigma_r^2}.$$

Rewrite $f(r)$ as:

$$f(r) = \frac{\alpha}{2(1-\alpha)^2\sigma_r^2}\Big(-r^2 + 2(\frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha})r - (\frac{\theta}{1+\theta}\bar{r})^2 - 2(1-\alpha)\sigma_r^2\eta_d\Big). \quad \text{(A16)}$$

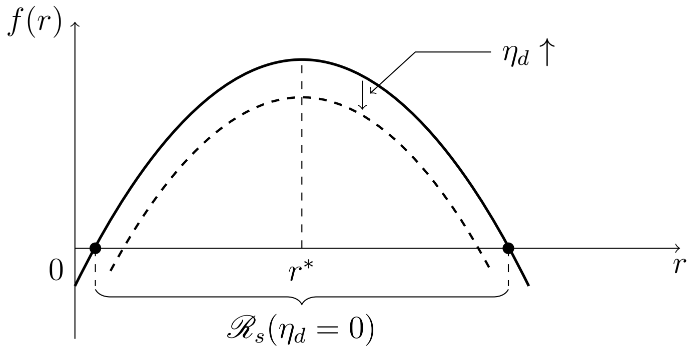
By equation (A14), for any given parameter vector of agents and risky asset, $\{\alpha, \eta_d, \theta, \bar{r}, \sigma_r\}$, function f must map onto $\mathbb{R}^+$. It follows from equation (A16) that $B^2 - 4AC > 0$, that is, parameters, $\{\alpha, \eta_d, \theta, \bar{r}, \sigma_r\}$, must satisfy the following inequality

$$\frac{1-\alpha}{\alpha}\Big(\frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{2\alpha}\Big) - \eta_d > 0. \quad \text{(A17)}$$

This proves that G_t^* exists if and only if the subspace of the rate of return on T-bill, $\mathscr{R}_s = \{r \in \mathbb{R}^+ \mid f(r) > 0\} \neq \varnothing$.

Donors do not contribute when parameter η_d equals zero. Straightforward calculations show that the subspace of rate of return on T-bill $\mathscr{R}_s(\eta_d = 0) = \frac{2(1-\alpha)\sigma_r}{\alpha}\sqrt{\frac{2\theta}{1+\theta}\bar{r}\alpha + (1-\alpha)^2\sigma_r^2}$ is not empty. This establishes that there exists a subspace $\mathscr{R}_s$ such that the NPO is willing to provide the public good when donors do not contribute.

Note that the function $f(r)$ has a critical point, $r^* = \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha}$, which does not depend on η_d; and $\mathscr{R}_s = \frac{2(1-\alpha)\sigma_r}{\alpha}\sqrt{\frac{2\theta}{1+\theta}\bar{r}\alpha + (1-\alpha)^2\sigma_r^2 - \frac{2\alpha^2}{(1-\alpha)}\eta_d}$. One can verify that $\mathscr{R}_s$ has the following property: $\frac{\partial \mathscr{R}_s}{\partial \eta_d} < 0$. As a result, increasing η_d continuously pushes the solid parabola curve downwards, which monotonically shrinks the subspace, $\mathscr{R}_s$ (See Figure below). Therefore, there exists $\hat{\eta}_d$, such that $\mathscr{R}_s = \{r \in \mathbb{R}^+ \mid f(r) > 0\} = \varnothing$. By equation (A17), the



The Subspace of Rate of Return on T-bill, $\mathscr{R}_s(\eta_d)$

Note: The subspace, $\mathscr{R}_s(\eta_d = 0)$, equals $\{r \in \mathbb{R}^+ \mid f(r) > 0 \cap \eta_d = 0\} \neq \varnothing$, where $f(r) = r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha\left(\frac{\theta}{1+\theta}\bar{r}-r\right)^2}{2(1-\alpha)^2\sigma_r^2}$. $r^* = \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha}$. The dashed parabola represents the case when η_d is increasing.

threshold $\hat{\eta}_d = \frac{1-\alpha}{\alpha}\left(\frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{2\alpha}\right)$. This completes the proof of Corollary 2.1. □

2.7.7 Proof of Corollary 2.2

Proof. Note that for any given parameters, $\{\alpha, \eta_d, \theta, \bar{r}, \sigma_r\}$, the function $f(r)$ has the critical point $(r^*, f(r^*)) = (\frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha}, \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{2\alpha} - \frac{\alpha}{1-\alpha}\eta_d)$. The subspace of the rate of return on T-bill is,

$$\mathscr{R}_s = \frac{2(1-\alpha)\sigma_r}{\alpha}\sqrt{\frac{2\theta}{1+\theta}\bar{r}\alpha + (1-\alpha)^2\sigma_r^2 - \frac{2\alpha^2}{(1-\alpha)}\eta_d}.$$

This subspace $\mathscr{R}_s$ has the property,

$$\begin{cases} \frac{\partial \mathscr{R}_s}{\partial \alpha} < 0, \\ \frac{\partial \mathscr{R}_s}{\partial \sigma_r} > 0, \ \frac{\partial \mathscr{R}_s}{\partial \bar{r}} > 0, \ \frac{\partial \mathscr{R}_s}{\partial \theta} > 0. \end{cases}$$

This establishes that the subspace of rate of return on T-bill, $\mathscr{R}_s$, increases with σ_r, $\bar{r}$, and θ; and decreases with the NPO's risk parameter, α.

Direct calculations show that the critical point $(r^*, f(r^*))$ shifts when parameters $\{\alpha, \theta, \bar{r}, \sigma_r\}$ change:

$$\begin{cases} \frac{\partial r^*}{\partial \alpha} < 0,\ \frac{\partial r^*}{\partial \sigma_r} > 0,\ \frac{\partial r^*}{\partial \bar{r}} > 0,\ \frac{\partial r^*}{\partial \theta} > 0, \\ \frac{\partial f(r^*)}{\partial \alpha} < 0,\ \frac{\partial f(r^*)}{\partial \sigma_r} > 0,\ \frac{\partial f(r^*)}{\partial \bar{r}} > 0,\ \frac{\partial f(r^*)}{\partial \theta} > 0. \end{cases}$$

Hence, the $f(r)$ curve shifts to lower left or upper right. This finishes the proof of Corollary 2.2. □

2.7.8 Proof of Proposition 2.5

Proof. By Proposition 2.3, given the NPO's optimal strategy $\{G_t^*, \beta_t^*\}$, donors' optimal decision $\{C_t^*, D_t^*\}$ is such that value function $\Psi(s_t, w_t)$ must satisfy

$$r\Psi(s_t, w_t) = \max_{\substack{C_t \in (0, \eta_c w_t] \\ D_t \in [0, \eta_d s_t]}} \Big\{ u^d(G_t^*) + C_t + \Psi_{s_t}\Big(\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r} - r) + r\big)s_t - (G_t^* - D_t)\Big) + \Psi_{w_t}\left(rw_t + \bar{I} - D_t - C_t\right) + \frac{1}{2}\Psi_{s_t,s_t}\beta_t^{*2}s_t^2\sigma_r^2 + \frac{1}{2}\Psi_{w_t,w_t}\sigma_I^2\Big\}. \quad \text{(A18)}$$

By equation (9), the donors' wealth variation is exactly the same as their income volatility, σ_I^2, which is not related to the donors' decision $\{C_t^*, D_t^*\}$. Thus, the change of the term $\frac{1}{2}\Psi_{w_t,w_t}\sigma_I^2$ in equation (A18) does not affect the donors' first-order conditions (See equations (A6, A7)). That is the change of donors' income risk exposure does not have any effect on the equilibrium of the game.

From Proposition 2.4, a more volatile investment project leads the NPO to lower its portfolio selection and provide more charitable goods, which decreases its endowment level. Meanwhile, donors' contribution shrinks. Proposition 2.5 complements the experimental evidence by Cettolin et al. (2017). This completes the proof of Proposition 2.5. □

2.7.9 Proof of Corollary 2.3

Proof. At time interval $[\,t,\, t+\Delta t\,]$, the discrete forms of donors' income and rate of return differential eqations are,

$$\begin{cases} I_t \Delta t = \bar{I}\Delta t + \sigma_I \varepsilon_t \sqrt{\Delta t}, \\ \\ r_t \Delta t = \vartheta(\tilde{r} - r_t)\Delta t + \tilde{\sigma}\varepsilon_t \sqrt{\Delta t}. \end{cases} \tag{A19}$$

It follows that the change of the wealth level, Δw_t, can be written as:

$$w_{t+\Delta t} - w_t = (e^{r_t \Delta t} - 1)(w_t + (I_t - D_t - C_t)\Delta t) - (D_t + C_t - I_t)\Delta t. \tag{A20}$$

Inserting equation (A19) into equation (A20), the conditional expectations of $w_{t+\Delta t} - w_t$ and $(w_{t+\Delta t} - w_t)^2$ at time t can be written as:

$$\mathbb{E}_t\{w_{t+\Delta t} - w_t\} = \left(\frac{\vartheta}{1+\vartheta}\tilde{r}w_t + \bar{I} - D_t - C_t\right)\Delta t + O((\Delta t)^2),$$
$$\mathbb{E}_t\left\{\,(w_{t+\Delta t} - w_t)^2\,\right\} = \left(\frac{1}{(1+\vartheta)^2}w_t^2\tilde{\sigma}^2 + \sigma_I^2\right)\Delta t + O((\Delta t)^2).$$

The corresponding stochastic differential equation of the state variable w_t is, therefore,

$$dw_t = \left(\frac{\vartheta}{1+\vartheta}\tilde{r}w_t + \bar{I} - D_t - C_t\right)dt + \sqrt{\frac{1}{(1+\vartheta)^2}w_t^2\tilde{\sigma}^2 + \sigma_I^2}dW_t. \tag{A21}$$

By Proposition 2.3, one can derive that NPOs and donors have the same first-order conditions as in the benchmark case. This proves Corollary 2.3. □

2.7.10 Proof of Proposition 2.6

Proof. Substituting β^*, G_t^*, and D_t^* into equation (4) leads to

$$ds_t = \Big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r} - r) + r - \big((\Lambda\alpha)^{1/(\alpha\,-\,1)} - \eta_d\big)\Big)s_t dt + \beta_t^* s_t \sigma_r dW_{tr},$$

where $\eta_d \geq 0$. Following Kuo (2006), this stochastic differential equation has the following solution:

$$\begin{aligned} s_t = {} & s_0 e^{\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r}-r)+r-\big((\Lambda\alpha)^{1/(\alpha\,-\,1)}-\eta_d\big)-0.5\beta_t^{*2}\sigma_r^{*2}\big)t+\beta_t^*\sigma_r W_{tr}} \\ & + \int_0^t 0 \times e^{\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r}-r)+r-\big((\Lambda\alpha)^{1/(\alpha\,-\,1)}-\eta_d\big)-0.5\beta_t^{*2}\sigma_r^{*2}\big)(t-\tau)+\beta_t^*\sigma_r(W_{tr}-W_{\tau r})} d\tau. \end{aligned}$$

I take the expectation of both sides conditional on the information at time t. By the property of geometric Brownian motion, I have

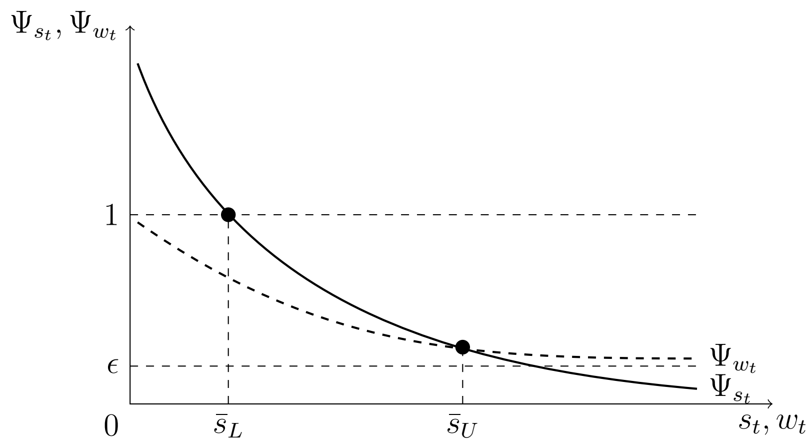
$$\begin{aligned} \mathbb{E}_t\{s_t\} &= \mathbb{E}_t\Big\{s_0 e^{\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r}-r)+r-\big((\Lambda\alpha)^{1/(\alpha\,-\,1)}-\eta_d\big)\big)t}\Big\} \\ &= s_0 e^{\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r}-r)+r-\big((\Lambda\alpha)^{1/(\alpha\,-\,1)}-\eta_d\big)\big)t}, \end{aligned} \tag{A22}$$

where $(\alpha\Lambda)^{1/(\alpha\,-\,1)} = r - \frac{\alpha}{1-\alpha}\eta_d - \frac{\alpha}{2}\sigma_r^2\beta_t^2$, and β_t^* equals $0, \frac{\frac{\theta}{1+\theta}\bar{r}-r}{(1-\alpha)\sigma_r^2}, 1$ for $r > r_U, r \in \mathscr{R}_e$, and $r < r_L$, respectively.

By equation (A22), the NPO's expected endowment can be simplified as,

$$\mathbb{E}\{s_t\} = s_0 e^{\big(\beta_t^*(\frac{\theta}{1+\theta}\bar{r}-r)+\frac{1}{1-\alpha}\eta_d+\frac{\alpha}{2}\sigma_r^2\beta_t^2\big)t}. \tag{A23}$$

By Proposition 2.4, the NPO chooses the optimal share of the risky asset equal to $1, \beta_t^*$, and 0, respectively, contingent on the rate of return on T-bill. It follows,



Donors Shadow Price Curves Ψ_{s_t} and Ψ_{w_t}

Note: the solid curve represents the donors' shadow price of NPO's endowment, whereas the dashed one represents the donors' shadow price of their wealth level. $\Psi_{s_t} > \Psi_{w_t}$ if $s_t \leq \bar{s}_L$; when $\bar{s}_1 < s_t < \bar{s}_U$, for an arbitrary w_t, $\Psi_{s_t} >< \Psi_{w_t}$; $\Psi_{s_t} < \Psi_{w_t}$ if $s_t > \bar{s}_U$.

$$\mathbb{E}\{s_t\} = \begin{cases} s_0 e^{\left(\frac{\theta}{1+\theta}\bar{r} - r + \frac{\eta_d}{1-\alpha} + \frac{\alpha}{2}\sigma_r^2\right)t} & \text{if } r \leq r_L,\ \beta_t^* = 1, \\ s_0 e^{\left(\frac{\eta_d}{1-\alpha} + \frac{(2-\alpha)(\frac{\theta}{1+\theta}\bar{r} - r)^2}{2(1-\alpha)^2\sigma_r^2}\right)t} & \text{if } r \in \mathscr{R}_e,\ \beta_t^* = \frac{\frac{\theta}{1+\theta}\bar{r} - r}{(1-\alpha)\sigma_r^2}, \\ s_0 e^{\frac{\eta_d}{1-\alpha}t} & \text{if } r \geq r_U,\ \beta_t^* = 0. \end{cases}$$

It is innocuous to assume that the donors' shadow price of wealth level, Ψ_{w_t}, follows $\lim_{t\to+\infty} \Psi_{w_t} = \epsilon$, where $0 < \epsilon < 1$ (See Figure above). Thus, I derive the following properties,

$$D_t^* = \begin{cases} \eta_d s_t & \text{if } s_t \leq \bar{s}_L, \\ \eta_d s_t \text{ or } 0 & \text{if } \bar{s}_L < s_t < \bar{s}_U, \\ 0 & \text{if } s_t \geq \bar{s}_U. \end{cases}$$

Therefore, the limit of $\mathbb{E}\{s_t\}$ is given by

$$\lim_{t\to+\infty} \mathbb{E}\{_t\} = \begin{cases} \infty & \textit{if } r < r_U, \\ \bar{s}_\tau & \textit{if } r \geq r_U. \end{cases}$$

where $\bar{s}_\tau \in (\bar{s}_1, \bar{s}_2]$ is the minimum level of the NPO's endowment such that donors do not contribute $\forall s_t > \bar{s}_\tau$. This proves Proposition 2.6. □

2.7.11 Proof of Proposition 2.7

Proof. By equation (A17), function $f(r)$ takes the quadratic form,

$$f(r) = \frac{\alpha}{2(1-\alpha)^2\sigma_r^2}\Big(-r^2 + 2(\frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha})r - (\frac{\theta}{1+\theta}\bar{r})^2 - 2(1-\alpha)\sigma_r^2\eta_d\Big),$$

with the critical point $(r^*, f(r^*)) = (\frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{\alpha}, \frac{\theta}{1+\theta}\bar{r} + \frac{(1-\alpha)^2\sigma_r^2}{2\alpha} - \frac{\alpha}{1-\alpha}\eta_d)$. It follows that the impact of r on the optimal provision of charitable good, G_t^*, is non-monotonic.

However, the change of other parameters shifts the function $f(r)$ curve to the lower left, vertically, or to the upper right (See Figure 2.6), but the dominance of function $f(r)$ in its domain, $\mathscr{R}_s$, is consistent, which shows that the impact of parameters except r is monotonic, as shown in Figure 2.9. This completes the proof of Proposition 2.7. □

2.7.12 Proof of Proposition 2.8

Proof. By the NPO's first-order condition with respect to β_t (See equation (15)), it is direct that if the portfolio ceiling is binding ($\tilde{\beta}_t < \beta_t^*$), the NPO chooses $\tilde{\beta}_t$ instead of β_t^*. This completes the proof of Proposition 2.8. □

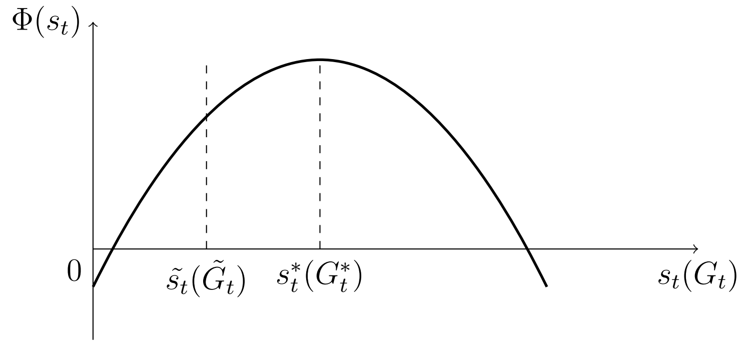


Figure 2.13: The Impact of Provision Floor, $\tilde{G}_t$

2.7.13 Proof of Proposition 2.9

Proof. Insert NPO's instantaneous utility function and value function into its first-order condition with respect to G_t, equation (14) turns to,

$$G_t^{\alpha-1} - \Lambda\alpha s_t^{\alpha-1} = 0.$$

Since the provision floor is binding, $\tilde{G}_t > G_t^*$, which leads $\tilde{s}_t < s_t^*$. The NPO is indeed worse off when setting the provision floor. Thus, the best choice for NPO is the provision floor. This completes the proof of Proposition 2.9. □

Chapter 3

The Partisan Effect on NPOs' Investment Decision–Evidence from the U.S. Private Foundations

3.1 Introduction

NPOs aim to maximize their social impact, at least in theory they are supposed to, and making more revenue means that they can better fulfill their mandate. Restricted from distributing their financial residuals to organisations' shareholders or members, except donors, as a return for their contributions (Hansmann, 1980), and *Sarbanes-Oxley* like requirements of laws and regulations (Ostrower et al., 2007), e.g., IRS990, UPMIFA, and GAAP,[1] there is a call to examine NPOs' financial behaviors, surpluses, and endowment compared with the proprietary firms (Bowman et al., 2012).

[1]IRS990, UPMIFA, and GAAP represent the United States Internal Revenue Service form for an NPO, the law of Uniform Prudent Management of Institutional Funds Act, and Generally Accepted Accounting Principles, respectively.

NPOs finance the provision of charitable goods by two significant sources of capital - accumulated surplus and debt[2], with preferred ranking order for certain forms of finance, i.e., accumulated internal funds, followed by debt or external equity (Frank and Goyal, 2009; Gaud et al., 2005). This feature primarily attributes to NPOs' precautionary concerns of default risk and limited access to other funding (Bowman, 2002; Jegers, 1997) instead of simply to the concerns of increasing cost of asymmetric information when climbing down the ranking order (Myers, 1984). The absence of autonomy and the constraint of non-distribution help NPOs attract voluntary contributions (Hansmann, 1980) and hold large investment portfolios without being suspected as possible hostile takeovers (Bowman, 2002). NPOs build an accumulated surplus when investment proceeds and other earnings exceed expenditures. For most NPOs, this surplus consists of the primary source of an NPO's equity, among which the investment proceeds contribute a significant share and help to stabilize the provision of charitable goods (Sherlock and Gravelle, 2009; Weisbrod, 2009).

On the other hand, a risky investment policy sets up guidelines for the investment portfolio, formulates legal and regulatory requirements to monitor and evaluate portfolio management. Rodgers (1995) further motivates this judgement, citing it as the indispensable component of NPOs' mission statement.

> "*Any organisation that has investments needs an investment policy statement. It is equally valuable whether investments are handed internally or by an external manager.*"
>
> —–*Rodgers (1995)*

[2]"accumulated surplus relates to that part of the funding that remains in the NPO: what was contributed at the foundation of the organisation (in cash and in-kind), later gifts, contributions and subsidies, and profits/losses, which are to be retained due to the non-distribution constraint. Debt is the whole of funds that are to be repaid (possibly with interest) to debtholders, which can be financial institutions (such as banks) or other parties (such as suppliers or tax authorities)" - Jegers and Verschueren (2006).

BC Non-Profit Housing Association, e.g., requires that all of the investment objectives should be rated BBB or above in its investment policy statement; asset allocation must specify the central percentage and the minimum and maximum values. Admittedly, not all NPOs have explicit investment policies, e.g., written policies. Moreover, some may have implicit policies, e.g., the management board's willingness to take on risk, and even the actual investments may or may not comply with the policy statement. However, it is worth noting the legal significance of NPOs' statements since the nonperformance of statement could lead to the invalid of tax-exempt status under section 501(c) by the IRS in the United States (Brinckerhoff, 2009).

As might be expected, the policy allows NPOs to put their stamps on the statement and, in turn, assists donors in evaluating NPOs' efficiency, effectiveness, and financial stability (Parsons, 2003). It also helps donors decide which NPO to contribute to (van der Heijden, 2013) and requires the investment to be committed to social responsibilities (Sparkes, 2008; Rodgers, 1995; Rosen et al., 1991).

A priori, it is worth noting that NPOs, donors, and government typically coexist in an ecosystem of multi interactions. The impact of political parties on the policy may be not substantial but significant all the time (Burstein and Linton, 2002). For example, the paper by Caughey et al. (2016) provides evidence that the elected Democrats have promoted more liberal policies from 1936 to 2014, ending mercantilist policies, monopolies by royal patent, and other trade barriers advocating free trade and marketization. It is also believed that the Democratic administrations seek to levy taxes on corporations and capital owners and promote growth through a consumption-driven approach, while the Republicans prefer to cut taxes with anticipation of spurring the economic growth to pay for itself (Quinn and Shapiro, 1991). Unless the Democratic and Republican converge ultimately, the policy divergence tends to create a different economic and social environment. On the other side, NPOs adapt to a more market-driven approach, as governments demand to become more efficient service providers (Eikenberry and Kluver, 2004). The paper by Wellens and Jegers (2014) also echoes this result but argues the negative side-effects of the government desired marketization on NPOs, e.g., managerial quality and service delivery. Therefore, it is rational to expect that donors' contribution behaviors and NPOs' borrowing activities are vulnerable to the political cycle and, in turn, affect NPOs' investment decisions. Interestingly, even though the features of NPO's investment policy and capital structure (borrowing relative to assets) have received considerable attention in the literature, little is known about the determination of NPOs' investment decisions. Notably, I am unaware of any systematic consideration of the partisan impact and the channels it makes through to influence NPOs' investment. It, therefore, naturally raises the research question of how political regime alternation affects NPOs' investment decisions and the effect it exerts.

This paper contributes to the existing literature by empirically examining NPOs' investment decisions under Republican and Democratic administrations. I develop a model that shows how the national-level political incumbent shapes the NPOs' risky investment, adjusting for a set of NPOs' characteristics and the real interest rate. My results paint a picture of Republicans' function as a *risky investment rein.* NPOs in the Republican regime, relative to the Democratic administration, are expected to reduce corporation stock investment and scale down equity share by 16.28%. Furthermore, I argue that the more severe interest conflict between board members and management or other staff, who serve as decision-makers, is generally associated with a less extensive risky investment. This study also presents the likelihood of NPOs getting involved in a risky investment, e.g., NPOs with larger foundation size are more likely to take the risky investment vehicle; NPOs incline to invest in stocks when the real interest rate increases in the sense of riding with the rational bubble.

The remainder of the paper proceeds as follows. Section 3.2 presents a literature review related to NPOs' vehicles to finance their projects. Section 3.3 discusses possible determinants of investment decisions. Then, Section 3.4 details the mode specification and Section 3.5 describes the dataset and provides descriptive statistics. I present and discuss results in Section 3.6. Section 3.7 summarizes the conclusions and discusses possible future implications. Finally, extended tables and figures are relegated to Appendix 3.8.

3.2 Literature Review

Although NPOs' capital structure and governments demanding NPOs to be more market-driven are a longstanding focus of the NPO finance literature, there is sparse research regarding the linkage between political regimes and NPOs' investment decisions. This paper identifies two literature clusters that examine the financing of philanthropic projects and the influences of political regimes on NPOs.

Past authors have typically focussed on how NPOs determine their capital structure to finance philanthropic activities. The paper by Wedig et al. (1988) models NPO in a stochastic differential game, selecting the level of borrowing and the charitable goods to provide. The author argues that NPOs choose a constant leverage ratio regardless of their equity levels and behave as risk-averse individuals such that a higher leverage ratio requires a more significant risk premium. Most of the subsequent literature examines the determinants of NPOs' capital structure. Bowman (2002), in a static framework, clarifies the role of NPOs' endowment and concludes that well-endowed NPOs tend to borrow more. Khodjamirian (2008) argues that the debt ratio is not fixed; instead, it is a process towards the time-varying target capital structure, which depends on NPOs' characteristics, e.g., financial deficit, personal cost. More recently, by examining the profitability, agency problem, and the one-year lagged leverage, Szymańska et al. (2015) conclude that more significant agency problems are more likely to invite financial debt. However, agency problems play the opposite role for Belgian social purpose companies, which already have debts.

Admittedly, there are varieties of lending sources, e.g., banks, credit unions, online banking, and alternative lends, facilitating NPOs to solve existing financial pressure, e.g., various operation costs, and providing charitable goods such as food to homeless people, health care. However, it is still hard for NPOs to borrow to pay for anything that does not produce a tangible asset. Primarily, most commercial banks will not lend without collateral. Moreover, considering tax-exempt and non-distribution constraints, the cost of internal funds is lower than debt. Therefore, it is rational for NPOs to finance the provision of charitable goods by internal funds instead of debt (Jegers and Verschueren, 2006).

Financial investment is an alternative way for NPOs to finance their activities. A line of literature examines the impact of investment policy in which risky asset allocation is the primary component or investigates the factors of NPOs' investment return, but the determinants of NPOs' investment decisions are missing. For instance, Surz et al. (1999) establish that the for-profit firm's policy explains approximately 100% of investment returns *ex-post* if fund managers stick to the policy and invest passively. Ibbotson and Kaplan (2000) echo this result but argue that asset allocation policy explains only 40% of the variation of returns among funds. As being an indispensable component of NPO's mission statement, investment policy helps donors to evaluate NPOs' efficiency, effectiveness, and financial stability (Parsons, 2003), which, in turn, facilitates the commitment of NPOs' mission statement to guide decision-making and attract external resources (Brown and Yoshioka, 2003; Mullane, 2002; Sawhill and Williamson, 2001). More recently, researchers examine NPOs' endowment performance and the substantial heterogeneity in investment returns across funds. By linking human capital to the university endowment investment, Binfare et al. (2021) suggest that endowment performance directly benefits from high levels of human capital involvement. Surprisingly, in the U.S., from 2009 to 2018, non-profit endowments underperform market benchmarks, and donors prefer to contribute to NPOs with substantial endowment returns (Dahiya and Yermack, 2018). The large diversity of endowment returns attributes to a set of NPOs' characteristics, e.g., fund size, sector affiliated, governance (Lo et al., 2019). Particularly, volatile contributions lead endowment funds to behave more conservatively.

To explain why political regime might influence NPOs' investment strategies, it is worth noting that liberals and conservatives possess different preferences and tastes (Vavreck, 2011; Green, 2007). Typically, the ideological partisanship embeds itself in the distinct growth strategies and policy engagement (Oatley, 1999). It naturally invites a substantial number of authors to examine the extent to which the political cycle influences economic performance. For example, Faricy (2011) provides evidence that the right-leaning Republican administration results in a higher ratio of indirect to direct social expenditure, reflecting that the Republicans prefer to subsidize the private provision of social benefits through tax expenditures instead of directly providing social benefits to citizens. From the public perspective, social benefits delivered through tax expenditure are more favorable (Haselswerdt and Bartels, 2015; Faricy and Ellis, 2014), which echos the results that the Republic is more likely to support private charities for its opposition to direct government grants (Brooks, 2007b; Jacoby, 1994). Other authors focus on how government oversight shapes public behaviors. For example, the paper by Fisman and Hubbard (2005) crystallizes the impact of government surveillance on NPOs' agency problem and provides evidence that NPOs in the states with inferior government oversight tend to exploit donors' generosity for perquisite consumption. Desai and Yetman (2015) also conclude a similar result, pointing out that solid state-level governance helps NPOs function as social insurance when facing economic shocks. More interestingly, contrary to the "accepted wisdom" that the right-leaning Republicans are superior to Democrats for business, Santa-Clara and Valkanov (2003) refer to the significant gap of stock market return between the Democratic regime and the Republican administration as the *presidential puzzle*.[3]

In all of these models, the determinants of NPOs' investment decision is not seen, especially in an environment with a different political regime. Implicitly, NPOs have no requirement for hedging potential investment losses and liquidity risks. In contrast to corporate financial theory's argument of the irrelevance of non-systematic risk,[4] NPOs must determine the optimal allocation of the disposable endowment along the portfolio frontier. However, research in this field is rather scarce. An exception is my chapter 2, which examines the NPOs' portfolio selection[5] and internal funds management in a stochastic dynamic economy. I argue that the optimal share of disposable endowment invested in risky asset is constant. However, donors' strategy depends on their shadow prices, either contributing or free-riding on the NPO's investments. It is also shown that the NPO will wish to hold a larger risky asset in an environment with a lower return rate on risk-free assets, facilitating its expected endowment accumulation. Financial market fluctuations affect NPOs' and donors' decisions; however, donors' income variance is irrelevant to the NPO's decision-making process.

[3]"The excess return in the stock market is higher under Democratic than Republican presidencies...The difference comes from higher real stock returns and lower real interest rates.... The difference in returns is not explained by business-cycle variables related to expected returns and is not concentrated around election dates. There is no difference in the riskiness of the stock market across presidencies that could justify a risk premium. The difference in returns through the political cycle is, therefore, a puzzle"− Santa-Clara and Valkanov (2003).

[4]Corporate financial theory argues the irrelevance of non-systematic risk by using the concept of complete markets and equilibrium asset pricing models such as the CAPM. For NPOs, the imperfect substitution of charitable goods makes the variance of returns on risky assets, which is generated by the random process, is crucial to the risk of assets.

[5]where the efficient portfolio that consists of only the tangency portfolio and one risk-free asset, T-bill. This is essentially the application of the mutual fund seperation theorem. The tangency portfolio is the combination of the risky asset such that the Sharpe ratio is maximized. That is the corresponding proportion of the endowment fund allocated to the risky asset is fully characterized by,

$$\max_{\beta_1 \ldots \beta_N} SR_p = \frac{\mu_p - r_f}{\sigma_p}$$

subject to $\mu_p = \mathbb{E}[R_p] = \sum \beta_i \mu_i; \sigma_p^2 = Var[R_p] = \sum \beta_i^2 \sigma_i^2 + 2 \sum_{1 \leq i < j \leq N} \sum \beta_i \beta_j Cov(x_i, x_j); \sum \beta_i = 1.$

By recognizing that an NPO has to hedge potential investment losses and liquidity risk, e.g., 5% minimum distribution rule,[6] the model in this paper characterizes the proportion of endowment invested in the risky asset as a critical decision made by NPOs. Further, by recognizing that NPOs, donors, and government typically coexist in an ecosystem of multi interactions, the model deliberately designs two channels, donors' contribution and NPOs' capital structure, through which the partisan incumbent shapes NPO's investment decision.

3.3 Determinants of Portfolio Selection

NPOs are mission-driven (Brinckerhoff, 2009), and the mission statement, e.g., investment policy, constrains the NPO's investment to be socially responsible (Sparkes, 2008; Rodgers, 1995). As for all other institutional investors, NPOs need to hedge potential investment losses and liquidity risks by employing portfolio strategy, which comprises the security screening and optimal allocation of the disposable endowment along the portfolio frontier. Furthermore, I suspect the contrast of policy instruments between partisan incumbents, e.g., the delivery of social benefits (Faricy, 2011) and the development of the economy (Quinn and Shapiro, 1991), subtlely determines donors' contribution behaviors and NPOs' accessibility to the debt market, influencing NPOs' investment decisions. To validate that the empirical results are relatively undisturbed, I consciously include a set of NPOs' intrinsic characteristics as controls, e.g., leverage ratio, contribution received, agency problem, investment profitability, foundation size, sector affiliation, and the macroeconomic variable-yearly real interest rate.

This section will highlight the rationale behind these possible determinants of NPOs' investment allocation, assuming that all the investments align with their mission statements.

[6] a private foundation is required to distribute annually through grants to other organizations for charitable purposesat at least 5% of the total fair market value of its noncharitable-use assets.

3.3.1 Political Regime

As governments require, NPOs are becoming more market-driven and have adopted for-profit organisation strategies to be more efficient (Wellens and Jegers, 2014; Eikenberry and Kluver, 2004). In particular, the distinct ideological partisanship to spur economic growth (Quinn and Shapiro, 1991) and to deliver social benefits (Faricy, 2011) by the Democratic and the Republican administrations inevitably leads the public to react differently. For example, the Republicans' promoted social benefits delivery policy by subsidizing the private sector with tax expenditure is more affirmative (Haselswerdt and Bartels, 2015; Faricy and Ellis, 2014), echoing the direct social spending being less supportive (Jacoby, 1994), but the impact on NPOs remains ambiguous. Interestingly, the *presidential puzzle* reveals that the stock market performance cannot be explained by business cycle variables and is irrelevant to the political cycle, with a higher return under the Democratic administration (Santa-Clara and Valkanov, 2003).

It is suspected that social benefits delivery related NPOs, e.g., benefits delivery for housing, education, medical care, and other aspects, tend to be beneficial from the Republican government for its opposition to direct government grants and therefore generate more revenue than having a Democratic president. By Kingma (1995) and Preston (1989), donors may be crowded out and contribute less than under the Democratic administration. Moreover, Republican administrations are less fiscally responsible for balancing government spending and tax than Democratic ones (Hess, 2022). Issuing excessive government securities (Treasury bills, notes, and bonds) to finance the deficits may put upward pressure on the interest and inflation rates, encroaching on donors' disposable income and contribution.

I also suspect that the public supports toward the Republican government's social benefit delivery policy (Faricy and Ellis, 2014) and the generosity of Republicans (Brooks, 2007b) may facilitate NPOs' borrowing accessibility. The rationale is that with the growing demand for

NPOs to deliver social benefits under the Republican administration, a more steady revenue stream from providing social benefit-related products and services and consistent cash flow are expected than under the Democratic government. As a result, the NPOs' enhanced operating performance and credit solidity facilitate their borrowing from financial institutions and alternative lenders even without collateral, decreasing the requirements for risky investment. Nevertheless, NPOs with capital assets, e.g., private foundations, can use capital assets as collateral to finance their growing mission requirement, e.g., grants distribution and self programs, increasing the borrowing from lenders and relatively reducing the risky investment. The *presidential puzzle* may also discourage NPOs' risky investments. Thus, it naturally leads to the hypothesis that the political administration will change donors' contribution and NPOs' borrowing behavior, therefore, influencing NPOs' risk portfolio selection,

H_1: Under the Republican presidents, NPOs may have lower risk investment than Democratic ones, *ceteris paribus*.

3.3.2 NPO Characteristics

3.3.2.1 Leverage Ratio

In philanthropic practice, NPOs borrow from a business bank, credit union, or alternative lenders to help deliver its program and improve charitable reach, e.g., maintaining operation, establishing a new location, major purchases, and consolidating outstanding debts. Admittedly, lenders generally are reluctant to lend out money without collateral or charge higher interest rates to secure the loan. However, the capital assets held by private foundations would serve as serve as adequate collateral. Nevertheless, NPOs' obligation to maintain theie tax-exempt status (Brinckerhoff, 2009, p.39) helps build credit reputation and facilitate borrowing from financial institutions and alternative lenders.

By recognizing the influence of liabilities on a firm's behaviors, e.g., potential default risk, debt overhang, and possible excessive risk taken, firm investment decisions are shown to be negatively related to debt ratio (Cleary, 1999), instead of financial status irrelevant where capital markets are perfect and complete (Modigliani and Miller, 1958).[7] The paper by Gebauer et al. (2018) echos this result by examining firm-level data from 2005-2014 but argues that this negative leverage-investment relationship is non-linear until the leverage ratio hits thresholds. Data of public listed companies in developing countries, e.g., China and Jordan, indicate the same pattern of negative leverage-investment correlation (Al-Shubiri, 2012; Yuan and Motohashi, 2008). I assume that NPOs behave as for-profit organisations, representing a negative relationship between debt ratio and investment decisions. The rationale lies in the fact that excessive debt may lead to potential default risk and, therefore, deters NPOs from a further risky investment. Thus,

H_2: NPOs with higher leverage ratio will have lower proportion of risky investments, *ceteris paribus.*

3.3.2.2 Contribution Received

NPOs with more contributions received are less motivated to borrow either from formal financial institutions or alternative lenders (Khodjamirian, 2008; Jegers and Verschueren, 2006). Therefore, the lower likelihood of defult due to excessive borrowing encourages NPOs to increase their investment. Nevertheless, a paper by Shaw (1996) argues that there is a positive relation between income growth and preference for risk taking. Wright (2017) echos this result, highlighting that every £1,000 increase in income, an individual's odds of becoming risk seeking increase by 1%.

I argue that the increase in contribution inflow leads NPOs to be willing to take more

[7]in the absence of taxes, bankruptcy costs, agency costs, and asymmetric information, and in an efficient market, the enterprise value of a firm is unaffected by how that firm is financed

risk and better able to reduce risk through portfolio diversification. Thus, it is expected that a more significant proportion of the internal funds would be allocated to the risky asset.

H_3: NPOs with higher contribution received will have larger risky investment, *ceteris paribus.*

3.3.2.3 Agency Cost

Agency relations occur in any situation (Jensen and Meckling, 1976).[8] For NPOs, founders or board members may delegate management and other staff as decision-makers, which naturally leads to the interest conflict between two sides, especially when incentive contracts are precluded (Steinberg, 1990). It is shown that NPOs suffering from agency problems are more likely to issue debt (Szymańska et al., 2015; Jegers and Verschueren, 2006), to have NPOs' behaviors monitored by lenders.

It is suspected that the more acquirement of non-equity financing by debt, the less incentive for NPOs to finance philanthropic projects by investing in the risky asset. Meanwhile, the higher agency cost lessens the disposable endowment, such that NPOs are less willing to bear more risk (Bach et al., 2016) and the proportion invested in risky assets shifts in the opposite direction as the agency cost (Brunnermeier and Nagel, 2008). It spontaneously leads to the hypothesis, a negative influence of agency problem on investment portfolio selection might be expected. Following Dyl et al. (2000), I employ the ratio of excutive compensation (i.e., remuneration, labor-related contributions, and pensions) to total assets as a proxy for agency cost. This leads to the hypothesis,

H_4: Investing NPOs with more severe agency cost will have lower risky investment, *ceteris paribus.*

[8]"One or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent. If both parties . . . are utility maximizers there is good reason to believe that the agent will not always act in the best interests of the principal" (Jensen and Meckling, 1976).

3.3.2.4 Investment Gain

Identical reasoning to the contribution received, a more considerable investment gain motivates NPOs to be less reliant on borrowing, instead, turn to take higher risk and allocate more proportion of internal funds to risky assets. Thus,

H_5: NPOs with higher invetsment gain will have larger portfolio selection, *ceteris paribus*.

3.3.2.5 Foundation Size

Survey evidence suggests that with economies of scale, large firms tend to hire more specialized crew and use investment techniques, e.g., fundamental analysis of stocks, portfolio analysis, options and futures strategy (Carter and Van Auken, 1990). Nevertheless, large firms are better diversified and therfoe, more resillient to financial constraints, e.g., tightening monetary policy (Gertler and Gilchrist, 1994) and economic downturn (Duchin et al., 2010). All these features help NPOs with larger size be more competetent to invest in the security market. However, the paper by Gala and Julio (2016) provide a countervailing effect of firm size on investment, demonstrating that small size firms invest significantly more by capturing technological decreasing returns to scale rather than differences in financial status, even controlling for Tobin's Q and cash flow.

For non-profit organisations, the paper by Lo et al. (2019) establishes that the return of large-size NPO funds significantly outperforms small funds, which escalates large-size NPOs' preference for risk-taking to hold more risky assets (Shaw, 1996). I suspect that NPOs behave similarly to for-profit organisations with respect to foundation size. On average, NPO with a larger size tends to allocate more endowments in risky securities due to economies of scale and greater willingness to take risks. However, for investing NPOs, small organisations invest more if taking account of the decreasing returns to scale. Given the contradictory findings in the literature, I consider two competing hypotheses,

H_{6a}: NPOs with higher foundation size are more likely to allocate more asset in risky investment, *ceteris paribus.*

H_{6b}: Investing NPOs with smaller foundation size allocate more asset in risky investment, *ceteris paribus.*

3.3.2.6 Sector Affiliation

Sanyal (2011) demonstrates the heterogeneity of a firm's debt ratio, which depends on the firm's sector affiliation and individual characteristics. As stated in Section 3.3.2.1, a negative relationship exists between NPOs' debt ratio and investment decisions since the potential default risk prevents NPOs from further risky investments. Therefore, the heterogeneous impact of sector affiliation on NPOs' investment decisions is expected.

A recent study by Lo et al. (2019) indicates that investment return is heterogeneous among NPO sector affiliations, with public and societal benefits, the environment, and the arts being the top performers. Identical reasoning to Section 3.3.2.2, the preference for risk-taking would be different among NPO sector affiliations. Thus,

H_7: NPO sector affiliation may have a heterogeneous impact on its risky investment decision, *ceteris paribus.*

3.3.3 Interest Rate

The impact of interest rate on investment is mixed. Intuitively, a higher interest rate raises the borrowing cost and mitigates the desire for input. This inverse correlation is identified by many empirical results (Wang and Yu, 2007; Larsen, 2004). In contrast, Beccarini (2007) argues that a positive correlation may exist if interest rate is volatile. More interestingly, using a VAR model with time-varying parameters, Galí and Gambetti (2015) point out that the stock market positively responds to the tightening monetory policy after a a short-run decline. While, other scholars report the irrelevance of interest rate to the investment, e.g., Dore et al. (2013) shows it is the macro-demand that determines the investment; Ibicioglu and Kapusuzoglu (2012) demonstrate that stock market investors do not respond to the Central Bank interest rate policy in the short term.

In this paper, I take the inverse correlation between invesmet and interest rate for granted. This can be captured by noting that NPOs receive returns without risk if investing the internal funds in risk-free assets, e.g., government bonds. And higher interest rate leads risky investments to be less attractive to NPOs. Thus,

H_8: The higher the interest rate the lower risky portfolio selection, *ceteris paribus*.

3.4 Model Specification

As highlighted in Section 3.3.1, the management board of NPO has good reasons to be concerned about the impact of the political regime on NPOs' investment portfolio selection (%, defined as the ratio of stock investment to the total investment) and the channels through which this impact exerts, i.e., contribution received ($) and leverage ratio (%). I examine the difference in risk portfoli selection across organizations that exist in different partisan incumbent.

The papers by Eberly et al. (2012) and Ghosal and Loungani (2000) suggest that the lagged investment explains best of the current investment. Recognizing that managers in NPOs are likely to be backward-looking, I account for the dynamic characteristics of investment portfolio selection by including the one-year lagged equity share (%) as an explanatory variable[9] and analyzing comprehensive panel data. I also consciously include the real interest rate (%) data and a conventional set of NPOs' intrinsic characteristics, e.g., executive compensation (%)

[9]Consistent with the definition of an NPO's investment portfolio, one-year lagged equity share is the ratio of stock investment to the total investment in the previous year.

indicating the agency problem cost, invest gain ($), foundation size, and sector affiliation, to control for the likely influences on NPOs' investment decisions.[10]

Independent variables are the one-year lagged equity share ($\beta_{i,t-1}$); contribution received (cont_{it}), as an inverse hyperbolic sine transformation of contribution received to account for the large number of NPOs who receive nothing; leverage ratio (leverage_{it}), as a ratio of current liabilities to current assets; executive compensation (agent_{it}), as a ratio of management compensation to total assets; investment gain (prof_{it}), as a gross margin from the selling of asset; foundation size (found_size_{it}); sector affiliation (found_type_{i}); yearly real interest rate (int_rate_{t}); possible time trend (time_trend_{t}), a category variable, defined as the fiscal year (fisyr_{t}) minus 1987; and dummy partisan incumbent (republic_{t}), where $\text{republic}_{t} = 1$ if the Republican party takes office and $\text{republic}_{t} = 0$ if the Democratic wins the election. I expect:

$$\beta_{it} = f(\beta_{i,t-1}, \text{republic}_{t},\ \text{cont}_{it},\ \text{cont}_{it}\#\text{republic}_{t},\ \text{leverage}_{it},\ \text{leverage}_{it}\#\text{republic}_{t},\ \text{agent}_{it},\ \text{prof}_{it},\ \text{found\_size}_{it},\ \text{int\_rate}_{t},\ \text{found\_type}_{i},\ \text{time\_trend}_{t}) + \text{constant}. \quad (1)$$

I implement the primary analyses in the following stages: (1) OLS regression. I look at the average changes in the stock share as the political regime alternates from the Democratic to the Republican. (2) Heckman two-step estimation. I note that a significant proportion of NPOs do not choose to invest in corporation stocks; only 756,432 observations carry risky investment consisting of 49.51% of the full sample with 1,527,984 entity-year pair observations. It is reasonable to consider that NPOs may not make investment decisions randomly, such that OLS regression could lead to inconsistent estimation. Following Heij et al. (2004), in the second stage, I implement the Heckman two-step estimation to explain the change of NPOs

[10] I categorize NPOs into small, medium, and large groups if their total assets belong to the interval 0 to $999,999, $1,000,000 to $9,999,999, and above $10,000,000, respectively. Following NCCS, there are 12 types of sector affiliations (See Table 3.6).

to purchase stock conditional on participation, i.e., for those NPOs that have invested in the stock market, when the political administration alternates. (3) Tobin model. Finally, I employ a Tobit model with left-censored portfolio level β^{o}_{it}=0 to verify my previous results (McDonald and Moffit, 1980).

3.5 Data

To examine how the national-level political incumbent changes the relationship of contribution received and leverage ratio on the NPOs' investment portfolio selection, I use the comprehensive financial information of NPOs from the National Center for Charitable Statistics (NCCS)[11] over the year from 1987 to 2014 period and connect it to the national-level political incumbent data during the same period. It is helpful to emphasize that I am looking at the impact of the presidential election instead of which political party controls the House or the Senate.

3.5.1 Reported Financial information

Data on NPOs' financial information spans from the year 1987 to 2014 and comes from the NCCS Core files, which only derive from the Internal Revenue Service's annual Return Transaction Files (RTF) and contain data on all 501(c)(3) organisations required to file a Form 990 or Form 990-EZ. The substantial error checking conducted by the NCSS leads the data to be more reliable than the data in the IRS's unedited files.

The sample is confined to private foundations[12] that report the necessary financial

[11] established in 1982 and dedicated to developing uniform standards for reporting on the activities of charitable organisations and building compatible national, state, and regional databases, is the national repository of data on the nonprofit sector in the United States.

[12] According to NCCS, private foundations are devoted to distributing money to public charities or individuals and meet to 5% minimun distribution rule; most have substantial investments to found giving; also run self-programs, provide services, and conduct direct charitable activities. By contrast, public foundations,

information over the stated interval. Public charities are excluded from the sample because most of them are not directly involved in the financial market, making the model developed in this paper inappropriate. The dataset contains NPOs identification, date, contribution received, compensation of officers, investment (corporation stock, corporate bonds, US & state government obligation), the net gain from sale, liabilities, total assets, and sector affiliation, categorizing NPOs into ten major groups.

I first remove out-of-scope organisations that file to IRS but are not included in the NCCS analyses. As a result, the sample is reduced to 153,470 entities from the original 154,889 organisations. Then, I exclude organisations with negative reported values, i.e., investment, contribution received, executive compensation, expenses, total liabilities, and total asset. These omissions result in a further reduction of 2,880 entities, leaving a total of 150,590 organisations with 1,610,990 entity-year pair observations. Finally, following Fisman and Hubbard (2005), I also delete the outliers for which the values of leverage ratio (leverage_{it}) and agency ratio (agent_{it}) are greater than 1. As a result, the final research sample consisted of 142,006 NPOs with 1,527,984 entity-year pair observations, identifying their ownership as private foundations.

It is helpful to stress that, in this study, portfolio selection (β_{it}) is defined as the ratio of investment in corporation stocks to financial market investment, excluding real estate. In addition, I divide NPOs into small, medium, and large groups if their total assets belong to the interval 0 to $999,999, $1,000,000 to $9,999,999, and above $10,000,000, respectively. Small group is the benchmark group.

Descriptive statistics are presented in Table 3.5 in Appendix 3.8. It illustrates that NPOs have some stock investments and allocate approximately 39.6% of the real investment into the corporation stocks. However, this percentage varies with the period and the NPOs' sector

e.g., community foundations, must demonstrate their support by the public and meet the public support test, relying on public fundraising to support its activities.

Table 3.1: The U.S. Political Incumbency

	Party	President	Number of Years
1987-1988	Republican	Ronald Reagan	2
1989-1992	Republican	George H. W. Bush	4
1993-2000	Democratic	Bill Clinton	8
2001-2008	Republican	George W. Bush	8
2009-2014	Democratic	Barack Obama	6

affiliations. For example, the largest number of NPOs affiliates to the public and societal benefit sector, which invests the most in corporation stocks with approximately 44.1% of its real investment (See Table 3.6 in Appendix). Tables 3.7 and 3.8 in the Appendix present pairwise correlations among the dependent and explanatory variables for the entire sample and the subsample restricted to NPOs from the year 1991 to 2014. It is evident that there is no high correlation between selected variables in both cases, which indicates collinearity problem is excluded in my regression models.

Figures 3.2 and 3.3 in the Appendix plot the distributions of contribution received by NPOs and the investment gain from selling financial assets. The donation to NPOs is not particularly skewed, except for a number of zeros or tiny donations received by NPOs. It is worth noting that risky investment may generate negative revenues for NPOs, which are typically normal distributed. In this study, I transform the measures of contribution reveived and investment gain using the inverse hyperbolic sine for ease of interpretation as semi-elasticities.

3.5.2 U.S. Presidential Elections

Table 3.1 demonstrates that the political incumbent alternated four times in the U.S. from 1887 to 2014. In particular, the right-leaning Republican won the presidential election three times in the year 1988, 2000, and 2004, respectively, among which the incumbency for the republican is a total of 16 years. It is worth noting that the Democratic also held the office of the chief executive three times from 1987 to 2014 and has 16 years of incumbency in total.

3.5.3 Interest Rate

It is accepted that the interest rate is the cost of borrowing money such that the stock market responds negatively to the interest rate hikes. As a result, investors may be more willing to deposit than hold corporation stocks.

The actual cost of funds to the borrower and the investor's real yield must account for the inflation effects. Therefore, I use the real interest rate as the opportunity cost to invest, derived from the World Bank data set from 1987 to 2014 (See Figure 3.1).

3.6 Empirical Results

This study compares portfolio selection in two groups of observations that both hold financial assets, e.g., corporation stocks, government bonds. The only difference between these observations is under the different political administrations, either the Republican or the Democratic. I investigate the relationship between investment portfolio selection and a set of explanatory variables within private foundations in the U.S.[13]

[13]Noting that in the case that unobservable factors are not time-invariant and their movements are correlated with independent variables, the random effect model would generate more reliable coefficient estimates. The rationale behind choosing this methodology is its ability to address unobservable variables and therefore provide consistent regression estimates in panel data.

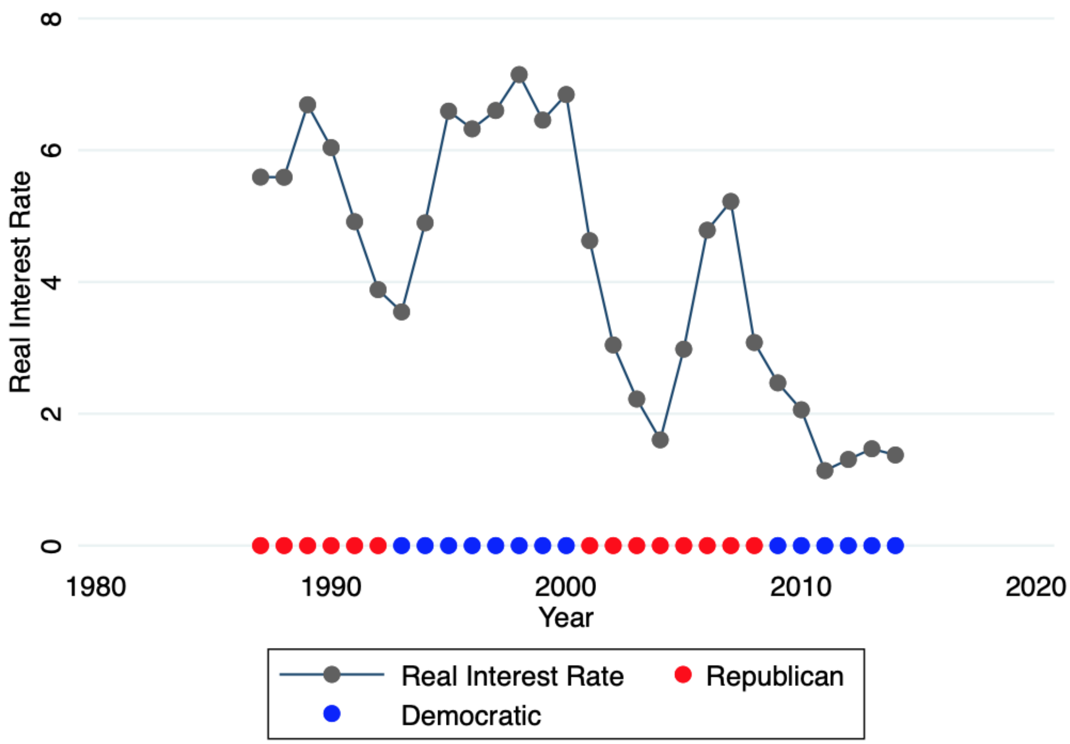


Figure 3.1: Real Interest Rate and the Corresponding Political Regime from 1987 to 2014

First, it is helpful to examine the relationship of partisan incumbents on contribution and leverage ratio. I use the inverse hyperbolic sine of contribution received (ihs_cont_{it}) and leverage ratio (leverage_{it}) as the dependent variable respectively. The independent variable is dummy republic_t, keeping time trend (time_trend_t), executive compensation (agent_{it}, investment gain (prof_{it}), foundation size (found_size_{it}), foundation type (found_type_{it}), and the real interest rate (int_rate_t) as controls. Table 3.2 presents the differential intercept coefficients of political regime alternation from the Democratic to the Republican, indicating that under the Republican, NPOs, on average, receive 58.52% less contribution with a 99% confidence level, *ceteris paribus*. Furthermore, a Republican president means a 1.32% increase in NPOs' average leverage ratio relative to the Democratic administration. This result

Table 3.2: OLS Estimation of Donation Received and Leverage Ratio

Regression Coefficient

	Dependent Variable	
	ihs(donation)	leverage
	(1)	(2)
republican	-.58519***	.01319***
	(.20777)	(.00405)
Additional Controls		
time_trend	✓	✓
execu_comp	✓	✓
ihs(invest gain)	✓	✓
found_size	✓	✓
found_type	✓	✓
int_rate	✓	✓
N	1,527,984	1,502,674
overall R^2	0.0139	0.0186

1. Standard errors in parentheses;
2. * $p < 0.1$, ** $p < 0.05$, ***· $p < 0.01$
3. **donation** is the dollar values of contribution received by NPOs.
4. **leverage** is the ratio of current liabilities to current assets.
5. **republican** equals 1 if having a Republican president; 0, Democratic.
6. **execu_comp** is defined as the ratio of executive compensation to assets.
7. **invest gain** is a gross margin from the selling of asset.
8. **int_rate** is the yearly real interest rate.
9. Inverse hyperbolic sine function **ihs(x)**=$\ln(x + \sqrt{x^2+1})$.

is consistent with my conjectures in Section 3.3.1 that the Republican government may crowd out donations and facilitate NPOs' borrowing accessibility from financial institutions and alternative lenders, attributed to the Republicans' distinct ideological partisanship, particularly the opposition to government dominated social benefits delivery policy.

Next, following my expectation in Eq.(1), I estimate:

$$\beta_{it} = \alpha_0 + \gamma \text{cont}_{it}\#\#\text{republic}_t + \eta \text{leverage}_{it}\#\#\text{republic}_t + \lambda X'_{it} + \theta_i + \mu_t + \epsilon_{it}, \quad (2)$$

where additional controls (X_{it}) contain one-year lagged equity share ($\beta_{i,t-1}$), executive compensation (agent_{it}), investment gain (prof_{it}), foundation_size ($\text{foundation\_size}_{it}$), and the yearly real interest rate (int_rate_{it}); dummy variable republic_{it} equals one if the Republican party takes office and 0 for the Democratic wins the presidential election; θ_i is an NPO's fixed effect that controls for time-invariant NPO's characteristics, e.g., NPO's sector affiliation (foundation_type_i), possibly correlated with the vector of regressors; μ_t is the year fixed effect, representing the time trend of portfolio selection. The time-variant error term ϵ_{it} assumes that $\mathbb{E}(\epsilon_{it}|\theta_i, X_{it}) = 0$. To be valid under less restrictive assumptions, e.g., the requirement of iid, I use the Huber-White sandwich estimator to calculate the variance-covariance matrix of the estimators to address the heteroskedasticity of the errors.

3.6.1 OLS Estimation

In this section, I present results under a set of controls, then compare NPOs' share of the investment portfolio that is held in equities under the alternative political administrations to validate the hypothesis in Section 3.3.1 that NPOs may have lower risky investment in the Republican government. Effects of other determinants are also verified.

3.6.1.1 Effects of Political Incumbent

Table 3.3 presents the main results derived from Equation (2), where the dependent variable is the equity share, representing the proportion allocated to the risky corporation stocks. It reveals that the alternation of the political incumbent, i.e., the Republican versus the Democratic administration, changes not only the simple slope of the equity share to donations and leverage ratio but also the simple effect of the political incumbent, such that NPOs invest less proportion of risky assets under the Republican regime relative to the Democratic administration.

Table 3.3: OLS Estimation of Political Incumbent Effect on NPOs' Equity Share

Regression Coefficient

	Dependent Variable (equity share)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
republican	-.34804***	-.09704*	-.09623*	-.08860*	-.08439*	-.08464*	-.08528*
	(.01516)	(.05046)	(.05046)	(.05039)	(.05028)	(.05024)	(.05020)
ihs(donation)	.00049***	.00106***	.00105***	.00113***	.00093***	.00097***	.00097***
	(.00007)	(.00005)	(.00005)	(.00005)	(.00005)	(.00005)	(.00005)
ihs(donation)# republican	.00046***	-.00034***	-.00033***	-.00034***	-.00033***	-.00032***	-.00032***
	(.00008)	(.00007)	(.00007)	(.00007)	(.00007)	(.00007)	(.00007)
leverage	-.14775***	-.07683***	-.07592***	-.07227***	-.07320***	-.06818***	-.06818***
	(.00407)	(.00314)	(.00314)	(.00314)	(.00313)	(.00313)	(.00313)
leverage# republican	-.01189**	-.04538***	-.04547***	-.04796***	-.04689***	-.04724***	-.04724***
	(.00517)	(.00455)	(.00455)	(.00455)	(.00454)	(.00453)	(.00453)
Controls							
time_trend	✓	✓	✓	✓	✓	✓	✓
L1_portfolio		✓	✓	✓	✓	✓	✓
execu_comp			✓	✓	✓	✓	✓
ihs(invest gain)				✓	✓	✓	✓
found_size					✓	✓	✓
found_type						✓	✓
int_rate							✓
N	1,502,674	1,280,070	1,280,070	1,280,024	1,280,024	1,280,024	1,280,024
overall R^2	0.0421	.7435	0.7435	0.7443	0.7453	0.7457	0.7457

1. Standard errors (robust) in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
2. Dependent variable **equity share** is the ratio of stock purchase to total investment.
3. Dummy variable **republican** equals 1 if the Republican party takes office; 0, Democratic.
4. **donation** is the contribution received by NPOs; **leverage** is the ratio of liability to assets.
6. **L1_portfolio** is the one-year lagged equity share.
7. **execu_comp** is defined as the ratio of executive compensation to assets.
8. **invest gain** is the gross margin from the selling of asset.
9. **int_rate** is the yearly real interest rate, derived from the World Bank data set.
10. Inverse hyperbolic sine function **ihs(x)**=$\ln(x + \sqrt{x^2+1})$.

Specifically, column 1 exclusively examines the possible time trend impact on regression coefficients. It suggests that when the Democrat party is in office, a 1% increase in donations is associated with a 0.049% increase in the share of the investment portfolio that is held in equities; meanwhile, a 1% increase in leverage ratio is linked to a 14.78% decrease in the equity share. Under the Republican administration, however, the donation impact almost doubles to 0.095%, and 1% increase of leverage ratio is associated with a 15.96% decrease in the ratio of equities to total investment.[14] Note that the coefficient of variable republican represents NPOs' difference in portfolio selection between the Republican and Democratic administration at donation=0 and leverage ratio=0, which equals -34.8%. Therefore, NPOs invest less proportion in corporation stocks by 36.50% under the Republican regime relative to the Democratic administration.[15]

With additional controls, having a Republican president reduces both the impacts of donations and leverage ratio but increases the simple effect of the political incumbent on the share of equities in the investment portfolio. For example, in column 2, I add the one-year lagged equity share ($\beta_{i,t-1}$) control, observing that for NPOs with the same previous one-year equity shares in the investment portfolio, the fewer impacts of two channels, i.e., donation and leverage, up to -0.034% and -4.54%, respectively, but a higher simple effect of the Republican relative to Democratic administration from -34.8% to -9.70%. Thus, the total impact of having a Republican president comes to a 17.17% decrease in the equity share.[16] In addition, the overall R^2 escalates dramatically (up to 0.7435 from 0.0421). Columns 3 to 7 gradually bring in executive compensation, investment gain, foundation size, foundation

[14] The coefficient of the interaction term "donation#republican" is 0.046%, representing the difference in the simple slopes of donation for the Republican versus Democratic administration. Thus, the impact of donations on the equity share: 0.049%+0.046%=0.095%; similarly, the impact of leverage ratio:$-$14.775%$-$1.189%=$-$15.96%.

[15] I calculate this gap at the mean values of the inverse hyperbolic sin of donation and leverage ratio, which are 4.5885 and 1.61%, respectively. So it comes to the result: $-$34.8%+0.046%*4.5885$-$1.189%*1.61=$-$36.50%.

[16] In this case, I calculate the net impact as: $-$9.7%$-$0.034%*4.5885$-$4.54%*1.61=$-$17.17%.

type, and the real interest rate as additional controls but typically render close estimators of the political impacts as column 2. Moreover, the overall R^2 tends to be stable (around 0.74). Finally, I focus on the model specification in column 7 for its integrity, where the Republican administration is associated with a 16.28% decrease in equity share relative to having a Democratic president.[17]

Figure 3.4 in the Appendix plots the predicted marginal impact on NPOs' risky investment, consistent with my results. Given the NPOs' leverage ratio, the expected proportion of stocks NPOs purchase is less at any level of donations received when the political regime alternates from the Democratic to the Republicans. The simple effect of political incumbents and the difference in simple slope of donations and leverage ratio for the Republican versus Democratic administration are statistically significant. I establish that NPOs have lower risky portfolio selection when the Republican party is in office, which confirms hypothesis H_1 (See Section 3.3.1).

Next, it is essential to verify whether the decrease of the risky portfolio is attributed to the shrink of corporation stock purchase or the escalation of total investment. I define the inverse hyperbolic sine of stock investment as a new dependent variable (ihs_stock_{it}), keeping all the controls the same but substituting lagged stock purchase for lagged portfolio selection. Table 3.9 in the Appendix highlights the influence of political regime alternation on NPOs' corporation stock purchase. As can be noted that having a Republican president, NPOs invest less in corporation stocks relative to the Democratic administration.[18]

[17] The model specification in column 7 suggests that the total impact of having a Republican president turns to a $-8.528\%-0.032\%*4.5885-4.724\%*1.61= -16.28\%$ decrease in NPOs' equity share.

[18] The alternation of the political incumbent from the Democratic to a Republican administration reduces the simple slope of the stock purchase to donations and leverage ratio by 0.6% and 112.1%, respectively, and the simple effect of the political incumbent by 149.07%.

3.6.1.2 Effects of Other Determinants

Focusing on the model specification in column 7 of Table 3.3, I provide the full OLS regression of NPOs' equity shares in the investment portfolio in Table 3.10, where richer models in columns 1 and 2 are set up on the data samples from 1987 to 2014, 1991 to 2014, respectively.

As noted, the determinants influencing equity shares are typically consistent in both regressions. Adding the one-year lagged equity share ($\beta_{i,t-1}$), I show that an increase of 1% in previous equity share raises the current ratio of equities to total invetsment by approximately 0.85%, ceteris paribus. It indicates that managers in NPOs are backward-looking when deciding the proportion to invest in risky corporation stocks or that the significant portfolio adjustment cost leads NPO's management board to be reluctant to change its portfolio selection. The data validate hypotheses regarding the leverage ratio and contribution received. NPOs with higher leverage ratios allocate less proportion of risky investments. Under the Democratic administration, a 1% increase in leverage ratio is associated with a 6.8% decrease in the equity share and an 11.54% plunge if having a Republican president. The impact of higher contribution received by NPOs supports hypothesis H_3, ceteris paribus (See H_2 and H_3 in Section 3.3.2). NPOs are expected to raise equity share by 0.1% and 0.065% if there is a 1% increase in donations received under the Democratic and Republican, respectively.

I also find that NPO's agency cost (agent_{it}), defined as executive compensation to total asset ratio, is negatively related to equity share at the 1% significance level. A 1% increase in executive compensation is associated with a 7.74% decrease in NPOs' risky portfolio, ceteris paribus, clearly supporting the hypothesis (H_4) that NPOs with more severe agency costs will have lower risky investments. The impact of investment gain meets the expectation that NPOs with a 1% higher investment gain will allocate 0.13% more proportion of real investment in the risky asset (hypothesis H_5).

NPO's foundation size has a positive influence on equity shares in the investment portfolio.

Compared with the reference category, i.e., small size NPOs, the proportions invested in risky assets for medium and large size NPOs are 3.1% and 3.6% more, respectively. Moreover, the data confirms hypothesis H_7, indicating the impacts of sectors are heterogeneous with the public and societal benefit sector affiliation has the most positive influence on NPOs' risky investment, compared with the reference sector affiliation, i.e., arts (including culture and humanities). Lastly, the data does not favor hypothesis H_8, indicating that a 1% higher real interest rate is associated with a 0.02% higher risky investment, but it is insignificant.

3.6.2 Heckman Two-Step Estimation

It is worth noting that only 676,227 observations carry risky investments, representing 52.83% of the sample with 1,280,024 entity-year pair observations in column 7 of Table 3.3. NPO who chooses to invest and whose portfolio selection is therefore observed may systematically differ from those who do not. Moreover, if NPOs do not randomly choose whether to invest, OLS regression could lead to inconsistent estimation due to the omission of the regressor, i.e., inverse Mills ratio[19] (Heckman, 1979, 1976).

I generate a dummy entry_{it}, where entry_{it}=1 if NPO_i purchases corporation stocks in year t and entry_{it}=0 otherwise. As specified in Section 3.4, I implement the Heckman selection model to explain the change of proportion that NPOs purchase stock conditional on participation (entry_{it}=1), i.e., for those NPOs that have invested in the stock market when the political administration alternates. Column 1 is the first step of Heckman estimation, i.e., a probit model, indicating predicted probability changes when control variables increase. Column 2 is the second step of Heckman estimation, i.e., an OLS regression restricted to NPOs that invest in corporation stocks. Lastly, following McDonald and Moffit (1980), I

[19] Heckman proposes that for positive y, $\mathbb{E}[y|y>0]=X'\beta+\sigma\lambda(X'\beta/\sigma)$, where inverse Mills ratio $\lambda(X'\beta/\sigma)$ is defined as the corresponding pdf $\phi(X'\beta/\sigma)$ over cdf $\Phi(X'\beta/\sigma)$.

Table 3.4: Heckman Estimation for NPOs Investing in Financial Market

Regression Coefficient

	Heckman		Tobit
	Step I(Probit)	Step II(OLS)	
	Entry	Equity Share	
	(1)	(2)	(3)
ihs(donation)	.00307***	.00193***	.00193***
	(.00055)	(.00005)	(.00010)
ihs(donation)#republican	.00120	-.00026***	.00043***
	(.00070)	(.00007)	(.00012)
leverage	-1.38635 ***	.00909	-.34687***
	(.04597)	(.00646)	(.00970)
leverage# republican	-.28084***	-.05824***	-.10250***
	(.06061)	(.00824)	(.01276)
Additional Controls			
L1_portfolio	3.03730***	.33267***	.86295***
	(.00582)	(.00091)	(.00141)
execu_comp	-.94765 ***	-.02453	-.18653***
	(.10242)	(.01554)	(.02310)
ihs(invest gain)	.01028***	.00008**	.00146***
	(.00029)	(.00003)	(.00005)
int_rate	.15366	-.11962***	-.00888
	(.09728)	(.01830)	(.02752)
found_size			
medium	.75666 ***	-.05177 ***	.12533***
	(.00636)	(.00072)	(.00138)
large	1.11783 ***	-.05727***	.16436***
	(.03779)	(.00330)	(.00678)
found_ type	✓	✓	✓
time_trend	✓	✓	✓
N	1,280,024	676,227	1,280,024
Corr(e.entry,e.beta)	.4101***		
Log likelihood	-41,680.48		-458,375.88

1. Standard errors in parentheses

2. * $p < 0.1$, ** $p < 0.05$, ***· $p < 0.01$

3. Reference categories: small foundation and AR sector affiliation

4. Reference year: 1987

employ a Tobit model with a left-censored portfolio level β^o_{it}=0 to the sample (N = 1,280,024) to verify my previous outcomes.

Table 3.4 presents the main results of my analysis (See Table 3.11 in the Appendix for the whole model). Heckman two-step estimation indicates that the correlation between the observation-level error for the equity share and the error for the selection model equals 0.4101, which is significantly different from zero. Therefore, NPOs' investment decision is an endogenous sample selection instead of random choice. Figure 3.5 in the Appendix plots the effect of political regime alternation on NPOs' expected risky investment proportion.

As seen in column (1), NPOs with more contribution received are motivated to invest in risky assets, consistent with the behaviors of investing NPOs.[20] Moreover, from the first step of the Heckman model (See column 1), the medium and large-size NPOs tend to invest in the stock market more than the reference group, i.e., small foundation size NPOs (H_{6a}). However, the second step of the Heckman model in column 2 indicates that among NPOs that already have risky investments, foundation size is negatively related to equity shares in the investment portfolio (H_{6b}). This observation matches my expectation in Section 3.3 but is not supported by the Tobit model. In addition, NPOs have a less extensive equity share if suffering from more severe agency costs, ceteris paribus. I also note from column 1 that NPOs are more likely to invest in stocks when the real interest rate increases, which may be attributed to the stock market's positive response to the increase in interest rate (Gala and Julio, 2016), but my result is not significant. However, for investing NPOs (columns 2 and 3), the negative impact of the real interest rate confirms my hypothesis (H_8).

[20] e.g., column 2 indicates that NPOs under the Democratic administration invest 0.193% more in the corporation stocks if there is a 1% increase in contribution received. Having a Republican president, NPOs invest 0.026% less, which comes to 0.193%−0.026%=0.167%. Tobit model in column 3 reveals that NPOs invest 0.193% and 0.236% more under the Democratic and the Republican, respectively, for an additional 1% increase in contribution received.

3.7 Conclusions and Future Applications

I perform a panel data analysis to investigate the determinants of the risky portfolio of U.S. private foundations by merging the National Center for Charitable Statistics (NCCS) data throughout 1987-2014 and the U.S. presidential elections data. I uniquely establish the channels through which political incumbent alternation influences NPOs' risky investments, adjusting for a set of NPOs' intrinsic traits and real interest rate level.

I find that right-leaning Republicans act as a rein to NPOs' risky investment by facilitating NPOs' accessibility to the debt market to finance their operation. NPOs are expected to reduce corporation stock investment and scale down risky investment proportion by 16.28% than in the Democratic administration. I argue that NPOs are backward-looking investors since their previous performances are positively correlated to current investment decisions.

Implementing Heckman two-step estimation, I explain the change of NPOs to purchase stock conditional on participation, i.e., for those NPOs that have invested in the stock market when the political administration alternates. I show that NPOs' investment decision is an endogenous sample selection instead of a random choice. As noted, larger size NPOs tend to purchase corporation stocks due to the economies of scale and greater willingness to take risks, but, for investing NPOs, opposite results are observed. Moreover, less extensive equity share is associated with more severe agency costs whether NPOs are involved in the financial market. It is also noted that NPOs incline to invest in stocks when real interest rate increases in the sense of riding with the rational bubble, consistent with the findings by Galí and Gambetti (2015); for investing NPOs, the risky investment proportion is expected to decrease by 12.0% if there is a 1% increase in the real interest rate.

3.8 Appendix

3.8.1 Tables

Table 3.5: NPOs Descriptive Statistics

	Full sample	Subsamples	
	1987-2014	1991-2014	1987-1990
portfolio (%)	39.59	41.33	1.67
	(44.3)	(44.4)	(10.0)
L1_portfolio (%)	40.96	41.79	1.11
	(44.4)	(44.4)	(7.14)
leverage (%)	1.61	1.44	5.51
	(9.28)	(9.34)	(6.65)
donation ($)	363,583	373,790	141,010
	(1.28e+07)	(1.30e+07)	(1.74e+06)
ihs(donation)	4.5885	4.5860	4.6427
	(5.714)	(5.724)	(5.485)
execu_comp (%)	.43	.43	.39
	(2.51)	(2.50)	(2.87)
ihs(invest gain)	3.0926	3.1089	2.7373
	(7.369)	(7.466)	(4.747)
found_size	1.3046	1.3095	1.1974
	(.473)	(.475)	(.407)
int_rate (%)	3.7365	3.6196	6.2860
	(1.986)	(1.951)	(.367)
republican	.4772	.4532	1.0000
	(.499)	(.498)	(.000)
N	1,527,984	1,460,986	66,998

1. Standard deviations in parentheses.
2. **portfolio** is the ratio of stock purchase to total invest.
3. **L1_portfolio** is the one-year lagged portfolio.
4. **leverage** is defined as the ratio of liability to assets.
5. **donation** is the contribution received by NPOs.
6. **execu_comp** is the ratio of executive compensation to assets.
7. **invest gain** is the gross margin from the selling of asset.
8. **found_size** (See Page 101 footnote 8).
9. **int_rate** is the yearly real interest rate from the World Bank.
10. **republican** equals 1 if the Republican party takes office; 0, Democratic.
11. Inverse hyperbolic sine function **ihs(x)**=$\ln(x + \sqrt{x^2+1})$.

Table 3.6: NPOs Sector Affiliation Equity Share Diversity (%)

	Full sample	Subsamples	
	1987-2014	1991-2014	1987-1990
Arts, culture, humanities (AR)	22.85	23.76	3.73
	(.19)	(.20)	(.34)
Education, higher (BH)	24.25	25.23	3.24
	(1.41)	(1.46)	(2.70)
Education (ED)	28.90	30.08	1.62
	(.11)	(.11)	(.12)
Hospitals (EH)	26.04	27.06	3.18
	(1.05)	(1.09)	(1.35)
Environment (EN)	25.31	26.12	3.04
	(.29)	(.30)	(.54)
Health (HE)	28.35	29.36	2.69
	(.21)	(.22)	(.32)
Human services (HU)	25.18	26.01	3.75
	(.16)	(.17)	(.30)
International (IN)	16.21	16.64	5.65
	(.55)	(.56)	(1.41)
Mutual benefit (MU)	29.61	31.31	1.71
	(.79)	(.83)	(.74)
Public, societal benefit (PU)	44.09	45.97	1.44
	(.04)	(.04)	(.04)
Religion (RE)	24.27	24.93	4.17
	(.25)	(.26)	(.59)
Unknown (UN)	10.63	10.86	5.73
	(.77)	(.79)	(2.61)
N	1,527,984	1,460,986	66,998

Standard deviations in parentheses.

Table 3.7: Pairwise Correlations with Year 1987 to 2014

	portfolio	L1 _portfolio	leverage	donation	execu_comp	invest gain	found _size	int_rate	republican
portfolio	1.000								
L1_portfolio	0.858	1.000							
leverage	-0.088	-0.068	1.000						
donation	0.002	-0.002	0.017	1.000					
execu_comp	-0.022	-0.020	0.032	-0.002	1.000				
invest gain	0.017	0.017	0.004	0.203	-0.003	1.000			
found_size	0.222	0.203	-0.017	0.057	-0.019	0.082	1.000		
int_rate	-0.083	-0.075	0.011	-0.004	-0.020	0.011	-0.051	1.000	
republican	-0.050	-0.038	0.029	-0.002	-0.013	-0.003	-0.020	0.043	1.000

Table 3.8: Pairwise Correlations with Year 1991 to 2014

	portfolio	L1 _portfolio	leverage	donation	excu_comp	invest gain	found _size	int_rate	republican
portfolio	1.000								
L1_portfolio	0.8559	1.000							
leverage	-0.0746	-0.0607	1.000						
donation	0.0013	-0.0018	0.0173	1.000					
execu_comp	-0.0243	-0.0206	0.0318	-0.0022	1.000				
invest gain	0.0173	0.0172	0.0044	0.2043	-0.0030	1.000			
found_size	0.2206	0.2027	-0.0140	0.0573	-0.0190	0.0815	1.000		
int_rate	-0.0346	-0.0524	-0.0132	-0.0034	-0.0200	0.0124	-0.0402	1.000	
republican	-0.0091	-0.0191	0.0107	-0.0015	-0.0135	-0.0020	-0.0094	-0.0200	1.000

Table 3.9: OLS Estimation of Political Incumbent Effect on NPOs' Stock Purchase Regression Coefficient

	Dependent Variable: ihs(stock purchase)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
republican	-4.321***	-1.614**	-1.599**	-1.457**	-1.359*	-1.357*	-1.4907**
	(.2284)	(.7107)	(.7107)	(.7089)	(.7038)	(.7032)	(.7026)
ihs(donation)	-.0009	.0254***	.0252***	.0261***	.0190***	.0196***	.0196***
	(.0010)	(.0007)	(.0007)	(.0007)	(.0007)	(.0007)	(.0007)
ihs(donation)# republican	.0046***	-.0071**	-.0070***	-.0070***	-.0062***	-.0060***	-.0060***
	(.0012)	(.0010)	(.0010)	(.0010)	(.0010)	(.0010)	(.0010)
leverage	-2.610***	-1.102***	-1.085***	-1.031***	-1.124***	-1.050***	-1.050***
	(.0596)	(.0443)	(.0443)	(.0442)	(.0439)	(.0439)	(.0439)
leverage# republican	-.1873**	-1.117***	-1.118***	-1.161***	-1.117***	-1.121***	-1.121***
	(.0756)	(.0641)	(.0641)	(.0640)	(.0635)	(.0634)	(.0634)
Controls							
time_trend	✓	✓	✓	✓	✓	✓	✓
ihs(L1_stock)		✓	✓	✓	✓	✓	✓
execu_comp			✓	✓	✓	✓	✓
ihs(invest gain)				✓	✓	✓	✓
found_size					✓	✓	✓
found_type						✓	✓
int_rate							✓
N	1,502,674	1,280,070	1,280,070	1,280,024	1,280,024	1,280,024	1,280,024
overall R^2	.0315	.7908	.7908	.7918	.7948	.7952	.7952

1. Standard errors (robust) in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
2. Dependent variable **stock purchase** takes the form of inverse hyperbolic sine transformation.
3. Dummy variable **republican** equals 1 if the Republican takes office; 0, Democratic.
4. **L1_stock** is the one-year lagged stock purchase.
5. **execu_comp** denotes the NPO's executive compensation.
6. **invest gain** is a gross margin from the selling of asset.
7. **int_rate** is the yearly real interest rate.
8. Inverse hyperbolic sine function **ihs(x)**=$\ln(x + \sqrt{x^2 + 1})$.

Table 3.10: OLS Estimation of NPOs Equity Share Determinants

Regression Coefficient

	Equity Share	
	(1)	(2)
	1987-2014	1991-2014
ihs(donation)	.00097***	.00096***
	(.00005)	(.00005)
ihs(donation)#republican	-.00032***	-.00028***
	(.00007)	(.00007)
leverage	-.06818***	-.06803***
	(.00313)	(.00316)
leverage#republican	-.04724***	-.04460***
	(.00453)	(.00460)
Additional Controls		
L1_portfolio	.85544***	.85545***
	(.00048)	(.00048)
execu_comp	-.07741***	-.07849***
	(.00824)	(.00841)
ihs(invest gain)	.00125***	.00126***
	(.00003)	(.00003)
int_rate	.00015	.00016
	(.00044)	(.00044)
found_size		
medium	.03073***	.03125***
	(.00045)	(.00046)
large	.03638***	.03699***
	(.00246)	(.00250)
found_type		
BH	.00241	.00264
	(.00881)	(.00897)
ED	.01132***	.01172***
	(.00141)	(.00144)
EH	.00424	.00480
	(.00688)	(.00700)
EN	.00409*	.00439**
	(.00220)	(.00223)
HE	.00932***	.00967***
	(.00181)	(.00184)

(*Continued*)

Table 3.10 (*Continued*)

	Equity Share	
	(1)	(2)
	1987-2014	1991-2014
HU	.00473***	.00503***
	(.00161)	(.00164)
IN	-.00824**	-.00781*
	(.00418)	(.00425)
MU	.01499***	.01508***
	(.00503)	(.00514)
PU	.02971***	.03030***
	(.00127)	(.00129)
RE	.00346*	.00357*
	(.00202)	(.00205)
UN	-.00015	-.00499
	(.00855)	(.00876)
time trend		
Y2013	-.00676***	-.00678**
	(.00239)	(.00240)
Y2012	.00021	.00023
	(.00244)	(.00246)
Y2011	-.00726***	-.00721***
	(.00250)	(.00252)
Y2010	-.00609***	-.00603***
	(.00216)	(.00217)
Y2009	-.00115	-.00105
	(.00204)	(.00205)
Y2008	.08574*	-.18240***
	(.05021)	(.00176)
Y2007	.08648*	-.18177***
	(.05020)	(.00158)
Y2006	.07713	-.19108***
	(.05020)	(.00157)
Y2005	.08048	-.18772***
	(.05021)	(.00181)
Y2004	.08063	-.18755***
	(.05023)	(.00218)
Y2003	.08292*	-.18523***
	(.05022)	(.00203)
Y2002	.08200	-.18621***
	(.05021)	(.00187)

(*Continued*)

Table 3.10 (*Continued*)

	Equity Share	
	(1)	(2)
	1987-2014	1991-2014
Y2001	.08636*	-.18184***
	(.05020)	(.00169)
Y2000	-.00345**	-.00348**
	(.00149)	(.00150)
Y1999	-.00073	-.00074
	(.00147)	(.00148)
Y1997	-.00027	-.00026
	(.00154)	(.00155)
Y1996	-.00323**	-.00321**
	(.00156)	(.00157)
Y1995	-.02180***	-.02178***
	(.00167)	(.00168)
Y1994	-.00162	-.00157
	(.00500)	(.00503)
Y1993	-.00985***	-.00979***
	(.00314)	(.00316)
Y1992	.12815**	-.14001***
	(.05021)	(.00192)
Y1991	.26817***	
	(.05021)	
Y1990	.03365	
	(.05021)	
Y1989	.01977	
	(.05072)	
_con	.03046***	.02970***
	(.00311)	(.00314)
N	1,280,024	1,254,982
overall R^2	0.7457	0.7424

1. Standard errors in parentheses;
2. * $p < 0.1$, ** $p < 0.05$, ***· $p < 0.01$
3. Reference category: small foundation and AR sector
4. Reference year: column 1, 1987; column 2, 1991
5. NPO Sector Affiliation

AR: Arts, culture, human.	EN: Environment	MU: Mutual benefit
BH: Education, higher	HE: Health	PU: Public, societal
ED: Education	HU: Human services	RE: Religion
EH: Hospital	IN: International	UN: Unknown

Table 3.11: Heckman Estimation of NPOs Investing Determinants

Regression Coefficient

	Dependent Variable		
	Entry	Equity Share	
	(1)	(2)	(3)
	Probit	OLS	Tobit
ihs(donation)	.00307***	.00193***	.00193***
	(.00055)	(.00005)	(.00010)
ihs(donation)#republican	.00120	-.00026***	.00043***
	(.00070)	(.00007)	(.00012)
leverage	-1.38635 ***	.00909	-0.34687***
	(.04597)	(.00646)	(0.00970
leverage#republican	-.28084***	-.05824***	-.10250***
	(.06061)	(.00824)	(.01276)
Additional Controls			
L1_portfolio	3.03730***	.33267***	.86295***
	(.00582)	(.00091)	(.00141)
execu_comp	-.94765 ***	-.02453	-.18653***
	(.10242)	(.01554)	(.02310)
ihs(invest gain)	.01028***	.00008**	.00146***
	(.00029)	(.00003)	(.00005)
int_rate	.15366	-.11962***	-.00888
	(.09728)	(.01830)	(.02752)
found_size			
medium	.75666 ***	-.05177 ***	.12533***
	(.00636)	(.00072)	(.00138)
large	1.11783 ***	-.05727***	.16436***
	(.03779)	(.00330)	(.00678)
found_type			
BH	.14365	-.00714	.10333*
	(.14607)	(.02583)	(.04477)
ED	.37650***	-.05225***	.13276***
	(.02524)	(.00470)	(.00787)
EH	.12096	-.00532	.08574**
	(.11012)	(.01957)	(.03277)
EN	.03400	.00154	.03109*
	(.03914)	(.00727)	(.01211)

(*Continued*)

Table 3.11 (*Continued*)

	Dependent Variable		
	Entry	Equity Share	
	(1)	(2)	(3)
	Probit	OLS	Tobit
HE	.19368***	-.018290 **	.08665***
	(.03149)	(.00578)	(.00972)
HU	.09822**	-.01252*	.02659**
	(.02867)	(.00539)	(.00888)
IN	-.25853**	.03671*	-.10087***
	(.07571)	(.01553)	(.02293)
MU	.45989***	-.04994**	.14124***
	(.08505)	(.01502)	(.02663)
PU	.56893***	-.02803***	.24970***
	(.02285)	(.00429)	(.00711)
RE	.13459***	-.02075**	.05776***
	(.03450)	(.00641)	(.01058)
UN	-.27820*	.09903***	-.06759*
	(.11681)	(.02522)	(.03125)
time_trend			
Y2013	-.04774	-.00014	-.01400**
	(.02643)	(.00276)	(.00483)
Y2012	.05562*	-.02203***	-.00378
	(.02650)	(.00255)	(.00462)
Y2011	.06268	-.05337***	-.01597*
	(.03517)	(.00493)	(.00787)
Y2010	-.04617	.05426***	-.00344
	(.07000)	(.01269)	(.01920)
Y2009	-.05606	.10180***	.00894
	(.10803)	(.02008)	(.03026)
Y2008	-.19639	.18278***	.01370
	(.16658)	(.03125)	(.04703)
Y2007	-.50670	.43831***	.03379
	(.37376)	(.07038)	(.10584)
Y2006	-.49712	.37648***	.01583
	(.33136)	(.06239)	(.09383)
Y2005	-.16503	.15823***	.00934
	(.15691)	(.02941)	(.04426)
Y2004	.07389*	-.01166*	.00030
	(.03321)	(.00472)	(.00752)

(*Continued*)

Table 3.11 (*Continued*)

	Dependent Variable		
	Entry	Equity Share	
	(1)	(2)	(3)
	Probit	OLS	Tobit
Y2003	.02400	.057303***	.01272
	(.08519)	(.01564)	(.02362)
Y2002	-.05907	.14753***	.02161
	(.16313)	(.03058)	(.04602)
Y2001	-.28824	.34399***	.04536
	(.31599)	(.05949)	(.08946)
Y2000	-.59649	.59864***	.06317
	(.53133)	(.10005)	(.15046)
Y1999	-.50701	.54756***	.06333
	(.49363)	(.09295)	(.13979)
Y1998	-.60651	.62349***	.07090
	(.56077)	(.10559)	(.15879)
Y1997	-.49681	.54666***	.06467
	(.50783)	(.09562)	(.14380)
Y1996	-.44762	.50237***	.05795
	(.48073)	(.09052)	(.13613)
Y1995	-.55267	.51648***	.03489
	(.50698)	(.09546)	(.14356)
Y1994	-.21842	.32546***	.04601
	(.34497)	(.06461)	(.09728)
Y1993	-.04241	.14221***	.02081
	(.21260)	(.05059)	(.05997)
Y1992	.13342	.21765***	.09442
	(.24406)	(.04591)	(.06906)
Y1991	.38970	.43979***	.28796**
	(.34389)	(.06476)	(.09739)
Y1990	-.71020	-.00256	-.19884
	(.45315)	(.08535)	(.12835)
Y1989	-.65848	.02255	-.24465
	(.52002)	(.09834)	(.14744)
_con	-2.32037***	.85194***	-.45572***
	(.13915)	(.02569)	(.03883)
N	1,280,024	676,272	1,280,024
Corr(e.entry,e.beta)	.4101		
Log likelihood	-41,680.48		-458,375.88

1. Standard errors in parentheses
2. * $p < 0.05$, ** $p < 0.01$, ***· $p < 0.001$
3. Reference categories: small foundation and AR sector

8.2 Figures

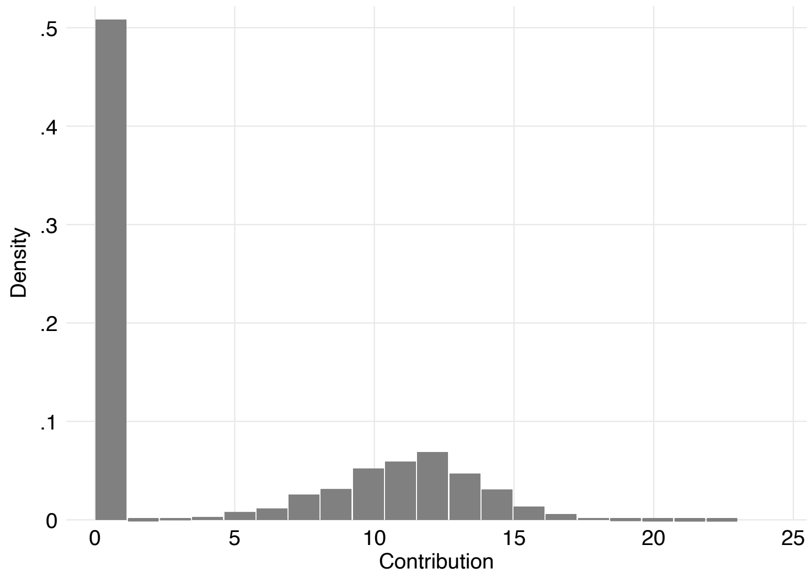


Figure 3.2: Histogram of NPOs contribution received

Note that this figure plots a histogram of contribution received by NPOs over the sample period from 1987 to 2014, where contribution received takes the form of inverse hyperbolic sine transformation.

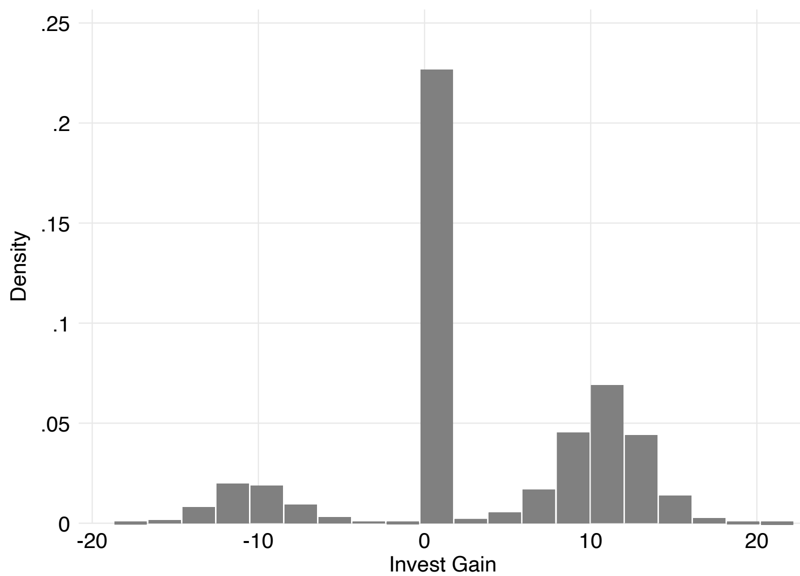


Figure 3.3: Histogram of NPOs Investment Gain

Note that this figure plots a histogram of investment gain from selling of financial asset by NPOs over the sample period from 1987 to 2014, where investment gain is inverse hyperbolic sine transformed.

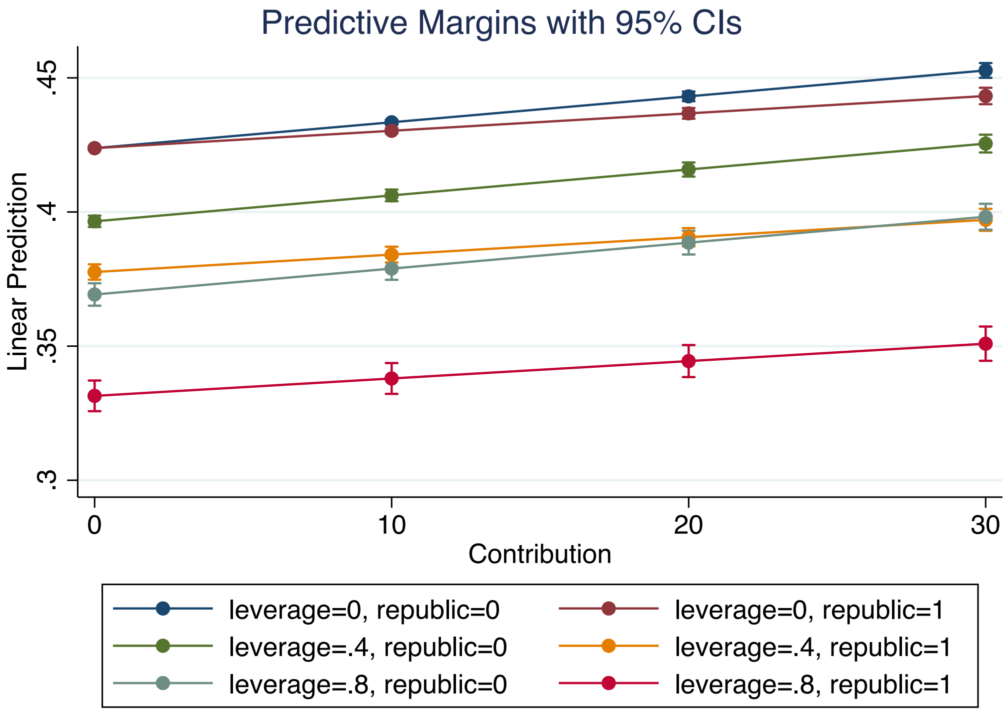


Figure 3.4: OLS Estimation Predictive Margins of the Republic with 95% Cls

Note that given the level of NPOs' leverage ratio, e.g., the expected proportion of stocks NPOs purchase is less when political regime alternates from the Democratic to the Republicans at any level of contribution received; similarly, for any given level of contribution received, NPOs hold less proportion of corporation stocks in the Republic regime relative to the Democratic administration. Contribution is inverse hyperbolic sine transformed.

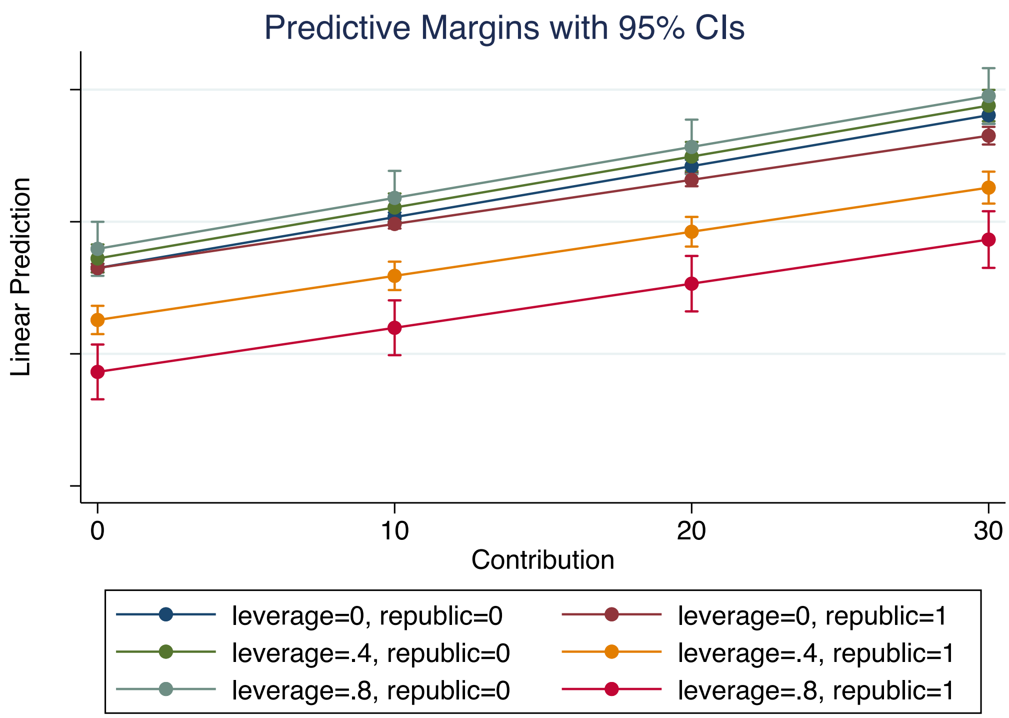


Figure 3.5: Heckman Estimation Predictive Margins of the Republic with 95% CIs

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