

ABSTRACT

Title of dissertation: ESSAYS ON THE IMPACT
 OF SOCIAL INFLUENCE
 IN INDUSTRIAL ORGANIZATION
 AND POLITICAL ECONOMY

Prateik Dalmia
Doctor of Philosophy, 2020

Dissertation directed by: Professor Emel Filiz-Ozbay
 Department of Economics

This dissertation theoretically and experimentally investigates the impact of social pressures in markets and politics.

In the first chapter, I provide a micro-foundation for persuasive advertising of conspicuous goods that can either be made more attractive by greater popularity (“conformist markets”) or by greater exclusivity (“snobbish markets”). Consumers are endowed with an identity and a social status implied by this identity. Consumers wish to signal a high status, and the function of advertising is to render brands a signaling device by linking products with social identity. In a conformist market, I find that advertising increases demand elasticity, inducing firms to converge on low prices, and can be used by a first mover to deter entry and gain monopoly rents. In a snobbish market, advertising reduces demand elasticity, dampens price competition and promotes firm entry.

In the second chapter, Emel-Filiz-Ozbay and I perform a laboratory experiment where subjects must decide how much effort to put into individual projects

that can succeed or fail. In our setting, subjects may receive feedback about a partner's outcome, and such pay comparisons might influence their effort. We find that subjects who failed while their partner succeeded increase their effort more in the next round than those whose partner also failed — consistent with an aversion to being behind. Furthermore, we find this effect is more pronounced for female subjects than male subjects.

In the third chapter, Allan Drazen, Erkut Ozbay and I experimentally study the tension between intrinsic reciprocity and forward-looking, instrumental motives. We do so in a political economy setting where incumbent officials may face competing desires. The first is the intrinsic desire to reciprocate to the kind actions of past voters by investing in policies favorable to them; and the second is the selfish desire to be reelected by investing in policies favorable to future voters to signal policy congruence. Our key finding, both theoretically and experimentally, is that when future and past voters do not perfectly overlap, reelection motives may constrain the intrinsic reciprocity of an elected leader to the voters who put her in office, but do not eliminate it entirely.

ESSAYS ON THE IMPACT OF SOCIAL INFLUENCE
IN INDUSTRIAL ORGANIZATION AND POLITICAL ECONOMY

by

Prateik Dalmia

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2020

Advisory Committee:
Professor Emel Filiz-Ozbay, Chair/Advisor
Professor Allan Drazen
Professor David Godes
Professor Erkut Y. Ozbay
Professor Daniel Vincent

© Copyright by
Prateik Dalmia
2020

Dedication

To my parents.

Acknowledgments

Acknowledging the numerous people who knowingly or unknowingly made it possible for me to reach this point would be impossible. I will just name a few. In considering the role of my friends, family and advisors, I realize that the borders separating these categories have blurred.

I owe a great debt of gratitude to Emel Filiz-Ozbay, my advisor, for investing in my success. With her doors always open, she kept me on track over the years, gracefully guiding me through all matters academic, professional and social. Furthermore, she taught me how to bridge the gap between theory and experiments.

I'm also deeply grateful to: Erkut Ozbay for demonstrating how to ask questions and opening my eyes to experiments, giving me a new lens through which to be curious about economics; Allan Drazen for seeing potential in me, providing me with interesting conversation, wisdom and unwavering support; Daniel Vincent for teaching me humility and how to think deeply, model carefully, and speak articulately; Yusufcan Masatlioglu for mentoring me, introducing me to decision theory, and showing me the ways of research; Jessica Goldberg for involving me in PADE, one of the most important experiences of my graduate career; and David Godes for gladly joining my committee, and supporting me in navigating the field of marketing.

I am also very grateful to the generous administrative staff for making the last six years run more smoothly than I would have thought possible — Cindy Clement, Terry Davis, Vickie Fletcher, Amanda Statland and Mark Wilkerson. And to my friends for making the last six years more fun than I would have thought possible,

and making some of the best memories of my life — Ian Chadd, Matt Furlow, Alejandro Graziano, Michael Hilgendorf, Seth Murray, Elif Bike Ösün, Fernando Saltiel, Matt Staiger, Eric Stradley, Cody Tuttle, Mateo Uribe-Castro, Santiago Velez-Ferro and Olivia Wood.

Last but not least, I am forever grateful to my incredible parents. You poured your energy, hearts and time into giving me every conceivable opportunity to succeed in life. With the challenges those opportunities presented, you have been a constant source of strength. Even as my academic interests became harder to understand, you took interest in my passions, sharing excitement in my ups, encouragement in my downs, and believing in me in those moments that I did not believe in myself.

Table of Contents

Dedication	ii
Acknowledgments	iii
Table of Contents	v
List of Tables	viii
List of Figures	x
1 Introduction	1
2 Persuasive Advertising in Conformist and Snobbish Markets	4
2.1 Introduction	4
2.2 Literature Review	11
2.3 A Model of Persuasive Advertising	13
2.3.1 Equilibrium Definition	20
2.4 Social Status Motivated Demand	21
2.4.1 Product Locations	28
2.4.2 Demand Partitions	30
2.5 Pricing in Conformist and Snobbish Markets	35
2.5.1 Pricing under Snobbism\Weak Conformity	35
2.5.2 Pricing under Strong Conformity	41
2.6 Persuasive Advertising Equilibria	43
2.6.1 Equilibria of Snobbish Market	45
2.6.2 Equilibria of Conformist Market	50
2.7 Welfare	52
2.8 Conclusion	55
3 Your Success is My Motivation (with Emel Filiz-Ozbay)	58
3.1 Introduction	58
3.2 A Problem of Costly Effort in a Risky Task	64
3.3 Hypotheses	69
3.4 Experimental Procedures	72
3.5 Results	77
3.6 Discussion	93
3.7 Conclusion	95

4	Reciprocity versus Reelection (with Allan Drazen and Erkut Y. Ozbay)	97
4.1	Introduction	97
4.2	Literature	101
4.3	A Model of Candidate Behavior	104
4.3.1	Overview	104
4.3.2	Model Set-up	106
4.3.2.1	Elections and Distribution of Benefits	106
4.3.2.2	Candidate and Voter Preferences	107
4.3.2.3	Voters' Beliefs, Candidate's Dilemma	109
4.3.2.4	Electoral Equilibria	111
4.3.2.5	Equilibria When V_2 Does Not Observe x_1 and x_2	111
4.3.2.6	Equilibria When V_2 Observes x_1 and x_2	112
4.3.2.7	Constrained Reciprocity Equilibria with Altruism	117
4.4	Experimental Design	120
4.5	Results and Interpretation	122
4.5.1	Distribution and Voting Patterns	122
4.5.2	Existence of Intrinsic Reciprocity	123
4.5.3	High Cost of Voting Games	127
4.5.3.1	Type 2 Candidates: Constrained Reciprocity	127
4.5.3.2	Type 1 Candidate Mimicking	131
4.5.3.3	V_2 's Propensity to Vote	136
4.5.4	Low Cost of Voting Games	139
4.5.4.1	Type 2 Candidates: Unconstrained Reciprocity	140
4.5.4.2	Type 1 Candidate Mimicking	143
4.5.4.3	V_2 's Propensity to Vote	147
4.5.5	Interpreting Constrained Reciprocity	149
4.6	Conclusion	151
A	Persuasive Advertising in Conformist and Snobbish Markets	153
A.1	Social Status	154
A.2	Tie-Breaking Rule for Undifferentiated Firms	155
A.3	Monopoly Pricing	157
A.4	Proofs	159
A.4.1	Proof of Lemma 1	159
A.4.2	Proof of Lemma 2	159
A.4.3	Proof of Proposition 1	160
A.4.4	Proof of Proposition 2	160
A.4.5	Proof of Proposition 3	161
A.4.6	Proof of Proposition 4	163
A.4.7	Proof of Proposition 5	165
A.4.8	Proof of Proposition 6	169
A.4.9	Proof of Proposition 7	172
A.4.10	Proof of Proposition 8	174

B	Your Success is My Motivation	188
B.1	Proofs	188
B.1.1	First Order Conditions	188
B.1.2	Independence of Periods	189
B.2	Additional Tables and Figures	190
B.3	Instructions	200
B.3.1	Individual Treatment, Part 1	200
B.3.2	Partner Treatment, Part 1	204
B.3.3	Part 2	208
C	Reciprocity versus Reelection	210
C.1	Reciprocity Theory	210
C.1.1	Reciprocity and Altruism Theory	214
C.1.2	Proofs	217
C.2	Instructions	222
C.2.1	Treatment SLC	222
C.2.2	Treatment SHC	227
C.2.3	Treatment NILC	232
C.2.4	Treatment NIHC	237
	Bibliography	242

List of Tables

2.1	Firm with Location Advantage, Prestige Advantage and more Prestigious Position when $\ell_a < \ell_b$	30
3.1	Individual Treatment, Mean (Period 2 Effort – Period 1 Effort)	84
3.2	Partner Treatment, Mean Period 2 Effort	87
3.3	Partner Treatment, Mean (Period 2 Effort – Period 1 Effort)	88
3.4	Partner Treatment, Two-Limit Tobit of Period 2 Effort	90
4.1	Treatments	122
4.2	Distribution of Benefits	123
4.3	Vote Proportions	123
4.4	OLS of Intrinsic Reciprocity	126
4.5	Type 2 Candidate \$ Benefit to V_1 with High Cost of Voting	128
4.6	Two-Limit Tobit, Type 2 Candidate \$ Benefit to V_1 in Election 1 (Treatments SHC vs NIHC)	131
4.7	Type 1 Candidate \$ Benefit to V_2 with High Cost of Voting	132
4.8	Two-Limit Tobit, Type 1 Candidate \$ Benefit to V_2 in Election 1 (Treatments SHC vs NIHC)	134
4.9	Logit Results on Marginal Effect of Candidate’s Type on V_2 ’s Probability of Voting in Treatment SHC	138
4.10	Type 2 Candidate \$ Benefit to V_1 with Low Cost of Voting	141
4.11	Two-Limit Tobit, Type 2 Candidate \$ Benefit to V_1 in Election 1 (Treatments SLC vs NILC)	143
4.12	Type 1 Candidate \$ Benefit to V_2 with High Cost of Voting	143
4.13	Two-Limit Tobit, Type 1 Candidate \$ Benefit to V_2 in Election 1 (Treatments SLC vs NILC)	145
4.14	Logit Results on Marginal Effect of Candidate’s Type on V_2 ’s Probability of Voting in Treatment SLC	149
B.1	Treatment Balance	190
B.2	Two-Limit Tobit of Period 1 Effort	192
B.3	Individual Treatment, Proportion Revise Effort in Period 2	193
B.4	Individual Treatment, Probit Regressions	194
B.5	Individual Treatment, Mean Period 2 Effort	195

B.6	Individual Treatment, Two-Limit Tobit of Period 2 Effort	195
B.7	Partner Treatment, Two-Limit Tobit of Period 2 Effort	196
B.8	Partner Treatment, Mean (Period 2 Effort – Period 1 Effort)	197
B.9	Partner Treatment, Proportion Revise Effort in Period 2	198
B.10	Comparing Effect of Own Failure in Partner and Individual Treat- ments, Two-Limit Tobit of Period 2 Effort	199

List of Figures

2.1	Timeline of Model	18
2.2	Social Status Function Examples	25
2.5	Price Equilibria in Strongly Conformist Market	43
2.6	Numerical Solution in Snobbish Market	49
3.1	Projects	73
3.2	CDFs of Period 1 Effort	80
3.3	Individual Treatment, Proportion of Subjects Revise Effort in Period 2 .	83
3.4	Partner Treatment, Proportion of Subjects Revise Effort in Period 2 .	91
4.1	No Information Game Equilibrium	112
4.2	Selfish Candidates Separating Equilibrium	113
4.3	No Information Game Equilibrium	115
4.4	Type 1 Candidate Reciprocity	125
4.5	Type 2 Candidate Reciprocity	125
4.6	Type 2 Candidate First Election Benefits with High Cost of Voting .	129
4.7	Type 2 Candidate First Election Benefits with High Cost of Voting .	130
4.8	Type 2 Candidate \$ Benefit to V_1 in the Two Elections with High Cost of Voting	130
4.9	Type 1 Candidate First Election Benefits with High Cost of Voting .	132
4.10	Type 1 Candidate First Election Benefits with High Cost of Voting .	133
4.11	Type 1 Candidate \$ Benefit to V_2 in the Two Elections with High Cost of Voting	135
4.12	Type 1 Candidate Second Election Benefits with High Cost of Voting	135
4.13	V_2 Decision by Benefit Received in First Election	137
4.14	Probabilities of Candidate Type and V_2 Voting by x_2 in Treatment SHC	137
4.15	Type 2 Candidate First Election Benefits with Low Cost of Voting .	142
4.16	Type 2 Candidate First Election Benefits with Low Cost of Voting .	142
4.17	Type 2 Candidate \$ Benefit to V_1 in the Two Elections with Low Cost of Voting	142
4.18	Type 1 Candidate First Election Benefits with High Cost of Voting .	144
4.19	Type 1 Candidate First Election Benefits with Low Cost of Voting .	145

4.20	Type 1 Candidate \$ Benefit to V_2 in the Two Elections with Low Cost of Voting	146
4.21	Type 1 Candidate Second Election Benefits with Low Cost of Voting	146
4.22	V_2 Decision by Benefit Received in First Election	148
4.23	Probabilities of Candidate Type and V_2 Voting by x_2 in Treatment SLC	148
A.1	Reputation Gain Function Implied by Social Status Function	154
B.1	CDFs of Period 1 Effort	191

Chapter 1: Introduction

In this dissertation, I examine the impact of social pressures on decision-making and equilibrium outcomes in markets and politics. I do so using modeling tools from behavioral economics, and empirical tools from experimental economics. These social pressures take various forms, such as status signaling, fear of inequity and reciprocity.

In Chapter 2, I model and give micro-foundation to “persuasive advertising” that has little informational content, instead appealing to consumers’ desire for social recognition. The model treats consumers as endowed with an identity unobservable to others, such as how sophisticated they are, and a social status implied by this identity. Consumers wish to signal high status to others, and the function of advertising is to render brands a signaling device so that others may infer a consumer’s identity and status from her purchases. I integrate a signaling game from the literature on Veblen effects [Corneo and Jeanne, 1997] with a classic model of two sequentially entering and horizontally differentiated firms. The premise of my model is that signaling motives can have two opposite effects on demand. They can create a “conformist effect” where goods are made more attractive by greater popularity or a “snob effect” where goods are made more attractive by greater exclu-

sivity. My model displays the disparate effects of persuasive advertising in markets characterized by conformity and snobbery, and explains several empirical puzzles in the industrial organization and marketing literatures.

In Chapter 3, Emel Filiz-Ozbay and I perform a laboratory experiment to study how an individual's effort choice is impacted by feedback on her own past performance and another individual's past performance. In an effort choice problem where effort is costly but increases the chance of receiving a prize, subjects who failed in the previous period increase their effort in the next period. More interestingly, failed subjects who observe that their partner succeeded exert higher effort in the next period than failed subjects who observe that their partner also failed — behavior consistent with behindness aversion. This effect is more pronounced for female subjects than male subjects, suggesting that failing women are more motivated by the success of others than failing men. Rather than letting subjects work in isolation, we find that the highest joint effort can be achieved by matching failed and successful subjects into pairs and providing feedback about the other's performance. Our results suggest that social comparisons in independently performed and paid tasks may mitigate moral hazard.

In Chapter 4, Allan Drazen, Erkut Ozbay and I study how reelection concerns affect reciprocity by elected leaders to the voters who elected them. If showing kindness to past voters reduces the chances of reelection, will an elected leader reduce or eliminate such intrinsic reciprocity? We present a signalling model of candidate behavior, where we show that candidates may limit intrinsic reciprocity to past voters to signal congruence with voters important for reelection, and selfish candidates

may mimic reciprocal behavior for instrumental purposes. We then present an experiment that tests these ideas in the laboratory and lends support for the model. Both candidates and voters behave as the signalling model predicts. Our key finding is that the desire to be reelected may limit intrinsic reciprocity of an elected leader to the voters who put her in office, but does not eliminate it entirely.

Chapter 2: Persuasive Advertising in Conformist and Snobbish Markets

“Advertising is one of the topics in the study of industrial organization for which the traditional assumptions are strained most (especially those with regard to consumer behavior). The advertising of a product has strong psychological and sociological aspects that go beyond optimal inferences about objective quality. For instance, ad agencies constantly try to appeal to consumers’ conscious or unconscious desire for social recognition, a trendy lifestyle and the like.”

Jean Tirole, *The Theory of Industrial Organization*, pp. 292-293

2.1 Introduction

It is estimated that around \$224 billion was spent on advertising in 2018 in the United States alone, roughly \$685 per capita [[Wagner, 2019](#)].¹ Despite being a major part of the economy, the role of advertising is still not well theoretically understood. One aspect of advertising is simply informational, apprising consumers

¹This entails only money firms paid to advertising platforms, and not their larger expenses in creating advertising content. Across a wide sample of industries, firms spent an average of 11% of their budgets on marketing in 2018 [[Moorman, 2019](#)].

of products and their attributes. However, a significant amount of advertising has little or no informational content, instead attempting to persuade consumers and influence their preferences.² Yet this important phenomenon is difficult to capture in traditional economic models based on the assumption that consumers have fixed preferences.

This model seeks to provide a micro-foundation for the role of advertising as appealing to consumers' desire for social recognition, and associating their consumption with a social identity, without sacrificing the assumption of fixed preferences. The premise of the model is that each consumer is endowed with a latent attribute measuring some aspect of her social identity, such as her cultural association with Southern America versus New England America, or a measure of her sophistication. The values and norms governing the community in which consumers reside assign each consumer a social status based on her latent attribute. Furthermore, consumers receive a reputational utility from signaling a high social status to a group of non-consuming spectators called "the public."

The function of advertising is to facilitate this signaling by bringing the public's attention and powers of discrimination to products, so that the public is enabled — and the consumer knows that it is enabled — to infer the latent attributes and social status of consumers from simply observing their consumption choices. In other words, advertising renders consumption a device for consumers to signal their attribute and the status thereby implied. Thus, advertising affects a consumer's

²See, for example, [Resnik and Stern \[1977\]](#), [Tom et al. \[1984\]](#), [Becker and Murphy \[1993\]](#) and [Abernethy and Franke \[1996\]](#).

purchase by calibrating the social reputation associated with different products. I incorporate advertising in a classic Hotelling model of two sequentially entering firms. Firms not only choose how much to advertise, but also which consumers to appeal to through their choice of horizontal attributes.

But to understand and model this signaling phenomenon, one must recognize that there are two main effects such signaling motives may have on consumer demand: a “conformist effect” (sometimes called a “bandwagon effect”) where market demand for a good increases by others purchasing it; and “snob effect” where market demand for a good decreases by others purchasing it. I analyze the workings and effects of advertising in markets dominated by each of these two forms of signaling. On the one hand, there are “conformist markets” in which goods are made attractive by their popularity. For example, you might be reluctant to frequent Dunkin’ Donuts if no one else does, but eager to do so if it is all the rage. On the other hand, there are “snobbish markets” in which goods are made attractive by greater exclusivity. You might drink “artesian water” to seem sophisticated, but as soon as artesian water becomes popular, you will move on to something else.

Economic theory dating back to [Leibenstein \[1950\]](#) has recognized the potential impact of conformist and snob effects on consumer demand.³ Surprisingly, however, the theoretical literature has said little about the impact of conformist and snobbish motives on persuasive advertising.⁴ That said, marketing practitioners often

³[Leibenstein \[1950\]](#) originally coined the terms “bandwagon effects” and “snob effects.” A large literature studies the presence of these effects on consumer demand, including: [Becker \[1991\]](#), [Bernheim \[1994\]](#), [Karni and Levin \[1994\]](#), [Corneo and Jeanne \[1997\]](#), [Grilo et al. \[2001\]](#), [Amaldoss and Jain \[2005b\]](#) and [Amaldoss and Jain \[2005a\]](#).

⁴One exception is [Buehler and Halbheer \[2012\]](#), which studies persuasive advertising that increases the perceived quality of products, and lies outside a signaling framework.

distinguish between campaigns built on “bandwagon appeal” (e.g. “America runs on Dunkin’”) versus “snob appeal” (e.g. Essentia Water’s campaign “Overachieving H_2O : someone is going to stand out, it might as well be you”).⁵

The specific signaling game adopted in my model is from [Corneo and Jeanne \[1997\]](#)’s study of Veblen effects.⁶ [Corneo and Jeanne \[1997\]](#) show that the occurrence of snob effects or conformist effects depends, in an identifiable way, on how a community allocates social status on the basis of a consumer’s underlying attribute. Essentially, snob effects or conformist effects are born from one of two like desires: the desire to avoid ostracism and not be considered a low type, or the hope for prestige and being considered a high type. It turns out that if there are *increasing status returns* to a more desired attribute, then the latter desire outweighs the former, and we get a market characterized by snob effects. By contrast, if there are *decreasing status returns* to a more valued attribute, then the former desire outweighs the latter, and we get a market characterized by conformist effects.

How does advertising function in these two different markets? By making it more likely the public recognizes the social reputation of a product, advertising amplifies consumers’ snobbish or conformist motives, depending on the type of market.

In a snobbish market, by increasing the strength of snob effects, advertising makes firms less willing to cut prices to expand market share, because fewer new consumers rush in to purchase when they do so. In other words, advertising reduces

⁵Others are less discreet. In the Fall of 2019 Volvo launched campaign “Follow No One, Update Your Status Symbols.”

⁶[Corneo and Jeanne \[1997\]](#) study pricing in a monopolist market for a Veblen good. Originally postulated by [Veblen \[1899\]](#), Veblen goods are a type of luxury goods for which the quantity demanded increases in its price.

the elasticity of demand for snob goods. This dampens price competition and allows firms to converge on higher, supranormal prices.

Furthermore, this promotes firm entry because there are greater profits to be had. In this way, advertising acts as a public good to firms, increasing both firms' profits. Moreover, even if firms locate symmetrically, asymmetries in firms' prices and market shares may result. This is because the firm which does a better job of appealing to high status consumers is considered more prestigious, and uses advertising to extract greater market share at a higher price.

These results speak to many stylized facts. First, in snobbish markets such as that for luxury goods, we often see unusually high prices and an abundance of brands. For example, reusable water bottles have become a millennial status symbol in the last few years, with a proliferation of dozens, if not hundreds, of brands, and prices ranging from \$10 to \$1,500. As of this writing, the price on Amazon for a 17 oz water bottle from the highly coveted brand, S'well, is \$30. Furthermore, S'well and its competitors are known for heavily advertising on Instagram and social media.⁷ The model shows that this may be due to advertising's influence in reducing demand elasticity. Additionally, despite goods being physically similar or homogeneous, we often see some firms charging a price premium, advertising heavily and earning greater market share [Bagwell, 2007]. Indeed, many decades of empirical research in homogeneous product markets have found price dispersion rather than the "law of one price" to be the norm [Baye et al., 2006; Chioveanu, 2008]. This may source from the prestige of a heavily advertised brand targeted at high status consumers,

⁷See Munro [2018] and Mull [2019].

like S’well [[Becker and Murphy, 1993](#); [Nichols, 1985](#)].

In a conformist market, advertising has the opposite effect. By increasing the strength of consumers’ conformist motives, advertising makes firms more willing to cut prices to expand their market share, because doing so results in a greater number of consumers rushing to buy the product. In short, advertising increases the elasticity of demand. This heightens price competition and induces firms to converge on lower, depressed prices. If the price competition becomes sufficiently severe, then advertising can enable a first-mover to deter the entry of future firms and gain monopoly power. This result holds even when the second mover faces zero production cost and entry is free. In this setting, advertising promotes a very cutthroat environment in which only one product can survive.

This helps make sense of empirical puzzles observed in conformist markets. We often see a first mover enter a geographic area, build an advertising presence, and dominate it for many years. For example: Dunkin Donuts’ started in Massachusetts in 1950 and dominates the northeast United States, appealing to its blue-collar New England identity. Krispy Kreme launched in the North Carolina in 1937, triumphs in the South, appealing to its wholesome and classy Southern identity. And Tim Hortons was founded by a Canadian hockey player in 1965, with its Canadian customer base often swearing by it with religious zeal.⁸ More rigorously, [Bronnenberg et al. \[2007, 2009, 2011\]](#) meticulously document the evolution of advertising, prices and firm entry across the United States in the packaged-foods industry, many goods

⁸In the model, the social attribute x a brand appeals to does not have to be a regional identity. For example, as in the market for reusable water bottles, it could be a measure of sophistication.

of which might be considered conformist such as beer and soft drinks. They find that brands which entered a given geographic area first and built an advertising presence — often over one hundred years ago — are very likely to maintain a stronger, leading presence today. My model provides an economic explanation for this result.

While the extant literature has argued persuasive advertising can be used to deter market entry [Bain, 1956; Braithwaite, 1928], it has often been unable to provide a mechanism through which advertising can bias demand to the benefit of the first-mover [Sutton, 1991, pp.312-313]. By contrast, my model provides a mechanism through which this can take place.

Finally, by giving persuasive advertising a micro-foundation, this model opens a path to welfare analysis, unlike the previous literature. The key insight is that since reputation signaling is a zero-sum game, the total pie of social status available is fixed [Frank, 2005; Heffetz and Frank, 2011]. Persuasive advertising can shift which consumers get what portion of that pie, but cannot *directly* affect aggregate consumer welfare since it does not impact the size of the signaling pie. However, advertising can influence consumer welfare *indirectly* through its effect on prices, entry, and on how well consumers' purchases respect their horizontal preferences. For example, in the cases where advertising raises prices, it creates a transfer of welfare from consumers to firms. Furthermore, by limiting entry and inducing status concerns to overpower horizontal preferences, advertising can increase consumers' transportation costs. This knowledge is important for evaluating how policies that limit or tax advertising might impact consumers, firms and market structures.

2.2 Literature Review

The theoretical literature on advertising broadly fits into three camps (i) the *informative* view that advertising informs consumers about the existence and attributes of products (ii) the *persuasive* view that advertising in some way affects consumer tastes and (iii) the *complementary* view that advertising is itself as a good entering consumer utility.⁹

While few would disagree that much advertising is uninformative, the persuasive view has known difficulty giving advertising a micro foundation. It is typically modeled as manipulating a parameter in consumer preferences chosen by the modeler. For example, in the linear city model adopted here, [Von der Fehr and Stevik \[1998\]](#) argues that persuasive advertising may either increase the perceived quality of a good, the perceived differences between goods (transportation costs), or influence the distribution of consumer tastes. Many models begin with the premise that advertising shifts demand up, increasing willingness to pay [[Dixit and Norman, 1978](#)]. One issue with this approach is that it leaves much freedom to the modeler, making it difficult to reach solid conclusions about advertising's market effects. Moreover, it makes welfare analysis tricky, as it not clear what standard should be adopted for measuring welfare. Which preferences should be considered the true preferences, those pre-advertising or post-advertising [[Dixit and Norman, 1978](#)]?

The solution of the complementary approach is to treat advertising as itself a good giving consumer's utility (or disutility), and complementary to the good

⁹See [Bagwell \[2007\]](#) for a comprehensive survey of the literature.

being sold [Becker and Murphy, 1993]. This implies a fixed preference, facilitating market and welfare analysis. The solution adopted here has a fixed preference like in complementary models, but without certain implications of such models like creating a consumer budget and demand function for receiving advertisements.

As mentioned, my approach is to superimpose a late stage signaling game, where consumers wish to signal their social status to a social contact, and advertising facilitates in that signaling by bringing the social contact’s attention to their purchase. Krähmer [2006] also incorporates persuasive advertising in this way. However, Krähmer [2006] studies a model with two consumer types, a cool type and a geeky type — where the geeky type wants to mimic the cool type — and firms sell homogenous products. By contrast, my model studies a signaling game with a continuum of consumer types, focusing on the conformist and snob effects signaling may generate, and firms sell horizontally differentiated products.

A couple recent models study informative advertising in the context of a social signaling game [Campbell et al., 2017; Vikander, 2017], and a well-developed body of literature studies advertising that helps firms signal private information, rather than consumers signal type [Albák and Overgaard, 1992; Bagwell and Ramey, 1988, 1990; Linnemer, 1998; Nelson, 1974]. More generally, my paper builds on a growing body of literature studying the effects of consumer signaling type on (non-advertising) firm behavior [Bagwell and Bernheim, 1996; Corneo and Jeanne, 1997; Kuksov and Wang, 2013; Kuksov and Xie, 2012; Liu et al., 2019; Pesendorfer, 1995; Rayo, 2013; Yildirim et al., 2016]. I am unaware of any previous work studying a social signaling game in a spatial model of competition. As pointed out in Lemma 1, spatial models

have a single-crossing property that makes them well-suited for superimposing a signaling game, and one hope of this paper is to inspire further exploration of such models.

Along such lines, [Grilo et al. \[2001\]](#) study price competition in a differentiated duopoly market with a reduced form consumption externality of either a conformist or snobbish nature.¹⁰ Similar analytic techniques are used in the price subgame of my model. While [Grilo et al. \[2001\]](#) are not motivated by the study of advertising, one could interpret my model as extending [Grilo et al. \[2001\]](#) along various dimensions. First, [Grilo et al. \[2001\]](#) study a symmetric consumption externality where the utility from others frequenting firm A are equivalent to that of others frequenting firm B . My paper explores asymmetry in the consumption externality, where the utility from others frequenting firm A are not necessarily equal to that of others frequenting firm B . This arises here because it matters not just *how many* people buy a good, but also *who* buys a good, and the people who occupy firm A may not have the same status as those who occupy firm B . Furthermore, my model endogenizes the consumption externality through the incorporation of a signaling game, and endogenizes firms' entry and location choices.

2.3 A Model of Persuasive Advertising

This section introduces the formal model with sequentially entering firms selling conspicuous and horizontally differentiated goods to status-driven consumers.

¹⁰In other words, a consumer's utility for a good directly increases or decreases in the number of others purchasing it.

The economy is populated by i) a unit mass of consumers uniformly distributed along some attribute x on the $[0,1]$ interval and ii) a unit mass of non-consuming spectators called the public. The latent attribute x measures some aspect of each consumer’s identity, such as the strength of her cultural association with New England America versus Southern America. Furthermore, this attribute helps shape the consumer’s demand. As common in models of horizontal differentiation, each consumer x has unit demand with quadratic transportation cost $\tau > 0$ and a bliss point at x .¹¹ Thus, x both defines the underlying social attribute of the consumer and her preferences over brands.

Furthermore, as in [Corneo and Jeanne \[1997\]](#), there is a continuous social status function $s(x) : [0, 1] \rightarrow \Re$ that assigns each consumer a social status given her attribute x .¹² The social status function is exogenous, and governed by the norms and values of the community in which consumers reside. Note that the attribute x both defines a consumer’s preferences over goods, as well as a consumer’s social status. After all, we all face the problem of being endowed with certain attributes which mold our preferences, as well as give us certain reputation in our relations to society.¹³

As [Corneo and Jeanne \[1997, p.58\]](#) explain:

¹¹Quadratic transportation costs help ensure the existence of equilibria at the pricing and location\advertising stages [[d’Aspremont et al., 1979](#); [Neven, 1985](#); [Shaked and Sutton, 1987](#)].

¹²[Corneo and Jeanne \[1997\]](#) and other papers in the Veblen effects literature model social status as a function of income. This is often motivated by the supposition that income is positively correlated with other desirable underlying qualities such as hard work, intelligence, etc. Indeed, in a laboratory experiment, [Clingsmith and Sheremeta \[2018\]](#) finds evidence that college students do not allocate status according to a subject’s earnings, but rather a subject’s academic abilities. Here, I model social status as directly a function of a consumer’s underlying social attribute.

¹³For example, more outdoorsy people may prefer water bottles that are suited for activities like rock climbing and hiking, and also receive certain status based on their outdoorsiness.

Following sociologists, we may define social status as a general claim to deference [e.g., [Coleman \[1990\]](#)]. In economic terms, an individual's status may be called a socially provided private good. Each individual has a certain fixed amount of a special good - say, deference - that he allocates to others according to some social norm... In turn, the norm may be taken as mirroring societal values that characterize the community in which the individuals interact.

As pointed out by [Fershtman and Weiss \[1993\]](#), the origins of this technical definition of status as a claim to “deference” or “esteem” by others traces back to Max Weber's work at the beginning of the 20th century [[Weber, 1978](#)]. Here, the individuals who allocate the good deference are the public. At the end of the game, consumers are randomly matched with partners from the public. A member of the public does not know her partner's social status, but tries to infer it. Each consumer receives a reputational utility equal to her partner's expectation of her social status [[Bernheim, 1994](#); [Fershtman and Weiss, 1993](#); [Ireland, 1994](#)]. We will see exactly how the public's inference is made later. This expectation can be thought of as the quantity of deference the public gives the consumer. For example, consumers in New England might receive a certain amount of deference for signaling their New England origins. One could instead require that the public take some action that influences consumer utility, other than allocating deference. For example, a consumer's professional, marriage [[Cole et al., 1992](#); [Pesendorfer, 1995](#)], mating [[Miller, 2011](#)], friendship or leadership opportunities could depend on others' inference of

her latent attribute x . For expositional clarity, I abstract from such interpretations of the reputational utility.

The ex-post utility u_x a consumer of type x receives from a given purchase is:

$$u_x = v - \tau(\ell - x)^2 - p + \underbrace{\text{Public's Expectation of } s(x)}_{\text{Reputational Utility}}$$

where $v > 0$ is the intrinsic utility of the good, $\ell \in [0, 1]$ is its location and horizontal features, and $p \geq 0$ is its price. The only departure from a standard model of horizontal differentiation is the addition of the reputational utility.

The time-line of the game is as follows, summarized in Figure 2.1. The framework is adopted from Schmalensee [1983] and motivated by the fact that in the real world firms usually enter sequentially rather than simultaneously.¹⁴

At $t = 0$, the incumbent, firm A , chooses a location $\ell_a \in [0, 1]$. The location choice measures the horizontal attributes of the product, such as how well a donut shop appeals to New England Americans through the features of its atmosphere, donuts and service. Furthermore, firm A chooses how much to advertise $\lambda_a \in [0, 1]$, paying a convex cost of advertising $\frac{c}{2}\lambda_a^2$ (where $c \geq 0$). λ_a represents the probability that a given member of the public receives an advertisement from firm A [Grossman and Shapiro, 1984]. I normalize firm A 's cost of production to zero.

At $t = 1$, firm B observes the location and advertising level of firm A and decides whether to enter. Furthermore, if firm B enters, then it must decide where to locate $\ell_b \in [0, 1]$ and how much to advertise $\lambda_b \in [0, 1]$, also paying a convex

¹⁴Moreover, from a technical perspective, sequential entry helps ensure the existence of equilibria in pure strategies in the location and advertising stages [Börger, 1988].

cost of advertising $\frac{c}{2}\lambda_b^2$. λ_b represents the probability that a given member of the public receives an advertisement from firm B . The probability a given member of the public receives an advertisement from firm B is independent of that of receiving an advertisement from firm A . Thus, if λ represents the probability that a given member of the public receives an advertisement from either firm, then $\lambda = \lambda_a + \lambda_b - \lambda_a\lambda_b$. This could be interpreted as a linear advertising production function.¹⁵ Furthermore, firm B also pays zero cost to production, implying that entry is free.¹⁶

If firm B enters, then at $t = 2$, firms A and B simultaneously choose prices $p_a \geq 0$ and $p_b \geq 0$ as in Bertrand competition. Otherwise, firm A is a monopolist and chooses its price unconstrained by competition. The assumption that advertising investments take place before pricing decisions is typical in models of persuasive advertising, and motivated by the view of advertising as a long-term investment to generate a brand image, and pricing as a more short-term oriented strategy [Belleflamme and Peitz, 2015, p. 150].

At $t = 3$, consumers make their purchase decisions. Consumers are expected utility maximizers, fully informed about the goods in the market, their advertising levels, locations and prices. Following, at $t = 4$, each consumer is randomly matched with a partner from the public. The public does not know a consumer's underlying identity and social status, but tries to infer it. Each consumers receives

¹⁵The model could be extended to accommodate a more general advertising production function $f(\lambda_a, \lambda_b)$ that is increasing in each of its arguments, and determines the probability that a member of the public receives an advertisement given firms' advertising efforts. Furthermore, one could allow for asymmetries in the advertising technologies of firms by letting the first order partial derivatives be unequal $f_1(\lambda_a, \lambda_b) \neq f_2(\lambda_a, \lambda_b)$ for given advertising levels (λ_a, λ_b) .

¹⁶The assumption that firm B pays zero fixed cost is conservative in that it makes it harder to get a result where firm B is deterred from entering.

a reputational utility equal to her partner's expectation of her social status.

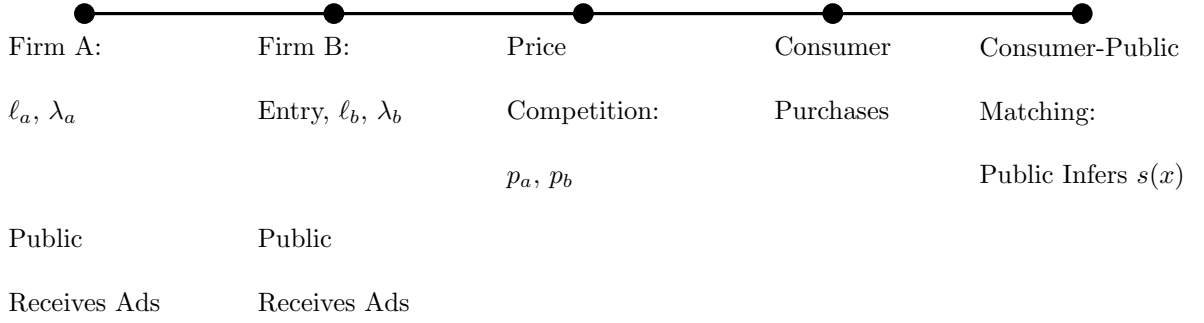


Figure 2.1: Timeline of Model

Let $\rho(x)$ denote the belief the partner assigns to the consumer being of type x , where $0 \leq \rho(x) \leq 1$ and $\int_0^1 \rho(x) dx = 1$. If the partner receives an advertisement from either firm, then his attention and powers of discrimination is brought to products, and he updates his belief of the consumer's social status conditional on the latter's product choice. That is, if we let $o \in \{a, b, \emptyset\}$ denote the chosen option of a given consumer (purchase good a , good b or not purchase respectively), and $\Omega = \{o, p_a, p_b, \ell_a, \ell_b, \lambda_a, \lambda_b\}$ the attributes of the products available, then the partner's inference of the consumer's social status is $\rho(x | o, \Omega)$.¹⁷ By contrast, if the partner does not receive an advertisement, then he does not pay attention to products and does not update his belief based on the consumer's purchase. In other words, he maintains his prior that x is uniformly drawn from $[0, 1]$.

The motivation of this framework is that consumers shop at stores, and thus pay full attention to the products available. However, the public does not shop, and thus does not pay full attention to products, and may not be able to readily recognize or distinguish products when they see them. For example, one might not

¹⁷The partner also uses her information about the parameters of the game c, α and β .

recognize the difference between a S'well water bottle or a Camelbak water bottle unless one receives an advertisement. Advertising does not affect consumer utility directly, but affects consumer utility indirectly by increasing the ability of the public to infer a consumer's social status from her consumption.¹⁸

Therefore, consumers are senders in a signaling game, making consumption choices based on the trade-off between their horizontal preferences and the signal of social status it conveys to the advertisement receiving public. Let S_o denote a consumer's expected utility from signaling given option o at $t = 3$. The expected utility of consumer x for each choice at $t = 3$ is:

$$U_x(a) = v - \tau(\ell_a - x)^2 - p_a + S_a \quad (2.1)$$

$$U_x(b) = v - \tau(\ell_b - x)^2 - p_b + S_b \quad (2.2)$$

$$U_x(\emptyset) = S_\emptyset \quad (2.3)$$

Furthermore, the signaling value of each choices is:

$$S_a = \lambda \int_0^1 \rho(x | a, \Omega) s(x) dx + (1 - \lambda) \int_0^1 \rho(x) s(x) dx \quad (2.4)$$

$$S_b = \lambda \int_0^1 \rho(x | b, \Omega) s(x) dx + (1 - \lambda) \int_0^1 \rho(x) s(x) dx \quad (2.5)$$

$$S_\emptyset = \lambda \int_0^1 \rho(x | \emptyset, \Omega) s(x) dx + (1 - \lambda) \int_0^1 \rho(x) s(x) dx \quad (2.6)$$

where the first terms are the probability of being matched with a member of the advertisement receiving public λ multiplied by the perceived status of those choosing

¹⁸This approach accords with evidence that brand advertising is often targeted at people who would not purchase from the given brand, instead aiming to increase the brand's recognizability to serve the signaling needs of its own customer base [Miller, 2011].

said option (found by multiplying the posterior probability a consumer is a given type with that type’s social status, and integrating over all possible types), and the second terms are the probability of being matched with a member of the non-advertisement receiving public multiplied by the perceived status of any random consumer. Advertising makes it more likely that a consumer’s purchase is recognized for the social status it conveys, and consumers incorporate this into their consumption choices.¹⁹ The signaling game produces a consumption externality where a consumer’s utility depends not only on her own consumption choice, but also that of every other consumer. It will be shown that the instance of snobbish or conformist effects depends on the shape of the social status function, and additional structure will be imposed on the social status function to highlight such demand effects.

2.3.1 Equilibrium Definition

In the consumption subgame (stages $t = 3$ and $t = 4$), the appropriate equilibrium notion is that of a signaling equilibrium where consumers are senders, choosing actions (a , b or $\emptyset$) based on type x and firms’ decisions prior Ω ; while the public

¹⁹There is a second behavioral interpretation of the model following the work of [Bénabou and Tirole \[2011\]](#). Under this interpretation, a consumer has two selves, a present self and a future self. Through a moment of self-reflection, the current self has insight into its own attribute x , and the status implied therein, but the future self may momentarily forget its own attribute (akin to “the public”). Though forgetful, the future self can readily observe its consumption choices, and may try to infer its attribute based on this action. The consumer receives utility based on its future self’s inference of its own identity. Thus, the current self is a sender in a signaling game, making consumption choices based on the utility the consumer will get from its future self’s inference. As explained in [Bénabou and Tirole \[2011\]](#), the function of advertising is to remind the consumer’s future self of the identity associated with products, increasing the salience of the conditional inference, and thus strengthening the use of consumption as signaling device. This alternative interpretation can potentially broaden the application of the model beyond that of conspicuous consumption to that of inconspicuous consumption.

are receivers, inferring consumer type x based on information about a consumer's action and the characteristics of firms Ω . I study *pure strategy* Perfect Bayesian Equilibrium (PBE). In a PBE, consumer actions must be optimal given the public's inferences, and the public's inferences must be deducible using Bayes Rule given information available about consumer actions. I restrict attention to PBE satisfying the following reasonable off-equilibrium public beliefs.

Suppose both firms enter the market and $\ell_a < \ell_b$. I assume that if all consumers purchase good a (good b), then a consumer who deviates by purchasing good b (good a) is perceived to be the consumer with greatest benefit from switching: $\rho(x = 1|b, \Omega) = 1$ ($\rho(x = 0|a, \Omega) = 1$). If instead $\ell_b < \ell_a$ and all consumers purchase good a (good b), then $\rho(x = 0|b, \Omega) = 1$ ($\rho(x = 1|a, \Omega) = 1$).²⁰ Note that members of the public who do not receive advertisements are unable to distinguish between the choices of consumers. Essentially, they perceive all consumers as choosing a single action. Their inference of a consumer's type is then unconditioned on her action, $\rho(x)$, and hence they form no off-equilibrium beliefs.

Finally, in the larger game I study pure strategy subgame perfect equilibria. All proofs are in Appendix [A.4](#).

2.4 Social Status Motivated Demand

Working backwards, I first solve for consumer demand, given firms' advertising levels, prices and locations. Consumers make their choices based on not only their

²⁰I discuss the case of undifferentiated firms $\ell_a = \ell_b$ in Appendix [A.2](#). Additionally, I outline analogous off-equilibrium beliefs in the case where firm B does not enter in Appendix [A.3](#).

horizontal preferences and prices, but also on the status their purchase conveys to the advertisement receiving public. It will be seen how this signaling motive generates conformist and snobbish effects on demand.

I impose the traditional assumption that v is sufficiently large that all consumers make purchases. Suppose firm B enters the market. I study the monopoly case in which firm B does not enter in Appendix A.3. The first thing to notice is that if $\ell_a \neq \ell_b$, then any equilibrium in which all consumers make purchases is characterized by a single cut-off $n \in [0, 1]$ such that consumers to the left of n buy the left most good, and consumers to the right of n the right most good.

Lemma 1 (Cut-Off Rule). *If $\ell_a \neq \ell_b$, then in any equilibrium in which all consumers make purchases, there must be a single cut-off $n \in [0, 1]$ such that consumers to the left of n buy the left most good, and consumers to the right of n buy the right most good.*

Consumer demand constitutes a semi-separating equilibrium if $n \in (0, 1)$ and both goods are purchased, and a pooling equilibrium if $n \in \{0, 1\}$ and only one good is purchased. This cut-off rule holds in most spatial models due to a single-crossing property arising from consumers' location dependent transportation costs, and the same applies here. The reason for this result is that all consumers face the same public perception for a given purchase regardless of their type x .²¹ Thus, reputation motives add an identical constant to each consumer's utility for a particular option independent of their x , not affecting the single-crossing property.

²¹If the public knew the consumer's type x , then there would be no signaling motives.

We can now calculate the signaling value of each good given an arbitrary cut-off n . Without loss of generality, suppose $\ell_a < \ell_b$. The analysis applies equally to the case of $\ell_a > \ell_b$ by switching the a and b terms in what follows.

$$S_a(n) = \frac{\lambda}{n} \int_0^n s(x) dx + (1 - \lambda) E(s(x)) \quad (2.7)$$

$$S_b(n) = \frac{\lambda}{1 - n} \int_n^1 s(x) dx + (1 - \lambda) E(s(x)) \quad (2.8)$$

where $\int_0^1 \rho(x | a, \Omega) s(x) dx = \frac{1}{n} \int_0^n s(x) dx$ and $\int_0^1 \rho(x | b, \Omega) s(x) dx = \frac{1}{1-n} \int_n^1 s(x) dx$.

Each consumer must compare the utility of good a and good b . This implies weighing the signaling gain from good a over good b , call it $S_{a/b}(n) \equiv S_a(n) - S_b(n)$, against the difference in transportation costs and prices.²² We can calculate the signaling gain from good a , $S_{a/b}(n)$, as follows.

$$S_{a/b}(n) = \lambda \left(\frac{1}{n} \int_0^n s(x) dx - \frac{1}{1 - n} \int_n^1 s(x) dx \right) \quad (2.9)$$

Note that, and this is at the heart of the model, the reputational gain from a purchase $S_{a/b}()$ is a function of the mass of consumers purchasing it n . There is a more formal correspondence between the signaling gain from a purchase $S_{a/b}()$ and the social status function.²³

Following [Leibenstein \[1950\]](#) and [Corneo and Jeanne \[1997\]](#), I say that demand is characterized by snobbery if the reputation gain from a purchase is enhanced by

²²Similarly, let $S_{b/a}(n) \equiv S_b(n) - S_a(n)$.

²³A continuous and differentiable signaling gain function $S_{a/b}()$ can be rationalized by a social status function of the form $s(x) = (1 - 2x)S_{a/b}(x) + x(1 - x)S'_{a/b}(x) + c$ where c is an arbitrary constant. See equation (11) in [Corneo and Jeanne \[1997\]](#).

its rarity and $S'_{a/b}(n) < 0$. Conversely, demand is characterized by conformity if the reputation gain from a purchase is heightened by its popularity and $S'_{a/b}(n) > 0$.²⁴ In order to highlight the effects of snobbery and conformity on demand, I focus on markets that are either snobbish or conformist for all possible values of n . In other words, cases where the reputation gain function $S_{a/b}(n)$ is monotonic. Furthermore, to make the model tractable, I restrict attention to reputation gain functions $S_{a/b}(n)$ that are linear. The next lemma establishes that $S_{a/b}(n)$ is linear and monotonic if and only if the social status function $s(x)$ is quadratic.

Lemma 2 (Monotonic and Linear Signaling Gain). *$S_{a/b}(n)$ is linear and decreasing if and only if $s(x)$ is quadratic and convex. $S_{a/b}(n)$ is linear and increasing if and only if $s(x)$ is quadratic and concave.*

The quadratic nature of the social status function buys linearity in the reputation gain function, and the convexity or concavity in social status generates snobbery or conformity respectively. Given the result in Lemma 2, I study social status functions with the below functional form.²⁵

Assumption 1 (Social Status Function). *$s(x)$ is a quadratic function centered at $\alpha \in [0, 1]$: $s(x) = \beta(x - \alpha)^2$.*

The sign of β determines whether demand is snobbish or conformist. Calcu-

²⁴In other words, conformity and snobbery capture the reputational affect of the marginal consumer's purchase.

²⁵Note that the signaling gain from a good is independent of adding a constant to the social status function. Intuitively, if each consumer's social status is increased or decreased by some identical amount, then it does not affect their reputation gain from a specific signal.

lating $S_{a/b}(n)$ by plugging in the social status function yields:

$$S_{a/b}(n) = -\frac{\lambda\beta}{3}n + \lambda\beta(\alpha - \frac{1}{3}) \quad (2.10)$$

As seen in equation (2.10), if the social status function is convex $\beta > 0$, then demand is snobbish and the reputation gain from a good decreases in the mass of consumers choosing it, i.e. $\frac{dS_{a/b}(n)}{dn} < 0$. If the social status function is concave $\beta < 0$, then demand is conformist and the reputation gain from a good increases in the mass of consumers choosing it $\frac{dS_{a/b}(n)}{dn} > 0$. Figure 2.2 shows examples of snobbish and conformist social status functions.²⁶

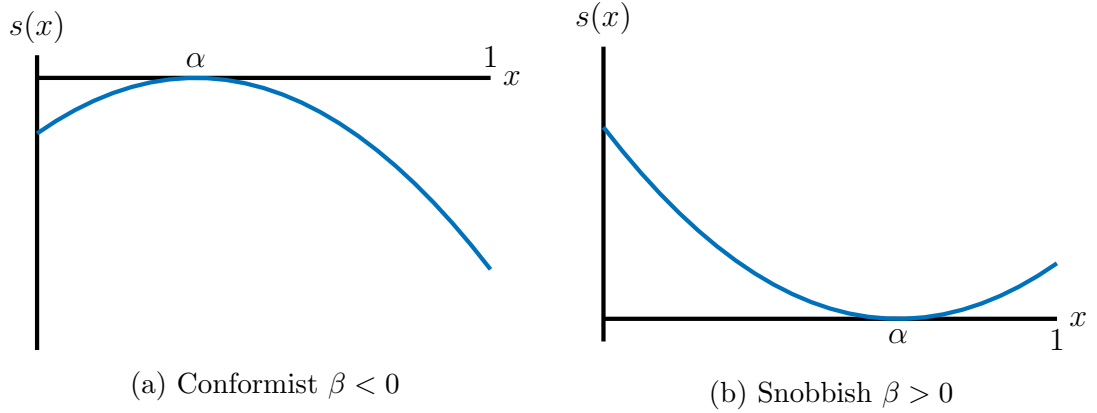


Figure 2.2: Social Status Function Examples

$$s(x) = \beta(x - \alpha)^2$$

The intuition for the dependence of snob and conformist effects on the concavity or convexity of the social status function is as follows.²⁷ Suppose the social status function is convex on some interval, and for argument's sake, decreasing (the

²⁶Figure A.1 in Appendix A.1 shows maps of the social status function to the reputational gain function generated for various β and α .

²⁷More precisely, the sign of the second derivative.

snobbery is independent of whether social status is increasing or decreasing). For example, x may be a scale of how sophisticated a consumer is at $x = 0$ to outdoorsy or rugged at $x = 1$, with increasing status returns to being more sophisticated. Consider some cut-off n in this interval such that those to the left of n buy good a and those to the right of n buy good b .²⁸ Due to the convexity, it is more costly to lose one's position when one is ranked high than when one is ranked low. Thus, as n shifts right and more consumers buy good a , the expected status of those choosing good a falls more rapidly than that of those choosing good b . This implies that the the signaling gain from good a , $S_{a/b}(n)$, which is the difference between those two, decreases. As [Corneo and Jeanne \[1997\]](#) puts it, societal norms emphasize a hope of being identified as a high type, and this results in snobbish behavior.

The vertex α also holds economic significance. In the snobbish case, α is interpreted as the least desired value of x . I allow for any $\alpha \in [0, 1]$.²⁹ α in the middle implies that extremists are more valued than centrists, which may be sensible in many snobbish settings such as the measure of sophistication to ruggedness described. α influences the signaling gain (the prestige) from a good, without affecting the responsiveness of those signaling gain to the good's consumer base.

The intuition for the conformist case is just the opposite. Suppose that the

²⁸Consumers to the left may prefer a water bottle that is more elegant and appealing in business settings, such as the S'well water bottle, and consumers to the right might prefer a water bottle that is more useful in outdoorsy environments, such as a Camelbak water bottle. S'well prides itself on making water bottles that are elegant and impressionable in a board room setting, even though many of its customers are students and others not using it in business settings. Camelbak sells water bottles that are durable, lightweight and well-suited for outdoor activities such as hiking and biking. Camelbak advertises that it supplies the United States military, and that its produced have been used in both the second Gulf war and the War in Afghanistan. However, most Camelbak consumers are probably not using their water bottles in such harsh climates.

²⁹In the analysis, I describe the implications of allowing for a broader range of α .

social status function is concave, and again for argument's sake, decreasing on some interval. For example, x could be a measure of how New England is a consumer's identity at $x = 0$ to Southern at $x = 1$, with decreasing status returns to a New England affiliation. Due to the concavity, it is now more costly to lose one's position when one is ranked low than when one is ranked high. Thus, as n shifts right and more consumers buy good a , the expected status of those buying good a decreases less rapidly than the expected status of those buying good b . This implies that the the signaling gain from good a , $S_{a/b}(n)$, increases as more buy it. Essentially, societal values instill a fear of being ostracized and identified as a low type, and this expresses itself in conformist behavior. Here, α signifies the most desired x . [Bernheim \[1994\]](#) argues that in many conformist settings centrists are more valued than extremists and α lies in the middle.

Equation (2.10) also hints at the effects of advertising on demand in these two settings. An increase in advertising λ raises the magnitude of the slope of $S_{a/b}(n)$, implying that the signaling gain from a good becomes more responsive to its consumer base. Intuitively, by increasing the chance that the public recognizes a purchase and the social identity it conveys, advertising increases the strength of conformist or snob effects on demand, depending on the case. We will see how firms can take advantage of this dynamic for strategic purposes when solving the model.

2.4.1 Product Locations

In order to understand consumer demand, it is useful to define a couple terms related to product positioning, as this will effect which brands consumers gravitate towards. Following the literature on horizontal differentiation, I say that firm A has a “location advantage” if $\ell_a + \ell_b > 1$ and it is closer to a greater mass of consumers, while firm B has the location advantage if $\ell_a + \ell_b < 1$ and it is closer to a greater mass of consumer. Firms are symmetric if $\ell_a + \ell_b = 1$.

However, and in contrast to the traditional literature on horizontal differentiation, in my model it matters not just *how many* consumers a firm is closer to, but also *who* a firm is closer to. Firms not only wish to appeal to a *large quantity* of consumers, but also to a *high quality* of consumers by winning the patronage of those with high status. This captures an intuitive and real market dynamic, where firms compete to gain the attraction of celebrities, social media “influencers,” and other high types — even-though such high types may constitute a small portion of customers.

I say that the firm on the side with more high types has a “prestige advantage.” In the snobbish case where $\beta > 0$, firm A (firm B) has the prestige advantage if $\alpha > \frac{1}{2}$ ($\alpha < \frac{1}{2}$) because there are higher types on the left than on the right (higher types on the right than on the left). In the conformist case where $\beta < 0$, firm A (firm B) has the prestige advantage if $\alpha < \frac{1}{2}$ ($\alpha > \frac{1}{2}$) because there are higher types on the right than on the left (on the left than on the right). Firms have a symmetric prestige advantage if $\alpha = \frac{1}{2}$. This terminology is summarized in Table 2.1.

However, just because a firm is on the side with more high types does not mean it captures a higher signaling value than the other firm. Firms must also position themselves away from low types to win the better reputation. For example, consider a snobbish market with vertex $\alpha = 0.6$, implying that the left side of the social status function is higher than the right. If $\ell_a = 0.9$ and $\ell_b = 1$, then firm A commands a prestige advantage because it is on the left side. However, it is also more preferred by low types near $x = 0.6$. Indeed, when the market is split equally between firm locations $n = \frac{\ell_a + \ell_b}{2}$, firm A has the lower signaling value $S_{a/b}(\frac{0.9+1}{2}) < 0$.

Thus, I define the firm with the more “prestigious position” as the firm which holds greater signaling value at an even split of the market between their locations. In other words, firm A has the more prestigious position if $S_{a/b}(\frac{\ell_a + \ell_b}{2}) > 0$, and firm B has the more prestigious position if $S_{a/b}(\frac{\ell_a + \ell_b}{2}) < 0$. Firms have symmetrically prestigious positions if $S_{a/b}(\frac{\ell_a + \ell_b}{2}) = 0$. It can be derived from equation (2.10) that firm A has the more prestigious position when $\beta > 0$ ($\beta < 0$) and $\ell_a + \ell_b < 6\alpha - 2$ ($\ell_a + \ell_b > 6\alpha - 2$). Furthermore, firm B has the more prestigious position when $\beta > 0$ ($\beta < 0$) and $\ell_a + \ell_b > 6\alpha - 2$ ($\ell_a + \ell_b < 6\alpha - 2$). Firms have symmetrically prestigious positions when $\ell_a + \ell_b = 6\alpha - 2$ or $\beta = 0$. This terminology is also summarized in Table 2.1.³⁰

³⁰If firms locate symmetrically ($\ell_a + \ell_b = 1$), then a firm has a prestige advantage if and only if it has a more prestigious position. However, if firms locate asymmetrically, then the firm with the prestige advantage may or may not be the firm with the more prestigious position, as in the example described above. That said, there needs to be significant asymmetry in firms’ locations for a firm with the prestige advantage to not also have the more prestigious position.

	Location Advantage
$\ell_a + \ell_b > 1$	Firm A
$\ell_a + \ell_b < 1$	Firm B
$\ell_a + \ell_b = 1$	Symmetric

	Prestige Advantage
Snobbish: $\beta > 0$ and $\alpha > \frac{1}{2}$	Firm A
Snobbish: $\beta > 0$ and $\alpha < \frac{1}{2}$	Firm B
Conformist: $\beta < 0$ and $\alpha < \frac{1}{2}$	Firm A
Conformist: $\beta < 0$ and $\alpha > \frac{1}{2}$	Firm B
$\beta = 0$ or $\alpha = \frac{1}{2}$	Symmetric

	More Prestigious Position
Snobbish: $\beta > 0$ and $\ell_a + \ell_b < 6\alpha - 2$	Firm A
Snobbish: $\beta > 0$ and $\ell_a + \ell_b > 6\alpha - 2$	Firm B
Conformist: $\beta < 0$ and $\ell_a + \ell_b < 6\alpha - 2$	Firm B
Conformist: $\beta < 0$ and $\ell_a + \ell_b > 6\alpha - 2$	Firm A
$\beta = 0$ or $\ell_a + \ell_b = 6\alpha - 2$	Symmetric

Table 2.1: Firm with Location Advantage, Prestige Advantage and more Prestigious Position when $\ell_a < \ell_b$

2.4.2 Demand Partitions

Armed with a better understanding of the dynamics of status signaling, we can calculate consumer demand given firms' decisions prior. The demand analysis below applies equally to the case of $\ell_b < \ell_a$ by flipping the a and b terms. I treat the case of $\ell_a = \ell_b$ in Appendix A.2. For any cut-off n , the expected utility of a given

consumer x for each good at the purchasing stage is:

$$U_x(a; n) = v - \tau(\ell_a - x)^2 - p_a + S_a(n) \quad (2.11)$$

$$U_x(b; n) = v - \tau(\ell_b - x)^2 - p_b + S_b(n) \quad (2.12)$$

where $S_a(n)$ and $S_b(n)$ are as defined in equations (2.7) and (2.8). A consumer buys good a if $U_x(a; n) > U_x(b; n)$, and buys good b if $U_x(b; n) > U_x(a; n)$. The equilibrium value of the cut-off n , call it $\hat{n}$, is defined by the consumer x who is just indifferent between buying goods a and b . Plugging $\hat{n}$ in for x , setting equations (2.11) and (2.12) equal and solving yields:

$$\hat{n} = \frac{p_b - p_a + \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3})}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}} \quad (2.13)$$

If $\beta = 0$ and there are no status motives, then $\hat{n}$ simplifies to the cut-off in a standard Hotelling model with quadratic transportation costs. Also, note that $\hat{n}$ is a similar cut-off to that in the model of Grilo et al. [2001] when $\alpha = \frac{1}{2}$, and signaling equally affects the market shares of firms A ($\hat{n}$) and B ($1 - \hat{n}$). However, allowing for $\alpha \neq \frac{1}{2}$ introduces an asymmetry in how signaling affects the market shares of the two firms.

One needs to check that $\hat{n}$ is in $[0, 1]$ in equation (2.13). Whether $\hat{n} \in [0, 1]$ depends on prices and the sign of the denominator. As in Grilo et al. [2001], I say demand is characterized by “Snobbism\Weak Conformity” if the denominator is positive. This necessarily holds in a snobbish market, and may hold in a conformist market if firms are sufficiently far and differentiated relative to the degree of

advertising and conformity. By contrast, I say demand is characterized by “Strong Conformity” if the denominator is non-positive.

Definition 1 (Weak and Strong Conformity). *Demand is characterized by “weak conformity” if $\beta < 0$ and $2\tau(\ell_b - \ell_a) > -\lambda\frac{\beta}{3}$. Demand is characterized by “strong conformity” if $\beta < 0$ and $2\tau(\ell_b - \ell_a) \leq -\lambda\frac{\beta}{3}$.*

Suppose demand is characterized by snobbism or weak conformity. Evaluating equation (2.13), there is a unique semi-separating equilibrium with $\hat{n} \in (0, 1)$ when the difference in firm prices is not too large and lies inside the following range: $\underline{p_a - p_b} < p_a - p_b < \overline{p_a - p_b}$.³¹ If the price difference is large and lies outside this range, then all consumers purchase the cheaper good and there is a pooling equilibrium. Let’s call the cut-off n_A when firm A captures the market (i.e. $\hat{n} = 1$), and n_B when firm B captures all demand (i.e. $\hat{n} = 0$). There is a unique pooling equilibrium with firm A capturing all demand, n_A , when $p_a - p_b \leq \underline{p_a - p_b}$. Furthermore, there exists a unique pooling equilibrium with firm B capturing the market, n_B , when $p_a - p_b \geq \overline{p_a - p_b}$. Figure 2.3a maps the consumer allocation for any given price vector (p_b, p_a) when demand is characterized by snobbism or weak conformity.

Suppose instead demand is characterized by strong conformity. In this case, there may be multiple equilibria of the consumption subgame, and demand is defined by a correspondence rather than a function. If firm A has a significantly lower price and $p_a - p_b < \underline{p_a - p_b}$, then there is a unique pooling equilibrium in which firm

³¹ $\underline{p_a - p_b} = \tau(\ell_b - \ell_a)(\ell_a + \ell_b - 2) + \lambda\beta(\alpha - \frac{2}{3})$ and $\overline{p_a - p_b} = \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3})$.

A captures the entire market n_a .³² If firm B has a significantly lower price and $p_a - p_b > \overline{\overline{p_a - p_b}}$, then there is a unique pooling equilibrium in which firm B captures the entire market n_b .³³ However, if $\underline{\underline{p_a - p_b}} \leq p_a - p_b \leq \overline{\overline{p_a - p_b}}$, then equilibria with any of the following consumer partitions are possible at a given price pair: n_A , n_B , or $\hat{n} \in (0, 1)$, where $\hat{n}$ is as defined by equation (2.13). Figure 2.3 shows a map of strongly conformist demand in (p_b, p_a) space.³⁴ We will revisit the issue of the multiplicity of demand partitions when we discuss the equilibria at the pricing stage.

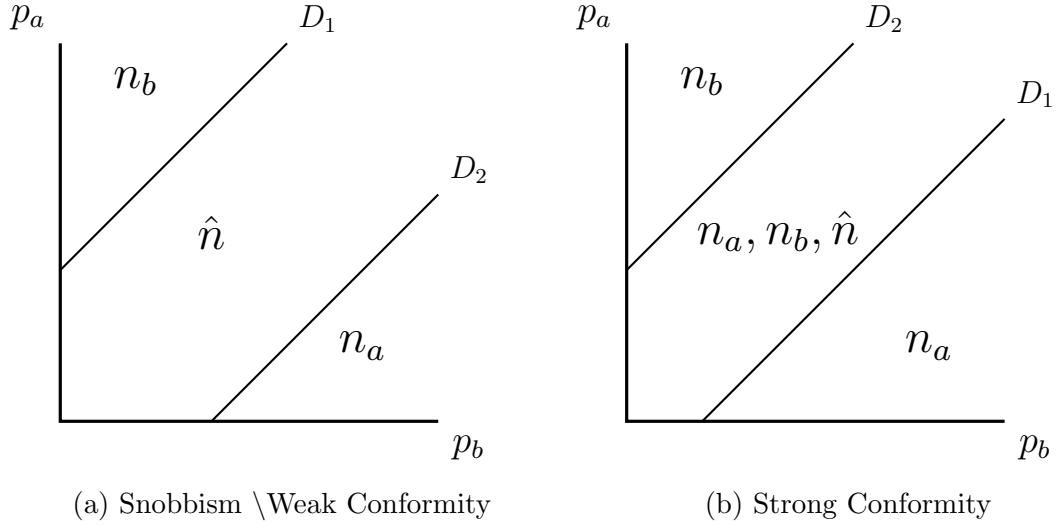


Figure 2.3: Possible Consumer Allocations in Price Space
 $\hat{n} \in (0, 1)$ defined by equation (2.13). n_a (n_b) indicates firm

A (firm B) gains the entire market share.

$$D_1 : p_a = p_b + \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3})$$

$$D_2 : p_a = p_b + \tau(\ell_b - \ell_a)(\ell_a + \ell_b - 2) + \lambda\beta(\alpha - \frac{2}{3})$$

³²In the case of strong conformity, $\overline{\overline{p_a - p_b}} < \underline{\underline{p_a - p_b}}$ and $\underline{\underline{p_a - p_b}} = \overline{\overline{p_a - p_b}} = \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3})$.

³³ $\overline{\overline{p_a - p_b}} = \underline{\underline{p_a - p_b}} = \tau(\ell_b - \ell_a)(\ell_a + \ell_b - 2) + \lambda\beta(\alpha - \frac{2}{3})$.

³⁴Not shown in Figure 2.3 is some upper price limits $\overline{\overline{p_a}}$ and $\overline{\overline{p_b}}$ above which consumers do not purchase.

The diagonal lines D_1 and D_2 in Figure 2.3 denote barriers between possible consumer partitions.³⁵ The positions of the diagonal lines will carry important implications at the pricing stage. Intuitively, the firm that commands a larger region of high market share on the (p_b, p_a) plane is likely to be able to use its strategic power to extract a greater price. Note that the positions of the diagonal lines are responsive to λ , β , α , τ , ℓ_a and ℓ_b .

In Figure 2.3 the diagonal lines are drawn on either side of the 45 degree line, but this need not always be the case. Given snobbish demand, D_1 is necessarily above the 45 degree line and D_2 is below it. As $\lambda\beta$ increases or firms move farther apart, then the diagonal lines separate farther apart. Intuitively, an increase in the degree of snobbery or differentiation implies that consumers are more likely to split their demand between the two stores for any given prices. However, as either $\lambda\beta$ decreases or firms move closer together, the diagonal lines drift closer together. Intuitively, an increase in the degree of conformity or a decrease in differentiation implies that it is easier to find a price vector such that all consumers patron the same store.

In the conformist case, the diagonal lines eventually cross when $\lambda\beta$ is sufficiently negative. The point at which the diagonal lines cross $D_1 = D_2$ is where the market switches from characterized by weak conformity to strong conformity. Whether the diagonal lines cross above or below the 45 degree line will have important implications when we solve for prices in a conformist market. If firm A has a

³⁵In Figure 2.3a, only partition n_b is possible on the D_1 line, and only partition n_a is possible on the D_2 line. By contrast, in Figure 2.3b, both partitions n_a and n_b are possible on both the D_1 and D_2 lines, and only partitions n_a and n_b are possible on the D_1 and D_2 lines.

more prestigious position and $\ell_a + \ell_b > 6\alpha - 2$, then the diagonal lines cross above the 45 degree line.³⁶ This implies that there may be a large region in (p_b, p_a) space where all consumers frequent store A . By contrast, if firm B has a more prestigious position and $\ell_a + \ell_b < 6\alpha - 2$, then the diagonal lines cross below the 45 degree line.³⁷ Thus, there may be a large region in (p_b, p_a) space where all consumers frequent store B . If $\ell_a + \ell_b = 6\alpha - 2$, then D_1 and D_2 cross at the 45 degree line.

2.5 Pricing in Conformist and Snobbish Markets

With the above map of consumer demand, we can calculate the equilibrium at the pricing stage, given firm advertising levels and locations. I treat the cases of snobbism\weak conformity and strong conformity separately.³⁸

Denote the demand of firm A and firm B by $Q_a(p_a, p_b, \lambda, \ell_a, \ell_b)$ and $Q_b(p_a, p_b, \lambda, \ell_a, \ell_b)$ respectively, as derived in Section 2.4, so firms maximize $p_a Q_a(p_a, p_b, \lambda, \ell_a, \ell_b)$ and $p_b Q_b(p_a, p_b, \lambda, \ell_a, \ell_b)$.³⁹

2.5.1 Pricing under Snobbism\Weak Conformity

Suppose we are in a market characterized by snobbism\weak conformity. The cut-off $\hat{n}$ is then given by equation (2.13). A pure strategy price equilibrium exists since demands are linear and decreasing in own prices. Differentiating $p_a Q_a(p_a, p_b, \lambda, \ell_a, \ell_b)$

³⁶Note that if $\alpha < \frac{1}{3}$, then the diagonal lines must cross above the 45 degree line.

³⁷Note that if $\alpha > \frac{2}{3}$, then the diagonal lines must cross above the 45 degree line.

³⁸I study the monopoly case in which firm B does not enter in Appendix A.3.

³⁹Since firms have already chosen their advertising levels, they maximize their revenues at this stage.

and $p_b Q_b(p_a, p_b, \lambda, \ell_a, \ell_b)$ with respect to own prices and solving yields:

$$p_a^* = \frac{\tau}{3}(\ell_b - \ell_a)(2 + \ell_a + \ell_b) + \lambda\alpha\frac{\beta}{3} \quad (2.14)$$

$$p_b^* = \frac{\tau}{3}(\ell_b - \ell_a)(4 - \ell_a - \ell_b) + \lambda(1 - \alpha)\frac{\beta}{3} \quad (2.15)$$

$$n^* = \frac{\frac{\tau}{3}(\ell_b - \ell_a)(2 + \ell_a + \ell_b) + \lambda\alpha\frac{\beta}{3}}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}} \quad (2.16)$$

For this to be a price equilibrium, it remains to be checked that $n^* \in (0, 1)$.

This holds if and only if:

$$-\lambda\beta < \tau(\ell_b - \ell_a) \min\left\{ \frac{2 + \ell_a + \ell_b}{\alpha}, \frac{4 - \ell_a - \ell_b}{1 - \alpha} \right\} \quad (2.17)$$

In a snobbish market, equation (2.17) always holds, so that $n^* \in (0, 1)$ and both firms earn positive revenues as described by equations (2.14) - (2.15).⁴⁰ This equilibrium is depicted graphically in Figure 2.4a. The blue dotted lines depict firms' price response lines $p_a(p_b)$ and $p_b(p_a)$, with the price equilibrium at their intersection. The positions of the price response lines are influenced by ℓ_a , ℓ_b , τ , λ , β and α .

⁴⁰Firm A 's revenues simplify to $\frac{p_a^{*2}}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}}$ and Firm B 's revenues to $\frac{p_b^{*2}}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}}$.

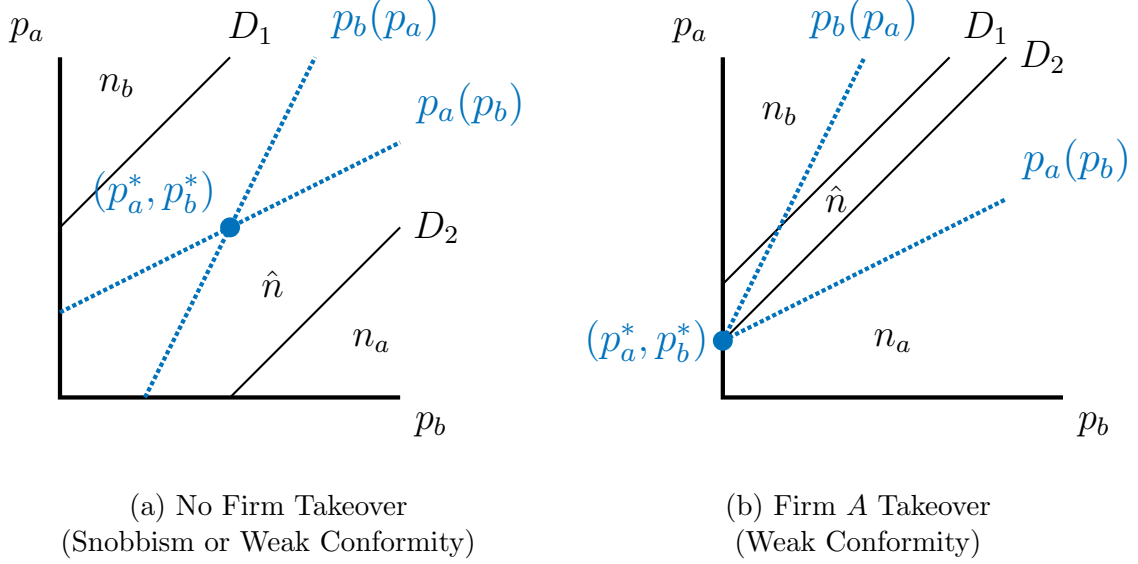


Figure 2.4: Price Equilibrium with Snobbism\Weak Conformity

$$\begin{aligned}
 p_a(p_b) &= \frac{p_b}{2} + \frac{\tau}{2}(\ell_b - \ell_a)(\ell_a + \ell_b) + \frac{\lambda\beta}{2}(\alpha - \frac{1}{3}) \\
 p_b(p_a) &= \frac{p_a}{2} + \frac{\tau}{2}(\ell_b - \ell_a)(2 - \ell_a - \ell_b) + \frac{\lambda\beta}{2}(\frac{2}{3} - \alpha)
 \end{aligned}$$

Inspection of the price equilibrium described by equations (2.14) - (2.16) reveals interesting insight into the dynamics of snobbish markets. First, both firms' prices are increasing in advertising. Intuitively, by increasing the strength of consumers' snobbish motives, advertising reduces the elasticity of demand with respect to prices.⁴¹ This is because when firms cut prices, fewer consumers rush in to buy their products, as their signaling gains from the product decrease the more who buy it. This dampens price competition, and induces firms to converge on higher

⁴¹More precisely, advertising reduces a weighted combination of the elasticity of demand of goods a and b with respect to their own and each others' prices that results in higher prices. For example, the elasticity of demand of good a with respect to p_a and p_b are $\epsilon_{p_a}^a = \frac{dn}{dp_a} \frac{p_a}{n} = \frac{-p_a}{p_b - p_a + \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3})}$ and $\epsilon_{p_b}^a = \frac{dn}{dp_b} \frac{p_b}{n} = \frac{p_b}{p_b - p_a + \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3})}$ respectively. Thus, in a snobbish market, the absolute value of elasticity of demand for good a with respect to p_a and p_b decreases in advertising when $\alpha \geq \frac{1}{3}$, and increases in advertising otherwise. Similarly, in a snobbish market, the absolute value of the elasticity of demand for good b with respect to p_a and p_b decreases in advertising when $\alpha \leq \frac{2}{3}$, and increases otherwise. The net result is that advertising affects $\epsilon_{p_a}^a$, $\epsilon_{p_b}^a$, $\epsilon_{p_a}^b$ and $\epsilon_{p_b}^b$ in a way that raises the prices of both goods.

prices. Moreover, advertising by one firm raises the price of the other firm. If the market share effects described below are not too large, then advertising can increase the profits of both firms. Thus, for certain parameters advertising can be non-combative, instead acting as a public good to firms. This is made visually clear in Figure 2.4a. Advertising shifts some (or all) of the diagonal lines and price response lines out in a way that pushes the price equilibrium in the north east direction.

However, advertising has a greater positive effect on the price of the firm with the prestige advantage. Intuitively, by increasing recognition that one firm has more high types, advertising allows that firm to extract a higher price. In Figure 2.4a, advertising pushes the price equilibrium out in a direction more favorable to the firm with the prestige advantage. Actually, if we extended the results by allowing for $\alpha \notin [0, 1]$, then advertising would lessen the price of the firm with the prestige disadvantage because it would have to undercut its price to attract customers.

Reputation motives also create interesting effects on firms' market shares. Advertising benefits the market share of the firm with the more prestigious position, at the detriment of the market share of the other. Intuitively, a firm preferred by more high status consumers can use advertising to attract more customers. Even if firms are symmetrically located, then asymmetries arise where the firm with the more prestigious position commands a higher price and earns greater market share. This can explain why we sometimes see physically similar or indistinguishable products with one earning greater market share and charging a price premium. These results are summarized in Proposition 1.

Proposition 1 (Advertising’s Effect on Prices and Market Share in a Snobbish Market). *In a snobbish market, advertising by either firm weakly raises the prices of both firms, with greater positive effect on the price of the firm with the prestige advantage. Advertising has a positive effect on the market share of the firm with the more prestigious position, and a negative effect on the market share of the firm with the less prestigious position.*

I turn to a weakly conformist market next (see Definition 1). If equation (2.17) holds in a weakly conformist market, then we get the equilibrium described by equations (2.14) - (2.16). It is apparent that advertising then has the opposite effect, decreasing firms’ prices. The intuition is that by strengthening consumers’ conformist motives, advertising increases the elasticity of demand with respect to prices — when firms cut prices, more consumers rush to buy in due to the reputation gains from others doing so. This heightens the price competition and induces firms to converge on lower prices. Here, it is found that advertising has a greater negative effect on the price of the firm with the prestige disadvantage, because it has added need to undercut its price to retain consumers.

Additionally, as in a snobbish market, we see that advertising benefits the market share of the firm with the more prestigious position, at the detriment of the market share of the other. Even if firms are symmetrically located, then the firm with the more prestigious position commands a higher price and earns greater market share. However, there are no parameters for which advertising benefits both firms, as in a snobbish market. These results are summarized in Proposition 2.

Proposition 2 (Advertising's Effect on Prices and Market Share in a Weakly Conformist Market). *In a weakly conformist market in which neither firm takes over, advertising by either firm weakly lowers the prices of both firms, with greater negative effect on the price of the firm with the prestige disadvantage. Advertising has a positive effect on the market share of the firm with the more prestigious position, and a negative effect on the market share of the firm with the less prestigious position.*

If price competition is sufficiently severe, then equation (2.17) may not hold in a conformist market. That is, if product differentiation is sufficiently low relative to the intensity of advertising and conformity, then equation (2.17) does not hold. In this case, one firm wins all consumer demand. Essentially, conformist motives overpower consumers' transportation costs, and all go to the most popular brand. It turns out that the the firm with the more prestigious positions takes over the market, charging a limit-price. If equation (2.17) does not hold and firm A has a more prestigious position, then it charges the highest price such that firm B cannot charge a weakly positive price and earn any customers:

$$p_a^* = -\tau(\ell_b - \ell_a)(2 - \ell_a - \ell_b) + \lambda\beta(\alpha - \frac{2}{3}) \quad (2.18)$$

$$p_b^* = 0 \quad (2.19)$$

$$n^* = n_a \quad (2.20)$$

This price equilibrium is depicted in Figure 2.4b. It occurs when the D_2 and $p_b(p_a)$ lines are sufficiently high that they intersect the $p_a(p_b)$ line on the p_a -axis.

If equation (2.17) does not hold and firm B has a more prestigious position,

then it charges the highest price such that no consumers patron firm A at any $p_a \geq 0$:

$$p_a^* = 0 \tag{2.21}$$

$$p_b^* = -\tau(\ell_b - \ell_a)(\ell_a + \ell_b) - \lambda\beta(\alpha - \frac{1}{3}) \tag{2.22}$$

$$n^* = n_b \tag{2.23}$$

This price equilibrium occurs when the D_1 and $p_a(p_b)$ lines are sufficiently low that they intersect the $p_b(p_a)$ line on the p_b -axis. This single firm dominance is a result we could not get in standard model of horizontal differentiation with zero production costs. Note that if firms are symmetrically located, then equation (2.17) always holds in a weakly conformist market.

2.5.2 Pricing under Strong Conformity

Let's now explore equilibrium prices in a market characterized by strong conformity. As shown in Section 2.4, there may be multiple possible consumer partitions for given prices, and demand is defined by a correspondence rather than a function.

This implies, as in Grilo et al. [2001], there may also be multiple equilibria at the pricing stage. However, many of these price equilibria are unreasonable and rely on unusual off-equilibrium consumer behavior where demand moves highly non-monotonically in prices. It turns out that under a reasonable refinement firms' revenues are uniquely determined in the equilibrium of the pricing stage. The axiom below is predicated on the premise that when there are three possible consumers par-

titions for a given price vector, firms anticipate consumers settling on the partition most beneficial to the firm with the cheaper product.

Axiom 1 (Cheaper is Better). *If price pair (p_b, p_a) can induce three possible partitions n_a , n_b and $\hat{n} \in (0, 1)$ and $p_a \neq p_b$, then consumers settle on the partition giving the highest market share to the firm with the lower price (n_a if $p_a < p_b$ and n_b if $p_a > p_b$).*

I assume Axiom 1 holds throughout the analysis that follows. This imposes a certain degree of monotonicity on the movement of demand with respect to prices, so that when prices move from the north west to the south east of the (p_b, p_a) quadrant in Figure 2.3b, the anticipated demand partitions generally move from firm B earning greater share to firm A . Under this refinement, firms' equilibrium revenues are uniquely determined in the pricing stage, as described in Proposition 3.⁴²

Proposition 3 (Strongly Conformist Price Equilibrium). *Consider a strongly conformist market with $\ell_a \leq \ell_b$. Under Axiom 1, the set of equilibria at the pricing stage is as follows. If D_1 and D_2 intersect the p_a -axis, then $p_b^* = 0$, $n^* = n_a$ and*

⁴²One could obtain the same equilibrium described in Proposition 3 by applying the invariance axiom introduced in Grilo et al. [2001] in combination with the following axiom: If price pair (p_b, p_a) can induce partitions n_a , n_b and $\hat{n} \in (0, 1)$ and $p_a \neq p_b$, then consumers do *not* settle on the partition giving the highest market share to the firm with the higher price (n_b if $p_a < p_b$ and n_a if $p_a > p_b$). The invariance axiom says that if price pair (p_b, p_a) induces consumer partition n^* , then $(p_b + z, p_a + z)$ induces the same partition n^* where z is an arbitrary constant, $(p_b + z, p_a + z) \geq (0, 0)$ and all consumers want to buy. In other words, if consumer utility for each good is added or subtracted by an identical constant, then consumers buy the same goods.

$$p_a^* = \tau(\ell_b - \ell_a)(\ell_a + \ell_b) + \lambda\beta(\alpha - \frac{1}{3}) \quad (2.24)$$

If D_1 and D_2 intersect the p_b -axis, then $p_a^* = 0$, $n^* = n_b$ and

$$p_b^* = \tau(\ell_b - \ell_a)(2 - \ell_a - \ell_b) - \lambda\beta(\alpha - \frac{2}{3}) \quad (2.25)$$

Otherwise, $p_a^* = p_b^* = 0$, and $n^* \in \{\hat{n}, n_a, n_b\}$.

These equilibria are depicted in Figure 2.5. The intuition as to why both firms may earn zero revenues is that as conformity grows very large, product differentiation matters comparatively less, and we get an equilibrium resembling Bertrand competition. However, if prestige effects are sufficiently large, then one firm may takeover and earn positive revenues.

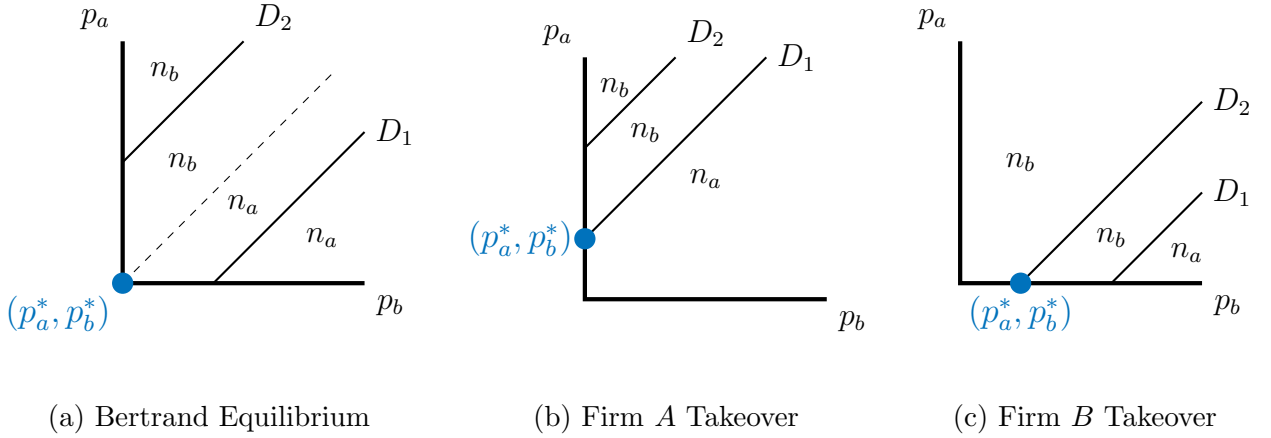


Figure 2.5: Price Equilibria in Strongly Conformist Market

2.6 Persuasive Advertising Equilibria

Turning to the main motivation of the paper, I incorporate firm location, advertising and entry choices, characterizing the equilibria of the full game. It will

be seen how these market variables are affected by snobbish and conformist demand, and whether such signaling motives can explain the empirical regularities outlined in the introduction.

Firm B chooses whether to enter, ℓ_b and how much to advertise λ_b given ℓ_a and λ_a , and firm A must choose ℓ_a and how much to advertise λ_a given the subsequent influence those choices will have on firm B . As a benchmark of comparison, it is useful to begin with the canonical case of a market without status motives $\beta = 0$.

Proposition 4 (Equilibrium of Standard Market). *If $\beta = 0$, then there exists a unique equilibrium in which firm B enters, firms locate at opposite ends $\ell_a^* \in \{0, 1\}$ and $\ell_b^* = 1 - \ell_a^*$, and do not advertise $\lambda_a^* = \lambda_b^* = 0$, thus charging equivalent prices $p_a^* = p_b^* = \tau$ and evenly splitting the market $n^* = \frac{1}{2}$.*

The intuition is as follows. Firm B enters because there are always positive profits to be had with zero production cost. Firms move as far apart as possible to avoid price competition, “the principal of maximal differentiation.” Zero advertising takes place because there are no status motives to capture.

A similar comparison could be drawn by studying a “full information version” of the model, as traditional in the signaling literature, where the public has complete knowledge of each consumer’s x and no informational asymmetries persist. If consumer identities are known, then consumers are unable to affect their perceived status through consumption, implying that their choices rely on weighing only their horizontal preferences and relative prices. In such a game, firms have no incentive to advertise, yielding the equilibrium described in Proposition 4 above. Such signaling

free setups do not explain the role of persuasive advertising, asymmetries in the prices and market shares of physically similar goods, and the barriers to entry often faced in heavily advertised markets.

2.6.1 Equilibria of Snobbish Market

If firm B enters and, without loss of generality, locates to the right of firm A ($\ell_a < \ell_b$), then firm profit functions at the location and advertising stage(s), incorporating the price equilibrium, are given by:

$$\pi_a(\ell_a, \lambda_a; \ell_b, \lambda_b) = \frac{(\frac{\tau}{3}(\ell_b - \ell_a)(2 + \ell_a + \ell_b) + \lambda\alpha\frac{\beta}{3})^2}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_a^2 \quad (2.26)$$

$$\pi_b(\ell_b, \lambda_b; \ell_a, \lambda_a) = \frac{(\frac{\tau}{3}(\ell_b - \ell_a)(4 - \ell_a - \ell_b) + \lambda(1 - \alpha)\frac{\beta}{3})^2}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_b^2 \quad (2.27)$$

If firm B locates to the left of firm A , then firm profit functions can be found by flipping the a and b terms in equations (2.26) - (2.27) above.⁴³ Note that the profits functions given in equations (2.26) - (2.27) are discontinuous at $\ell_a = \ell_b$ when $\alpha \neq \frac{1}{2}$. Even-though an equilibrium exists at the pricing stage, this discontinuity implies that establishing the existence of an equilibrium at the location and advertising stages is not trivial [Dasgupta and Maskin, 1986; Simon, 1987].⁴⁴

However, note that in any equilibrium, if it exists, firm B enters because there

⁴³If $\ell_b = \ell_a$ and $\alpha \geq \frac{1}{2}$, then firm A (firm B) earns profits given by equation (2.26) (by equation (2.27)); and if $\ell_b = \ell_a$ and $\alpha < \frac{1}{2}$, then firm A (firm B) earns profits given by equation (2.27) (by equation (2.26)). See end of section 2.4.

⁴⁴A large literature studies issues arising from the existence of equilibria at both the pricing and location stages of product differentiation models (see Shaked and Sutton [1987, pp.132-133] for a summary). Many describe the characteristics of an equilibrium, should it exist, without guaranteeing its existence [Lane, 1980; Neven, 1987; Prescott and Visscher, 1977; Shaked and Sutton, 1987].

are always positive profits to be had. For example, firm B can locate at any $\ell_b \neq \ell_a$ without advertising $\lambda_b = 0$ and earn positive profits. These profits may be higher than firm B could earn without status motives $\beta = 0$. Although only shown here for the case of two firms, this sheds some light on the abundance of brands often observed in snobbish markets.

In order to ensure existence, firm B 's profits should not be maximized near the discontinuity $\ell_b = \ell_a$. I find that if either $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, or $\alpha \in [0, \frac{1}{3}) \cup (\frac{2}{3}, 1]$ and β is not too large, then firm B 's profits are not maximized near the discontinuity, and there exists an equilibrium.

Proposition 5 (Existence of Equilibrium in Snobbish Market). *Suppose $\beta > 0$. If either $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, or $\alpha \in [0, \frac{1}{3}) \cup (\frac{2}{3}, 1]$ and β is not too large, then there exists an equilibrium of the game.*

The intuition for these conditions facilitating the existence of equilibrium is as follows. There are two forces at play in firm B 's location choice. The first is the traditional force, described in Proposition 4, of avoiding price competition by locating as far from firm A as possible. However, status motives introduce a second force. It comes from choosing a location that appeals to high types, giving one's product greater prestige, and the ability to extract a higher price. If $\alpha \notin [\frac{1}{3}, \frac{2}{3}]$ and β is very large, then firm B may not sufficiently fear price competition to be driven to an end. All else equal, it may extract such a high price that it prefers to drift towards ℓ_a to be closer to a greater quantity of consumers and improve its market share. When this second force comes to dominate, firm B may wish to locate as close

as possible to the discontinuity $\ell_b = \ell_a$, preventing the existence of an equilibrium.

In the cases where it exists, the next proposition characterizes equilibrium properties related to advertising, prices and market share in Proposition 6. Note that closed-form solutions of the equilibrium do not exist.

Proposition 6 (Equilibrium of Snobbish Market). *Suppose $\beta > 0$. If either $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, or $\alpha \in [0, \frac{1}{3}) \cup (\frac{2}{3}, 1]$ and β is not too large, then in equilibrium:*

- (1) *Firm B enters.*
- (2) *Total advertising is positive.*
- (3) *Firm B locates at an end.*
- (4) *The firm with the prestigious advantage charges a higher price and earns greater market share.*

Propositions 1 and 6 capture many of the stylized fact observed in snobbish markets: an abundance of brands; inflated prices; and the greater market share, price and advertising efforts of the more prestigious. (1), (3) and (4) are unsurprising given the prior analysis. Total advertising is positive because when there are zero advertisements, then at least one, and possibly both firms have positive marginal revenues from advertising, while the marginal cost is zero.

To give a fuller picture of the equilibria, I provide numerical solutions in Figure 2.6. The numerical solutions shed light on how changes in β and α affect market variables, as the envelope theorem cannot be applied to analytically derive these comparative statics due to potential non-differentiability in firms' best reply func-

tions. Figure 2.6 shows firm prices, market shares, advertising levels and profits for various α and β , assuming $c = \tau = 2$. In all the equilibria pictured, it is found that firm A locates at the end with the prestige advantage $\ell_a^* = 1$ and firm B locates at the other end $\ell_b^* = 0$. Figure 2.6 suggests that total advertising expenditures and firm prices increase in β . Except when firms have symmetric prestige $\alpha = \frac{1}{2}$, it is found that firm A invests more in advertising than firm B because it has greater marginal revenues from advertising. Furthermore, as β increases or α moves to an end, the dispersion in firm prices, market shares and profits widens as status motives carry greater weight.

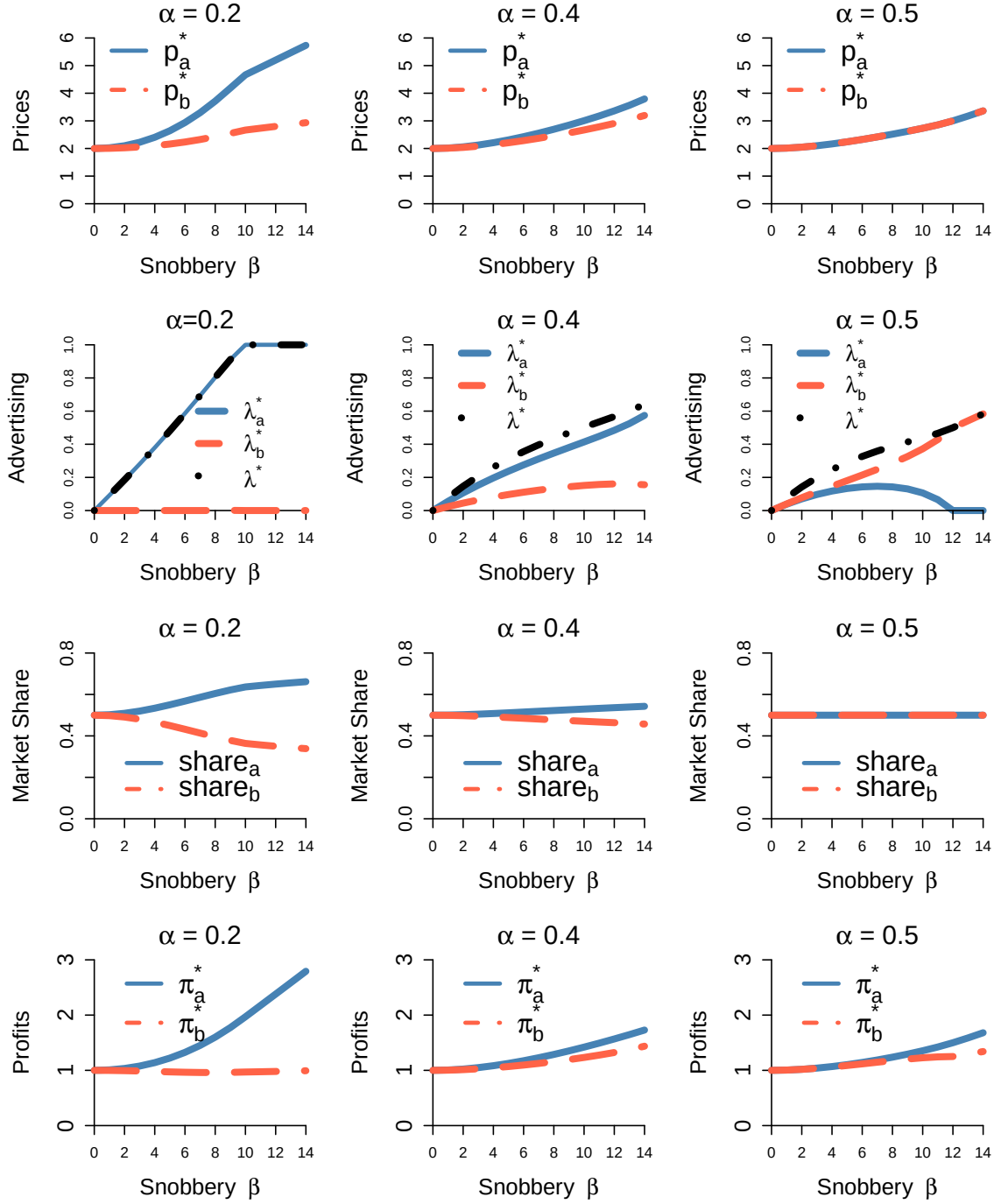


Figure 2.6: Numerical Solution in Snobbish Market

Snobbery β on the x -axis. In descending rows: prices, advertising, market shares and profits on the y -axis. In columns, from left to right: $\alpha = 0.2$, $\alpha = 0.4$ and $\alpha = 0.5$. In all equilibria depicted, $\ell_a^* = 1$ and $\ell_b^* = 0$. Assumes $c = \tau = 2$.

Calculated using Matlab.

2.6.2 Equilibria of Conformist Market

Turning to the conformist case, let's see if the model can shed light on the barriers to entry often created in such markets by well advertised and branded firms. As before, I first establish the existence of an equilibrium.

Proposition 7 (Existence of Equilibrium in Conformist Market). *If $\beta < 0$, then there exists an equilibrium of the game.*

Firm A can pursue one of two classes of strategies: accommodate firm B 's entry, or deter firm B 's entry. Firm A can deter firm B 's entry by choosing a prestigious enough position, and advertising heavily enough that firm B could not earn positive profits from entering. I consider equilibria where firm B does not enter if it cannot earn positive profits from entry.

In order for an entry deterrence strategy to exist, β needs to be sufficiently negative, creating adequate consumer conformity for firm A to capture. If β is sufficiently negative, then there exists a compact set of strategies $\Delta \subset [0, 1]^2$ such that if $(\ell_a, \lambda_a) \in \Delta$, then firm B cannot earn positive profits from entry. Additionally, in order for deterring entry to be profitable, the cost of advertising must be sufficiently small. If these two criteria are met, then firm A chooses $(\ell_a, \lambda_a) \in \Delta$, deterring firm B 's entry and seizing monopoly rents.

If firm A chooses to accommodate firm B 's entry, then firms locate at opposite ends. Firm A can take the more prestigious end. Firm A only advertises if the positive market share effect of advertising significantly outweighs the negative price effect. This may occur if $\alpha \notin [\frac{1}{3}, \frac{2}{3}]$, but does not occur if $\alpha \in [\frac{1}{3}, \frac{2}{3}]$. Firm B

never advertises because, as the firm with the less prestigious position, it can only lose market share and price from advertising. Proposition 8 fully characterizes the equilibria.

Proposition 8 (Equilibrium of Conformist Market). *Suppose $\beta < 0$. If β is sufficiently low and c is sufficiently small, then firm A chooses some location and positive level of advertising such that it deters firm B 's entry and allows firm A to capture monopoly profits. Otherwise, firms locate at opposite ends $\ell_a^* \in \{0, 1\}$ and $\ell_b^* = 1 - \ell_a^*$, firm B does not advertise $\lambda_b^* = 0$, and firm A does not advertise $\lambda_a^* = 0$ if $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, and might advertise otherwise $\lambda_a^* \geq 0$ if $\alpha \notin [\frac{1}{3}, \frac{2}{3}]$.*

Interestingly, it may be the case that firm B 's entry would make firm A 's entry deterring strategy sub optimal. In other words, it may be the case that if firm B happened to enter when firm A chose $(\ell_a, \lambda_a) \in \Delta$, then firm A 's strategy would no longer be optimal. However, firm A rationally anticipates that firm B would not enter, thus allowing firm A to gain monopoly power.⁴⁵ The intuition resembles that of the chain store paradox [Selten, 1978]. In the language of the chain store paradox, firm A 's location and advertising choice can serve as a commitment to fight by generating harsh conditions of price competition upon firm B 's entry.

Another striking aspect of this result is the strength of first mover advantage implied to firm A . For example, there does not exist an equilibrium in which firm B takes over. In order for firm B to take over, firm A would have to act non-rationally or there would have to be an unanticipated shock to the social status function. In

⁴⁵It is shown in the proof of Proposition 8 that for certain parameters it is can also be the case that firm A would choose $(\ell_a, \lambda_a) \in \Delta$ regardless of whether firm B entered.

other words, firms would have to be out of equilibrium. The strength of the first mover advantage in the game captures the strength of the first mover advantage observed in conformist markets. Unlike many other models of entry deterrence, this result does not require assumptions about a specific production or cost function implying economies of scale. Indeed, the model assumed zero cost to production. If the model incorporated a fixed cost of production, then firm B 's entry would be even less likely.

2.7 Welfare

With the above equilibria in mind, let's explore the implications for the old question of the welfare consequences of persuasive advertising. As mentioned, since this model has a fixed preference, it easily lends to welfare analysis.

Without loss of generality, suppose both firms enter the market and $\ell_a^* < \ell_b^*$. The equilibrium levels of consumer surplus ("CS"), producer surplus ("PS") and total surplus ("TS" $\equiv$ CS + PS) are given below. Consumer surplus is equivalent to consumers' valuation of the good, minus their money spent and transportation costs incurred, plus their aggregated reputational utility from signaling. Producer surplus is equal to firms' profits. Furthermore, total surplus is equal to producer surplus plus consumer surplus, where money spent by consumers cancels with firm revenues, representing a transfer of welfare from consumers to firms.

$$\begin{aligned}
CS^* &= \underbrace{v}_{\text{good value}} - \underbrace{\tau \left(\int_0^{n^*} (x - \ell_a^*)^2 dx + \int_{n^*}^1 (x - \ell_b^*)^2 dx \right)}_{\text{transport costs}} - \underbrace{(n^* p_a^* + (1 - n^*) p_b^*)}_{\text{expenditures}} + \underbrace{E(s(x))}_{\text{reputational surplus}} \\
PS^* &= \underbrace{n^* p_a^* + (1 - n^*) p_b^*}_{\text{revenues}} - \underbrace{\left(\frac{c}{2} \lambda_a^{*2} + \frac{c}{2} \lambda_b^{*2} \right)}_{\text{advertising cost}} \\
TS^* &= \underbrace{v}_{\text{good value}} - \underbrace{\tau \left(\int_0^{n^*} (x - \ell_a^*)^2 dx + \int_{n^*}^1 (x - \ell_b^*)^2 dx \right)}_{\text{transport costs}} - \underbrace{\left(\frac{c}{2} \lambda_a^{*2} + \frac{c}{2} \lambda_b^{*2} \right)}_{\text{advertising cost}} + \underbrace{E(s(x))}_{\text{reputational surplus}}
\end{aligned}$$

The consumer reputational surplus is calculated as follows.

$$\begin{aligned}
& n^* \frac{\lambda}{n^*} \int_0^{n^*} s(x) dx + (1 - n^*) \frac{\lambda^*}{1 - n^*} \int_{n^*}^1 s(x) dx + (1 - \lambda^*) \int_0^1 s(x) dx \\
&= \int_0^1 s(x) dx \\
&= E(s(x))
\end{aligned}$$

The first term in the calculation of consumer's reputational surplus is the mass of consumers who purchase good a (n^*) multiplied by both the fraction of such consumers whose partner receives an advertisement (λ^*), and the status inference of their partners ($\frac{1}{n^*} \int_0^{n^*} s(x) dx$). The second term is the same calculation for consumers purchasing good b . The last term is the fraction of the public that does not receive an advertisement ($1 - \lambda^*$), multiplied by their inference of a random consumer's status ($\int_0^1 s(x) dx$). The main thing to notice is that advertising λ^* does not affect consumer surplus from signaling. This is a consequence of the law of iterated expectations, and generalizes to any social status function, firm locations, advertising, prices, or entry decisions.

As mentioned in Section 2.1, since status signaling is a zero-sum game, advertising can affect which consumer gets what portion of that reputational utility pie, but cannot affect the overall size of the pie [Frank, 2005; Heffetz and Frank, 2011]. In other words, if one consumer’s perceived status goes up by a certain amount, then other consumer’s perceived status must go down by a proportional amount, as the average perceived status must be held constant. On aggregate, any reputational gains and losses cancel out, and advertising has zero effect on the aggregate consumer surplus from signaling.

Furthermore, since advertising is costly to producers, it negatively affects producer and total surplus. Thus, persuasive advertising is found to be wasteful, and the social planner would select zero persuasive advertising. However, this result should be judged in context, as it could be perturbed in several ways: for example, by adopting a non-expected reputational utility framework; or modeling the utility of the public, and allowing for the public’s utility to depend in some way on their inference of the consumer’s type.⁴⁶

However, perhaps more interestingly, advertising indirectly affects consumer surplus through other channels. In the cases where advertising increases prices, it leads to a transfer of welfare from consumers to firms. Furthermore, advertising can raise the transportation costs consumers incur in a couple ways. First, advertising creates signaling motives that lead some consumers to purchase products they otherwise would not. In other words, it induces consumers to not fully respect their

⁴⁶The latter may be a more natural analysis if we modeled the public as taking an action, such in a mating or an employee-employer matching game, where there could be higher returns to the public from certain allocations of matches.

horizontal preferences in favor of status motives. The argument that advertising raises welfare by building brand prestige [Becker and Murphy, 1993; Nichols, 1985] fails to consider that advertising also increases the reputational cost from an alternative brand, or not purchasing. Some consumers may ex-ante prefer zero advertising, even if it causes switch to their choices. Second, advertising can limit entry in the conformist case, thus increasing consumers' transportation costs through this mechanism as well.

This helps bring micro foundation to the old and debated sentiment that persuasive advertising can have harmful consequences for consumers and society, by improving our understanding of the channels through which this may take place [Dixit and Norman, 1978]. Indeed, while the welfare consequences from the price effects of advertising have been heavily discussed, the welfare consequences from advertising inducing consumers to not fully respect their horizontal preferences and increasing their transportation costs are less often discussed, if at all [Bagwell, 2007]. It should be clarified that this paper does not try to address the welfare consequences from other forms of advertising, such as informative advertising.

2.8 Conclusion

This paper provides a micro-foundation for persuasive advertising, using an approach inspired by the literature on Veblen effects. The fundamental premise is that consumers buy products to signal a reputable social identity, and that advertising makes this signaling possible by establishing connections in the minds of

spectators between products and status claims. This signaling is dominated by one of two consumer motives — conformism or the desire to fit in and snobbism or the desire to stand out. This framework brings a new perspective to spatial models of firm competition.

In snobbish markets, it shows, persuasive advertising reduces the elasticity of demand, generating inflated prices and profits, and facilitating the entry of new firms. In this setting, advertising can be mutually beneficial to firms. These results help make sense of the abundance of designer products and supranormal prices observed in such markets. They also help to explain how, even when goods are almost indistinguishable, more prestigious firms are able to use advertising to command a greater price and market share — causing price dispersion. They explain, in short, certain puzzling failures of the law of one price.

In conformist markets, by contrast, advertising turns out to be highly combative because it heightens, rather than lessens, price competition. Here, a first mover may use advertising to deter the entry of new firms and gain monopoly power. This entry deterrence holds even when production costs are zero and entry is free. In contrast to previous models of advertising's entry deterrence, my model explains how demand is influenced to the benefit of the first mover. This helps to explain the near-religious brand loyalty that consumers often form to the first mover in their region, as well as the high market concentrations found in conformist settings.

These results suggest that empirical advertising research may benefit by focusing on the conspicuousness of the goods marketed and by carefully distinguishing between snobbish and conformist settings. Future research may empirically test

these predictions about advertising's differential effects in the two kinds of markets. Furthermore, from a theoretical perspective, the underlying approach of superimposing a social signaling game on a spatial model can be applied to other questions. The framework may be adopted to study the effects of other types of consumer motives beyond snobbery or conformity on firm competition. It may also be extended beyond economic to electoral activity on the hypothesis that in voting, no less than in purchasing, individuals make their selection not only to achieve desired policies, but also to signal their political values to others.

Chapter 3: Your Success is My Motivation (with Emel Filiz-Ozbay)

3.1 Introduction

In many economically relevant decisions, agents decide how much risk to take while observing other people facing similar decisions rather than acting in isolation. In the process of weighing the costs and benefits of risk taking and figuring out her best action, a decision maker may compare their earlier performance with respect to the performance of their peers. For example, a worker may be motivated to work harder when she sees a coworker succeed in his project. Our laboratory experiments investigate how feedback about an agent's self-performance and relative performance with respect to a partner impacts their investment in a risky task. Our design isolates these effects from other externalities between agents arising directly from the production technology or compensation scheme.

We find that subjects who failed in a task are more likely to increase their effort in the next task. However, we find that the magnitude by which they increase their effort increases if they observe a partner who succeeded in the previous task. This suggests that being behind a peer motivates subjects to exert higher levels of effort.

Our environment imitates the decision problem of an agent in a standard moral

hazard situation. An agent exerts costly effort in order to increase her chance of a good outcome (success on a task). Her payment scheme is contingent on a good outcome, as typically the case in a moral hazard setting: for example, a salesman’s pay is proportional to his sales, a student’s grade is based on her exam score, a farmer’s earnings is based on the farmer’s harvest, and an assistant professor’s tenure depends on her publications. The degree of proximity among workers may naturally allow them to compare their outcomes with each other — a salesmen observe others’ sales, students often catch wind of each other’s grades, a farmer notices a neighboring farm’s harvest, and assistant professors pay attention to the publications of their peers.¹ Indeed, employers may actively provide relative performance information even when they do not tie the payments of employees to each other’s performances [Anderson et al., 1983]. We aim to understand how such feedback about an agent’s relative performance affects her effort. This question is applicable both to labor settings where co-workers might be motivated or demotivated from observing each other’s outcomes, and to more general problems of performance feedback in risk-taking environments beyond those of moral hazard. For example, investment in lottery tickets might be affected by observing a peer win the jackpot.

In order to measure the peer effect, our main treatment (Partner Treatment) assigns each subject a partner and requires her to choose an effort level; while in our control treatment (Individual Treatment) subjects perform their tasks in isolation. In both treatments, subjects know that they will learn their own outcome (success or

¹For example, observability of the performance of co-workers is present in Falk and Ichino [2006] and Mas and Moretti [2009].

failure) after their tasks. In the Partner Treatment, they are informed that they will learn their partner's outcome as well. Someone who is behindness averse or status seeking may exert higher effort when she knows that she will receive feedback about her partner's performance. However, even if subjects have such a behavioral motive, they may not anticipate it. We also ask whether subjects anticipate their inequity concerns, or if these behavioral motives only affect effort after having experienced inequity in the past. To study this question, we implement a two-period design where subjects repeat the task twice. This allows us (i) to compare the behavior in the first period of the Partner and Individual Treatments to study the anticipation of peer effects and (ii) to study whether experiencing inequity with respect to a partner in the earlier task affects effort the next time around. Subjects are randomly assigned a different partner in each period so that there is no room for reputation building.

Standard economic theory rules out the co-dependence of agent objectives as long as their tasks are independently performed and paid. On the other hand, observing a peer's outcome in a previous task may generate a reference point in an agent's objective. Someone who failed while her partner succeeded may feel behind. Such an emotion may motivate her to get ahead by exerting higher effort. Alternatively, someone who succeeded while her partner failed may feel guilty over this unequal outcome and exert lower effort to avoid such outcomes. Several papers in the last decade incorporate social preferences such as inequality aversion [[Bolton and Ockenfels, 2000](#); [Fehr and Schmidt, 1999](#)] in a moral hazard problem and formally analyze their influence on optimal incentive contract to extract greatest effort [[Bartling, 2011](#); [Bartling and Von Siemens, 2010](#); [Demougin et al., 2006](#); [Englmaier](#)

and Wambach, 2010; Itoh, 2004; Neilson and Stowe, 2010]. Our hypotheses are built on the predictions of a model of an inequity averse agent.² Our experiments aim to answer the following questions: (i) Does the anticipation of feedback about a peer’s outcome motivate an agent to invest more? (ii) Does an agent revise her effort based on feedback about her prior performance? (iii) Does an agent revise her effort based on feedback about her prior relative performance with respect to a partner?

Since we only pay for one period determined randomly ex-post, an expected utility maximizer with selfish motives should view the two periods independently and choose the same effort level in each period, with or without partner. However, even in the Individual Treatment, our subjects revise their efforts based on their own prior outcomes. Subjects who failed increase their effort and subjects who succeeded decrease their effort. Hence, this rules out standard expected utility maximization and suggests some adaptive learning may take place. Furthermore, we find that this effect is more pronounced for female subjects than male subjects. This result contributes to the question in the reinforcement effects literature about whether risk preferences in future lotteries are influenced by the instance of success or failure in past lotteries [Andrade and Iyer, 2009; Dillenberger and Rozen, 2015; Imas, 2016; Langer and Weber, 2008; Liu et al., 2010; Nielsen, 2019; Smith et al., 2009; Thaler and Johnson, 1990; Tserenjigmid, 2019].³

²Since we are only interested in the behavior of agents, we omit the principal’s problem of constructing an optimal incentive scheme. However, our results allow us to understand the motivations of agents better and can lead to richer models characterizing the optimal contract choice in moral hazard problems.

³This literature studies environments where both the outcomes in past and future lotteries hold an impact on the agent’s final payoff, thus allowing for an income effect between periods. In our environment, income effects are minimized as only one period’s pay is realized, allowing us to isolate the effect of feedback. We find that feedback about failure in past lotteries decreases an

Additionally, we find that subjects do not anticipate peer effects as the distribution of effort is similar in the first periods of the Individual and Partner Treatments. However, feedback about an agent’s self and relative performances affects behavior in the second period of decision making. Subjects revise their effort choices differently based on their relative performance with respect to a partner. The subjects who failed while their partners’ succeeded increase their second period effort more than those who failed while their partner also failed. Furthermore, this behavior is more pronounced for female subjects than male subjects.⁴ This is in line with evidence that women typically react more strongly to feedback than men [Berlin and Dargnies, 2016].⁵ Our results suggest that matching employees who are likely to have unequal outcomes may motivate those who are behind to exert higher effort without discouraging those who are ahead.

Many laboratory experiments [Charness et al., 2013b; Dohmen and Falk, 2011; Dohmen et al., 2011; Falk and Ichino, 2006; Kuhnen and Tymula, 2012] and other empirical studies [Bandiera et al., 2010; Breza et al., 2018; Cohn et al., 2014; Guryan et al., 2009; Mas and Moretti, 2009] investigate the effect of performance comparisons between individuals on effort in settings without uncertainty and risk. However, there is little evidence of the role of social comparisons on effort in labor settings where risk plays a central feature.⁶ Risk is present in many real-world applications

agent’s risk taking in future lotteries.

⁴Our results contribute to a growing experimental literature on gender differences in preferences relevant to labor market environments, such as preferences for risk, social comparison, cooperation, competition and self-promotion (see Croson and Gneezy [2009] for a summary).

⁵Xia [2018] documents that women attribute negative feedback to ability while men attribute it to luck. That is in line with the higher increase in effort by women who failed than men who failed in our experiments.

⁶Instead, the literature on risk and social comparisons tends to focus on distinguishing ex-post

and a necessary feature of a moral hazard problem. Furthermore, incorporating uncertainty allows us to directly address the aforementioned theoretical literature.

There is a body of literature investigating peer effects in risk taking behavior over lottery choices. Those studies typically ask subjects to choose between simple lotteries and analyze the influence of peers on risk attitudes (see, for example, [Linde and Sonnemans \[2012\]](#), [Linde and Sonnemans \[2015\]](#), [Rohde and Rohde \[2011\]](#) and [Schwerter \[2019\]](#)). Our effort choice problems can be viewed as lottery choice selections, as true of any moral hazard problem with a known distribution of probabilities over effort. In the studies mentioned, subjects compare net payoffs.⁷ Our research builds on this literature by adding a labor context to the decision problem. In a labor context, it becomes relevant to disentangle the influence of the outcomes of peers and their effort. We study peer effects over outcomes rather than actions, and gross payoffs rather than net payoffs. [Cooper and Rege \[2011\]](#) and [Lahno and Serra-Garcia \[2015\]](#) also give subjects feedback on peers' choices, studying whether subjects imitate their peers' actions. Certainly, there are applications relevant for both types of references. It is an open question as to how social comparisons about the realization of uncertainty affect risk taking when peers' actions are unknown.⁸

Peer effects and other forms of competition have been studied in labor eco-

and ex-ante fairness concerns (for example, see [Brock et al. \[2013\]](#) and [Saito \[2013\]](#)).

⁷Furthermore, the references generated by the peer in [Linde and Sonnemans \[2012\]](#), [Rohde and Rohde \[2011\]](#) and [Schwerter \[2019\]](#) are exogenous and known before the lottery choice, while the reference in our setting is determined endogenously.

⁸The reaction to realizations of uncertainty is also studied in tournament like settings [[Gächter et al., 2018](#); [Gill and Prowse, 2012, 2014](#)], or settings without peer effects (as in the reinforcement effects literature). While peer effects are documented to be positive in risky tournaments, the reaction to earlier realizations of uncertainty in single person decisions are mixed — some papers have found risk taking behavior to increase after a loss [[Andrade and Iyer, 2009](#); [Clark, 2010](#); [Langer and Weber, 2008](#); [Schneider et al., 2016](#); [Smith et al., 2009](#); [Verbruggen et al., 2017](#)] and others have found risk reduction [[Liu et al., 2010](#); [Nielsen, 2019](#); [Shiv et al., 2006](#)].

nomics. The tournament literature has documented evidence that rank based payments provide strong incentives for agents to exert greater effort [Bull et al., 1987; Hannan et al., 2008; Lazear and Rosen, 1981].⁹ We differ from this literature as we shut down competition for a monetary prize and pay subjects independently.

The remainder of the paper is organized as follows. Section 3.2 describes the decision problem and states the predictions of the standard theory and a behavioral model of inequity aversion for this setup. Section 3.3 states the Hypotheses based on the theoretical models. Sections 3.4 and 3.5 present the experimental design and results, respectively. Section 3.6 discusses our findings while Section 3.7 concludes. The instructions of the experiments are provided in Appendix B.3.

3.2 A Problem of Costly Effort in a Risky Task

In this section, we outline a model of an inequity averse agent in a moral hazard problem, forming the basis of our hypotheses in the next section. An agent chooses a costly effort level in an individual task, $e \geq 0$, where the unit cost of effort is $c > 0$. The task has two possible outcomes: *success* and *failure*. The outcome is a random variable and for a given effort level, e , the probability of success is denoted by $p(e) \in [0, 1]$. Assume that $p(\cdot)$ is differentiable, increasing and concave in e and $p(0) = 0$. When the effort choice of the agent is unobservable to the principal and

⁹Feedback on relative performance may have detrimental effects to the firm. For example, it may encourage people to cheat [List et al., 2001], or to sabotage other’s outcomes even when there are no material benefits of high rank [Charness et al., 2013b]. This might arise from a desire for status [Charness and Grosskopf, 2001], self-image concerns [Bénabou and Tirole, 2006a], or a joy of outperforming others [Dohmen et al., 2011]. Our setup does not provide subjects any opportunities for sabotage or cheating.

there are only two possible outcomes, it is well-known that the optimal payment structure to incentivize a risk averse agent to exert a positive effort level specifies a fixed payment and a bonus contingent on success (assuming that success is more desirable outcome for the principal).¹⁰

Let (f, b) denote the fixed payment and bonus features of the payment scheme. An agent with utility function $u(\cdot)$ — which is strictly increasing, concave and differentiable — will choose her effort level by solving:

$$\max_e p(e) u(f - ce + b) + (1 - p(e)) u(f - ce) \quad (3.1)$$

We enrich the standard model by allowing the agent to experience disutility or utility from inequity with respect to a partner. Suppose two agents simultaneously choose their effort levels (e_1, e_2) . Agents can observe their partners' outcomes but not effort. Agents care not only about their own outcomes but also how it compares with their partners'. Since the compensation scheme is identical for the two agents, knowing the partner's outcome is equivalent to knowing how the partner's gross compensation. Let w_i denote the gross compensation of agent i . Hence, w_i is f when agent i 's project fails and $(f + b)$ when it succeeds. For agent i who takes agent j 's earnings as a reference, her optimization problem described in (3.1) becomes:

$$\max_{e_i} p(e_i) u(f - ce_i + b) + (1 - p(e_i)) u(f - ce_i) - E[v(w_j - w_i)] \quad (3.2)$$

¹⁰See for example, [Bolton and Dewatripont \[2005, pp. 130-136\]](#)

where the first bracket is the expected utility of agent i from her net monetary payoffs (as in (3.1)), and the second term is her expected disutility from the inequality in gross wages. Neilson and Stowe [2010] models v as follows:

$$v(x) = \begin{cases} v(x) & \text{if } x \geq 0 \\ \lambda v(-x) & \text{if } x < 0 \end{cases}$$

where v is differentiable, weakly positive, strictly increasing and convex such that $v(0) = 0$, and λ is a constant. Note that, in this representation, agent i dislikes it when her partner's gross wage is higher than hers.¹¹ We call this *behindness* aversion. When agent i 's gross wage is higher than her partner's, then the sign of the disutility term in problem 3.2 depends on the sign of λ . A positive λ implies that agent i dislikes being ahead, and a negative λ implies that agent i enjoys being ahead — perhaps out of a preference for *competition* [MacCrimmon and Messick, 1976] or *status* [Frank, 1985]. Fehr and Schmidt [1999] support behindness aversion by assuming $|\lambda| < 1$.

In our experiments, we create the benchmark described by model (3.1) by having individuals complete their tasks in isolation. We also have experiments where subjects receive feedback about the performance of a partner to test the predictions of model (3.2).

Given the two-outcome set-up and payment scheme (f, b) , problem (3.2) be-

¹¹Note that one may alternatively construct a model where net rather than gross earnings are compared. We study the case of gross earnings comparisons to be close to the literature. Moreover, the unobservability of a partner's effort in our experiment makes relative net earnings comparisons difficult. We leave it as an open question for future research to investigate the effect of feedback about net earnings on effort.

comes:

$$\begin{aligned}
\max_{e_i} [p(e_i) u(f - ce_i + b) + (1 - p(e_i)) u(f - ce_i)] - [p(e_j) (1 - p(e_i))] v(b) \\
- [p(e_i) (1 - p(e_j))] \lambda v(b)
\end{aligned} \tag{3.3}$$

where the second term is the expected disutility in the event that agent j succeeds and agent i fails; and the third term is the expected disutility in the event that agent i succeeds and agent j fails. These last two terms are absent in problem (3.1).

Let e_i^{Ind} and $e_i^{Partner}$ be solutions to problems (3.1) and (3.2), respectively.

If $\lambda \leq 0$ and the agent is competitive or status-seeking, then in the symmetric equilibrium of problem (3.2), $e_i^{Partner} > e_i^{Ind}$.¹² If $\lambda > 0$ and the agent dislikes being ahead, then the model still predicts higher effort from having a partner as long as λ is sufficiently small, as may be implied by behindness aversion.¹³ When $\lambda > 0$ and large, then the disutility of being ahead dominates and leads to lower effort from having a partner to avoid such guilt.

Note that the two versions of the problem above assume a one-shot environment and require that people with behavioral concerns anticipate the possible disutility from inequity when choosing effort. One may argue that this is a strong assumption. Even if people compare their outcomes with their partners' outcomes ex-post, they may be incapable of anticipating such feelings before taking an action.

¹²See Appendix B.1 for proof.

¹³If $\lambda < \frac{p(e^{Partner})}{1-p(e^{Partner})}$, then $e^{Partner} > e^{Ind}$. Fehr and Schmidt [1999] argues $|\lambda| < 1$ and in our data, the average probability of success in the partner treatment given the average effort (9.5) is roughly 0.39 which makes $\frac{p(e^{Partner})}{1-p(e^{Partner})} = 0.63$.

If this is true, then people will solve problem (3.1) in a one-shot decision regardless of whether they expect to receive feedback about their partner’s outcome. The experienced inequity may lead to some form of adaptive learning and revision of strategies to avoid the previous outcome.

Our experiment requires subjects to choose their effort twice in a two-period problem. Hence, we can analyze whether agents can anticipate the disutility from inequity, or whether they need to experience such a situation to revise their effort choices in the second period.

One needs to be careful about possible income effects in a two-period setup. An agent with selfish utility would solve a different problem in the second period after earning a high payoff in the first period than earning a low payoff. In order to minimize such an income effect in the experiment, we pay subjects for one randomly selected period. The period which they are paid for is determined randomly ex-post (with equal probability). In such an environment, an expected utility maximizer whose utility depends only on own-payment and is free from reference dependence would choose the same effort level in both periods, independent of her success or failure in the first period (see Appendix B.1 for proof). The assumption of random payment might be violated in some applications. However, we implement such a payment structure in order to focus on the role of performance feedback.

3.3 Hypotheses

Our main question is how observing a peer’s success or failure affects effort in a risky task that is completed and rewarded independently?

As mentioned, a sophisticated agent with behavioral motives may anticipate the potential disutility from unequal outcomes, knowing that she will receive feedback about her partner’s performance (as modeled in problem (3.2)). This might influence her effort. Hypothesis 1 summarizes this idea.

Hypothesis 1: *Agents choose different period 1 effort in the risky task when they anticipate feedback about a partner’s performance as compared to when they do not receive (or anticipate) such feedback.*

As shown in the behavioral model, depending on the relative strength of possible emotions, agents may exert higher or lower effort when they expect feedback about a partner’s outcome as compared to working in isolation. Based on the previous literature, we expect the disutility from being behind to be stronger than the disutility from being ahead (or there to be a status seeking motivation at play). Hence, if subjects are indeed sophisticated in anticipating the disutility from social comparisons, then we conjecture they exert higher effort with a partner than without.

Hypothesis 1 is about first period behavior and builds on the assumption that agents can anticipate a disutility from social comparison. However, those who do

not anticipate such concerns may start thinking about social comparisons once they experience inequity, and then incorporate such behavioral concerns into their objective functions. Hence, they may start with a reference-free utility and incorporate the feedback as a reference into their utilities later. Testing such adaptation of the utility function requires examining the dynamics of effort revision with feedback.

Note that an expected utility maximizer working in isolation should pick the same effort in each period, independent of the feedback received in the first period. Hypothesis 2 below states this implication of the standard theory.

Hypothesis 2: *Agents conducting their tasks in isolation choose the same effort in periods 1 and 2.*

One may be skeptical of Hypothesis 2 if one believes that agents are unsure about their optimal effort ¹⁴ or do not fully understand the production function of their effort ¹⁵. Such agents may revise their choice in the second period, even when working in isolation.

When paired with a partner, an agent who fails to anticipate behavioral con-

¹⁴Impulsive reactions and reinforcement learning strategies have been studied in the learning literature. The idea is that after some experience, people think about what might have been a better decision last time, and then adjust their behavior in that direction [Avrahami and Kareev, 2011; Hart et al., 2016; Kareev et al., 2014; Selten and Buchta, 1998; Selten and Stoecker, 1986]. Subjects may also revise their effort choice in the second period due to adaptive learning. However, unlike a typical adaptive learning environment, we have a single person decision problem with objective probabilities.

¹⁵Bandiera et al. [2015] shows that feedback on past performance affects students' future performances. They argue that students have imperfect information on how their effort translates into test scores and that the provision of feedback might be a cost-effective means to increase students' exam performance. Note that in our setup subjects know the objective probability of success for each effort level.

cerns will use the objective function described in problem (3.1) in the first period and continue to do so in the second period as long as she receives the same outcome as her partner. However, once she experiences an unequal realization, she may start using the behavioral model described by problem (3.2). Our next hypothesis addresses the dynamics of reference dependent behavior in our set-up.

Hypothesis 3: *Agents who receive unequal outcomes from their partners in period 1 revise their effort differently than agents who receive the same outcomes as their partners.*

Hypotheses 1 and 3 are independent. If Hypothesis 1 is supported, and subjects anticipate social comparisons in their effort choice the first time they make the decision, they may choose the same effort the second time they make the decision. Hence, we may reject Hypothesis 3. It is also possible to support both Hypotheses because even if subjects anticipate social comparisons, the dynamic decision problem may be different than the static one as discussed in Hypothesis 2. On the other hand, if we reject Hypothesis 1, and conclude that agents cannot anticipate the disutility from social comparison, we may still (i) find support for Hypothesis 3 because once they experience a differential outcome, they may start taking into account behavioral concerns, or (ii) reject Hypothesis 3 if there are no behavioral concerns at play.

Activation of nonzero v function or nonzero parameter λ in the behavioral model may also capture heterogeneity in the population. Motivated by the literature

on gender differences in risk attitudes and inequality aversion, we will analyze the data not only at the aggregate level but also by gender. As we will see, some of our findings can shed light on observed gender differences in labor settings and other applications involving the influence of feedback.

3.4 Experimental Procedures

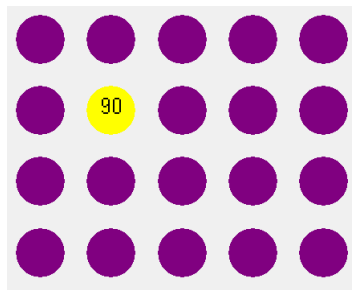
The experiments were run at the Experimental Economics Lab at the University of Maryland (EEL-UMD). All participants were undergraduate students at the University of Maryland. The data was collected in 25 sessions and there were two parts in each session. No subject participated in more than one session. Sessions lasted less than an hour. The subjects answered two identical effort choice problems in Part 1, and their risk attitude and fairness concerns were elicited in an incentivized way in Part 2. In each session, subjects were asked to sign a consent form first and given written experimental instructions (provided in Appendix B.3), read to them by the experimenter. The instructions for Part 2 were given after Part 1 of the experiment was completed. Before the experiment started, subjects answered a hand-written quiz testing their understanding of the decision problem. The experimenter walked around the room and checked each subject's answers, and the experiment did not start until everyone answered the quiz correctly.

The experiment was programmed in z-Tree [Fischbacher, 2007]. The screen shots for the decision and feedback screens can be found in the instructions provided in Appendix C. All earnings in the experiment were denominated in Experimental

Currency Units (ECUs). The final earnings of a subject were the sum of her payoffs in one randomly selected decision problems (out of two) in Part 1, one randomly selected decision problem (out of two) in Part 2, and the participation fee of \$7. The payoffs in the experiment were converted to US dollars at the conversion rate of 15 ECUs = 1 USD. Cash payments were made at the conclusion of the experiment in private. The average payment was \$ 13.29 (including a \$7 participation fee).¹⁶

The decision problem in the first part of the experiment was described to the subjects as a project. A project is represented by a box with 20 balls in it as in Figure 3.1. One of the balls is yellow and the others are purple. The project succeeds if the yellow ball is drawn from the box in any of the subject's tries. A subject decides how many times she wants to try drawing the yellow ball with *replacement*. Each try costs 3 ECUs. In order to afford these tries, each subject is given a 60 ECUs endowment. Subjects can choose any number of tries from $\{0, 1, 2, \dots, 20\}$.¹⁷

Figure 3.1: Projects



Project is successful if at least one yellow ball is drawn from box with replacement.

¹⁶Including the participation fee, participants could earn a minimum of \$ 7.13 and a maximum of \$ 21.47 during the experiment. In practice, one unlucky participant earned \$7.13 and the highest payment earned was \$20.67.

¹⁷There are many ways to create a moral hazard problem or risky investment problem in the laboratory. Our objective was to keep the environment easy to understand and close to the (standard and behavioral) theoretical model. We chose to have a two outcome, multi-effort decision problem as such a rich action space allows large variation in the data for a given outcome and increases our statistical power.

After choosing a total number of tries, the computer randomly draws one ball with replacement for each try. The computer continues drawing balls until all the tries are exhausted, regardless of the color of the ball drawn on the previous try. Each try is an independent draw where the chance of drawing a yellow ball is $\frac{1}{20}$. If the yellow ball is drawn in at least one try, the project succeeds and the subject receives 90 ECUs prize.¹⁸ If a purple ball is drawn in all tries, then the project fails and the subject receives zero prize. Hence, if we interpret the chosen number of tries as the subject's choice of costly effort, $e \in \{0, 1, 2, \dots, 20\}$, then the probability of success is $p(e) = 1 - \left(\frac{19}{20}\right)^e$ where $\frac{19}{20}$ is the probability of drawing a purple ball in a single draw. Note that this particular function $p(\cdot)$ satisfies the assumptions made of the theoretical model.¹⁹ While not presented this way, one may also interpret an effort choice of e as opting for the following lottery where the probability of high outcome increases with e and the prizes decreases with it.²⁰ In this light, our findings can be generalized to other risk taking or investment problems with uncertainty where decision makers have reference dependent utilities.

In order to help subjects calculate the probability of success for each effort level, we present a table of probabilities in the printed instructions as well as the decision screens.

¹⁸A subject can only receive the 90 ECUs once, even if the subject draws the yellow ball in more than one try.

¹⁹Implementing a stylized effort provision setup allows us to know and control both the cost of effort and the probability of success function. Furthermore, [Dutcher et al. \[2015\]](#) find identical results when comparing an experiment with stylized effort and real effort provision.

²⁰In theory, there should not be any difference between these alternative presentation methods, but we hope that explaining the procedure generating the probability of success and how it relates with their effort choice will improve the subjects' understanding of the decision problems. Our pilot experiments as well as the experiment of [Sjöström et al. \[2019\]](#) show that subjects understand this design and respond to changes (such as endowment, prize, and number of yellow balls in the box) in a rational way.

This methodology is also used by [Sjöström et al. \[2019\]](#) in a different research question.²¹ We believe that our subjects might be familiar with this kind of decision problem as it is analogous to effort choices in their lives. For example, a student who is deciding how many summer internship applications to complete understands that the chance of getting an internship increases with each application, and that having at least one internship offer (like drawing at least one yellow ball) is enough to receive an internship. Furthermore, the probability of getting a summer internship increases more in the first application than the 20th. Similarly, while preparing for an exam, a student decides how many topics to master. The more topics studied, the higher the chance of receiving a familiar exam question, but the chances of seeing a familiar question may improve more in the first hour of study than the 20th hour.

In each period, subjects receive a new 60 ECUs endowment and decide how much effort to select that period. We have two treatments in Part 1: the Individual and the Partner Treatments. We had 122 subjects in the Individual Treatment (8 sessions) and 261 subjects in the Partner Treatment (17 sessions).²² The two treatments differ from each other as described below.

Individual Treatment: Each subject chooses her effort level in two periods. After each period, subjects learn their project's outcome and their net payoff. Subjects do not learn anything about the performance of others in the room.

²¹They aim to understand how the motivation to exert effort varies based on whether the task is assigned by the experimenter or chosen by the subject.

²²We collected more data for the Partner Treatment than the Individual one, in order to have enough observations for each of the four possible history in the Partner Treatment.

Partner Treatment: At the beginning of each period, each subject is randomly matched with a partner in the room. Subjects do not know the identity of their partners. After choosing an effort level, a subject learns the outcomes of both her and her partner’s projects. She does not learn her partner’s effort (hence, she cannot infer the partner’s net payoff in that period).²³ Subjects encounter a new partner in each round to prevent reputational concerns from creating a repeated game.

Note that the only difference between the two treatments is whether a subject receives feedback about her relative performance with respect to a partner’s outcome. If a subject does not consider a partner’s success or failure as reference, then such feedback about the partner’s performance is irrelevant information and there should be no difference in the distribution of effort between the treatments (as implied by the standard theory).

Part 2 of our experiments elicits subjects’ risk attitudes and fairness preferences and does not vary across treatments. We chose two well-known and easy to administer methods that are often preferred when measures are needed for control

²³Subjects in the Partner Treatment learn only about the partner’s outcome but not about the partner’s effort. We chose this feedback structure for two reasons: (i) In many applications of moral hazard problems, an agent’s outcome but not effort is observable. For example, a researcher may see another colleague’s publications on her resume but may not be able to see how hard that colleague is working. (ii) We are interested in the effect of feedback on one’s effort choice. Providing feedback on outcome can create four possible history in the Partner Treatment. One of these four realizations of outcome can occur in terms of a subject’s own outcome and partner’s outcome, i.e. {(Fail,Fail), (Fail,Success), (Success, Fail), (Success, Success)}. However, if we had provided feedback on partner’s effort choice as well, there would have been around $21 \times 21 = 441$ different possible realizations of history for each of the outcome pair and that would have been very hard to collect enough observations. Such a research question would require a different design with a smaller set of effort levels and we leave that as an open question for future research.

purposes rather than the heart of the study. To elicit risk preference we used a simple methodology (also used by [Eckel and Grossman \[2002\]](#) and [Dave et al. \[2010\]](#)) where subjects asked to choose one out of six gambles of varying levels of risk.²⁴ To measure fairness concerns, we asked subjects to pick one of the three allocations of money between themselves and another randomly assigned subject differing in their maximization of selfish, equity and efficiency concerns [[Charness and Rabin, 2002](#); [Engelmann and Strobel, 2004](#)]. After completing Part 2, subjects self-reported their gender, SAT/ACT scores, age, gpa, major, current employment status, job experience, and two questions about their work and grading preferences.²⁵

3.5 Results

Before studying subjects' choice of effort, we check to see whether there is balance between the two treatments along various demographic factors and behavioral measures collected in part 2 of the experiment. The results from this balance comparison are reported in Table [B.1](#) in Appendix [B.2](#). Except for age, which has a small yet statistically significant difference between treatments (half a year higher average age in the Partner Treatment than the Individual Treatment), there are no apparent statistical differences between treatments. Furthermore, the significance of the difference in age would disappear if we corrected for multiple hypothesis testing. We conclude that there is little relevant difference in the underlying characteristics

²⁴See [Charness et al. \[2013a\]](#) for a review of prevailing methods of eliciting risk preferences.

²⁵One question asked whether subjects preferred their homework to be graded based on their individual scores or on their scores relative to others in their class; and the other question asked whether they preferred to work on homework individually or in a team.

of subjects between treatments.

Choosing zero tries (zero effort) is the risk-free option in the decision problem. A subject with zero attempts at drawing a yellow ball will fail on the project for sure and keep the endowment of 60 ECUs. On the other hand, choosing the maximum number of tries of 20 requires a subject spending her entire endowment, receiving the prize of 90 ECUs with around 0.64 probability and receiving zero ECUs otherwise. A subject's expected return is maximized at $e = 8$. Hence, risk aversion predicts an effort choice less than 8, and extreme risk aversion predicts an effort choice of zero. We found that subjects chose an average effort level of 9.44 across both periods and treatments, with only 35% (266 out of 766 observations) of observations falling below 8. Hence, most subjects exerted more than the effort level implied by the maximization of expected return. This is unsurprising in the context of our experiment, as many other experiments conducted in labor-environment settings document that subjects take actions higher than would maximize expected returns. For example, even under a flat payment scheme where subjects are paid fixed amounts independent of effort, subjects exert positive effort (see for example [Charness et al. \[2013b\]](#), and [Falk and Ichino \[2006\]](#)). Thus, we somewhat expected to see such high risk taking in this labor context.

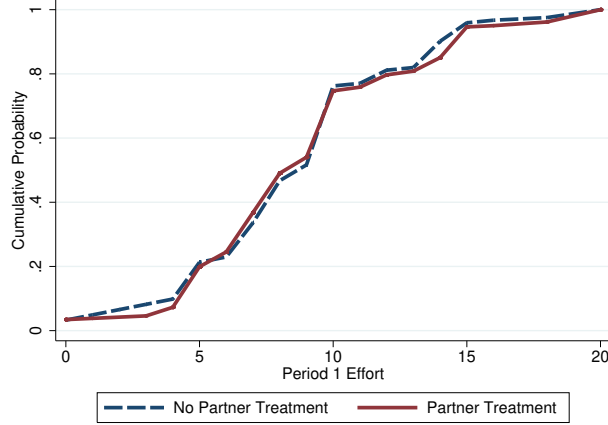
We start by comparing the first period effort in the two treatments.²⁶ Recall that if subjects are inequity averse and can anticipate their inequity aversion without any prior experience in the task, then Hypothesis 1 predicts that period 1 effort is

²⁶In this section, where applicable, we report p-values from two-tailed t-tests comparing the means of relevant data samples. We leave out the p-values from Mann-Whitney U tests when they deliver similar results and report them if there are contradictory results by these two methods.

subject to vary based on the treatment. Figure 3.2 shows that the cumulative distributions of period 1 effort is similar between the two treatments. We fail to reject the null hypothesis that the two cumulative distributions are equal ($p=0.972$ in a Kolmogorov-Smirnov test). Figure B.1 in Appendix B.2 shows that there are also no discernible differences in the period 1 effort cumulative distributions between the two treatments when broken down by gender. The average period 1 effort in the Individual and the Partner Treatments are 9.00 and 9.20, respectively, with $p=0.673$ in a two-tailed t-test. Table B.2 in Appendix B.2 also shows that this result is robust to a regression analysis. We use a Two-Limit Tobit regression to account for censoring from below (at 0) and above (at 20), regressing subjects' period 2 effort on their assigned treatment, and demographic and behavioral measures from Part 3 and the end of experiment survey.²⁷ The partner treatment dummy is insignificant when genders are pooled or separated, indicating that neither gender anticipates inequity concerns in selecting their period 1 effort. Thus, we reject Hypothesis 1 that a subject's effort varies based on her anticipation of feedback regarding a partner's relative performance.

²⁷We also control for subjects risk attitudes, fairness preferences, gpa, and relative grading preferences. The results are robust to adding in controls for additional demographic or behavioral variables as well.

Figure 3.2: CDFs of Period 1 Effort



Result 1: *We reject Hypothesis 1. Subjects choose similar effort in the first period when they know they will receive feedback about their partner's outcome as compared to when they do not receive such feedback.*

Next, we study whether effort choices vary between periods in the Individual Treatment. If subjects do not have behavioral motives and simply maximize the expected utility of their monetary payoffs, then they should solve the optimization problem independently in the two periods and hence submit the same effort level in each, as argued in Hypothesis 2. Rejection of Hypothesis 2 implies that a subject's effort may be affected by the outcome in the first period. Our next set of results investigate this question.

Since only 37% of subjects in the Individual Treatment submit the same effort choice in the two periods, we reject the null hypothesis that 100% choose the same effort between periods ($p=0.000$ in a two-tailed t-test).²⁸ In our setup, the

²⁸Similarly, in the Partner Treatment, we observe that only 35% of subjects choose the same effort between periods.

probabilities are fixed and objectively given. Thus, one may argue that the findings documented below indicate that subjects revise their objective functions, using the feedback as a reference in determining their next-period optimization. This is consistent with the finding in the reinforcement effects literature that subjects change their behavior even when the probability distribution over outcomes is relatively simple [Nielsen, 2019].

In general, female subjects are more likely to revise their second period effort than male subjects (73% and 55% respectively, $p=0.033$ in a two-tailed t-test).

Moreover, the direction of effort revision varies based on feedback about the first period outcome. As seen in Figure 3.3a (as well as its table version, Table B.3 in Appendix B.2), while 48% of failed subjects increased their effort, only 16% of successful subjects increased their effort (49% of them decreased their effort, and the remaining 35% did not change their effort). This difference between the upward revision rates of failed and successful subjects is statistically significant ($p=0.001$ in a two-tailed t-test). Additionally, the effect of failure on likelihood of upward effort revision is more pronounced for females than males. For females, the rate of upward effort revision increases from 11% given success to 58% given failure ($p=0.001$ in a two-tailed t-test), and for males the rate of upward effort revision increases from 21% given success to 40% given failure ($p=0.139$ in a two-tailed t-test).

We find that subjects are more likely to downward revise their effort if they were successful in period 1 than if they failed. As seen in Figure 3.3b (also in Table B.3 in Appendix B.2), the downward effort revision rate of successful subjects is

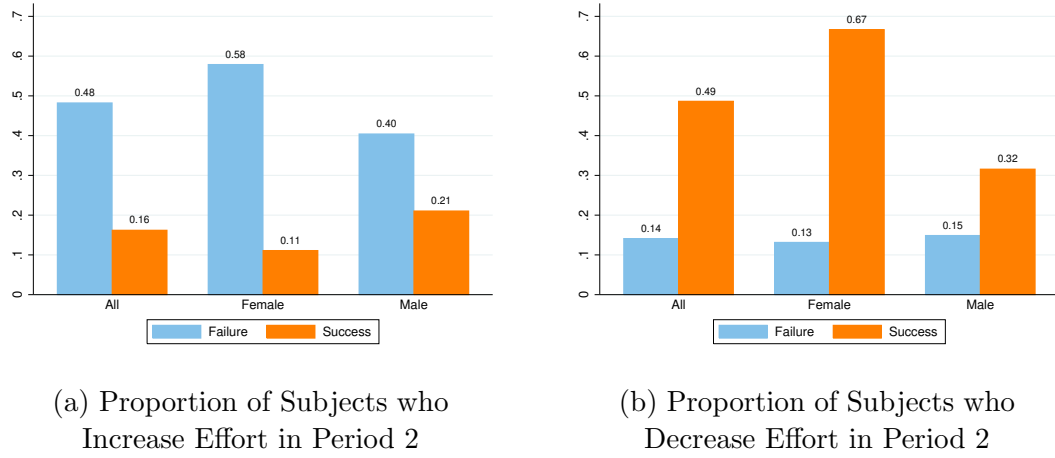
49%, while that of failed subjects is 14% ($p=0.000$ in a two-tailed t-test).²⁹ Here too, the effect of success on downward effort revision is more pronounced for females than males: success leads females to downward revise their effort in 67% of instances and failure in 13% of instances ($p=0.000$ in a two-tailed t-test); by contrast, success leads males to downward revise their effort in 32% of instances and failure in 15% of instances ($p=0.127$ in a two-tailed t-test).

These results summarized by Figure 3.3a and 3.3b are supported by a regression analysis. Tables B.4a and B.4b in Appendix B.2 report results from Probit regressions of a subject's period one outcome on the likelihood of upward and downward effort revision, respectively. Table B.4a shows that failing leads to a 33 to 34 percentage point increase in the likelihood of upward effort revision when genders are pooled, and a 51 to 54 percentage point increase in the likelihood of upward effort revision for females. However, the effect of failure on upward effort revision is statistically insignificant for males. Similarly, as seen in Table B.4b, success leads to a 28 percentage point increase in the likelihood of downward effort revision when genders are pooled, and a 46 to 47 percentage point increase in the likelihood of downward effort revision for females, while the effect of success on downward effort revision is statistically insignificant for males.³⁰

²⁹Similarly, in the Partner Treatment we find more frequent upward effort revision of failed (50%) than successful subjects (21%, $p=0.000$ in a two-tailed t-test); and more frequent downward effort revision of successful subjects (33%) than failed subjects (21%, $p=0.031$ in a two-tailed t-test). These results are reported in Table B.9a in Appendix B.2.

³⁰The above analysis shows that there are differential effects of failure and success on effort revision between genders. It is interesting to note that we also observe signs of gender differences when comparing the revision rates of males and females for a given history: Figure 3.3b shows that 67% of females and only 32% of males decreased their effort after a success ($p=0.033$ in a two-tailed t-test); and Figure 4a shows that 58% of females and 40% of males increased their effort after a failure ($p=0.112$ in a two-tailed t-test). In the Partner Treatment, failed female subjects also upward revise their effort level more frequently than failed male subjects, 63% and

Figure 3.3: Individual Treatment, Proportion of Subjects Revise Effort in Period 2



A principal in a moral hazard problem must not only consider which direction agents revise their effort, but also *by how much*. Next, we analyze the magnitude of effort level revision between the two periods. Table 3.1 summarizes the mean of effort level change in two periods, by period 1 outcome and gender. In comparing the period 2 effort of failed and successful subjects, one needs to control for their period 1 effort because subjects who failed exert lower period 1 effort on average (8.35) than subjects who succeeded (10.30). Thus, the two populations may have different underlying preferences. This is why Table 3.1 reports the mean revision in effort between periods rather than the average absolute period 2 effort level. Mean period 2 effort levels can be found in Table B.5 in Appendix B.2.

37% respectively ($p=0.001$ in a two-tailed t-test). However, in the Partner Treatment, successful female subjects downward revise their effort at a similar rate to successful male subjects (39% and 30% respectively, $p=0.335$ in a two-tailed t-test). These Partner Treatment results are reported in Table B.9a in Appendix B.2.

Table 3.1: Individual Treatment, Mean (Period 2 Effort – Period 1 Effort)

Period 1 Outcome	All	Female	Male
Failed	1.38*** (4.28) n=85	1.55** (4.08) n=38	1.23* (4.48) n=47
Succeeded	-0.95** (2.63) n=37	-1.39* (2.87) n=18	-0.53 (2.39) n=19
P-values	0.003	0.008	0.111

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Stars indicate whether mean is statistically different from zero in a two-tailed t-test. Standard deviations in parentheses. n=number of observations. Bottom row reports p-values from a two-tailed t-test comparing the mean effort revision of subjects who failed and succeeded in a given column.

Table 3.1 shows that subjects who failed increased their effort by 1.38 tries on average, and subjects who succeeded decreased their effort by 0.95 tries on average.³¹ Furthermore, these two effects are more pronounced for females than males. The results are supported in Two-Limit Tobit regressions where the dependent variable is subjects' period 2 effort and the independent variables are period 1 effort and a dummy for failure in period 1 (see Table B.6 in Appendix B.2). When both genders are pooled, the coefficient on failure is positive and significant. When genders are

³¹Similarly, in the Partner Treatment we find that subjects who failed increase their effort by 1.49 on average, and subjects who succeeded decrease their effort by 0.98 on average (see Table B.8 of Appendix B.2). Furthermore, we find that the effect of own-failure is statistically indistinguishable in the Individual and Partner Treatments. When comparing the effect of own-failure between the two treatments, we want to control for the potential impact of peer effects in the Partner Treatment. To do so, we separately compare the effect of own-failure for subjects in the Individual Treatment with that of i) subjects in the Partner Treatment whose partner succeeded and ii) subjects in the Partner Treatment whose partner failed. Table B.10 in Appendix B.2 shows Tobit regressions of failure, being in the partner treatment, and their interaction on period 2 effort for the two groups separately (the former group in columns (1) and (2), and the latter group in columns (3) and (4)). The statistical insignificance of the interaction term indicates that the effect of own-failure is similar in the two treatments.

separated, we see that this is driven by the fact that the coefficient is significant and positive for females, but insignificant for males.

Result 2: *We reject Hypothesis 2. In the Individual Treatment, failed subjects increase their effort and successful subjects decrease their effort. Both the effect of failure on upward effort revision, and the effect of success on downward effort revision is more pronounced for female subjects than male subjects.*

The Partner Treatment allows us to explore how a subject's period 2 effort is affected by comparison of her period 1 outcome with that of her partner. If an agent makes no social comparison, then her period 2 effort choice in the Partner Treatment should be independent of her partner's period 1 outcome. Hence, for example, the effort choice of failed subjects should be the same regardless of their partner's success or failure.

Tables 3.2 and 3.3 report subjects' average period 2 effort and revision in effort between periods 1 and 2, respectively, by period 1 outcome and gender. As seen in Table 3.2, the average period 2 effort of failed subjects whose partner succeeded is higher than those whose partner also failed (10.82 versus 8.94 respectively, $p=0.023$ in a two-tailed t-test).³² This observation holds when genders are either pooled or separated, applying to both females and males. Furthermore, this result is largely driven by the fact that *the magnitude*, rather than *the rate*, of upward effort revision

³²At the same time, the average period 1 effort of failed subjects is similar regardless of their partner's success or failure, as one would expect (8.41 and 8.06 respectively).

of failed subjects is higher for those whose partner succeeded than those whose partner failed (an average increase of 2.41 and 0.88 respectively, as seen in Table 3.3). Indeed, 15% (10 out of 66) of failed subjects whose partner succeeded choose the maximum effort of 20 in period 2, while only 5% (5 out of 99) of failed subjects whose partner failed choose the maximum effort in period 2. Both male and female subjects increased their effort significantly after observing an outcome behind their partner's, i.e. after observing history (Fail, Success): female subjects increased their effort by 2.89, and male subjects increased their effort by 2.05 (Table 3.3, second row).

Subjects who succeeded in period 1 were not as sensitive to their partner's outcome as those who failed. This is potentially good news for a principal in a moral hazard problem. Among successful subjects, only male subjects whose partner succeeded, i.e. observed history (Success, Success), show a statistically significant change in effort — decreasing their effort by 2.42 ($p=0.052$). However, the number of observations that generates this result is not very large ($n=19$).

Table 3.2: Partner Treatment, Mean Period 2 Effort

Period 1 Outcome (Self, Partner)	All	Female	Male
(Fail, Fail)	8.94 (4.86) n=99	8.95 (4.45) n=56	8.88 (5.54) n=41
(Fail, Success)	10.82 (5.57) n=66	11.43 (5.52) n=28	10.37 (5.64) n=38
(Success, Fail)	10.09 (4.98) n=66	9.33 (4.15) n=27	10.37 (5.32) n=38
(Success, Success)	9.57 (4.07) n=30	8.64 (3.35) n=11	10.11 (4.43) n=19

Standard deviations in parentheses. n=number of observations. Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male. 2 of these subjects received outcome (Fail, Fail), and 1 such subject received outcome (Success, Fail).

Table 3.3: Partner Treatment, Mean (Period 2 Effort – Period 1 Effort)

Period 1 Outcome (Self, Partner)	All	Female	Male
(Fail, Fail)	0.88* (4.73) n=99	1.13* (4.68) n=56	0.59 (4.94) n=41
(Fail, Success)	2.41*** (5.20) n=66	2.89** (4.46) n=28	2.05** (5.72) n=38
(Success, Fail)	-0.58 (3.28) n=66	-0.67 (3.23) n=27	-0.66 (3.27) n=38
(Success, Success)	-1.87** (4.20) n=30	-0.91 (1.76) n= 11	-2.42* (5.08) n=19

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Stars indicate whether mean is statistically different from zero in a two-tailed t-test. Standard deviations in parentheses. n=number of observations. Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male.

The results outlined regarding the influence of social comparison on period 2 effort are supported by regression analysis. Table 3.4a and 3.4b report Two-Limit Tobit regressions for failed and successful subjects, respectively. They show regressions of period 2 effort (censored at 0 and 20) on a dummy for receiving an unequal outcome with one's partner in period 1 and period 1 effort. For failed subjects (Table 3.4a), the coefficient for receiving an unequal outcome from one's partner is significant and positive, indicating that failed subjects select greater period 2 effort if their partner succeeded (columns 1-2). However, when the regression is performed separately by gender, this dummy is significant at the 5% level for females, and only significant at the 10% level for males. That said, it is positive and of similar mag-

nitude for both genders (columns 3-6). Furthermore, when we carry out the same regressions for successful subjects (Table 3.4b), we find the dummy for receiving an unequal outcome from one's partner is insignificant when genders are either pooled or separated. This supports our conclusion that the period 2 effort level of successful subjects is not sensitive to their partner's outcome.

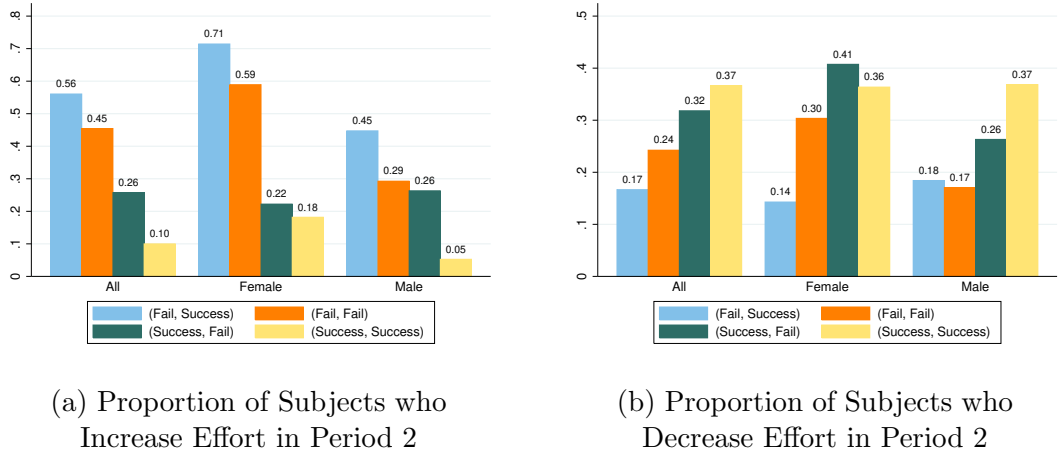
Table 3.4: Partner Treatment, Two-Limit Tobit of Period 2 Effort

(a) Subjects who Failed in Period 1						
	(1) All	(2) All	(3) Female	(4) Female	(5) Male	(6) Male
Unequal Outcomes	1.907** (0.845)	2.259*** (0.835)	2.346** (1.114)	2.422** (1.112)	1.796 (1.356)	2.410* (1.291)
Period 1 Effort	0.687*** (0.109)	0.695*** (0.108)	0.653*** (0.170)	0.676*** (0.172)	0.735*** (0.153)	0.746*** (0.150)
Constant	3.351*** (0.324)	-0.991 (3.120)	3.904*** (1.469)	0.187 (0.389)	2.515 (1.610)	-3.541 (0.519)
Controlling for Heterogeneity		Yes		Yes		Yes
Observations	165	164	84	83	79	79
Log-Likelihood	-463.9	-456.4	-237.9	-233.9	-218.6	-213.7
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1						
(b) Subjects who Succeeded in Period 1						
	(1) All	(2) All	(3) Female	(4) Female	(5) Male	(6) Male
Unequal Outcomes	1.342 (0.821)	1.326 (0.836)	0.389 (0.981)	0.262 (0.940)	1.833 (1.184)	1.322 (1.193)
Period 1 Effort	0.818*** (0.092)	0.821*** (0.094)	0.741*** (0.115)	0.736*** (0.113)	0.848*** (0.134)	0.849*** (0.128)
Constant	0.189 (1.253)	-0.357 (2.314)	1.562 (1.376)	-0.229 (2.548)	-0.567 (1.919)	1.210 (3.378)
Controlling for Heterogeneity		Yes		Yes		Yes
Observations	96	96	38	38	57	57
Log-Likelihood	-248.4	-247.2	-90.46	-88.35	-151.2	-147.8
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1						

Dependent variable is period 2 effort. Censored from below at 0 and above at 20. Unequal outcomes is a dummy equal to one if a subject received a different outcome from their partner in period 1. Controlling for heterogeneity includes controls for risk preferences (dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6), fairness preferences (dummy for 2 of the 3 possible allocations in the fairness task), a linear term for GPA, and relative grading preferences (dummy equal to 1 if the subject is indifferent to, or strictly prefers being graded relatively to individually on a homework assignment). Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male. Column (4) of Table 3.4a excludes 1 subject who did not report a GPA.

We argued before that the observed increase in period 2 effort of subjects with history (Fail, Success) is largely driven by the magnitude, rather than rate, of upward period 2 effort revision being influenced by inequity concerns. In other words, failed subjects are likely to increase their effort regardless of their partner's outcome but increase their effort more if they see their partner succeed. Figure 3.4a and 3.4b show the proportion of subjects who revise their effort upwards and downwards, respectively, broken down by history and gender (one can find this figure's table version in Table B.9b in Appendix B.2).

Figure 3.4: Partner Treatment, Proportion of Subjects Revise Effort in Period 2



Figures 3.4a and 3.4b lend added support to our conclusion. We see that subjects who failed in period 1 are somewhat more likely to increase their effort if their partner succeeded than if their partner failed (56% versus 45%, respectively, blue and orange columns in Figure 3.4a). However, this difference is not statistically significant ($p=0.184$ in a two-tailed t-test). Additionally, there is no statistically significant difference in the upward effort revisions rates of (Fail, Success) and (Fail, Fail) subjects when genders are separated ($p=0.269$ for females and $p=0.158$ for

males). Moreover, subjects who succeed in period 1 increase or decrease their effort in similar proportions regardless of their partner’s success or failure (green and yellow columns in Figure 3.4a and 3.4b). We summarize our findings in period 2 of the Partner Treatment as follows.

Result 3: *We find support for Hypothesis 3 for failed subjects, but not for successful subjects.*

1. *Failed subjects select higher effort in period 2 when their outcome is behind their partner’s. This effect is more pronounced for female subjects than male subjects.*
2. *Successful subjects are not sensitive to their partner’s outcome.*

In short, subjects behave consistent with behindness aversion (i.e. $v \geq 0$). Recall from the discussion of the behavioral model that Hypotheses 1 and 3 might be independent. While we reject Hypothesis 1, we find support for Hypothesis 3 for failed subjects. This indicates that subjects may not be able to anticipate social comparisons in the Partner Treatment, hence, acting similarly in the first periods of the Individual and Partner Treatments. However, once they experience an outcome lower than their person of reference, they are motivated to exert higher effort. Those who are ahead of their person of reference do not seem to diminish (as suggested by “aversion to be ahead” and a positive λ in the behavioral model) or to increase their effort (as suggested by “competitiveness” or “status seeking” and a negative λ in the behavioral model).

While behindness aversion can explain our results in the Partner Treatment, it cannot explain all of our results. Given our findings in the Individual Treatment and the literature showing that past realizations of uncertainty can affect future individual risk taking, it is fair to argue that both social comparisons and some adaptation of preferences are taking place. Our findings might be viewed as indicating that prior experiences can create a new reference in utility, triggering a revision of strategies.

3.6 Discussion

Our findings have direct implications for incentivizing agents in a moral hazard problem. The decision problem subjects faced require them to choose a costly effort level which increases their chance of winning a prize. This is a typical moral hazard problem with an outcome contingent payment scheme. We identify two feedback dependent motivations for higher effort: (i) feedback about an agent's failure motivates higher effort, and (ii) feedback about receiving a worse outcome than a partner motivates an agent to exert even higher effort. The standard model cannot explain either of these two effects.

This suggests non-monetary incentives can be used to increase an agent's effort. A principal in a moral hazard problem may be able to extract more effort out of agents who experienced the feeling of being behind others in prior periods. Thus, a principal may consider placing a mixture of workers in close proximity or in contact who would be likely to fail and succeed, rather than letting them perform their tasks

in isolation. This way, in future tasks, the principal will be able to extract greater effort out of the agents who failed when their partner succeeded. To anticipate the net effect, we need to know how such matching affects the combined effort of agents who are likely to succeed and who are likely to fail, as compared to the counterfactual where they act in isolation. Our earlier results suggest that subjects who succeeded downward revise their effort in similar amounts when their partner failed as compared to when in isolation (-0.95 and -0.58 respectively). However, there is more meaningful difference in the effort increase of subjects who failed and see a partner succeed (2.41) as compared those who failed in isolation (1.38). The net result is that the average period 2 effort of subjects who receive an outcome incongruent with their partner's in the Partner Treatment is 10.45, or 8% larger than the average period 2 effort of failed and successful subjects in the Individual Treatment (9.67).³³ Therefore, a principal could extract higher effort by putting in contact agents who are unsuccessful with those who are successful. This is consistent with the findings of [Bandiera et al. \[2010\]](#) in a study of the assignment of high and low ability fruit pickers to the fields of a farm.³⁴

Note that our setup provides subjects individual monetary incentives rather than relative payment incentives (as in the tournaments literature) to distinguish social comparisons from competition for a monetary prize. Hence, we show that agents may choose greater effort in individually performed and rewarded tasks when

³³This is a rough comparison of average effort in period 2 of these two groups as it does not control for subjects' effort in period 1.

³⁴This study focuses on the productivity impact of social comparisons between friends versus non-friends. On the other hand, we study the impact on effort revision of social comparison versus the case of no social comparison.

they observe each other's outcomes.

Finally, note that the behindness aversion observed is independent of a reputational concern, which could provide an added non-monetary incentive. In the experiments, subjects are matched with a new partner in each period. Hence, revision of effort when behind a partner is not to prove to the partner that one can be successful too, as there is a different partner in the next period. We argue that being behind is enough to activate an agent's inequity aversion concerns and greater effort — out of the agent's desire to avoid that experience again. We conjecture that repeated interaction with the same peer would amplify the effects reported.

3.7 Conclusion

We conducted laboratory experiments to study the effects of feedback on one's own and a peer's performance on the motivation for taking a costly action. We showed that behindness aversion plays a role in the effort choice of subjects. Those who felt behind exerted higher effort while those who were ahead did not diminish their effort much. Subjects do not seem to anticipate such social comparisons, but it affects their future effort once they experience being behind. Furthermore, this effect is more pronounced for female subjects than male subjects.

Our findings have direct implications for non-monetary incentives in labor settings. For example, a student who learns about the high grades of fellow students may be motivated to work harder even when grading is not relative. A farmer may be motivated to work harder after observing the flourishing harvests of other farmers.

Our results also have implications for settings beyond the labor environments we focused on here. For example, they can be applied to the purchase of lottery tickets or any risky investment, suggesting that observing others win may motivate the purchase of more lottery tickets.

Additionally, while our main research question is about social comparisons, our Individual Treatment provides interesting findings as well. We find that subjects who work in isolation revise their effort choices based on the feedback they received on their own past performances. Failed subjects (of any gender) increased their effort and successful female subjects decreased their effort. This result contributes to the literature about the impact of performance feedback (see, for example, [Akin and Karagözoğlu \[2017\]](#); [Bandiera et al. \[2015\]](#); [Eriksson et al. \[2009\]](#); [Hannan et al. \[2008\]](#); [Ockenfels et al. \[2014\]](#)).

Chapter 4: Reciprocity versus Reelection (with Allan Drazen and Erkut Y. Ozbay)

4.1 Introduction

Incumbent politicians care strongly about being reelected and hence about strategies to help their reelection chances. One such tool is the allocation of resources to potential voters that incumbency allows them. This may be especially important when commitment to post-election policies is seen as not fully credible, so that the distribution of resources before an election may be used to indicate post-election intentions. Allocating resources to show congruence with the policy preferences of key voting groups may therefore be an important reelection strategy. Voters would use spending choices observed before an election to try to infer an incumbent's policy priorities and hence her likely policy choices if reelected.¹

Such a strategy of course implies trade-offs when voting groups have different policy preferences. By giving benefits to one group of voters to indicate that she

¹The view that commitment to policy platforms is not credible has led to the “citizen-candidate” approach (e.g., [Besley and Coate \[1997\]](#) or [Osborne and Slivinski \[1996\]](#)) where candidates follow their policy preferences once elected, so that platform commitments in themselves carry no information. Key to his approach is that these preferences are known to voters. The argument here is a variant of the citizen-candidate where candidate preferences are not known ex-ante, and pre-electoral choices are used to signal these choices, as in [Drazen and Eslava \[2013\]](#).

shares their preferences, a candidate signals to a group with different preferences that she does not share theirs. Hence, a candidate who uses distribution of benefits instrumentally to improve her reelection prospects must weigh the net benefits of a distributional choice in gaining votes from one group of potential voters while losing them from another.

Groups whose turnout is expected to be low will have little weight in this instrumental electoral calculus from a candidate whose goal is reelection, unless of course distribution of benefits can induce higher turnout. This is a key argument in the debate of “who should be targeted?” — swing voters who might change the candidate for whom they vote versus a candidate’s “core” constituency, where a candidate’s goal is to induce them to turn out to vote.²

Ideological considerations of course could also affect an incumbent’s choice of policies or distribution of benefits in the run-up to an election. A candidate who is motivated by both reelection concerns and ideology may temper her purely instrumental choice of the distribution of benefits if it conflicts too strongly with her underlying policy preferences. (As we shall argue, “ideological limitations” on the distribution of benefits a candidate is willing to choose is what may give them their signaling value about post-electoral policy.)

Absent from the literature on instrumental or ideological motivations for choices made by an incumbent facing reelection is another type of motivation entirely. Might a candidate’s choices be such as to show gratitude to those who put her in office, independent of any instrumental benefits such a display might have? That is, will

²For example, see [Cox \[2010\]](#).

incumbent’s display non-instrumental reciprocity to the voters who elected her (for example, as in [Sobel \[2005\]](#))?³ To the extent that resources are then distributed to individuals who are not central to reelection, or to those whose turnout is expected to be exogenously low in the upcoming election, such reciprocity (or even basic altruism) is potentially costly to reelection efforts. How might reciprocity alter reelection-oriented behavior? This is the issue we explore in this paper, both theoretically and experimentally.

We consider a model in which an elected candidate attracts votes in her reelection bid by trying to convince voters that she will enact policies favorable to them if reelected. She does this by showing that her policy preferences are “congruent” with theirs. When her policy tool is distribution of benefits before an election, she must give them enough benefits to signal her congruent preferences. Doing so successfully will increase her chances of reelection.

We demonstrate, however, that candidates with reciprocal preferences still show reciprocal behavior when facing reelection, but that the conflict between reciprocity and reelection may lead them to limit their reciprocity when voters have a sufficiently high cost of voting. This is a key result, which we find confirmed in a laboratory experiment. We further find that (both in the theory and the experimental results) when congruent candidates use distribution of benefits to signal her policy preferences, a “non-congruent” candidate may mimic a congruent one in order to

³“Intrinsic reciprocity is a property of preferences... It is more traditional to view reciprocity as the result of optimizing actions of selfish agents. Responding to kindness with kindness in order to sustain a profitable long-term relationship or to obtain a (profitable) reputation for being a reliable associate are examples of instrumental reciprocity. Economics typically describes instrumental reciprocity using models of reputation and repeated interaction” [[Sobel, 2005](#), pp. 392-392].

be reelected. Voters respond to signalling by not voting for a candidate whom they believe does not share their policy interests, a theoretical prediction of a signalling model that is confirmed in the lab.

A laboratory experiment allows us to isolate reciprocity to past voters from benefits to prospective voters in a way that is difficult, if not impossible, in naturally occurring election data. For example, one identification issue that may arise is that when the set of voters in past and future elections significantly overlap, an incumbent giving benefits to past voters who strongly supported her (or punishing voters who did not) may both reflect her attempting to influence their votes in the next election, and her reciprocity motives. By having a different set of voters in sequential elections, our experimental design allows us to disentangle reciprocal and reelection motives.

The plan of the paper is as follows. In the next section, a brief review of the literature is presented, and in [section 4.3](#) we go over the basic conceptual set-up of our approach and outline a model of candidates giving benefits to different voters to signal their preferences and describe the equilibria of the election games. [Section 4.4](#) sets out the experimental design and [section 4.5](#) presents our experimental results and interprets them. The final section presents conclusions. [Appendix C](#) presents a more formal treatment of the theory and the equilibria described in the text, as well as the instructions for the experiment.

4.2 Literature

Our paper relates to several literatures. One of course is the literature on reciprocity, with the theoretical literature considering a range of questions such as whether there is reciprocity to the actions, the intentions, or the motivations of the original actor. In the experimental literature there is significant evidence of intrinsic reciprocity in gift-exchange, trust, public goods, ultimatum and other games. [Fehr and Schmidt \[2006\]](#) present a fairly comprehensive summary.

We are interested in the specific question of how other goals affect reciprocal behavior. There is a literature on how signalling motives may induce people with selfish preferences to act as if they are kind — “crowding in” of reciprocity – as in the work of [Levine \[1998\]](#), [Bénabou and Tirole \[2006b\]](#), [Camerer and Fehr \[2006\]](#), and [Malmendier et al. \[2014\]](#) among others. This may result from self-image concerns, social pressure, or the desire for reciprocity from other agents. Mimicking of reciprocal types by selfish types is, in a sense, the opposite of our main point, namely how the desire to signal that the candidate’s selfish preferences are congruent with those of the voter in the upcoming election induces less kind behavior by the candidate.

On “crowding out” of kind behavior, the literature considers how the perception that intrinsic kindness may be seen as motivated by selfish desires may reduce kind actions [[Ariely et al., 2009](#); [Bénabou and Tirole, 2006b](#); [Frey and Oberholzer-Gee, 1997](#); [Gneezy and Rustichini, 2000](#); [Promberger and Marteau, 2013](#)]. For example, giving monetary incentives for blood donations or for contributing to a charity may reduce the donations [[Mellström and Johannesson, 2008](#); [Niza et al.,](#)

2013]. The reduction in intrinsically motivated behavior is analogous to our finding, but the mechanism is conceptually rather different. In particular, in these cases reciprocity is reduced because it aligns with other selfish motives, whereas in our case reciprocity is reduced because it conflicts with other, perhaps selfish, reelection motives. Limiting reciprocity because of “crowding out” would seem to be a not uncommon event, but we are aware of no experimental work showing such “constrained reciprocity” that we study.

In the political economy literature, the role of reciprocity in elections focuses on reciprocity by voters, for example in the work of Finan and Schechter [2012] or Ozbay and Tonguc [2018], which link successful vote buying by politicians to reciprocity by targeted voters, and Hahn [2009]. Of course, a trade of votes for politician favors is conceptually different than ex post distribution of benefits by politicians to those who elected them due to intrinsic reciprocity.

To the best of our knowledge, there are almost no papers in the literature examining the intrinsic reciprocity of politicians to the voters who elected them. Drazen and Ozbay [2019] studied a one-shot dictator game where they considered how the way in which the dictator was chosen affected the degree of other-regarding behavior. In a laboratory experiment, they found that leaders who are elected are significantly more likely to share than leaders who are appointed, and that elected leaders tend to favor the voter who elected them rather than the losing candidate, while appointed leaders show no such tendency. They argued that the results provided support for the view that non-selfish behavior of leaders reflects a reciprocity motive. Enemark et al. [2016] performs a laboratory experiment involving a trust

game, where the subjects are former political candidates, and finds that having held office makes individuals subsequently more intrinsically reciprocal than politicians who ran for office but were not elected. Empirical discussion of reciprocity of elected leaders to voters tends to be more of an anecdotal nature ([Schlesinger \[1994, chapter 6\]](#), [Inquirer \[November 8, 2012\]](#)).

By contrast, there are several papers that look at instrumental reciprocity of elected politicians once in office to other politicians, especially in legislatures [[Binder, 1997](#); [Kirkland and Williams, 2014](#); [Martorano, 2004](#); [Weingast, 1979](#)].

Our paper also relates to literature on the actions of candidates seeking reelection. More precisely, there are a number of models in which an incumbent seeking reelection chooses an expenditure other than her first best in order to improve her reelection chances. The earliest models which considered this in a model of candidate signalling to rational voters were [Rogoff and Sibert \[1988\]](#) and [Rogoff \[1990\]](#). A significant number of models followed, of which [Drazen and Eslava \[2013\]](#), on which our model is based, is but one example. These models all considered candidates who were motivated by a combination of their own utility in getting reelected and social welfare, rather than by reciprocity to voters. However, the conceptual motivation is the same. In the absence of reelection motives (or observability of candidate expenditure behavior), candidates would simply maximize their own utility, however defined. Reelection motives induce them to choose a different pattern of expenditure to signal their type (competence, congruence with voting groups) in order to increase the probability of reelection.

Moreover, our paper relates to the experimental literature on reputation for-

mation, and the behavior of a long run player (the candidate) facing a sequence of short-term players (voters) who are unsure about her preferences and observe her previous choices. The literature tends to focus on testing whether a particular refinement is a good predictor of behavior in industrial organization or financial market games.⁴ While we find data consistent with the intuitive criterion, rather than comparing refinements, we manipulate the observability of information about past behavior and focus on the effects of signalling itself, as in [Grosskopf and Sarin \[2010\]](#) and [Bolton et al. \[2004\]](#). Furthermore, we distinguish ourselves by focusing on the interaction of signalling motives with other-regarding preferences, two rich areas of research, and also by allowing for a continuum rather than a finite number of types.

4.3 A Model of Candidate Behavior

4.3.1 Overview

In this section, we present a game-theoretic model of a candidate running for election to represent the conflict she may face between intrinsic reciprocity to past voters and her reelection prospects. The model also forms the basis of our experiment. After describing the model, we informally summarize the equilibria and the main theoretical result, that is, the constraint a high cost of voting and reelection concerns may impose on a candidate's reciprocity to past voters. These predictions

⁴[Camerer and Weigelt \[1988\]](#), [Neral and Ochs \[1992\]](#) and [Brandts and Figueras \[2003\]](#) study how well sequential equilibrium predicts behavior. [Brandts and Figueras \[2003\]](#) and [Cadsby et al. \[1998\]](#) explore whether the intuitive criterion provides a plausible refinement.

will inform our interpretation of the experimental data. Interested readers can find a more formal treatment of the theory in [Appendix C.1](#), establishing the uniqueness of the equilibria described here.

Central to our model is that policies chosen by an incumbent before an election may signal her unobserved policy preferences – more specifically, whether or not they are congruent with those of a voter — and hence the choices she would make if reelected. That is, if an incumbent wants to signal that she places a high priority on, let’s say, environmental issues and will continue to do so if reelected, she may devote resources to protecting the environment before an election in a way that she would not do if she did not have that priority. [Drazen and Eslava \[2013\]](#) model this idea formally, and we use this idea to represent how distribution of benefits by the incumbent can be an effective reelection strategy.

To consider the possible conflict between rewarding voters who voted in the previous election and using benefits to gain votes in the next election, we assume that there are two groups of non-overlapping voters — those who voted in the last election and those who will vote in the subsequent election – and consider benefits to voters who will vote in only one of these elections. For example, consider a politician who faces a different constituency than in a previous election (perhaps because of a significant redistricting), where, for example, the previous constituency was weighted towards retirees — who voted heavily for the candidate and were crucial to her being elected — whereas the new constituency she will face is much more heavily weighted towards young workers. Helping enact a policy to raise Social Security benefits via higher taxes on workers reciprocates to retirees for their votes, but may be seen

by the young as indicating the incumbent doesn't share their concerns and thus endanger her reelection. She may thus need to limit her reciprocity in order to get reelected.

4.3.2 Model Set-up

4.3.2.1 Elections and Distribution of Benefits

There are two sequential elections, two voters V_1 and V_2 and one candidate C who runs in the first election and then, if she is elected in the first election, runs for reelection in the second. Voter V_1 either votes or abstains in the first election, while voter V_2 votes or abstains in the second election. In other words, there is only one voter in each election who is pivotal to C being elected or not (when the relevant voter chooses not to vote). Hence a voter's actions are equivalent to his intentions (whether to see the candidate elected or not). The cost of voting in an election is $k > 0$, assumed identical for the two elections.

If elected, C has $X > 0$ to distribute after the first election and, if reelected, Y to distribute after the second election. The amount given to the two voters is x_1 and x_2 respectively (where $x_1 + x_2 = X$) after the first election (if C is elected) and y_1 and y_2 (where $y_1 + y_2 = Y$) after the second election (if C is reelected). One could think of x_1 and y_1 (x_2 and y_2) as choice of policies favorable to V_1 (V_2) in the first election and second election respectively.

It is assumed that $X > Y > \frac{X}{2}$ and $Y > k$. The first assumption is made because i) if Y is too big, then all candidates would pool to be reelected and there

would be no signalling of preference congruence with V_2 , and ii) if Y is too small, then candidates would not care enough about reelection to try to signal preference congruence with V_2 . The value of Y relative to X could be motivated by thinking of election benefits as identical in each election, but there being some common discount factor δ with $\frac{1}{2} < \delta < 1$ applied to future benefits. The second assumption is made because if $Y < k$, then V_2 would always abstain in the second election and there would likewise be no signalling motives.

4.3.2.2 Candidate and Voter Preferences

We say that C has a “policy preference”, $\tau = 1, 2$, where her material payoff is equal to the amount of benefits given to the voter of her policy type (V_1 if $\tau = 1$ and V_2 if $\tau = 2$). For a $\tau = 1$ candidate, acting selfishly and giving benefits to V_1 coincide, while for a $\tau = 2$ candidate, acting selfishly and giving benefits to V_2 coincide. This is a simple way of representing candidate preferences over policies, and voter preferences over candidates based on policies they would enact. C is also characterized by a “reciprocity parameter” θ between 0 (a “selfish” candidate) and $\theta \geq 0$. Hence, a candidate’s type is a function of her policy preference and reciprocity parameter (τ, θ) , where type is not directly observed by voters. This is central to the model, as discussed in the next subsection.

To model reciprocal preferences, we assume that C ’s utility depends not only on her own payoff, but also the payoff of the voter electing her according to her reciprocity parameter θ . A selfish candidate cares only about her own material

payoff, while a reciprocal elected candidate may also care about the payoff of the voter who put her in office. That is, a reciprocal C has a psychological payoff from giving to V_1 if he voted for her in election 1 and to V_2 if he voted for her in election 2.

We characterize C 's utility function as follows. If $r \in \{x_1, y_2\}$ for “reciprocity” represents the amount given to the voter who elected C in an election (x_1 in election 1 and y_2 in election 2), and $s \in \{x_1, x_2, y_2, y_2\}$ for “selfishness” is the amount C gives to the voter of her type (x_1 or y_1 if $\tau = 1$ and x_2 or y_2 if $\tau = 2$), then a simple way to represent C 's utility in said election is to use a Cobb-Douglas utility function, $u = r^\theta s^{1-\theta}$, where the terms r and s depend on the election and τ of the candidate. This utility function is consistent with the reciprocity model of [Cox et al. \[2007\]](#). According to this utility function, a C with $\theta = 0$ is selfish, and a C with $\theta > 0$ is reciprocal, with her reciprocity increasing in θ . We assume $\theta \leq 0.5$ so that candidates selfish motives are at great as large as their other-regarding motives, as in [Fehr and Schmidt \[1999\]](#). Furthermore, we assume a candidate's θ is identical in both elections.⁵

For example, we represent first-period candidate utility as

$$u_{(1,\theta)}^1(x_1, x_2) = x_1^\theta x_1^{1-\theta} \quad (4.1)$$

$$u_{(2,\theta)}^1(x_1, x_2) = x_1^\theta x_2^{1-\theta} \quad (4.2)$$

Regardless of her θ , a $\tau = 1$ candidate would clearly choose $x_1 = X$ if she were simply

⁵Our theoretical results would not be qualitatively affected by modifying this assumption, and might actually be strengthened.

maximizing first-period utility (her “first-best”), while a type $(2, \theta)$ candidate would choose $x_1 = \theta X < X$.

Similarly, second-period candidate utility is represented as

$$u_{(1,\theta)}^2(y_1, y_2) = y_2^\theta y_1^{1-\theta} \quad (4.3)$$

$$u_{(2,\theta)}^2(y_1, y_2) = y_2^\theta y_2^{1-\theta} \quad (4.4)$$

where a type $(1, \theta)$ candidate’s first-best is $y_2 = \theta Y < Y$, and a $\tau = 2$ candidate’s first-best is $y_2 = Y$.

Finally, we assume voters are risk neutral and selfish. In other words, we assume voters have $\theta = 0$ so their utility function is linear in their payoffs. Risk-neutrality is assumed for simplicity of exposition. Voter selfishness allows us to focus on candidate rather than voter reciprocity. We do not model reciprocity by voters to candidates.⁶ At the end of the section, we explore the implications of incorporating candidate altruism into the model, allowing candidates to also care about giving to a policy incongruent and non-voting voter in an election.

4.3.2.3 Voters’ Beliefs, Candidate’s Dilemma

We assume that $\tau = 1$ and $\tau = 2$ are initially equally likely, and that θ is independently distributed by a continuous distribution function $F(\theta)$ with support $[0, \theta]$, where this distribution is assumed to be common knowledge. V_1 has no information about C ’s type (τ, θ) when she votes other than his priors over these two

⁶See [Hahn \[2009\]](#) for an interesting exploration of the effect of voter reciprocity on elections.

variables. In contrast, and this is the heart of both the model and the experiment, since V_2 votes after C chooses x_1 and x_2 , these may reveal information about the C 's type. The problem that a reciprocal $\tau = 2$ candidate faces is that choosing too high a value of x_1 out of her desire to be reciprocal to V_1 may lead V_2 to believe she has policy preference $\tau = 1$. Hence, when voting is costly, V_2 would choose to abstain and C would not be reelected. Put differently, a reciprocal $\tau = 2$ candidate may choose to limit her reciprocity to V_1 after the first election in order to not be perceived as a $\tau = 1$ candidate by V_2 .

In order to study constrained reciprocity, we compare what a reciprocal $\tau = 2$ candidate — that is, one whose θ is positive — would do if V_2 had no information about x_1 and x_2 before voting to the case where she does. More precisely, we study two different set-ups, following [Grosskopf and Sarin \[2010\]](#). The first is where V_2 observes first election benefits (x_1 and x_2) before deciding whether to vote. In this set-up, candidates are motivated to signal policy preference congruence with V_2 to be reelected. In the second set-up V_2 does not observe first election benefits (x_1 and x_2) before deciding whether to vote, so that C cannot use distribution of benefits to signal type. This no-signalling set-up will serve as a useful benchmark to understand how signalling for electoral purposes affects candidate reciprocity.

We expect a $\tau = 2$ candidate's reciprocity to be unconstrained in the no information game as a high value of x_1 is unobserved by V_2 and thus has no implications for reelection prospects. By contrast, in the signalling game, the desire to get reelected may constrain C in her choice of x_1 in order not to harm her reelection chances.

4.3.2.4 Electoral Equilibria

We can now summarize the equilibria in our two set-ups. Our basic result is that when signalling is possible, a reciprocal $\tau = 2$ will in fact constrain her reciprocity when the cost of voting is high, but less so when it is low. The key driver of this result is that since the policy preferences of a candidate are not known ex ante, a candidate with policy preference $\tau = 1$ may choose to mimic the x_1 choice that a reciprocal $\tau = 2$ candidate would make. Pooling by $\tau = 1$ type candidates reduces the benefit V_2 expects from voting to reelect C , and the higher the cost of voting, the more likely V_2 is to abstain. Reducing her reciprocity to V_1 reduces the mass of $\tau = 1$ type candidates who pool while increasing the mass of $\tau = 2$ type candidates who pool, thus increasing the expected benefit of voting, which, as indicated, is more important when voting costs are high.

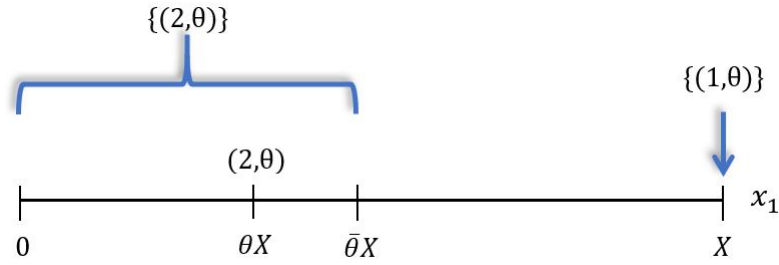
To give more detail on the role of constrained reciprocity when benefits may signal a candidate's policy preferences, we consider the cases where benefits are not observed — the “no-information” case where signalling is not possible — and where they are, the “signalling case.” Under the latter, a $\tau = 2$ type candidate may face a trade-off between reciprocating to V_1 after the first election and signalling her congruence of policy preference with V_2 .

4.3.2.5 Equilibria When V_2 Does Not Observe x_1 and x_2

In this no-information case, C cannot signal her type, so she simply maximizes her single period utility in each election (her first-best). Hence, a type $(2, \theta)$ candi-

date chooses $x_1 = \theta X$ in the first election, her optimal balance between benefits to V_1 and to herself. Furthermore, she chooses $y_2 = Y$ if reelected since her self-interest and reciprocity motives align in dictating the giving of second selection benefits to V_2 . By contrast, a type $(1, \theta)$ candidate chooses $x_1 = X$ in the first election, regardless of her reciprocity preference, and $y_2 = \theta Y$ if reelected, her first-best in each election. The equilibrium in the first election is depicted in Figure 4.1, where we note that there is complete separation of $\tau = 1$ and $\tau = 2$ candidates. V_1 and V_2 vote rather than abstain if the expected benefit from voting exceeds the cost.⁷

Figure 4.1: No Information Game Equilibrium



4.3.2.6 Equilibria When V_2 Observes x_1 and x_2

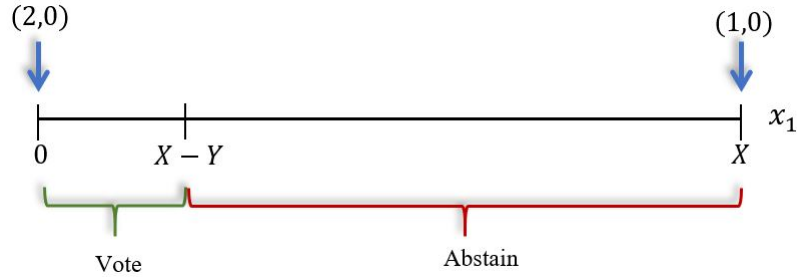
To better understand C 's choices when x_1 and x_2 are observed before the second election, suppose that all candidates are selfish, and it is common knowledge that there are only $(1,0)$ and $(2,0)$ type candidates.

Consider the first-best of a $(2,0)$ candidate, $x_1 = 0$. Clearly $(2,0)$ will choose this if it implies her reelection. If a type $(2,0)$ candidate chose $x_1 = 0$, a type $(1,0)$ candidate would not mimic as she receives a higher utility from choosing her

⁷Given the chosen benefits of $\tau = 1$ and $\tau = 2$ candidates, for V_2 , this is $\frac{1}{2}Y + \frac{1}{2}Y \int_0^{\overline{\theta}} \theta dF(\theta) > k$, where the first two terms are his expected benefits from electing a $\tau = 2$ and $\tau = 1$ candidate respectively, weighted by their probabilities.

first-best, $x_1 = X$, and foregoing reelection than mimicking when $X > Y$. Thus, in equilibrium, a type $(2,0)$ chooses $x_1=0$ and is reelected, while a type $(1,0)$ chooses $x_1 = X$ and foregoes reelection, so that $\tau = 1$ and $\tau = 2$ candidates locate at the extremes. This equilibrium is depicted in Figure 4.2.

Figure 4.2: Selfish Candidates Separating Equilibrium



In contrast — and this summarizes key results of the paper — when candidates may be reciprocal, but distribution of benefits is observed, we get a result “between” the cases of reciprocal candidates without observation of x_1 and x_2 as in section 3.3.1 and observation of x_1 and x_2 without reciprocal candidates. C ’s distribution of benefits will be interior but often not as much as compared to reciprocal candidates in the no-information case.

To see why, suppose that all $(2, \theta)$ incumbents played their first-best. In other words, suppose that any given $(2, \theta)$ candidate plays $x_1 = \theta X$, as in the no information case. Furthermore, consider the implications for the most reciprocal incumbent with policy preference $\tau = 2$, that is, type $(2, \bar{\theta})$ choosing $x_1 = \bar{\theta}X$.

If $\bar{\theta}$ is sufficiently large, then some $\tau = 1$ candidates would be willing to mimic choosing $\bar{\theta}X$ to get reelected instead of their first-best X . The lower is the reciprocity θ of a $\tau = 1$ candidate, the greater the benefit of mimicking (as utility after election

2 will be higher),⁸ so that this would include $\tau = 1$ with sufficiently low θ . With a positive mass of such $\tau = 1$ candidates⁹ relative to the mass of $(2, \bar{\theta})$, V_2 would abstain if the voting cost is too high. Hence, $x_1 = \bar{\theta}X$ would not be an equilibrium choice for $(2, \bar{\theta})$ as she would not be reelected.

However, suppose $(2, \bar{\theta})$ constrains her reciprocity, that is choosing a lower value of x_1 . As $(2, \bar{\theta})$ decreases her choice of x_1 , so too must all highly reciprocal $\tau = 2$ candidates with first-best greater than that value of x_1 which $(2, \bar{\theta})$ chooses. For a low enough value of x_1 , the mass of reciprocal $\tau = 2$ candidates who choose to constrain themselves will imply just enough mass of $\tau = 2$ candidates such that V_2 votes even if with mimicking by some (low reciprocity) $\tau = 1$ candidates. Note further the lower is x_1 , the fewer $\tau = 1$ candidates who will want to mimic x_1 so that the relative weight of $\tau = 2$ candidates would increase for two reasons (though the expected benefit to V_2 from voting if the date is a mimicker also falls as more reciprocal $\tau = 1$ drop out of the pool).

Ultimately, in equilibrium, a $\tau = 2$ candidate face a reciprocity cut-off, based on the cost of voting, $\theta_2(k)$. All $\tau = 2$ candidates with reciprocity greater than or equal to that reciprocity cut-off $\theta \geq \theta_2(k)$ will constrain their reciprocity and choose $x_1 \theta_2(k)X$, and all $\tau = 2$ candidates with reciprocity less than that cut-off choose their first-best $x_1 = \theta X$. Similarly, there is a reciprocity cut-off for $\tau = 1$ candidates, $\theta_1(k)$. All $\tau = 1$ candidates with reciprocity less than that cut-off $\theta < \theta_1(k)$ mimic

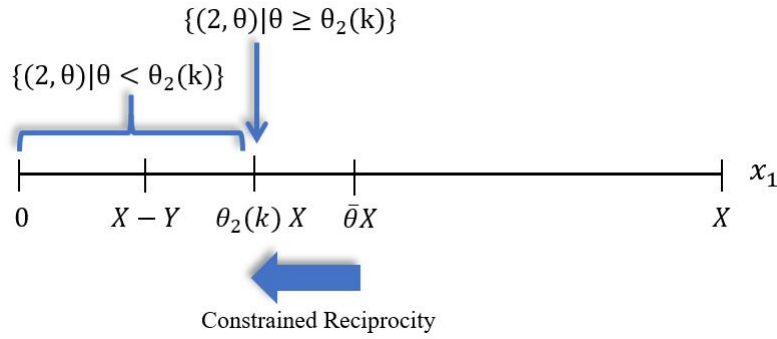
⁸Since $0 \leq \theta \leq \frac{1}{2}$, second period utility of a $(1, \theta)$ candidate is monotonically decreasing in θ from equation (4.3).

⁹We assume $F(0) > 0$ following the observation of positive mass of selfish players in gift exchange games [Fehr et al., 1993]. This assumption is not necessary for this result, but simplifies the proofs in the Appendix.

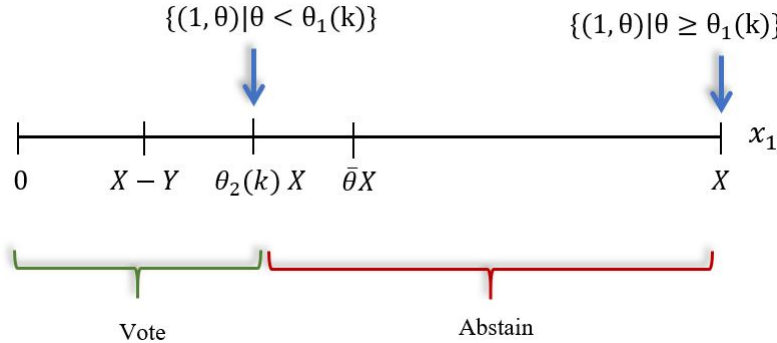
the highly reciprocal $\tau = 2$ candidates by choosing $x_1 = \theta_2(k)X$, while all other $\tau = 1$ candidates simply choose their first-best $x_1 = X$.

Figure 4.3a depicts this semi-separating equilibrium with constrained reciprocity by the highly reciprocal $\tau = 2$ candidates and Figure 4.3b mimicking by the more selfish $\tau = 1$ candidates.

Figure 4.3: No Information Game Equilibrium



(a) Constrained Reciprocity by Highly Reciprocal $\tau = 2$ Candidates



(b) Mimicking by Selfish $\tau = 1$ Candidates

Furthermore, since V_2 is less willing to vote as the cost of voting rises, $\tau = 2$ candidates further constrain themselves at a higher cost of voting to ensure their reelection. In other words, the cut-off at which $\tau = 2$ candidates limit their reciprocity ($x_1 = \theta_2(k)X$) is weakly decreasing in the cost of voting. We view this as our central theoretical finding, and important for interpreting our experimental results.

We predict to see greater constrained reciprocity for a higher cost of voting, and might not even be able to detect constrained reciprocity for a sufficiently low cost of voting. Before continuing to the experimental results, a couple notes about how our theoretical results might be affected by relaxing some of the simplifying assumptions.

First, we assumed the distribution of reciprocity $F()$ is independent of k . One might suspect that $F()$ is dependent on k , with candidates feeling greater reciprocity towards voters when they pay a higher cost to vote. In this case, it might be that a greater number of highly reciprocal $\tau = 2$ candidates constrain their reciprocity with a higher cost of voting, apart from the amount they constrain as shown here. However, at the same time, the degree to which $\tau = 2$ candidates constrain their reciprocity may be less because there is a higher ratio of reciprocal $\tau = 2$ candidates to selfish $\tau = 1$ candidates. Which effect dominates depends strongly on the distributional assumptions imposed, and how that distribution is affected by k . We leave a formal analysis out as this significantly increases the complexity of the model.

Additionally, for simplicity, we assumed voters are risk-neutral and there is no ambiguity about the underlying reciprocity distribution $F()$. If voters are risk-averse and/or there is ambiguity about $F()$, then this should strengthen the robustness of the constrained reciprocity equilibrium as V_2 would be less willing to reelect $\tau = 1$ candidates, and $\tau = 2$ candidates would need to further constrain themselves to ensure reelection.

Lastly, we focused on a candidate's reciprocal and policy preferences. Out of

a desire to be altruistic, candidates may also care about giving benefits to the non-voting citizen in an election, even if this citizen's preferences are not those of the candidate. We summarize the results below and present a more formal treatment in the Appendix C.1. The main intuition driving constrained reciprocity, type 2 candidates' need to prevent type 1 mimicking to be reelected, still holds when we incorporate altruism.

4.3.2.7 Constrained Reciprocity Equilibria with Altruism

In addition to a reciprocity parameter θ and a policy preference τ , here we assume that each candidate is endowed with an altruism parameter α . The altruism parameter represents the weight a candidate places on giving to the non-voting voter in an election. We assume α is distributed according to some continuous distribution function $G()$ with support $[0, \bar{\alpha}]$. We assume there is a positive mass of selfish candidates $G(0) > 0$, and candidates self-interest is at least as large as their altruism $\bar{\alpha} < 0.5$. Furthermore, we assume $G()$ and $F()$ are independently distributed, as candidates may have different definitions of what constitutes kindness. Some candidates might believe kindness comes from reciprocating to kind actions, others might believe it comes from distributing benefits to everyone, and others might believe it comes from a combination of both. The utility function of each candidate

in the first election is as follows:

$$u_{(1,\theta,\alpha)}^1(x_1, x_2) = x_1^{1-\theta-\alpha} x_1^\theta x_2^\alpha = x_1^{1-\alpha} x_2^\alpha \quad (4.5)$$

$$u_{(2,\theta,\alpha)}^1(x_1, x_2) = x_2^{1-\theta-\alpha} x_1^\theta x_2^\alpha = x_1^\theta x_2^{1-\theta} \quad (4.6)$$

A $(1, \theta, \alpha)$ candidate would choose $x_1 = (1 - \alpha)X$ if she were simply maximizing first-period utility, while a type $(2, \theta, \alpha)$ candidate would choose $x_1 = \theta X$.

Similarly, second-period candidate utility is represented as

$$u_{(1,\theta,\alpha)}^2(y_1, y_2) = y_1^{1-\theta-\alpha} y_2^\theta y_1^\alpha = y_1^{1-\theta} y_2^\theta \quad (4.7)$$

$$u_{(2,\theta,\alpha)}^2(y_1, y_2) = y_2^{1-\theta-\alpha} y_2^\theta y_1^\alpha = y_1^\alpha y_2^{1-\alpha} \quad (4.8)$$

where a type $(1, \theta, \alpha)$ candidate's first-best is $y_2 = \theta Y$, and a $(2, \theta, \alpha)$ candidate's first-best is $y_2 = (1 - \alpha)Y$.

Consider the first election of the signaling game. As can be seen in equation (4.6), type 2 candidate first election motives are unchanged by the incorporation of altruism. Besides their self-interest, the only other relevant first election motive of type 2 candidates is reciprocity. However, as seen in equation (4.5), altruistic type 1 candidates may also care about giving to V_2 in the first election.

Suppose all candidates played their first-bests in the first election. Type 1 candidates' benefits to V_1 would then be continuously distributed along the continuum $[(1 - \bar{\alpha})X, X]$ with a positive mass at $x_1 = X$. As before, type 2 candidates' benefits to V_1 would be continuously distributed along the continuum $[0, \overline{\theta}X]$

where $\bar{\theta}X < (1 - \bar{\alpha})X$. If the expected θ of type 1 candidates is not too high, then V_2 would not reelect them (see equation (4.7)). Thus, type 1 candidates would have an incentive to mimic the most reciprocal type 2 candidate at $x_1 = \bar{\theta}X$ to be reelected. Furthermore, altruistic type 1 candidates would have to deviate less to mimic, giving them greater incentive to mimic. Additionally, type 1 candidates with low reciprocity would have greater incentive to mimic because they would have more utility to gain from reelection. There would then be a positive mass of mimicking type 1 candidates according to their reciprocity and altruism parameters. The remaining non-mimicking type 1 candidates would play their first-bests.

However, V_2 would not reelect where there is low mass of type 2 candidates and high mass of mimicking and low reciprocity type 1 candidates. Type 2 candidates would then have to constrain their x_1 until they accrue just enough mass relative to the mimicking type 1 candidates that V_2 still reelects. Incorporating altruism implies that type 2 candidates may have to constrain their reciprocity below $x_1 = \frac{X-Y}{X}$ because altruistic type 1 candidates are even more willing to mimic. In this light, incorporating altruism strengthens the robustness of the theoretical results. Furthermore, the amount type 2 candidates have to constrain their reciprocity is increasing in the cost of voting.

The only differences between the equilibrium with altruism and without are that i) some non-mimicking and altruistic type 1 candidates select $x_2 > 0$ and ii) altruistic type 2 candidates choose $y_1 > 0$. Informed by these theoretical predictions, we turn to the experimental results.

4.4 Experimental Design

The aim of our experiment is to investigate the interaction between intrinsic reciprocity and reelection concerns on candidate behavior as suggested by the signalling model above. We implemented four treatments in a 2 x 2 experimental design. Treatments differed in the cost of voting, \$1 in the “low cost of voting games” and \$6 in the “high cost of voting games.” Additionally, as in the two election games in the model, treatments varied in whether V_2 observed the distribution of first election benefits in the signalling games or did not observe the distribution of first election benefits in the no information games before deciding whether to vote.¹⁰ We label treatments as “SLC” (signalling low cost), “SHC” (signalling high cost), “NILC” (no information low cost) or “NIHC” (no information high cost).

The experiment was run in the Experimental Economics Lab at the University of Maryland. There were 300 participants, all undergraduate students at the University of Maryland. We conducted five sessions for each treatment (15 participants per session, i.e. 75 participants per treatment). No subject participated in more than one session. Participants were seated in isolated booths. The experiment was programmed in z-Tree [[Fischbacher, 2007](#)].

At the beginning of each session, subjects were randomly assigned one of three roles: “Voter 1” (V_1), “Voter 2” (V_2), or “Candidate” (C). The assigned roles stayed fixed for all 5 rounds (until the end of the experiment). At the beginning of each of the 5 rounds in a session, participants were given a \$6.00 endowment

¹⁰Instructions for each treatment can be found in [Appendix C](#).

(each) and randomly sorted into groups of 3 people, consisting of V_1 , V_2 , and C . In each round, C was independently and randomly assigned a policy type, “Type 1” ($\tau = 1$) or “Type 2” ($\tau = 2$), with equal probability of being assigned either type. Voters did not learn the candidate’s type at any point, but knew the initial probability associated with each type. No participant was ever grouped with any other participant in more than one round. Thus, each round can be thought of as a one-shot game.

Each round consisted of two sequential elections, with V_1 voting in the first election and V_2 voting in the second election. In each election, the respective voter decided whether to vote at a cost or abstain at zero cost. If a candidate was elected in election 1 (election 2), then the candidate was given \$15 (\$10) to distribute between voter 1 and voter 2. The candidate could divide the money in any penny amount. Furthermore, the candidate was given an additional penny to keep for every penny distributed to the voter of her type. Thus, the candidate could earn up to \$15 (\$10) in the first election (second election). If a voter abstained in an election, then the candidate was not elected and the round immediately came to an end. Thus, if the candidate was not elected in the first election, then the second election did not occur. Given a \$10 second election pie, a cost of voting of \$6 implies that constrained reciprocity should hold for a very general set of distributions of reciprocity, as V_2 would not want to reelect the most reciprocal type 1 candidate if $\theta < 0.6$. This is why a \$6 cost of voting was chosen.¹¹ The treatments may be summarized as follows:

¹¹Also, note that these parameter choices imply $\theta_1 = 0.084$.

Table 4.1: Treatments

Treatment	Signalling Game?	Voting Cost	Election 1 Distribution (X)	Election 2 Distribution (Y)
SLC	Yes	\$1	\$15	\$10
SHC	Yes	\$6	\$15	\$10
NILC	No	\$1	\$15	\$10
NIHC	No	\$6	\$15	\$10

Once all 5 rounds were finished, 1 round out of the 5 rounds was randomly picked, and the earnings in that round were the participant's final earnings for the experiment in addition to a \$7 participation fee. Including the participation fee, subjects averaged a total of \$23.62 in earnings.

4.5 Results and Interpretation

4.5.1 Distribution and Voting Patterns

To give a preliminary overview of the data, we summarize the distribution of benefits in Table 4.2, where the elected candidate has \$15 to distribute in the first election and \$10 to distribute in the second election.

Table 4.2: Distribution of Benefits

(a) \$ Benefit to V_1 in First Election

	Treat SLC	Treat NILC	Treat SHC	Treat NIHC
Type 1	9.07 (2.21)	13.61 (2.16)	10.05 (3.26)	11.88 (2.96)
Type 2	3.50 (3.29)	2.59 (3.53)	2.82 (2.97)	4.93 (3.60)
Observations	119	120	109	119

Mean, standard deviation in parentheses.

(b) \$ Benefit to V_2 in Second Election

	Treat SLC	Treat NILC	Treat SHC	Treat NIHC
Type 1	1.39 (1.87)	1.61 (1.96)	2.36 (2.77)	3.31 (2.50)
Type 2	8.38 (2.06)	8.72 (1.77)	9.18 (1.39)	8.02 (1.82)
Observations	96	111	73	78

Mean, standard deviation in parentheses.

Additionally, voting proportions are given in Table 4.2. Sections 4.5.3.3 and 4.5.4.3 describe V_2 's voting pattern broken down by actual candidate types.

Table 4.3: Vote Proportions

	Treat SLC	Treat NILC	Treat SHC	Treat NIHC
Voter 1	0.952 (0.215)	0.960 (0.197)	0.872 (0.335)	0.952 (0.215)
Voter 2	0.807 (0.397)	0.925 (0.264)	0.670 (0.472)	0.655 (0.477)

Mean vote proportions, standard deviation in parentheses.

4.5.2 Existence of Intrinsic Reciprocity

The first question we investigate is whether candidates exhibit intrinsic reciprocity to the voters who elected them when they are free from reelection motives.

We focus on the no information games where candidates are unable to signal their policy type to V_2 , so that observed reciprocity must be intrinsic rather than instrumental. We look at whether a type 1 candidate gives a non-zero amount of money to V_2 after the second election, and, analogously, whether a type 2 candidate gives a non-zero amount of money to V_1 after the first election. In these cases giving cannot be motivated by the candidate's self-interest and hence is evidence of intrinsic reciprocity.¹²

As seen in the histograms in Figures 4.4 and 4.5, while some candidates are selfish, many give a substantial reward to the voter who elected her. Indeed, on average candidates give a positive amount of money to the voter who elected them: type 1 candidates give \$1.61 and \$3.31 to V_2 in the second election in treatments NILC and NIHC respectively (Table 4.2 and Figure 4.4); type 2 candidates give \$2.59 and \$4.93 to V_1 in the first election in treatments NILC and NIHC respectively (Table 4.2 and Figure 4.5). Furthermore, since there exists positive mass above $x_2=\$3.33$ in Figure 4.4 and $x_1=\$5$ in Figure 4.5, it is clear that $\theta > \frac{1}{3} = \frac{X-Y}{X}$, an important condition for constrained reciprocity in the signalling games without altruism.

¹²One might argue that candidates are free from reelection concerns in the second election of treatments 1 and 2, so that if a type 1 candidate gives a non-zero amount of money to voter 2 in the second election, then this would indicate intrinsic reciprocity. However, when signalling of type is possible after the first election, it may be that observed candidate behavior after the second election behavior may be affected by signalling mechanism in the first election, including selection of more selfish types in the semi-separating equilibrium as discussed in the formal model.

Figure 4.4: Type 1 Candidate Reciprocity

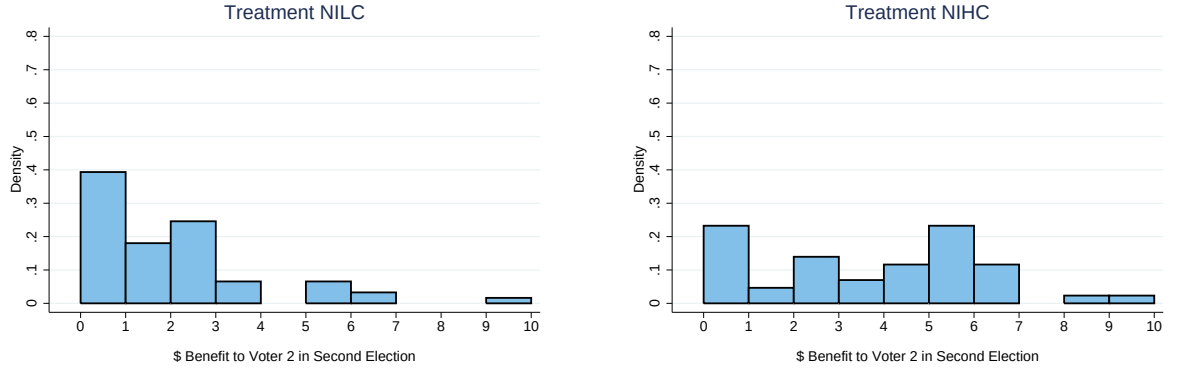
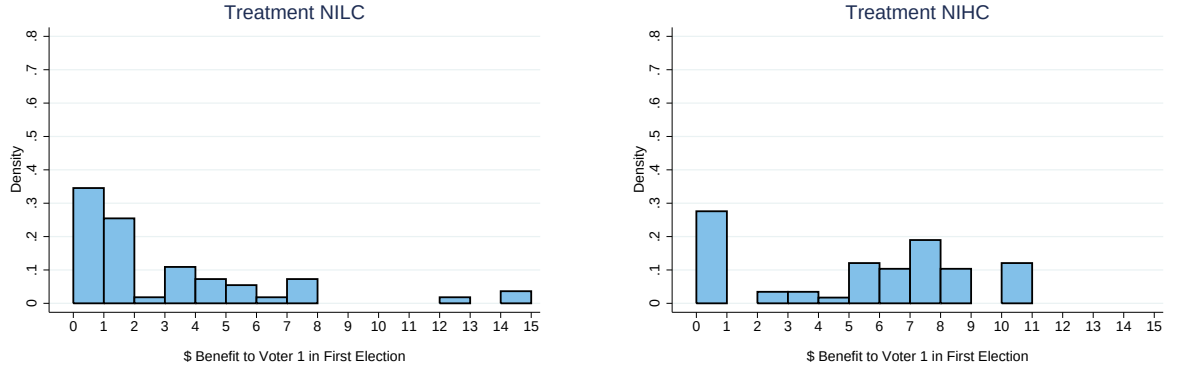


Figure 4.5: Type 2 Candidate Reciprocity



Next, we estimate the average value of θ and test whether it is statistically different from zero in table 4.4. We use an OLS regression of the percentage benefits given by a type 2 (type 1) candidate to voter 1 in election one (voter 2 in election two) on a constant term, a linear term for the period to account for possible learning effects across periods (which we do not find) and clustered at the candidate level (to account for serial correlation in a given candidate's choices). The coefficient on the constant term can be interpreted as an estimate of the expected value of θ . We find that the constant term is significant and positive in both treatments (NILC and NIHC), indicating that θ is statistically different from zero, and ranges from

an average of 17.4% to 41.1%. It is interesting to note that the amount of intrinsic reciprocity is greater in the high voting cost game (NIHC) than the low voting cost game (NILC). This might reflect candidates showing higher reciprocity when voting costs are higher.

Table 4.4: OLS of Instrinsic Reciprocity

	Type 1 Candidate % Benefit to V_2 in Election 2		Type 2 Candidate % Benefit to V_1 in Election 1	
	(1)	(2)	(3)	(4)
	Treat NILC	Treat NIHC	Treat NILC	Treat NIHC
Period	-0.033* (0.0165)	-0.029 (0.0258)	-0.000 (0.0219)	-0.0215 (0.0181)
Constant	0.261*** (0.0713)	0.411*** (0.0957)	0.174** (0.0669)	0.398*** (0.0852)
Observations	61	43	55	58
R-squared	0.068	0.027	0.000	0.015
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				
Clustered at candidate level.				

Additionally, we observe evidence of altruism. Note that type 1 candidates give on average \$1.39 and \$3.12 to V_2 in the first election of treatments NILC and NIHC respectively (see Table 4.2). Similarly, type 2 candidates give a positive amount to V_1 in the second election, with an average of \$1.28 and \$1.98 in treatments NILC and NIHC respectively. This is consistent with the model incorporating altruism and a positive α for some candidates.

4.5.3 High Cost of Voting Games

Here, we explore the results for the high cost of voting games with and without room for signalling. We find results consistent with the theoretical model. First, there is clear evidence that not all candidates are selfish. Consistent with the existence of non-selfish desires, type 1 and type 2 candidates do not fully separate in the first election at the extremes of $x_1=\$15$ and $x_1=\$0$ respectively. Instead, we observe many interior values of x_1 both with (treatment SHC) and without (treatment NIHC) reelection motives.

Furthermore, we find that aggregate behavior closely resembles the constrained reciprocity equilibrium outlined in Proposition 11 in Appendix C.1. That is, reciprocal type 2 candidates must constrain their reciprocity to ensure their reelection. Furthermore, the less reciprocal type 1 candidates mimic the highly reciprocal type 2 candidates and are reelected, while the remaining type 1 candidates choose $x_1=\$15$ and forego reelection. Lastly, V_2 's actions also reflect play in this equilibrium. His propensity to vote increases with his benefits received in the first election. Indeed, V_2 's behavior most closely resembling a cut-off strategy, with his likelihood of voting increasing significantly if he receives x_2 around \$5-\$6 or more in the first election.

4.5.3.1 Type 2 Candidates: Constrained Reciprocity

Our main finding is that type 2 candidates who display reciprocity limit the amount they give to V_1 in the first election, deviating from their first-best in order to help their reelection chances. We regard this as a key result, as it indicates that

reelection concerns may limit reciprocity. Let's consider the results as a whole.

When the cost of voting is high, we find that some type 2 candidates are selfish, but the majority display reciprocity towards V_1 in the first election. In treatment SHC (treatment NIHC), 31.88% (21.67%) of candidates give $x_1 = \$0$ to V_1 in the first election, and the remaining 68.12% (78.33%) select interior values of x_1 . We focus on the motives of the reciprocal type 2 candidates.

We show evidence of the constraints signalling concerns place on a type 2's intrinsic reciprocity. As shown in Table 4.5, type 2 candidates give on average \$2.11 more to V_1 in the no information game than in the signalling game (\$4.93 in treatment NIHC and \$2.82 in treatment SHC). The same trend is found if restricting the data to type 2 candidates who select $x_1 > \$0$ and thus might be labeled reciprocal (\$6.35 in treatment NIHC and \$4.50 in treatment SHC). Note in Table 4.8 that type 2 candidates give on average \$1.12 more to V_1 in the second election of the no information game than the signalling game. While our theory does not account for this difference in type 2 second election behavior, we note that it is not very large.

Table 4.5: Type 2 Candidate \$ Benefit to V_1 with High Cost of Voting

	First Election	Second Election
Treat SHC	2.82 (2.97)	0.82 (1.39)
Treat NIHC	4.93 (3.60)	1.98 (1.82)
Observations	117	86
P-values	0.001	0.001

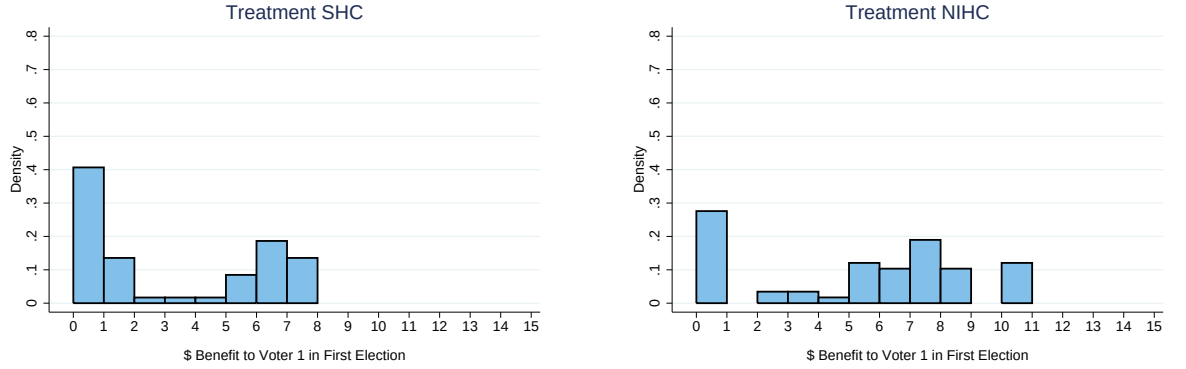
Mean, standard deviation in parentheses.

P-values based on two-tailed t-test.

The constrained reciprocity in the first election can be seen visually in the

histograms in Figure 4.6. There is much less density towards the right of the treatment SHC graph than the right of the treatment NIHC graph, and the rightmost (maximum) choice of x_1 is also lower (\$7.5 in treatment SHC and \$11 in treatment NIHC), reflecting a constraint at some x_1^* .

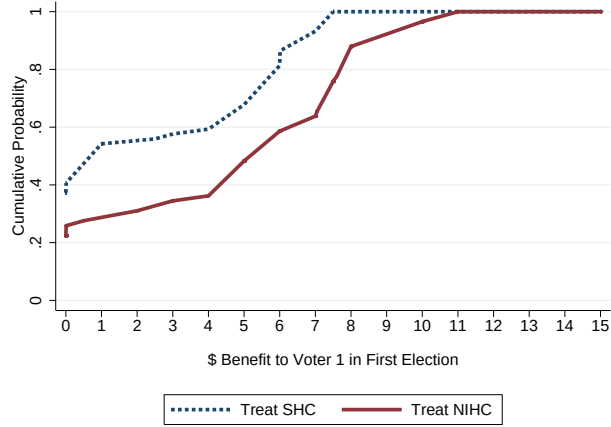
Figure 4.6: Type 2 Candidate First Election Benefits with High Cost of Voting



Furthermore, Figure 4.7 shows that the CDF of type 2 candidate giving to V_1 in the first election of treatment NIHC first-order stochastically dominates that in treatment SHC. We find this to be significant using the first order stochastic dominance test in [Barrett and Donald \[2003\]](#).¹³

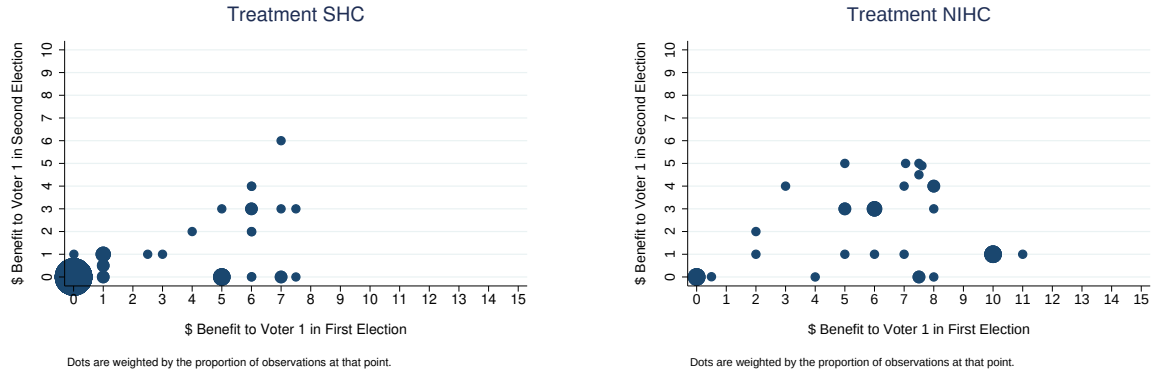
¹³We use a bootstrap of size 1,000 to calculate p-values. The test consists of two steps. We first test the null hypothesis that the treatment NIHC distribution either first order stochastically dominates or is equal to the treatment SHC distribution in the \$0 to \$15 range. We cannot reject the null, with a corresponding p-value of 0.719. We then test the null hypothesis that the treatment SHC distribution first order stochastically dominates or is equal to the treatment NIHC distribution (in the \$0 to \$15 range). We reject this null hypothesis in this case, with a corresponding p-value of 0.077.

Figure 4.7: Type 2 Candidate First Election Benefits with High Cost of Voting



The scatter plots in Figure 4.8 display the benefit given to V_1 in each election. As one can see, there is a lot more mass to the left side of the treatment SHC scatter plot than the treatment NIHC scatter plot, indicating that in the former type 2 candidates constrain their reciprocity to V_1 .

Figure 4.8: Type 2 Candidate \$ Benefit to V_1 in the Two Elections with High Cost of Voting



Finally, in Table 4.6 we test whether the apparent constraints that reelection places on reciprocity are statistically significant. We use a two-limit Tobit regression to account for censoring from below (\$0) and above (\$15). The coefficient on the

treatment NIHC dummy shows that the amount type 2 candidates give to V_1 in the first election is significantly higher without signalling motives than with signalling motives.

Table 4.6: Two-Limit Tobit, Type 2 Candidate \$ Benefit to V_1 in Election 1 (Treatments SHC vs NIHC)

Treat NIHC	2.944** (1.196)
Period	-0.629** (0.241)
Constant	3.507*** (0.925)
Observations	117
*** p<0.01, ** p<0.05, * p<0.1 SE clustered at candidate level.	

4.5.3.2 Type 1 Candidate Mimicking

We find that some type 1 candidates play their first-best in distributing first election benefits, thus foregoing reelection, while at the same time, many type 1 candidates pool with type 2 candidates in order to be reelected. Furthermore, we show evidence that the type 1 candidates who pool with type 2 candidates to be reelected tend to be less reciprocal.

First, note that signalling motives lead type 1 candidates to mimic type 2 candidates to help their reelection chances. As shown in Table 4.7, type 1 candidates give on average \$1.83 more to V_2 in the first election of the signalling game than the no information game (\$4.95 in treatment SHC and \$3.12 in treatment NIHC).

Table 4.7: Type 1 Candidate \$ Benefit to V_2 with High Cost of Voting

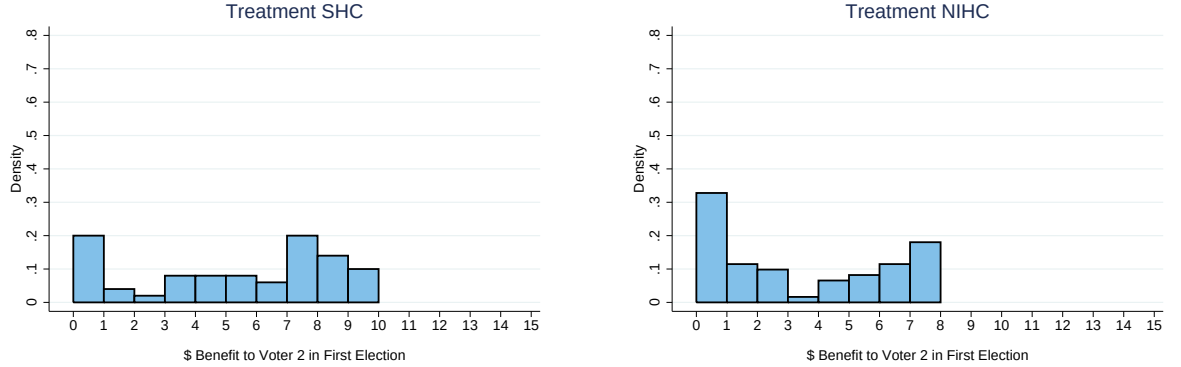
	First Election	Second Election
Treat SHC	4.95 (3.26)	2.36 (2.77)
Treat NIHC	3.12 (2.96)	3.31 (2.50)
Observations	111	65
P-values	0.003	0.170

Mean, standard deviation in parentheses.

P-values based on two-tailed t-test.

This can be seen visually in the histograms in Figure 4.9 showing type 1 candidate choices of x_2 . There is much higher density towards the the middle in the treatment SHC histogram (higher benefit to V_2) and left in the treatment NIHC histogram (lower benefit to V_2).

Figure 4.9: Type 1 Candidate First Election Benefits with High Cost of Voting



This may also be seen in Figure 4.10, which shows that the CDF of what type 1 candidate benefits to V_2 in the first election of treatment SHC first-order stochastically dominates that in treatment NIHC. We find this to be significant using the first order stochastic dominance test in [Barrett and Donald \[2003\]](#).¹⁴

¹⁴We use a bootstrap of size 1,000 to calculate p-values. We first test the null hypothesis that the

Figure 4.10: Type 1 Candidate First Election Benefits with High Cost of Voting

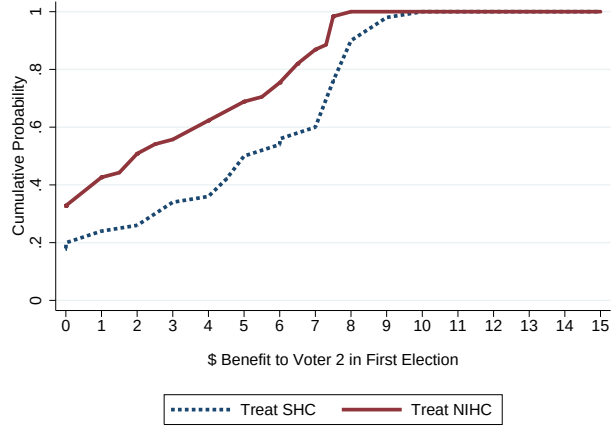


Table 4.8 presents a two-limit (from below at \$0 and above at \$15) Tobit regression clustered at the candidate level (to account for serial correlation in a given candidate's choices). The coefficient on the treatment 4 dummy shows that the amount type 1 candidates give to V_2 in the first election is significantly lower in treatment NIHC than in treatment SHC, that is, without versus with the possibility of signalling.

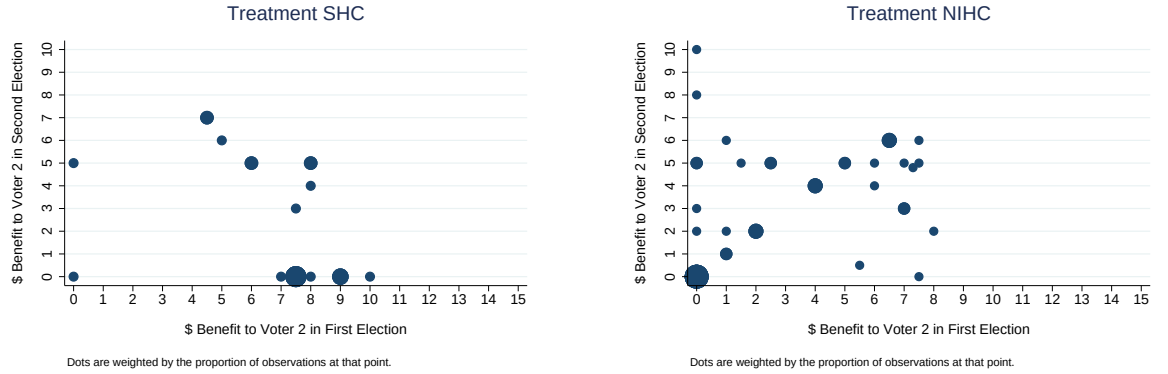
treatment SHC distribution either first order stochastically dominates or is equal to the treatment NIHC distribution in the \$0 to \$15 range. We fail to reject this null hypothesis, the corresponding p-value is 0.664. We then test the null hypothesis that the treatment NIHC distribution first order stochastically dominates or is equal to the treatment SHC distribution (in the \$0 to \$10 range). We reject the null hypothesis in this case, with a corresponding p-value of 0.079.

Table 4.8: Two-Limit Tobit, Type 1 Candidate \$ Benefit
to V_2 in Election 1 (Treatments SHC vs NIHC)

Treat NIHC	-2.374** (1.116)
Period	-0.535** (0.265)
Constant	6.178*** (0.893)
Observations	111
*** p<0.01, ** p<0.05, * p<0.1 SE clustered at candidate level.	

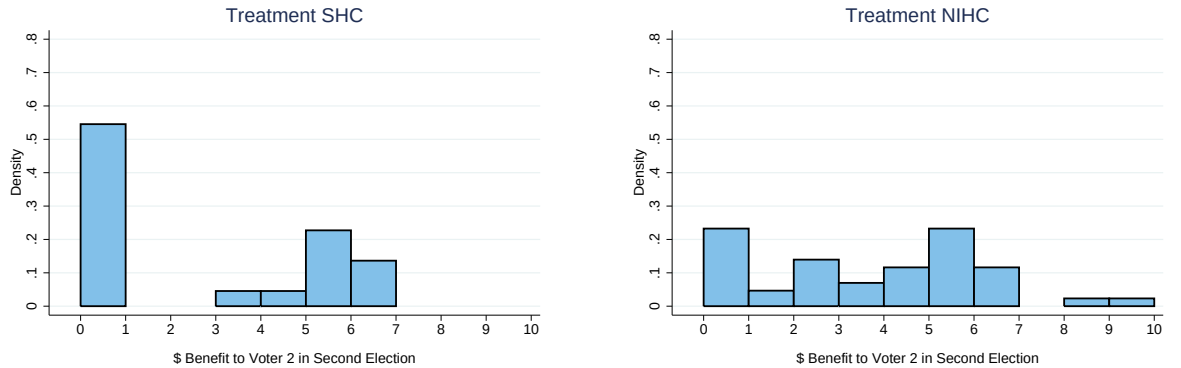
While it is clear that mimicking is going on, an important next question is what kind of type 1 candidates are mimicking? While both types are concerned about reelection, we saw in the theoretical model that the least reciprocal type 1 candidates earn the highest utility gain from reelection, and are thus most likely to mimic. The scatter plots of distribution of benefits to V_2 in the first and second election in Figure 4.11 suggest that this is likely the case. The large mass at the bottom left of the treatment NIHC graph disappears in the treatment SHC graph, and a new mass appears in the bottom middle. This suggests that many of the mimickers are selfish, with a signalling motive leading her to give near half of total dollar benefits to V_2 in the first election but little in the second election.

Figure 4.11: Type 1 Candidate \$ Benefit to V_2 in the Two Elections with High Cost of Voting



Similarly, Figure 4.12 shows the distribution of type 1 candidates benefits to V_2 in the second election. There is much higher density to the left of the treatment SHC histogram, indicating that the reelected type 1 candidates tend to be less reciprocal and more selfish in the signalling game than in the no information game.

Figure 4.12: Type 1 Candidate Second Election Benefits with High Cost of Voting



Indeed, of the type 1 candidates who give between \$6 and \$10 to V_2 in the first election of treatment SHC (which constitutes 48.00%, or 24 out of 50 type 1 candidate observations), 66.67% are reelected (16 of 24 type 1 candidate observations); and, of those that are reelected, 62.50% (10 of 16 give type 1 candidate

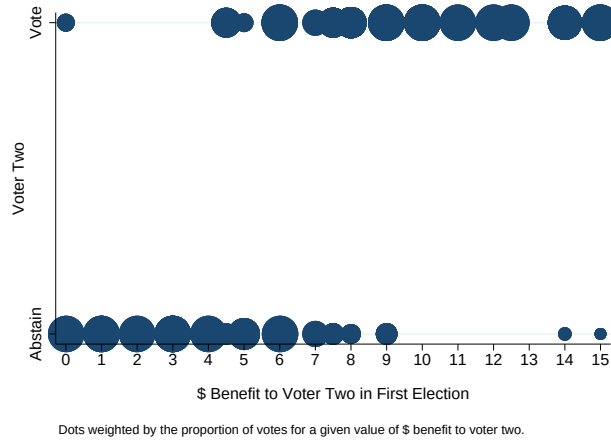
observations) give nothing to V_2 and the entire \$10 to V_1 in the second election. Mimicking increases their total payoff above the \$15 they would receive if they simply maximized their first period payoff by giving everything to V_1 in the first election as short-sighted selfishness would dictate.

4.5.3.3 V_2 's Propensity to Vote

Is restricting x_1 an effective reelection strategy for type 1 and type 2 candidates? To answer that question, we consider the voting behavior of V_2 in the signalling game with high voting costs. We show that V_2 is substantially more likely to vote not simply when C is indeed type 2 (remember that C's type is never directly revealed to V_2), but also the higher is the amount of money he received in the first election (the higher is x_2).

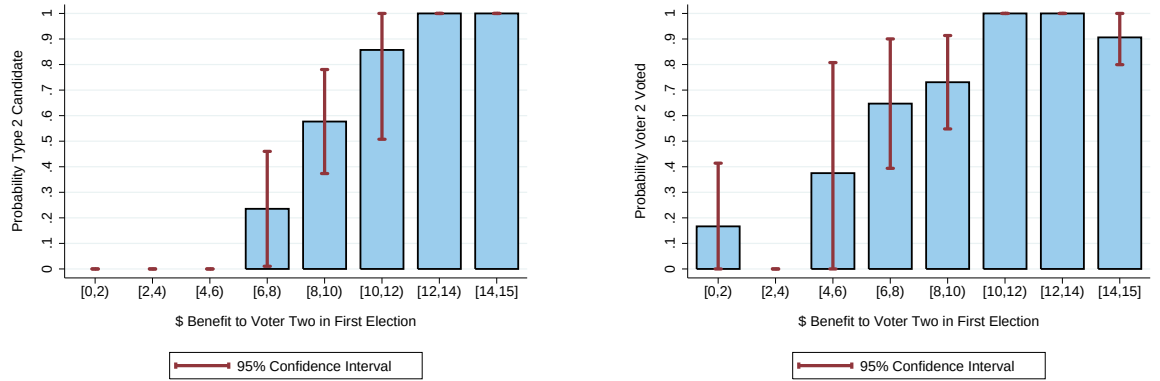
First, we look at V_2 's propensity to vote given his benefits received in the first election (x_2). The scatter plot in Figure 4.13 shows that the likelihood of V_2 voting increases in x_2 , and strongly suggests that he uses a cut-off strategy, only considering voting when he receives at least \$5 to \$8 in the first election.

Figure 4.13: V_2 Decision by Benefit Received in First Election



Furthermore, Figure 4.14 shows that both the probability of V_2 's voting and a type 2 candidate decline sharply near this range. This lends greater credibility to the premise of the data representing equilibrium play.

Figure 4.14: Probabilities of Candidate Type and V_2 Voting by x_2 in Treatment SHC



Let's more closely examine V_2 's abstention rate given a candidate's type. When the candidate is in fact type 2, V_2 abstains only 13.6% of the time (8 of 59 observations), about the same as the 12.8% overall abstention by V_1 in the first election of treatment SHC (16 of 125 observations) and much lower than the 34.5% overall

abstention by V_2 in treatment NIHC where he had no information about either x_1 or the candidate's type (41 of 119 observations). We might expect some subjects to always abstain due to high risk aversion. In contrast, when the candidate is in fact type 1, V_2 abstains 56% of the time (28 of 50 observations), much higher than the 13.6% abstention rate with a type 2 candidate and the 34.5% abstention rate with no information. Note that the significant non-zero abstention rate when the candidate is actually type 2 can be explained by some subjects having high risk aversion, combined with uncertainty about candidate type.

This is confirmed in the logit regression results in Table 4.9 which shows V_2 's likelihood of voting is significantly higher when facing a type 2 candidate in the signalling treatment with high voting costs.

Table 4.9: Logit Results on Marginal Effect of Candidate's Type on V_2 's Probability of Voting in Treatment SHC

Type 2	0.520*** (4.47)
Period	-0.0709* (-2.21)
Observations	109
Baseline Predicted Probability	0.579

t statistics in parentheses

Baseline predicted probability calculated for treatment SHC, period 1 and a type 1 candidate.

SE clustered at voter two level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.5.4 Low Cost of Voting Games

We now turn to the results with a low cost of voting, with (treatment SLC) and without (treatment NILC) reelection motives. As in the high cost of voting games, we find that type 1 and type 2 candidates do not fully separate in the first election at the extremes of $x_1=\$15$ and $x_1=\$0$ respectively, as evidence for the existence of non-selfish candidate motives. In fact, we find more interior than non-interior choices of x_1 in the first election.

Consider first the choice of a type 2 candidates. Our main finding, consistent with the result in Section 5, is that with low voting cost, there is no discernible conflict between showing intrinsic reciprocity to V_1 and getting reelected, even when such benefits are observable by V_2 . That is, type 2 candidates can largely show their desired reciprocity to V_1 without hurting their reelection chances. This is a key finding of the paper.

As in the high cost of voting games, the results suggest that some type 1 candidates pool with reciprocal type 2 candidates in order to get reelected, and the type 1 candidates who do so tend to be less reciprocal. Meanwhile, other type 1 candidates play their first election first-best and forego reelection.

Lastly, we show that V_2 is more likely to vote in more money received after the first election, employing a strategy that most closely resembles a cut-off strategy.

4.5.4.1 Type 2 Candidates: Unconstrained Reciprocity

When the cost of voting is low we find that some type 2 candidates are selfish, but the majority display reciprocity towards V_1 in the first election (as was the case with a high cost of voting). In treatment SLC (treatment NILC), 24.00% (32.76%) of candidates give $x_1 = \$0$ to V_1 in the first election, and the remaining 76.00% (67.24%) select interior values of x_1 . Again, we focus on the motives of the non-selfish type 2 candidates.¹⁵

As Corollary 1 in the online Appendix suggests might be the case, the results show no clear sign that type 2 candidates meaningfully limit their reciprocity in order to get reelected in the signalling game with a low cost of voting. That is, we see no discernible differences in choices made by type 2 candidates when signalling of type is possible (treatment SLC) and when it is not (treatment NILC): in both cases they play their first best or close enough to their first best to be indistinguishable.

This can be seen in Table 4.10 showing the mean type 2 candidate first election benefits to V_1 in the two treatments. Type 2 candidates display intrinsic reciprocity to V_1 in the first election of both treatments. If anything, they give a little more (\$0.91) to V_1 when type may be signaled by distribution of benefits than when it cannot. This is the opposite direction from what one would expect if the need to signal created a conflict between intrinsic reciprocity and the desire to be reelected,

¹⁵The fact that more type 2 candidates select $x_1 > \$0$ in treatment SLC (76.00%) than in treatment SHC (68.12%) is consistent with a higher cost of voting constraining a type 2's reciprocity. The fact that fewer type 2 candidates select $x_1 > \$0$ in treatment NILC (67.24%) than in treatment NIHC (78.33%) is consistent with a candidate's reciprocal motives increasing with the cost of voting.

as is the case with a high cost of voting.

Table 4.10: Type 2 Candidate \$ Benefit to V_1 with Low Cost of Voting

	First Election	Second Election
Treat SLC	3.50 (3.29)	1.62 (2.06)
Treat NILC	2.59 (3.53)	1.28 (1.77)
Observations	104	98
P-values	0.180	0.381

Mean, standard deviation in parentheses.

P-values based on two-tailed t-test.

The histograms in Figure 4.15 and CDFs in Figure 4.16 also shows no apparent impact of restricting reciprocity when V_2 uses first election choices to update his voting decision. We find the CDFs to be equal using the first order stochastic dominance test in Barrett and Donald [2003].¹⁶ Furthermore, considering only those type 2 candidates who are reelected (which is 98% of them), the scatter plots in Figure 4.17 show they give similar amounts to V_1 in the first election of treatments SLC and NILC, indicating unconstrained reciprocity.

¹⁶We use a bootstrap of size 1,000 to calculate p-values. We first test the null hypothesis that the treatment NILC distribution either first order stochastically dominates or is equal to the treatment SLC distribution in the \$0 to \$15 range. We cannot reject the null, with a corresponding p-value of 0.637. We then test the null hypothesis that the treatment SLC distribution first order stochastically dominates or is equal to the treatment NILC distribution (in the \$0 to \$15 range). We again cannot reject the null hypothesis in this case, with a corresponding p-value of 0.629.

Figure 4.15: Type 2 Candidate First Election Benefits with Low Cost of Voting

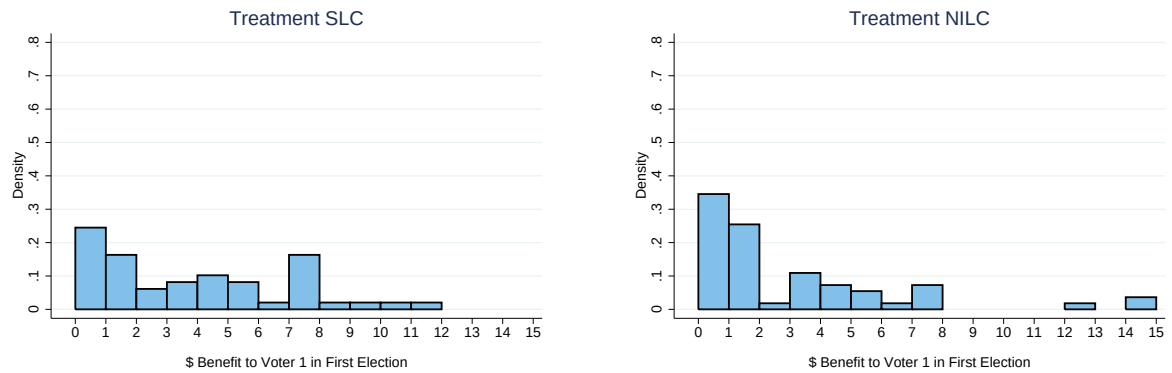


Figure 4.16: Type 2 Candidate First Election Benefits with Low Cost of Voting

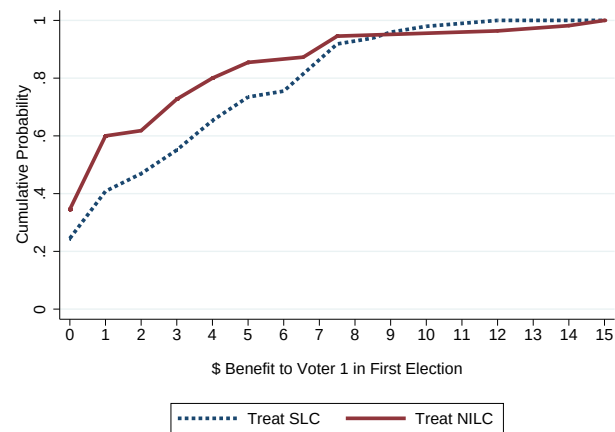
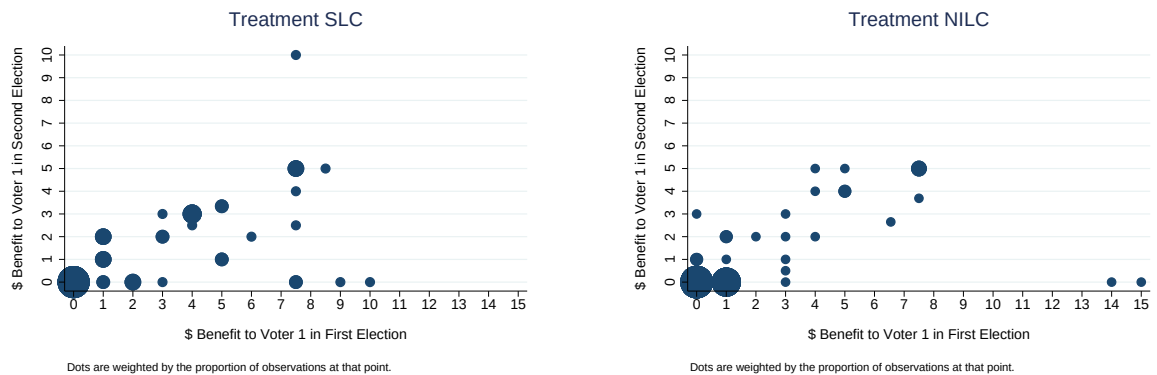


Figure 4.17: Type 2 Candidate \$ Benefit to V_1 in the Two Elections with Low Cost of Voting



In the Tobit regression shown in Table 4.11, the coefficient on the treatment

3 dummy confirms that there is no statistically significant difference in type 2 candidate choice of first election benefits when these benefits may affect V_2 's choice of whether to vote or abstain and when they cannot.

Table 4.11: Two-Limit Tobit, Type 2 Candidate \$ Benefit to V_1 in Election 1 (Treatments SLC vs NILC)

Treat NILC	-1.250 (1.237)
Period	0.0714 (0.313)
Constant	2.585* (1.452)
Observations	104
*** p<0.01, ** p<0.05, * p<0.1 SE clustered at candidate level.	

4.5.4.2 Type 1 Candidate Mimicking

Next, we show evidence that type 1 candidates pool with type 2 candidates in order to help their reelection chances. As shown in Table 4.12, type 1 candidates give on average \$4.54 more to V_2 in the first election when signalling of type is possible than when it is not. (\$5.93 in treatment SLC and \$1.39 in treatment NILC).

Table 4.12: Type 1 Candidate \$ Benefit to V_2 with High Cost of Voting

	First Election	Second Election
Treat SLC	5.93 (2.21)	1.39 (1.87)
Treat NILC	1.39 (2.16)	1.61 (1.96)
Observations	135	109
P-values	0.000	0.554

Mean, standard deviation in parentheses.

P-values based on two-tailed t-test.

This can be seen visually in the histograms in Figure 4.18 showing type 1 candidate first election benefits to V_2 , with much higher density towards the left in the treatment NILC histogram (lower benefit to V_2) and the middle in the treatment SLC histogram (higher benefit to V_2).

Figure 4.18: Type 1 Candidate First Election Benefits with High Cost of Voting

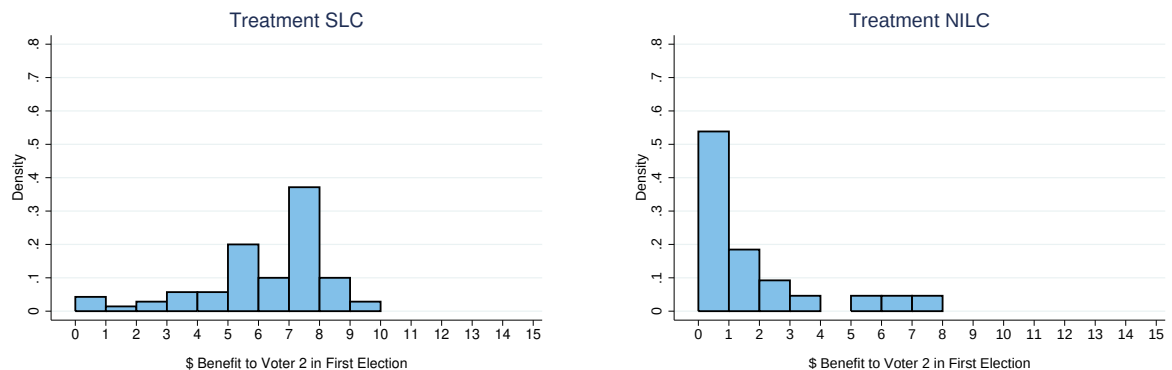
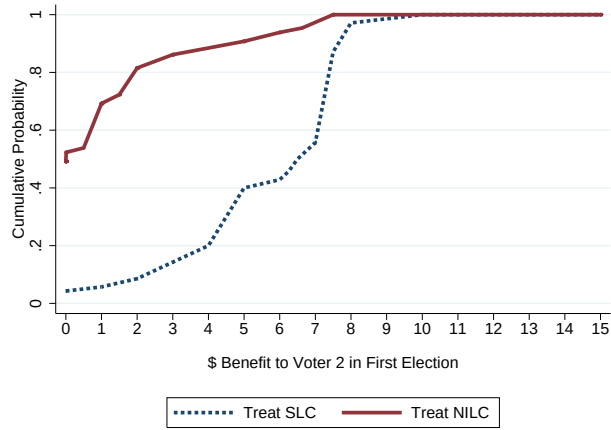


Figure 4.19 shows that the CDF of type 1 candidate giving to V_2 in the first election of treatment SLC first order stochastically dominates that in treatment NILC. We find this to be significant using the first order stochastic dominance test in Barrett and Donald [2003].¹⁷

¹⁷We use a bootstrap of size 1,000 to calculate p-values. We first test the null hypothesis that the treatment SLC distribution either first order stochastically dominates or is equal to the treatment NILC distribution in the \$0 to \$15 range. We fail to reject this null hypothesis, the corresponding p-value is 0.589. We then test the null hypothesis that the treatment NILC distribution first order stochastically dominates or is equal to the treatment SLC distribution (in the \$0 to \$15 range). We reject the null hypothesis in this case, with a corresponding p-value of 0.00.

Figure 4.19: Type 1 Candidate First Election Benefits with Low Cost of Voting



This pattern is confirmed by the Tobit regression in Table 4.13, which shows that this difference in a type 1 candidate's first election behavior with and without the possibility of signalling type is statistically significant.

Table 4.13: Two-Limit Tobit, Type 1 Candidate \$ Benefit to V_2 in Election 1 (Treatments SLC vs NILC)

Treat NILC	-5.461***
	(0.713)
Period	-0.137
	(0.134)
Constant	6.264***
	(0.542)
Observations	135

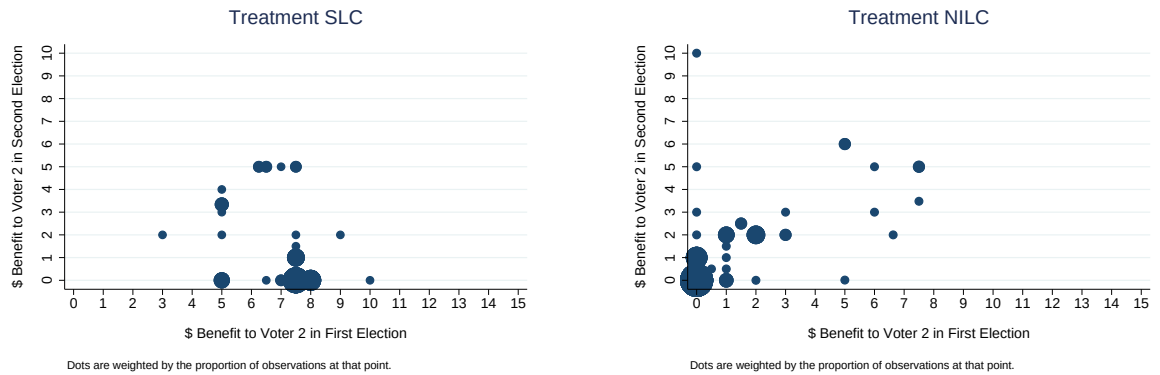
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

SE clustered at candidate level.

As in the case with a high voting cost, we argue pooling with type 2 candidates is often driven by more selfish rather than more reciprocal type 1 candidates. The scatter plots in Figure 4.20 show type 1 candidate giving in both elections of each treatment. It seems that the large mass to the bottom left of the treatment NILC

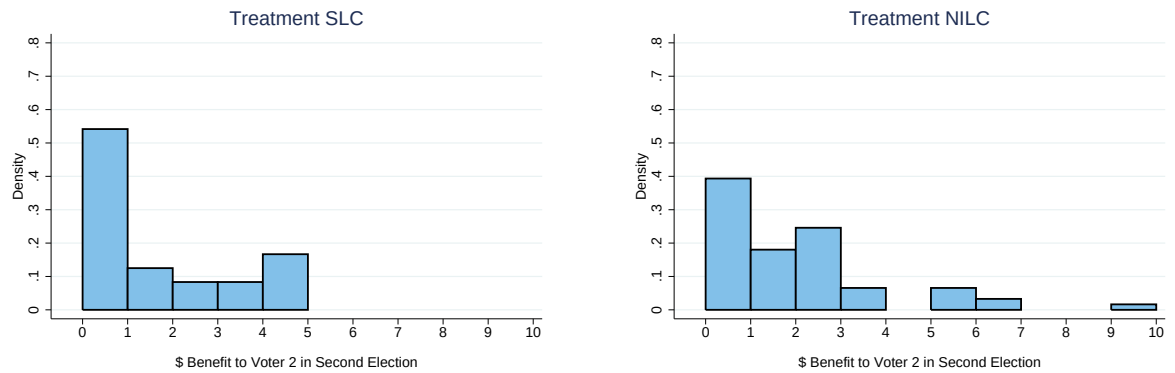
graph disappears in the treatment SLC graph, and a new mass appears in the bottom middle. This supports the claim that many of the mimickers are more selfish, as the signalling motive induces her to give near half of the pie to V_2 in the first election but little to V_2 in the second election.

Figure 4.20: Type 1 Candidate \$ Benefit to V_2 in the Two Elections with Low Cost of Voting



Similarly, Figure 4.21 shows the average benefits by type 1 candidates to V_2 in the second election. There is higher density to the left of the treatment SLC histogram, indicating that the reelected type 1 candidates tend to be less reciprocal and more selfish in the signalling game than in the no information game.

Figure 4.21: Type 1 Candidate Second Election Benefits with Low Cost of Voting



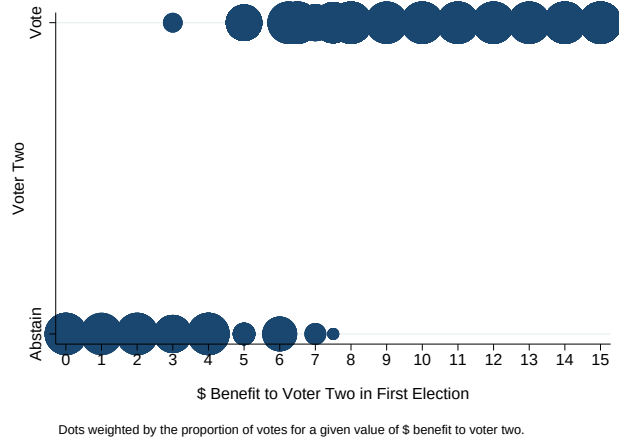
Indeed, as shown in Figure 4.18 above, the modal amount of benefits type 1 candidates give to V_2 in the first election of treatment SLC is \$7.5 (31%, or 22 out of 70 candidate observations), exactly half the pie. Of the type 1 candidates who give between \$4 and \$10 to V_2 in the first election of treatment SLC (which constitutes 84.29%, or 59 out of 70 type 1 candidate observations), 77.97% are reelected (46 out of 59 candidate observations). Of those that are reelected, 54.35% (25 out of 46 type 1 candidate observations) give \$0 to V_2 in the second election and 65.22% (30 out of 46 type 1 candidate observations) give \$1 or less. As argued above in the case of high voting costs, by not giving \$15 to V_1 after election 1, as one period optimization would imply, they get reelected and enjoy a higher overall utility.

4.5.4.3 V_2 's Propensity to Vote

Lastly, we consider the voting behavior of V_2 in the signalling game with a low voting cost. While V_2 voted in fairly high proportions due to the low voting cost, we find — analogous to the high voting cost case, that he is substantially more likely to vote the more money he received in the first election and when C is indeed type 2 (where C 's type is never directly revealed to V_2).

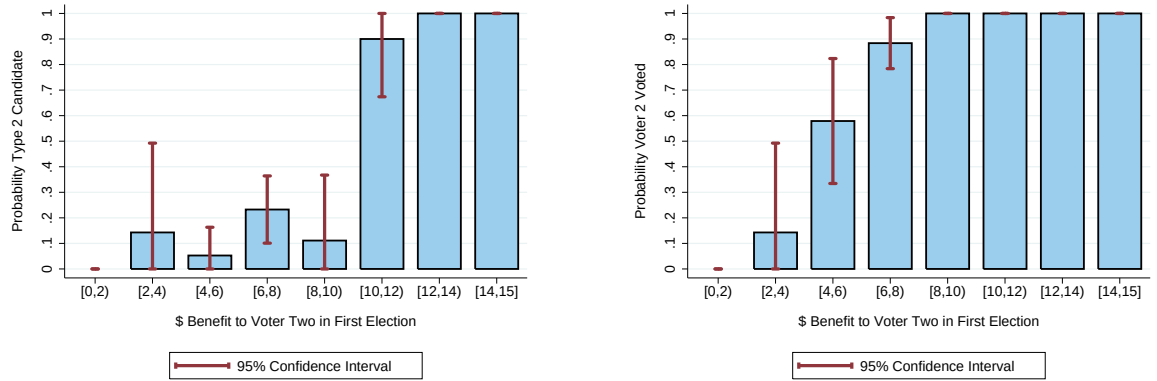
The scatter plot in Figure 4.22 shows clear evidence that V_2 uses a cut-off strategy, only considering voting when he receives at least \$5 to \$8 in the first election.

Figure 4.22: V_2 Decision by Benefit Received in First Election



This can also be seen in the histogram in Figure 4.23 which shows that both the probability of V_2 's voting and of a type 2 candidate declines sharply near this range.

Figure 4.23: Probabilities of Candidate Type and V_2 Voting by x_2 in Treatment SLC



Let's examine V_2 's abstention rate for each type of candidate in treatment SLC. When the candidate is in fact type 2, V_2 abstains only 2.0% of the time (1 out of 49 observations), slightly lower than the 4.8% overall abstention by V_1 in treatment SLC (6 out of 125 observations) and the 7.5% overall abstention (9 out

of 120 observations) by V_2 in treatment NILC when there is no possibility of the candidate signalling her type with no information. In contrast, when C is in fact type 1, V_2 abstains 31.4% of the time (22 out of 70 observations), significantly lower than V_2 's 56.0% abstention rate found when voting costs were high. Additionally, this is much higher than the 2.0% abstention rate with a type 2 candidate and the 7.5% abstention when no information about candidate type is conveyed.

The type 2 candidate dummy in the logit regression results in Table 4.14 shows that V_2 's voting likelihood is significantly higher when facing a type 2 candidate (when candidates' first election choices are observable to him).

Table 4.14: Logit Results on Marginal Effect of Candidate's Type on V_2 's Probability of Voting in Treatment SLC

Type 2	0.688**
	(3.16)
Period	0.0184
	(0.48)
Observations	119
Baseline Predicted Probability	0.655

t statistics in parentheses

Baseline predicted probability calculated

for treatment SLC, period 1 and a type 1 candidate.

SE clustered at voter two level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.5.5 Interpreting Constrained Reciprocity

Put simply, our results indicate that the degree of reciprocity depends on the perceived consequences for reelection. When gratitude is seen as posing little threat to reelection, we see reciprocity to past voters. When gratitude is seen as potentially

costly, that is, in sending “the wrong message” to voters so that they do not vote to reelect, the candidate constrains her reciprocity. Hence, reciprocity is not an absolute depending on simply underlying preferences, but reflects the circumstances in which a candidate finds herself.

This argument applies more generally. While reciprocity is a common human trait (see Brown [1991], pp. 107-108), the amount of reciprocity actually shown will depend on the situation in which people find themselves. As discussed in the literature review, it has been argued that external factors such as social pressure, social image, or norms may lead to an increase apparently reciprocal behavior that do not really represent intrinsic reciprocity. That is, self-interested agents may be induced to show “kindness” because of external constraints. Our results indicate that the argument goes both ways, where (very different) sorts of constraints may lead other-regarding agents to not show reciprocity even though they are inherently reciprocal.

The argument that external circumstances help determine how one acts has another implication central to the design of our experiment. Our basic premise is a clear implication of a principal-agent model. The desire of an agent to be retained in a position will lead her to act to satisfy the principal who has the power over this decision, and may limit inherent gratitude to other agents who put her in the position to begin with. That is, the situation of wanting to be “reelected” to a position influences behavior in addition to any inherent other-regarding preferences (or lack of them, in the case of selfish candidates who mimic in order to be reelected). For incumbent politicians, the desire to be reelected is a key “constraint” on their

behavior when it comes to courting potential voters, as argued in the introduction. Hence, an experiment putting individuals in the situation where retention in office is key to their material payoffs seems a good laboratory to test how such concerns affect their inherent reciprocity, even though the subjects themselves are not professional politicians.

4.6 Conclusion

Reelection or retention is a key desire of officeholders. Reciprocity to kind actions is a key characteristic of human behavior. How will this desire affect gratitude to voters who were responsible for the leader to be in office in the first place, when such reciprocity conflicts with the likelihood of reelection? We study this conflict in a theoretical model of a setting where reelection requires a candidate signalling to the relevant voters that she shares their policy preferences. We then test the model in a laboratory experiment and find its predictions are upheld. We think the model is interesting in itself in presenting a reelection strategy not common in the literature (and hence may provide a useful approach to modeling electoral strategies), but the more novel part of the paper is the experiment and its results.

We may divide our results into two parts. First, we find that in a setting where attracting voters means signalling unobserved candidate type, subjects in the lab act in accordance with a basic signalling model. Candidates play their first-best choices where signalling is not possible but restrict those choices when signalling of type may help their reelection chances. Voters appear to read the signals correctly.

Second, we find that in the laboratory that the desire to be reelected may limit intrinsic reciprocity of an elected leader to reciprocate to the voters who put her in office, but does not eliminate it entirely. In other words, reciprocity still is present in elected leaders (in the lab) even when put in a situation where “political” concerns, such as the desire to be reelected, are also present.

This would certainly seem to be descriptive of other-regarding individuals. Instrumental concerns may reduce their kindness and reciprocity to kindness, but do not generally eliminate them. We would argue the same is true for politicians and elected leaders in the real world. Elected officials are grateful to the voters who elected them. If self-interest fully (T)rumps gratitude, it is probably because those officials weren’t very other-regarding to begin with.

Appendix A: Persuasive Advertising in Conformist and Snobbish Markets

A.1 Social Status

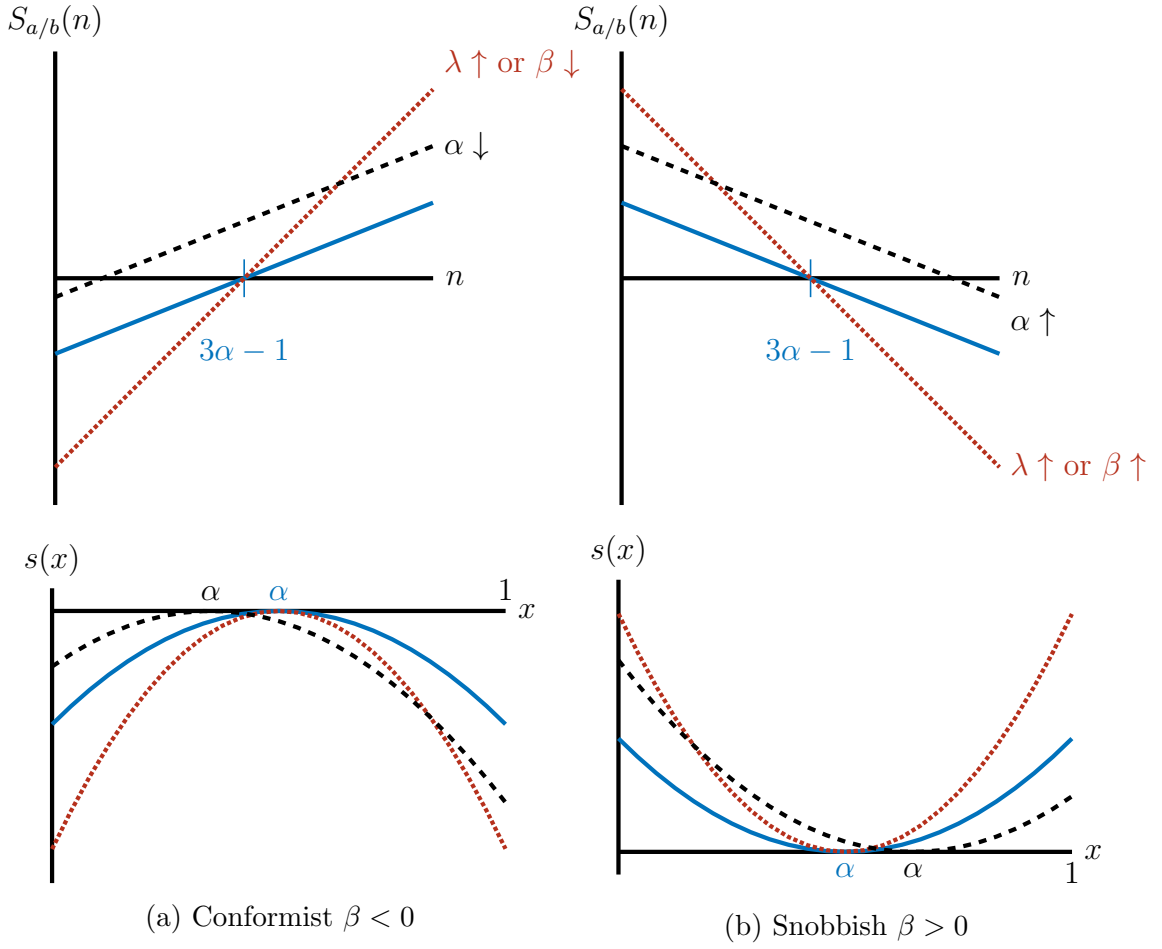


Figure A.1: Reputation Gain Function Implied by Social Status Function

$$s(x) = \beta(x - \alpha)^2$$

$$S_{a/b}(n) = -\frac{\lambda\beta}{3}n + \lambda\beta(\alpha - \frac{1}{3})$$

A.2 Tie-Breaking Rule for Undifferentiated Firms

If firms choose alike locations $\ell_a = \ell_b$, then the single crossing property of consumer demand fails, and demand can, but does not necessarily have to follow the cut-off rule described in Lemma 1. This issue also arises in the standard Hotelling model without status motives.

The Hotelling literature usually accommodates this by assuming, à la Bertrand competition, that homogeneous firms evenly split the market at $n = \frac{1}{2}$ if they charge equivalent prices, and the firm with the lower price captures all demand if they charge different prices. I impose the same tie-breaking rule here in the case of a standard market where $\lambda\beta = 0$.

However, this is not always a possible demand partition in a market with reputational motives. For example, in a snobbish market, some consumers might still shop at the higher priced firm even if firms are undifferentiated. Furthermore, in a conformist market, consumers prefer to all buy from same firm when alike firms charge alike prices.

To extend the tie-breaking rule to the cases of snobbery and conformity, I assume that demand follows the partition described in the analysis preceding that is most advantageous to firm A . This helps ensure the existence of equilibria by making firm A 's profit function upper-semi continuous in (ℓ_a, λ_a) . For example, consider snobbish market in which $\alpha \geq \frac{1}{2}$ and the firm to the left has a prestige advantage. I then assume firm A captures the demand described by it being to the left as in equation (2.13) with $\ell_a = \ell_b$: $\hat{n} = \frac{p_b - p_a + \lambda\beta(\alpha - \frac{1}{3})}{\lambda\frac{\beta}{3}}$. If instead $\alpha < \frac{1}{2}$ and

$\lambda\beta > 0$, then firm A captures demand: $\hat{n} = \frac{p_a - p_b + \lambda\beta(\frac{2}{3} - \alpha)}{\lambda\frac{\beta}{3}}$.

In a conformist market, the lack of differentiation between firms implies the market is characterized by strong conformity. If the firm to the left has a prestige advantage and $\alpha \leq \frac{1}{2}$, then I assume demand follows the partition described by the strongly conformist case with firm A to the left as in Figure 2.3b. If instead the firm to the right has a prestige advantage and $\alpha < \frac{1}{2}$, then I assume that firm A captures the demand described by the strongly conformist case where $\ell_a \geq \ell_b$ (constructed by flipping the a and b terms in Figure 2.3b).

A.3 Monopoly Pricing

Here, I establish prices in the monopoly subgame resulting from firm B not entering the market. In congruence with the oligopoly subgame, I maintain the traditional assumption that v is sufficiently large that a monopolist supplies the whole market.

The calculation of the signaling gains from purchasing good a parallels that in the oligopoly case at the beginning of the section. Here, the signaling gains from good a , call it $S_{a/\emptyset}$, are the perceived status of a consumer who purchases less than that of a consumer who picks the outside option of not purchasing (rather than less than that of a consumer who purchases good b). Since every consumer purchases in equilibrium, the signaling gains from purchasing are determined by the advertisement receiving public's off-equilibrium beliefs about a consumer's identity should she not purchase.¹

I restrict attention to the following off-equilibrium beliefs. A consumer who does not purchase is believed to be the consumer at the end furthest from the good and, thus benefiting most from foregoing purchase. That is, $\rho(x = 1 | \emptyset, \Omega) = 1$ if $\ell_a < \frac{1}{2}$ and $\rho(x = 0 | \emptyset, \Omega) = 1$ if $\ell_a > \frac{1}{2}$. If $\ell_a = \frac{1}{2}$, then consumers at both ends benefit equally from not purchasing. In this case, I assume that a consumer who does not purchase is believed to be at the end with the lower social status: $\rho(x = 1 | \emptyset, \Omega) = 1$ if $\beta \geq 0$ and $\alpha \geq \frac{1}{2}$, or if $\beta < 0$ and $\alpha \leq \frac{1}{2}$; and $\rho(x = 0 | \emptyset, \Omega) = 1$ otherwise.² These off-equilibrium beliefs are reasonable and congruent with the

¹Just as in the conformist case with takeover, where the signaling gains from the favored good are determined by off-equilibrium beliefs about a consumer's identity should she purchase the less favored good.

²This makes firm A 's profit function upper semi-continuous at $\ell_a = \frac{1}{2}$, helping ensure the

off-equilibrium beliefs assumed in an oligopolistic market.

If a consumer who foregoes purchase is believed to be at end $x = 1$, then $S_{a/\emptyset} = \lambda\beta(\frac{2}{3} - \alpha)$. If a consumer who does not purchase is believed to be at end $x = 0$, then $S_{a/\emptyset} = \lambda\beta(\alpha - \frac{1}{3})$. Firm A charges the highest price such that a consumer located at the furthest end is just indifferent to purchasing $U_x(a) = U_x(\emptyset)$. Firm A 's monopoly price, and likewise revenues, is:

$$p_a^M = \begin{cases} v - \tau(1 - \ell_a)^2 + \lambda\beta(\alpha - \frac{2}{3}) & \text{if } \ell_a < \frac{1}{2} \\ & \text{or } \ell_a = \frac{1}{2}, \beta < 0 \text{ and } \alpha \leq \frac{1}{2} \\ & \text{or } \ell_a = \frac{1}{2}, \beta > 0 \text{ and } \alpha \geq \frac{1}{2} \\ v - \tau\ell_a^2 - \lambda\beta(\alpha - \frac{1}{3}) & \text{otherwise} \end{cases} \quad (\text{A.1})$$

existence of an equilibria.

A.4 Proofs

A.4.1 Proof of Lemma 1

A proof by contradiction is given here. Suppose not. Without loss of generality (WLOG), suppose $\ell_a < \ell_b$. Furthermore, suppose a consumer at some point $x' \in [0, 1]$ purchases good b while a consumer at $x'' \in (x', 1]$ purchases good a . Let $S_a \in \Re$ and $S_b \in \Re$ denote the signaling value of choosing goods A and B respectively. For this to be equilibrium behavior, it must be that the expected utility gains to consumer x'' from good a over good b are weakly greater than that of consumer x' .

$$\begin{aligned} U_{x''}(a) - U_{x''}(b) &\geq U_{x'}(a) - U_{x'}(b) \\ (v - \tau(x'' - \ell_a)^2 - p_a + S_a) &- (v - \tau(x'' - \ell_b)^2 - p_b + S_b) \\ &\geq (v - \tau(x' - \ell_a)^2 - p_a + S_a) - (v - \tau(x' - \ell_b)^2 - p_b + S_b) \end{aligned}$$

Canceling like terms, this is equivalent to $-(x'' - \ell_a)^2 + (x'' - \ell_b)^2 \geq -(x' - \ell_a)^2 + (x' - \ell_b)^2$. Further simplifying, this is equivalent to $x'' \leq x'$. This is a contradiction.

A.4.2 Proof of Lemma 2

($\Rightarrow$) Suppose $S_{a/b}(n) = kn + c$. Equation (11) in [Corneo and Jeanne \[1997\]](#) shows that $S_{a/b}(n)$ can be rationalized by any social status function of the form $s(x) = (1 - 2x)S_{a/b}(x) + x(1 - x)S'_{a/b}(x) + d$ where d is an arbitrary constant. This yields $s(x) = (1 - 2x)(kx + c) + x(1 - x)k + d = -3kx^2 + 2x(k - c) + cs + d$. $s(x)$

is quadratic, $s''(x) = -6k$, and $S'_{a/b}(n) = k$.

($\Leftarrow$) Let $s(x) = k_1x^2 + k_2x + c$. Then, $S_{a/b}(n) = \frac{\lambda}{n} \int_0^n s(x)dx - \frac{\lambda}{n} \int_n^1 s(x)dx = -\frac{k_1}{3}(n+1) - \frac{k_2}{2}$. Furthermore, $s''(x) = 2k_1$ and $S'_{a/b}(n) = -\frac{k_1}{3}$.

A.4.3 Proof of Proposition 1

Suppose $\beta > 0$. Furthermore, WLOG, suppose $\ell_a \leq \ell_b$ and $\alpha \geq \frac{1}{2}$. Then, $\frac{dp_a^*}{d\lambda} = \alpha \frac{\beta}{3} \geq \frac{dp_b^*}{d\lambda} = (1-\alpha) \frac{\beta}{3} \geq 0$. Additionally:

$$\frac{dn^*}{d\lambda} = \frac{[2\tau(\ell_b - \ell_a) + \lambda \frac{\beta}{3}][\alpha \frac{\beta}{3}] - [\frac{\tau}{3}(\ell_b - \ell_a)(2 + \ell_a + \ell_b) + \lambda \alpha \frac{\beta}{3}][\frac{\beta}{3}]}{[2\tau(\ell_b - \ell_a) + \lambda \frac{\beta}{3}]^2}$$

The denominator is always positive. Thus, the sign of $\frac{dn^*}{d\lambda}$ is the sign of the numerator. The numerator is positive if $\ell_a + \ell_b < 6\alpha - 2$, zero if $\ell_a + \ell_b = 6\alpha - 2$, and negative if $\ell_a + \ell_b > 6\alpha - 2$. The same technique can be applied to show that $\frac{d(1-n^*)}{d\lambda} > 0$ if $\ell_a + \ell_b > 6\alpha - 2$, $\frac{dn^*}{d\lambda} = 0$ if $\ell_a + \ell_b = 6\alpha - 2$ and $\frac{d(1-n^*)}{d\lambda} < 0$ otherwise.

A.4.4 Proof of Proposition 2

Suppose $\beta < 0$ and neither firm takes over the market. Furthermore, WLOG, suppose $\ell_a < \ell_b$ and $\alpha \leq \frac{1}{2}$. Then, $\frac{dp_b^*}{d\lambda} = (1-\alpha) \frac{\beta}{3} \leq \frac{dp_a^*}{d\lambda} = \alpha \frac{\beta}{3} \leq 0$. The value of $\frac{dn^*}{d\lambda}$ is given in the proof of Proposition 1. The denominator of $\frac{dn^*}{d\lambda}$ is always positive. Thus, the sign of $\frac{dn^*}{d\lambda}$ is the sign of the numerator. The numerator of $\frac{dn^*}{d\lambda}$ is greater than zero if $\ell_a + \ell_b > 6\alpha - 2$, equals zero if $\ell_a + \ell_b = 6\alpha - 2$ and is negative otherwise.

The same technique can be applied to show that $\frac{d(1-n^*)}{d\lambda} > 0$ if $\ell_a + \ell_b < 6\alpha - 2$, $\frac{dn^*}{d\lambda} = 0$ if $\ell_a + \ell_b = 6\alpha - 2$ and $\frac{d(1-n^*)}{d\lambda} < 0$ otherwise. Finally, if $\ell_a = \ell_b$ then the market is characterized by strong conformity so the proposition does not apply.

A.4.5 Proof of Proposition 3

Suppose Axiom 1 holds in a strongly conformist market.

First, consider Figure 2.5a where the D_1 and D_2 lines lie on opposite sides of the 45 degree line. I will show that no strictly positive price vector $(p_a, p_b) > (0, 0)$ can be a price equilibrium. Recall that on the 45 degree line partitions n_a , n_b and $\hat{n}$ are possible, and on the D_1 and D_2 lines only partitions n_a and n_b are possible. Consider a strictly positive price vector to the right of 45 degree line with partition n_a . This cannot be a price equilibrium because firm B can lower its price to some point to the left of the 45 degree line and earn positive revenues. The same applies to any strictly positive price vector to the left of the 45 degree line with partition n_b , because firm A lower its price and earn positive revenues. Additionally, there is no strictly positive price vector on the D_1 line (D_2 line) with partition n_b (n_a) that can be a price equilibrium, because firm A (firm B) can raise its price by an arbitrarily small epsilon and earn positive revenues. Similarly, there is no strictly positive price vector on the 45 degree line with consumer partition n_a , n_b or $\hat{n}$ that can be a price equilibrium, because one firm would have an incentive to lower its price by an arbitrarily small epsilon and earn greater revenues. Thus, we are only left with price vectors for which one or both of the firms charge a zero price. Consider a price vector

such that $p_b = 0$ and $p_a > 0$. This cannot be a price equilibrium, because firm B could improve its revenues by raising its price by some arbitrarily small epsilon and earning market share n_b . The same holds mutatis mutandis for any price vector such that $p_b > 0$ and $p_a = 0$. We are left to prove that the price vector $(p_a, p_b) = (0, 0)$ can be supported as an equilibrium for any consumer partition $n^* \in \{\hat{n}, n_a, n_b\}$. At such a price vector, both firms earn zero revenues. This zero price vector can be supported as an equilibrium if consumers settle on the following partitions off the equilibrium path: consumers settle on partition n_b at the point on the D_2 line where $p_b = 0$, and consumers settle on partition n_a at the point on the D_1 line where $p_a = 0$. In this case, neither firm can improve its revenues by raising its price. Thus, $(p_a, p_b) = (0, 0)$ is a price equilibrium.

Next, consider the case of Figure 2.5b where the D_1 and D_2 lines lie above the 45 degree line. There is no price vector on the D_1 line or above it with partition $n = n_b$ that can be supported as a price equilibrium, because firm A could lower its price and earn positive revenues. Furthermore, no price vector on the D_2 line with $n = n_a$ can be supported as a price equilibrium, because firm B can raise its price by epsilon and capture the market. This leaves us with price vectors on the D_1 line with partition n_a , and price vectors below it. There cannot exist a price equilibrium below the D_1 line, because firm A would have an incentive to raise its price. There also cannot be a price equilibrium on the D_1 line with strictly positive prices, because one firm would have an incentive to lower its price and improve its revenues by capturing the market. This leaves only the price vector on the D_1 line such that $p_b = 0$. This can be supported as a price equilibrium if consumers settle

on partition n_a , because then neither firm can improve its revenues by changing its price. The same arguments apply mutatis mutandis to the case of Figure 2.5c where the D_1 and D_2 lie to the right of the 45 degree line.

A.4.6 Proof of Proposition 4

Suppose $\beta = 0$. For convenience, I denote firm strategies as pairs (ℓ_a, λ_a) and (ℓ_b, λ_b) . The price strategies firms associate with their location and advertising choices are given by equations (2.14) - (2.15). First, let's consider an equilibrium where $\ell_b^* \geq \ell_a^*$. The profit functions of firms at the location and advertising stages are:

$$\pi_a = \frac{\tau}{18}(\ell_b - \ell_a)(2 + \ell_a + \ell_b)^2 - \frac{c}{2}\lambda_a^2$$

$$\pi_b = \frac{\tau}{18}(\ell_b - \ell_a)(4 - \ell_a - \ell_b)^2 - \frac{c}{2}\lambda_b^2$$

From these profit functions, it is apparent that neither firm advertises in any equilibrium since $\frac{d\pi_a(\lambda_a, \ell_a, \lambda_b, \ell_b)}{d\lambda_a} = \frac{d\pi_b(\lambda_a, \ell_a, \lambda_b, \ell_b)}{d\lambda_b} = -c \leq 0$. Next, I examine firm locations. Suppose firm A locates at some $\ell_a \in [0, 1)$. Firm B 's strategy $(1, 0)$ strictly dominates any other strategy $(\ell_b, 0)$ such that $\ell_b \geq \ell_a$ since $\frac{d\pi_b(\lambda_a, \ell_a, \lambda_b, \ell_b)}{d\ell_b} > 0$ for all $\ell_b \geq \ell_a$. Similarly, given that firm A anticipates firm B choosing strategy $(1, 0)$, firm A 's strategy $(0, 0)$ strictly dominates any other strategy $(\ell_a, 0)$ such that $\ell_a \leq \ell_b$ since $\frac{d\pi_a(\lambda_a, \ell_a, \lambda_b, \ell_b)}{d\ell_a} < 0$ for all $\ell_a \leq 1$. Thus, $(\ell_a, \lambda_a) = (0, 0)$ and $(\ell_b, \lambda_b) = (1, 0)$ is an equilibrium. Furthermore, firms are indifferent between locating at either of opposing ends, because each earns profits $\frac{\tau}{2}$ in either case. Therefore, $(\ell_a, \lambda_a) =$

$(1, 0)$ and $(\ell_b, \lambda_b) = (0, 0)$ is another equilibrium. There are no other equilibria since firms do not advertise in any equilibrium and must locate at opposite ends.

A.4.7 Proof of Proposition 5

Suppose $\beta > 0$. Suppose either $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, or $\alpha \in [0, \frac{1}{3}) \cup (\frac{2}{3}, 1]$ and β is not too large. The proof proceeds as follows. I begin by evaluating and establishing the existence of firm B 's best response $(\ell_b, \lambda_b) \in [0, 1]^2$ to any firm A strategy $(\ell_a, \lambda_a) \in [0, 1]^2$. Following, I demonstrate the existence of firm A 's maximization over strategies $(\ell_a, \lambda_a) \in [0, 1]^2$, where firm A incorporates firm B 's best response into its program.

Given firm A chooses some $(\ell_a, \lambda_a) \in [0, 1]^2$, firm B must decide between locating to the left or right of firm A . Let firm B consider maximizing profits on each side of ℓ_a in turn. Let $\Gamma^L(\ell_a, \lambda_a) : [0, 1]^2 \rightarrow [0, 1]^2$ denote firm B 's best response such that $\ell_b \leq \ell_a$. Similarly, let $\Gamma^R(\ell_a, \lambda_a) : [0, 1]^2 \rightarrow [0, 1]^2$ denote firm B 's best response such that $\ell_b \geq \ell_a$. I show below that i) $\Gamma^L(\ell_a, \lambda_a)$ and $\Gamma^R(\ell_a, \lambda_a)$ are well-defined upper hemi-continuous correspondences, ii) $\ell_b^L = 0$ for all $(\ell_b^L, \lambda_b^L) \in \Gamma^L$ and iii) $\ell_b^R = 1$ for all $(\ell_b^R, \lambda_b^R) \in \Gamma^R$. For any given $(\ell_a, \lambda_a) \in [0, 1]^2$, firm B 's profits to the left $\ell_b < \ell_a$ and right $\ell_b > \ell_a$ of firm A are given respectively by:

$$\pi_b^L(\ell_b, \lambda_b; \ell_a, \lambda_a) = \frac{(p_b^L)^2}{2\tau(\ell_a - \ell_b) + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_b^2 \quad (\text{A.2})$$

$$\pi_b^R(\ell_b, \lambda_b; \ell_a, \lambda_a) = \frac{(p_b^R)^2}{2\tau(\ell_b - \ell_a) + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_b^2 \quad (\text{A.3})$$

where $p_b^L = \frac{\tau}{3}(\ell_a - \ell_b)(2 + \ell_a + \ell_b) + \lambda\alpha\frac{\beta}{3}$, $p_b^R = \frac{\tau}{3}(\ell_b - \ell_a)(4 - \ell_a - \ell_b) + \lambda(1 - \alpha)\frac{\beta}{3}$ and $\lambda = \lambda_a + \lambda_b - \lambda_a\lambda_b$. Firm B 's profits when $\ell_b = \ell_a$ are given by (A.2) if $\alpha \leq \frac{1}{2}$, and equation (A.3) otherwise. Thus, technically firm B 's profits are discontinuous

at $\ell_b = \ell_a$ when $\alpha \neq \frac{1}{2}$. However, it will be shown that firm B does not locate at the discontinuity. For exposition's sake, consider firm B 's maximization of (A.2) on the domain $0 \leq \ell_b \leq \ell_a$ and $\lambda_b \in [0, 1]$, and firm B 's maximization of (A.3) on the domain $\ell_a \leq \ell_b \leq 1$ and $\lambda_b \in [0, 1]$. The partial derivative of equation (A.2) with respect to ℓ_b is:

$$\frac{d\pi_b^L}{d\ell_b} = \frac{-\frac{4\tau}{3} (1 - \ell_b) p_b^L [2\tau(\ell_a - \ell_b) + \lambda \frac{\beta}{3}] + 2\tau p_b^{L^2}}{[2\tau(\ell_a - \ell_b) + \lambda \frac{\beta}{3}]^2} \quad (\text{A.4})$$

I will show that equation (A.4) is strictly negative for any $\ell_b \leq \ell_a$. This implies that $\ell_b^L = 0$ for all $(\ell_b^L, \lambda_b^L) \in \Gamma^L(\ell_a, \lambda_a)$. The denominator of equation (A.4) is always positive. Thus, the sign of the derivative is given by the sign of the numerator. Setting the numerator less than or equal to zero and simplifying yields:

$$2\tau(2 + 2\ell_b)(\ell_a - \ell_b) + (2 + 2\ell_b)\lambda \frac{\beta}{3} > \tau(\ell_a - \ell_b)(2 + \ell_a + \ell_b) + \lambda\alpha\beta \quad (\text{A.5})$$

Note that $2\tau(2 + 2\ell_b)(\ell_a - \ell_b) > \tau(\ell_a - \ell_b)(2 + \ell_a + \ell_b)$ simplifies to $2 + 3\ell_b > \ell_a$, which holds for all location pairs. Furthermore, $(2 + 2\ell_b)\lambda \frac{\beta}{3} \geq \lambda\alpha\beta$ if $\alpha \leq \frac{2}{3}$. Thus, inequality (A.5) holds if $\alpha \leq \frac{2}{3}$. If $\alpha > \frac{2}{3}$ and β is not too large, then inequality (A.5) still holds even if $(2 + 2\ell_b)\lambda \frac{\beta}{3} \leq \lambda\alpha\beta$, as the size of the first terms on each side of inequality (A.5) dominate the second. This implies that $\ell_b^L = 0$ for all $(\ell_b^L, \lambda_b^L) \in \Gamma^L(\ell_a, \lambda_a)$. Applying the same procedure to the derivative of equation (A.3) with respect to ℓ_b demonstrates that $\ell_b^R = 1$ for all $(\ell_b^R, \lambda_b^R) \in \Gamma^R(\ell_a, \lambda_a)$.

Denote firm B 's optimized profits to the left of firm A as $\pi_b^{L*}(\ell_a, \lambda_a) = \pi_b^L(\ell_b^L, \lambda_b^L; \ell_a, \lambda_a)$ where $(\ell_b^L, \lambda_b^L) \in \Gamma^L(\ell_a, \lambda_a)$, and firm B 's optimized profits to the

right of firm A as $\pi_b^{R*}(\ell_a, \lambda_a) = \pi_b^R(\ell_b^R, \lambda_b^R; \ell_a, \lambda_a)$ where $(\ell_b^R, \lambda_b^R) \in \Gamma^R(\ell_a, \lambda_a)$. Note that firm A 's profit function defined by equation (A.2) is continuous in $\ell_b, \lambda_b, \ell_a$ and λ_a over the compact constraint set $0 \leq \ell_b \leq \ell_a$ and $0 \leq \lambda_b \leq 1$. The same applies for firm A 's profit function defined by equation (A.3) over the compact constraint set $\ell_a \leq \ell_b \leq 1$ and $0 \leq \lambda_b \leq 1$. It then follows from Berge's Theorem of the Maximum that i) $\Gamma^L(\ell_a, \lambda_a)$ and $\Gamma^R(\ell_a, \lambda_a)$ are well-defined upper hemi-continuous correspondences and ii) $\pi_b^{R*}(\ell_a, \lambda_a)$ and $\pi_b^{L*}(\ell_a, \lambda_a)$ are continuous functions [Border, 1985, p.64].

Next, I move to firm A 's problem. Define $L \in [0, 1]^2$ as the set of firm A strategies that make firm B 's profits at least as great from locating to the right of firm A as to the left of firm A : $\{(\ell_a, \lambda_a) | 0 \leq \ell_a \leq 1, 0 \leq \lambda_a \leq 1, \text{ and } \pi_b^{L*}(\ell_a, \lambda_a) \leq \pi_b^{R*}(\ell_a, \lambda_a)\}$. Similarly, define $R \in [0, 1]^2$ as the set of firm A strategies that make firm B 's profits at least as great from locating to the left of firm A as to the right of firm A : $\{(\ell_a, \lambda_a) | 0 \leq \ell_a \leq 1, 0 \leq \lambda_a \leq 1, \text{ and } \pi_b^{R*}(\ell_a, \lambda_a) \leq \pi_b^{L*}(\ell_a, \lambda_a)\}$. Since $\pi_b^{R*}(\ell_a, \lambda_a)$ and $\pi_b^{L*}(\ell_a, \lambda_a)$ are continuous, $L(\ell_a, \lambda_a)$ and $R(\ell_a, \lambda_a)$ are closed sets. Additionally, $L(\ell_a, \lambda_a)$ and $R(\ell_a, \lambda_a)$ are bounded within $[0, 1]^2$. Together, this implies that $L(\ell_a, \lambda_a)$ and $R(\ell_a, \lambda_a)$ are compact sets.

It will be shown that firm A 's maximization problem can be reduced to choosing between the two programs below:

$$\max_{(\ell_a, \lambda_a) \in L} \pi_a^L(\ell_a, \lambda_a) = \frac{(\frac{\tau}{3}(1 - \ell_a)(3 + \ell_a) + \lambda_a \frac{\beta}{3})^2}{2\tau(1 - \ell_a) + \lambda_a \frac{\beta}{3}} - \frac{c}{2} \lambda_a^2 \quad (\text{A.6})$$

where $\lambda = \lambda_a + \lambda_b - \lambda_b \lambda_a$ and $(1, \lambda_b) \in \Gamma^R(\ell_a, \lambda_a)$, or

$$\max_{(\ell_a, \lambda_a) \in R} \pi_a^R(\ell_a, \lambda_a) = \frac{(\frac{\tau}{3}(\ell_a)(4 - \ell_a) + \lambda(1 - \alpha)\frac{\beta}{3})^2}{2\tau(\ell_a) + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_a^2 \quad (\text{A.7})$$

where $\lambda = \lambda_a + \lambda_b - \lambda_b \lambda_a$ and $(0, \lambda_b) \in \Gamma^L(\ell_a, \lambda_a)$. Note that the above formulation of firm A 's programs assumes that firm A retains the profit function described when $\ell_a = \ell_b$. However, the tie-breaking rule at $\ell_a = \ell_b$ implies that firm A 's profits at such a location pair depends on whether $\alpha \gtrless \frac{1}{2}$. I will show that there does not exist $(\ell_a, \lambda_a) \in L$ such that $\ell_a = 1$ and there does not exist $(\ell_a, \lambda_a) \in R$ such that $\ell_a = 0$. Since $\ell_b^R = 1$ for all $(\ell_b^R, \lambda_b^R) \in \Gamma^R$, and $\ell_b^L = 0$ for all $(\ell_b^L, \lambda_b^L) \in \Gamma^L$, this is sufficient to establish that firm A 's problem can be reduced to the two programs above.

Suppose $(\ell_a, \lambda_a) \in L$ and $\ell_a = 1$. If $\alpha \leq \frac{1}{2}$, then firm B 's profits are described by equation (A.2) for all $\ell_b \leq \ell_a = 1$. As shown above, this implies firm B locates at $\ell_b = 0 < \ell_a = 1$. Thus, $(\ell_a, \lambda_a) \notin L$. If $\alpha > \frac{1}{2}$, then firm B 's profits are described by equation (A.2) for all $\ell_b < \ell_a = 1$ and by equation (A.3) when $\ell_b = \ell_a = 1$. Note that firm B 's profits are lower in equation (A.3) than in equation (A.2) given $\ell_b = \ell_a = 1$, and any λ_b, λ_a . Thus, firm B 's optimal location must come from maximization of equation (A.2) over $\ell_b < \ell_a$, and firm B chooses $\ell_b = 0 < \ell_a = 1$. Thus, $(\ell_a, \lambda_a) \notin L$. The same technique can be applied to show that does not exist $(\ell_a, \lambda_a) \in R$ such that $\ell_a = 0$. This demonstrates that firm A 's problem can be reduced to the two programs above.

Next, I show that there exists a solution to each of firm A 's programs above.

Note that $\Gamma^L(\ell_a, \lambda_a)$ and $\Gamma^R(\ell_a, \lambda_a)$ are upper-hemi continuous correspondences. In instances where $\Gamma^L(\ell_a, \lambda_a)$ or $\Gamma^R(\ell_a, \lambda_a)$ have multiple solutions, suppose that firm B choose the most preferred strategy (ℓ_b, λ_b) by firm A . This implies that firm A 's profit functions described in equations (A.6) and (A.7) are upper semi-continuous in (ℓ_a, λ_a) . Since the constraint sets $R(\ell_a, \lambda_a)$ and $L(\ell_a, \lambda_a)$ are compact, the extreme value theorem implies there exists a solution to each of firm A 's programs defined above [Hellwig and Leininger, 1987, p.60].

Let (ℓ_a^L, λ_a^L) and (ℓ_a^R, λ_a^R) denote solutions to programs (A.6) and (A.7) respectively. We need to just show that there exists a solution to firm A 's choice between the two programs. Without loss of generality, suppose that firm A 's profits are at least as great at (ℓ_a^L, λ_a^L) as at (ℓ_a^R, λ_a^R) . If $\pi_b^{R*}(\ell_a^L, \lambda_a^L) \neq \pi_b^{L*}(\ell_a^L, \lambda_a^L)$, then it immediately follows that there exists an equilibrium where firm A chooses (ℓ_a^L, λ_a^L) . If $\pi_b^{R*}(\ell_a^L, \lambda_a^L) = \pi_b^{L*}(\ell_a^L, \lambda_a^L)$, then let firm B locate at $\ell_b = 1 > \ell_a^L$ when firm A chooses (ℓ_a^L, λ_a^L) . It follows that there exists an equilibrium where firm A chooses (ℓ_a^L, λ_a^L) and firm B locates at $\ell_b = 1$.

A.4.8 Proof of Proposition 6

Suppose $\beta > 0$. Suppose either $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, or $\alpha \in [0, \frac{1}{3}) \cup (\frac{2}{3}, 1]$ and β is not too large.

(1): Proven in the main text.

(2): I will prove that either $\lambda_a^* > 0$ and/or $\lambda_b^* > 0$ by contradiction. Suppose there exists an equilibrium (ℓ_a^*, λ_a^*) and (ℓ_b^*, λ_b^*) in which $\lambda_b^* = \lambda_a^* = 0$. It is shown in the proof of Proposition 5 that firm B must locate at an end $\ell_b^* \in \{0, 1\}$ such that $\ell_b^* \neq \ell_a^*$. Without loss of generality, suppose $\ell_b^* = 0 < \ell_a^*$. At the equilibrium, firm B 's profits as a function of λ_b are:

$$\pi_b(\lambda_b) = \frac{(\frac{\tau}{3}\ell_a^*(2 + \ell_a^*) + \lambda_b\alpha\frac{\beta}{3})^2}{2\tau\ell_a^* + \lambda_b\frac{\beta}{3}} - \frac{c}{2}\lambda_b^2 \quad (\text{A.8})$$

Firm B must advertise $\lambda_b^* > 0$ if $\frac{d\pi_b(\lambda_b)}{d\lambda_b} > 0$ at $\lambda_b = 0$. It can be shown that $\frac{d\pi_b(\lambda_b)}{d\lambda_b} > 0$ at $\lambda_b = 0$ if and only if $\ell_a^* < 12\alpha - 2$. If $\alpha > \frac{1}{4}$, then this inequality holds for all ℓ_a^* . Thus, if $\alpha > \frac{1}{4}$, then $\lambda_b^* = 0$ cannot be part of an equilibrium.

Suppose instead $\alpha \leq \frac{1}{4}$. Holding $(\ell_b^*, \lambda_b^*) = (0, 0)$ fixed, firm A 's profits as a function of (ℓ_a, λ_a) are:

$$\pi_a(\ell_a, \lambda_a) = \frac{(\frac{\tau}{3}(\ell_a)(4 - \ell_a) + \lambda_a(1 - \alpha)\frac{\beta}{3})^2}{2\tau\ell_a + \lambda_a\frac{\beta}{3}} - \frac{c}{2}\lambda_a^2 \quad (\text{A.9})$$

Note that $\frac{d\pi_a}{d\lambda_a} > 0$ when $\lambda_a = 0$. Furthermore, when $\lambda_a = 0$, $\pi_a(\ell_a, \lambda_a)$ is maximized at $\ell_a = 1$, as shown in the proof of Proposition 4. If firm A chooses a strategy (ℓ'_a, λ'_a) where $\ell'_a = 1$ and $\lambda'_a > 0$, then firm B 's best reply is to choose $\ell_b = 0$ and some $\lambda_b \geq 0$. Firm A can then strictly improve its profits over its equilibrium strategy (ℓ_a^*, λ_a^*) where $\lambda_a^* = 0$ by choosing some (ℓ'_a, λ'_a) where $\ell'_a = 1$ and $\lambda'_a > 0$. Therefore, $\lambda_a^* = 0$ cannot be part of an equilibrium strategy for firm A .

(3): See proof of Proposition 5.

(4): Without loss of generality, suppose $\ell_a < \ell_b^* = 1$ and $\lambda^* > 0$. This implies:

$$\begin{aligned} p_a^* &= \frac{\tau}{3}(1 - \ell_a^*)(3 + \ell_a^*) + \lambda^* \alpha \frac{\beta}{3} \\ p_b^* &= \frac{\tau}{3}(1 - \ell_a^*)(3 - \ell_a^*) + \lambda^*(1 - \alpha) \frac{\beta}{3} \\ n^* &= \frac{p_a^*}{2\tau(1 - \ell_a^*) + \lambda^* \frac{\beta}{3}} \\ 1 - n^* &= \frac{p_b^*}{2\tau(1 - \ell_a^*) + \lambda^* \frac{\beta}{3}} \end{aligned}$$

where n^* is the market share of firm A , and $1 - n^*$ is the market share of firm B .

It is apparent that if one firm has a greater price than the other, then it also has greater market share. If $\alpha < \frac{1}{2}$, then firm B has the prestige advantage. In this case $p_b^* > p_a^*$. If $\alpha > \frac{1}{2}$, then firm A has the prestige advantage. The condition $p_a^* > p_b^*$ simplifies to $2\tau(1 - \ell_a^*)\ell_a^* > \lambda^*\beta(1 - 2\alpha)$. Since the left hand side of this inequality is positive, and the left hand side is negative, it follows that $p_a^* > p_b^*$.

A.4.9 Proof of Proposition 7

Suppose $\beta < 0$ and $\alpha \in [0, 1]$. The proof will make use of Theorem 1 in [Harris \[1985\]](#). A specialized version of the theory that is sufficient for present purposes says: Suppose a finite number of players move sequentially and choose actions from compact metric spaces. Furthermore, suppose the set of actions available to each player is independent of the actions made by other players, and each player's payoff is a continuous function of the actions of all players. Such a game has a subgame perfect equilibrium in pure strategies.

As shown in the proof of Proposition 8, firm A 's strategy at $t = 0$ can be broken down into deterring firm B 's entry and choosing an action $(\ell_a, \lambda_a) \in \Delta$ where Δ is a compact subset of $[0, 1]^2$, or choosing an action $(\ell_a, \lambda_a) \in [0, 1]^2 \setminus \Delta$ and accommodating firm B 's entry. If firm A deters firm B 's entry, then it earns monopoly profits. If firm A accommodates firm B 's entry, then it earns oligopoly profits as described in the main text.

First, suppose Δ is empty. Firm B must then enter in any equilibrium. It is shown in the proof of Proposition 8 that firms then locate at opposite ends. Thus, the game can be reduced to firms decisions over advertising given their exogenous locations at either end, with firm A choosing its more preferred end. In this reduced game, firms choose actions sequentially from independent and compact sets $\lambda_a \in [0, 1]$ and $\lambda_b \in [0, 1]$, and firms profit functions are continuous in their actions. Thus, we can apply Theorem 1 in [Harris \[1985\]](#) to guarantee the existence of an equilibrium in this reduced game. This equilibrium must also be an equilibrium of the original

game.

Next, consider the case in which Δ is non-empty. Firm A must decide between choosing a strategy $(\ell_a, \lambda_a) \in \Delta$ and earning monopoly profits, or choosing $(\ell_a, \lambda_a) \in [0, 1]^2 \setminus \Delta$, accommodating firm B 's entry and earning oligopoly profits. An equilibrium in which firm A deters entry is given by the solution to:

$$\begin{aligned} \max_{(\ell_a, \lambda_a)} \quad & \pi_a^M(\ell_a, \lambda_a) \\ \text{subject to} \quad & (\ell_a, \lambda_a) \in \Delta \end{aligned}$$

where π_a^M is as defined in equation (A.1). Since the objective function is upper semi-continuous, and the constraint set is compact, the extreme value theorem guarantees a solution to this program.

If firm A accommodates entry in equilibrium, then once again, the proof of Proposition 8 that firms then locate at opposite ends. Thus, the game can be reduced to firms decisions over advertising given their exogenous locations at either end, with firm A choosing its more preferred end. In this reduced game, firms choose actions sequentially from independent and compact sets $[0, 1]$, and firms profit functions are continuous in their action of advertising. Thus, we can apply Theorem 1 in Harris [1985] to guarantee the existence of an equilibrium in this reduced game. This equilibrium must also be an equilibrium of the original game.

A.4.10 Proof of Proposition 8

Suppose $\beta < 0$ and $\alpha \in [0, 1]$. One word on notation before proceeding. Since we have already solved for firm pricing decisions in the main text, I often refer to firm A and B 's strategy as pairs (ℓ_a, λ_a) and (ℓ_b, λ_b) respectively. Their associated pricing strategies are implied by the analysis in the main text.

Define the compact set Δ as the set of strategies $(\ell_a, \lambda_a) \in [0, 1]^2$ that imply firm B cannot earn positive profits from any $(\ell_b, \lambda_b) \in [0, 1]^2$. I consider equilibria where firm B does not enter if firm A chooses $(\ell_a, \lambda_a) \in \Delta$.

Claim 1: If β is sufficiently low, then there exists a non-empty, compact space $\Delta \subset [0, 1]^2$ such that firm B cannot earn positive profits from entry.

Proof of Claim 1. Suppose $\beta < 0$. Let $\Delta \subset [0, 1]^2$ be the set of $(\ell_a, \lambda_a) \in [0, 1]^2$ satisfying the inequalities below

$$\lambda \geq \frac{-\tau(1 - \ell_a)}{\beta} \min\left\{\frac{3 + \ell_a}{\alpha}, \frac{3 - \ell_a}{1 - \alpha}\right\} \quad (\text{A.10})$$

$$\lambda \geq \frac{-\tau\ell_a}{\beta} \min\left\{\frac{2 + \ell_a}{\alpha}, \frac{4 - \ell_a}{1 - \alpha}\right\} \quad (\text{A.11})$$

$$\lambda \geq \frac{-\tau(1 - \ell_a)^2}{\beta(\frac{2}{3} - \alpha)} \quad (\text{A.12})$$

$$\lambda \geq \frac{-\tau\ell_a^2}{\beta(\alpha - \frac{1}{3})} \quad (\text{A.13})$$

Δ defines the set of firm A strategies (ℓ_a, λ_a) that prevent firm B from earning positive profits at any $(\ell_b, \lambda_b) \in [0, 1]^2$. The significance of the inequalities is as

follows. Inequalities (A.10) and (A.11) ensure that one of the firms takes over when firm B chooses $(1, 0)$ and $(0, 0)$ respectively. It can be seen in Figure 2.5 that if $\ell_a \leq \ell_b$ ($\ell_a > \ell_b$) and some firm takes over when firm B chooses $(1, 0)$ ($(0, 0)$) so that the distance $D_1 - D_2$ is as large as possible, then some firm takes over for all other $(\ell_b, \lambda_b) \in [0, 1]^2$.

Inequalities (A.12) and (A.13) ensure that firm B earns non-positive profits when choosing $(1, 0)$ and $(0, 0)$ respectively. It can be seen in Figure 2.5 that if $\ell_a \leq \ell_b$ ($\ell_a > \ell_b$) and the D_2 line intercepts the p_a axis when firm B chooses $(1, 0)$ (the D_1 line intercepts the p_a axis when firm B chooses $(0, 0)$), then firm B does not earn positive profits for any other (ℓ_b, λ_b) in which takeover occurs.

Furthermore, since each of the inequalities forms a compact set in $[0, 1]^2$, Δ must be compact, as the intersection of compact sets is compact. Moreover, each of the inequalities becomes increasingly slack as β becomes increasingly negative. If β is sufficiently close to zero from below, then there are no $(\ell_a, \lambda_a) \in [0, 1]^2$ that satisfy all of the inequalities and Δ is empty. However, as $\beta \rightarrow \infty$, then $\Delta \rightarrow [0, 1]^2$. In other words, if β is sufficiently low, then Δ is non-empty. $\square$

Firm A must decide between a strategy $(\ell_a, \lambda_a) \in \Delta$ and earning monopoly profits, or $(\ell_a, \lambda_a) \in [0, 1]^2 \setminus \Delta$ and earning the oligopoly profits implied by the subgame in which firm B enters.

Note a couple features of Δ . First, if Δ is non-empty, then $\inf\{\lambda_a | \lambda_a \in \Delta\} > 0$. Second, if $\alpha \leq \frac{1}{3}$ ($\alpha \geq \frac{2}{3}$), then $\Delta = \{(\ell_a, \lambda_a) | \ell_a = 0 \text{ and } \lambda_a \geq \underline{\lambda}_a \text{ for some } \underline{\lambda}_a > 0\}$ ($\Delta = \{(\ell_a, \lambda_a) | \ell_a = 1 \text{ and } \lambda_a \geq \underline{\lambda}_a \text{ for some } \underline{\lambda}_a > 0\}$).

Additionally, let's define a couple more terms here before proceeding. Let the original game as described in the main text be denoted G . It will be useful to also consider a modified game G' in which firm B cannot choose whether to enter, and automatically enters regardless of firm A 's strategy (ℓ_a, λ_a) . In other words, firm B can take any action $(\ell_b, \lambda_b) \in [0, 1]^2$, but firm B cannot choose to not enter. In every other respect besides firm B 's entry decision, game G' is defined exactly as game G .

Claim 2: There does not exist an equilibrium of either game G or G' in which firm B earns positive revenues and firm A earns zero revenues.

Proof of Claim 2. Firm A has a cost-less strategy that prevents firm B from capturing all demand at a positive price: $\ell'_a = (\min\{\max\{3\alpha - 1, 0\}, 1\}, 0)$ and $\lambda'_a = 0$. If $\ell_b = \ell'_a$, then firm B makes zero revenues. If $\ell_b > \ell'_a$, then $\ell'_a + \ell_b > 6\alpha - 2$ and firm A has the more prestigious position. If $\ell_b < \ell'_a$ then $\ell'_a + \ell_b < 6\alpha - 2$ and firm A again has the more prestigious position. In either case, firm B cannot earn positive revenues in an equilibrium with weak conformity and take over or in an equilibrium with strong conformity. Thus, firm A must earn positive revenues in any equilibrium. $\square$

Claim 3: Consider game G' . If $(\ell_a^*, \lambda_a^*) \notin \Delta$, then firms locate at opposite ends and $\lambda_b^* = 0$. Additionally, if $\alpha \in [\frac{1}{3}, \frac{2}{3}]$, then $\lambda_a^* = 0$.

Proof of Claim 3. The proof proceeds in steps. Steps 1-5 establish firm B 's best-response to firm A and equilibrium strategy of locating at an end and not advertising. Steps 6-7 characterize λ_a and ℓ_a given firm B 's best response. This proof only

concerns behavior in game G' , and assumes $(\ell_a^*, \lambda_a^*) \notin \Delta$.

Step 1: If $\alpha > \frac{1}{3}$ and $\ell_b^* \leq \ell_a^*$, then $\ell_b^* = 0$. *Proof:* Suppose $\alpha > \frac{1}{3}$ and $\ell_b^* \leq \ell_a^*$.

As shown in claim 1, ℓ_b^* must be some ℓ_b where neither firm takes over. That is, for a given λ , ℓ_b^* must be some $\ell_b \in [0, \ell_b^{wc})$ where $\ell_b^{wc} \in [0, \ell_a)$ is the highest $\ell_b < \ell_a$ such that neither firm takes over. It will be demonstrated that given any λ , firm B earns higher profits at $\ell_b = 0$ than any other $\ell_b \in [0, \ell_b^{wc})$. Using equations (2.14) - (2.16), firm B 's profits at any $\ell_b \in [0, \ell_b^{wc}]$ are given by:

$$\pi_b^L(\ell_b, \lambda_b) = \frac{(\frac{\tau}{3}(\ell_a - \ell_b)(2 + \ell_a + \ell_b) + \lambda\alpha\frac{\beta}{3})^2}{2\tau(\ell_a - \ell_b) + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_b^2 \quad (\text{A.14})$$

where L stands for to the left of firm A . It will be show that if $\alpha > \frac{1}{3}$, then π_b^L has no local maximum on $\ell_b \in (0, \ell_b^{wc})$. It then follows that π_b^L must achieve a maximum at at one of the ends: $\ell_b = 0$ or ℓ_b^{wc} . Furthermore, since firm B cannot earn positive revenues when a firm takes over, π_b^L must be higher at $\ell_b = 0$ than at ℓ_b^{wc} . A necessary condition for an interior local maximum is that $\frac{d\pi_b^L}{d\ell_b} = 0$. The function π_b^L has four first order conditions with respect to ℓ_b :

$$(A) \quad \ell_b = -1 - \frac{1}{\tau}\sqrt{\alpha\lambda\beta\tau + \tau^2 + 2\ell_a\tau^2 + \ell_a^2\tau^2}$$

$$(B) \quad \ell_b = -1 + \frac{1}{\tau}\sqrt{\alpha\lambda\beta\tau + \tau^2 + 2\ell_a\tau^2 + \ell_a^2\tau^2}$$

$$(C) \quad \ell_b = \frac{(2\lambda\beta - 6\tau + 12\ell_a\tau) - \sqrt{(2\lambda\beta - 6\tau + 12\ell_a\tau)^2 + 36\tau(2\lambda\beta - 3\alpha\beta\lambda + 6\ell_a\tau - 3\ell_a^2\tau)}}{18\tau}$$

$$(D) \quad \ell_b = \frac{(2\lambda\beta - 6\tau + 12\ell_a\tau) + \sqrt{(2\lambda\beta - 6\tau + 12\ell_a\tau)^2 + 36\tau(2\lambda\beta - 3\alpha\beta\lambda + 6\ell_a\tau - 3\ell_a^2\tau)}}{18\tau}$$

(A) is clearly non-positive if real, and thus outside $(0, \ell_b^{wc})$. Furthermore, it can

be shown that if $\alpha > \frac{1}{3}$, then (C) is non-positive (if real) and also outside $(0, \ell_b^{wc})$. If the first parenthetical term in (C) is non-positive, $2\lambda\beta - 6\tau + 12\ell_a\tau \leq 0$, then (C) is clearly non-positive because the term in the square root must be non-negative. Suppose instead $2\lambda\beta - 6\tau + 12\ell_a\tau > 0$. Rearranging terms, this is equivalent to $\lambda\beta > 3\tau - 6\ell_a\tau$. If $36\tau(2\lambda\beta - 3\alpha\beta\lambda + 6\ell_a\tau - 3\ell_a^2\tau) > 0$, then (C) is non-positive because the term in the square root is greater than the first parenthetical term on the left. Simplifying, this is equivalent to $\lambda\beta(2 - 3\alpha) > 3\tau\lambda_a(\ell_a - 2)$. If $\alpha \geq \frac{2}{3}$, then this inequality holds because the right hand side is weakly positive and the left hand side is negative. If $\alpha < \frac{2}{3}$, then this condition can be simplified to $\lambda\beta > \frac{3\ell_a\tau(\ell_a-2)}{2-3\alpha}$. Furthermore, note that $3\tau - 6\ell_a\tau \geq \frac{3\ell_a\tau(\ell_a-2)}{2-3\alpha}$ for all $\alpha \in (\frac{1}{3}, \frac{2}{3})$. Thus, if $\alpha > \frac{1}{3}$, then (C) must be non-positive and outside $(0, \ell_b^{wc})$. This leaves only (B) and (D).

Next, I show that either (B) or (D) must be a local maximum outside $(0, \ell_b^{wc})$. There is a clear discontinuity of π_b^L where the denominator equals $\ell_b^{sc} = \ell_a + \frac{\lambda\beta}{6\tau}$. $\ell_b^{sc} > \ell_b^{wc}$ because it is the point where demand becomes characterized by strong conformity. Applying l'Hôpital's rule, note that $\lim_{\ell_b \rightarrow \ell_b^{sc}+} \pi_b^L = -\infty$ and $\lim_{\ell_b \rightarrow \infty} \pi_b^L = -\infty$. Thus, there must be a local maximum at some $\ell_b > \ell_b^{sc}$. This then implies that can be at most one local extremum in $(0, \ell_b^{wc})$. However, if there exists an extremum in $(0, \ell_b^{wc})$, then it cannot be a local maximum. This is because, again applying l'Hôpital's rule, $\lim_{\ell_b \rightarrow \ell_b^{sc}-} \pi_b^L = \infty$. This concludes the proof that if $\alpha > \frac{1}{3}$ and $\ell_b^* \leq \ell_a^*$, then $\ell_b^* = 0$.

Step 2: It follows, mutatis mutandis, that if $\alpha < \frac{2}{3}$ and $\ell_b^* \geq \ell_a^*$, then $\ell_b^* = 1$.

Step 3: $\ell_b^* \in \{0, 1\}$ in any equilibrium. *Proof:* Suppose not. Suppose $\ell_b^* \in (0, 1)$. As demonstrated above, it must then be that $\lambda^* > 0$ and $\alpha \notin (\frac{1}{3}, \frac{2}{3})$, because otherwise firm B would have a dominant strategy in locating at one of the ends. Without loss of generality, suppose $\alpha \geq \frac{2}{3}$ and $\lambda^* > 0$. It must be that $\ell_a^* < \ell_b^*$, otherwise firm B would have chosen $\ell_b = 0$. As demonstrated above, firm A 's best location $\ell_a < \ell_b$ is at $\ell_a = 0$. Firm A 's price when $\ell_a = 0 < \ell_b < 1$ is $p_a = \frac{\tau}{3}\ell_b(2 + \ell_b) + \lambda\alpha\frac{\beta}{3} < \tau$ and firm A 's market share is given by $\frac{\frac{\tau}{3}(\ell_b)(2 + \ell_b) + \lambda\alpha\frac{\beta}{3}}{2\tau\ell_b + \lambda\frac{\beta}{3}} < \frac{1}{2}$. However, this cannot be optimal strategic behavior for firm A . If firm A had chosen $\ell_a = 1$ and $\lambda_a = 0$, then firm B 's best-response would have been $\ell_b = \lambda_b = 0$. Firm A would have then charged a higher price $p_a = \tau$ while earning greater market share $\frac{1}{2}$. Thus, there cannot exist an equilibrium where $\ell_b^* \in (0, 1)$.

Step 4: $\lambda_b^* = 0$ in any equilibrium. *Proof:* Suppose not. Suppose $\lambda_b^* > 0$ in some equilibrium. WLOG, suppose $\ell_b^* = 0$. Since p_b is always decreasing in λ , it must be that firm B has the more prestigious position and its market share is increasing in λ . Thus, it must be that $\alpha < \frac{1}{2}$. It is demonstrated above that if $\ell_b = 0$ and $\alpha < \frac{1}{2}$, then firm A 's profits are maximized when $\ell_a = 1$. If $\ell_a = 1$ and $\ell_b = 0$, firm A 's price is given by $p_a = \tau + \lambda(1 - \alpha)\frac{\beta}{3} < \tau$ and market share by $\frac{\tau + \lambda(1 - \alpha)\frac{\beta}{3}}{2\tau + \lambda\frac{\beta}{3}} < \frac{1}{2}$. However, this cannot be optimal strategic behavior for firm A . If firm A had chosen $\ell_a = \lambda_a = 0$, then firm B 's best-response would have been $\ell_b = 1$ and $\lambda_b = 0$. Firm A would have then charged a higher price $p_a = \tau$ while earning greater market share $\frac{1}{2}$. Thus, there cannot exist an equilibrium where $\lambda_b^* > 0$.

Step 5: If firm A locates at the end with the prestige advantage and does not advertise $\lambda_a = 0$, then firm B 's best response is to locate at the opposite end and not advertise: $\ell_b(\ell_a, \lambda_a) = 1 - \ell_a$ and $\lambda_b(\ell_a, \lambda_a) = 0$. *Proof:* WLOG, suppose $\alpha \leq \frac{1}{2}$, $\ell_a = \lambda_a = 0$. It has already been shown that if firm B prefers not to take over, then firm B 's best reply is $\ell_b = 1$ and $\lambda_b = 0$. It will next be shown that firm B prefers not to take over. If $\alpha \leq \frac{1}{3}$, then firm A always has the more prestigious position and firm B cannot take over. If $\alpha \in (\frac{1}{3}, \frac{1}{2}]$, then there may exist some combination of $\ell_b \in (0, 1)$ and $\lambda_b > 0$ where firm B takes over.

Suppose $\alpha \in (\frac{1}{3}, \frac{1}{2}]$. If firm B took over, its revenues would be maximized when the D_1 line and D_2 lines are equal, as seen in Figures 2.4 and 2.5. This occurs when $\ell_b = \frac{-\lambda_b\beta}{6\tau}$ and demand is at the border of strong conformity and weak conformity. Plugging $\ell_b = \frac{-\lambda_b\beta}{6\tau}$ into firm B 's profits from takeover, firm B 's optimal takeover strategy can be found by solving:

$$\begin{aligned} \max_{\lambda_b} \quad & \tau\left(\frac{-\lambda_b\beta}{6\tau}\right)\left(2 + \frac{\lambda_b\beta}{6\tau}\right) - \lambda_b\beta\left(\alpha - \frac{2}{3}\right) - \frac{c}{2}\lambda_b^2 \\ \text{subject to } & \lambda_b \in [0, 1] \end{aligned}$$

This program is concave in λ_b , and has solution: $\lambda_b = \frac{6\tau\beta(1-3\alpha)}{\beta^2+18c\tau} \in (0, 1)$ and $\ell_b = \frac{\beta^2(3\alpha-1)}{\beta^2+18c\tau} \in [0, 1)$. By the envelope theorem, firm B 's optimized profits from takeover are strictly decreasing in c . Thus, if firm B does not takeover at $c = 0$, then it does not takeover at any $c > 0$.

Indeed, firm B 's profits at $c = 0$ are $\tau(1 - 3\alpha)^2$. Firm B 's profits from $\ell_b = 1$ and $\lambda_b = 0$ are $\frac{\tau}{2}$, and $\frac{\tau}{2} \geq \tau(1 - 3\alpha)^2$ for any $\alpha \in [\frac{1}{3} - \frac{1}{3\sqrt{2}}, \frac{1}{3} + \frac{1}{3\sqrt{2}}]$. Furthermore,

$\frac{1}{3} - \frac{1}{3\sqrt{2}} < \frac{1}{3}$ and $\frac{1}{3} + \frac{1}{3\sqrt{2}} > \frac{1}{2}$. Thus, firm B 's best response is $\ell_b = 1$ and $\lambda_b = 0$.

Step 6: Given firm B 's best-reply $\ell_b(\ell_a, \lambda_a)$ and $\lambda_b(\ell_a, \lambda_a)$, firm A cannot do better than by locating at the end with the prestige advantage and not advertising $\lambda_a = 0$ if $\alpha \in (\frac{1}{3}, \frac{2}{3})$. *Proof:* WLOG, suppose $\alpha \geq \frac{1}{2}$. It has been shown that if firm A locates at the end with the prestige advantage $\ell_a = 1$, then firm B chooses $\ell_b = \lambda_b = 0$. Next, I show that this strategy maximizes firm A 's profits given firm B 's reaction. I divide into two cases based on the value of α . First, suppose $\alpha \in [\frac{1}{2}, \frac{2}{3})$.

If $\alpha \in [\frac{1}{2}, \frac{2}{3})$, then given any λ and $\ell_b = 0$, it has been demonstrated that firm A 's profits are maximized when $\ell_a = 1$. In other words, fixing firm B 's actions at $\ell_b = 0$ and some λ_b , $\ell_a = 1$ maximizes firm A 's profits. However, in order to show that firm A cannot improve its profits at some other $\ell_a \neq 1$, it needs to also be shown that firm A cannot induce firm B to a strategy more profitable to firm A by choosing some $\ell_a \neq 1$. First, notice if firm A chooses $\ell_a < 1$, then firm B will still choose $\ell_b = 0$ if firm B remains to the left of firm A . Furthermore, firm A 's profits are higher to the right of firm B than to the left, as demonstrated above. Thus, firm A cannot influence firm B 's location in its favor. Next, notice that if firm B found it profitable to advertise $\lambda_b > 0$, then this advertising must hurt firm A because advertising can benefit at most one firm. This implies that firm A cannot improve its profits by choosing some ℓ_a that induces $\lambda_b > 0$.

Next, it also needs to be shown that firm A 's profits are maximized by $\lambda_a = 0$ when $\alpha \in [\frac{1}{2}, \frac{2}{3})$. If we fix $\ell_a = 1$ and $\ell_b = \lambda_a = 0$, then firm A 's revenues as a

function of its advertising is:

$$\frac{(\tau + \lambda_a \frac{(1-\alpha)\beta}{3})^2}{2\tau + \lambda_a \frac{\beta}{3}}$$

The highest λ_a firm A can set without taking over is $\lambda_a = \frac{-3\tau}{\beta\alpha}$. The second derivative of firm A 's revenues with respect to λ_a is positive in the considered domain: $\lambda_a \in [0, \frac{-3\tau}{\beta\alpha})$. Thus firm A 's revenues are convex in λ on this domain and have no interior maximum. Furthermore, firm A 's revenues are higher at $\lambda = 0$ than at the right closure of the relevant domain, $\lambda_a = \frac{-3\tau}{\beta\alpha}$. Firm A 's revenues at $\lambda_a = 0$ are $\frac{\tau}{2}$. Firm A 's revenues at $\lambda_a = \frac{-3\tau}{\beta\alpha}$ are $\frac{\tau(2\alpha-1)}{\alpha}$, and $\frac{\tau}{2} \geq \frac{\tau(2\alpha-1)}{\alpha}$ if $\alpha \leq \frac{2}{3}$. Since firm A 's revenues are highest at $\lambda_a = 0$, and firm A 's costs are strictly increasing in λ_a , firm A 's profits are maximized at $\lambda_a = 0$.

I now move to the second case, where $\alpha \geq \frac{2}{3}$. Here, it needs to be shown that firm A cannot do better than locating at $\ell_a = 1$, given the reaction of firm B . It has already been demonstrated that the optimal strategy of firm B such that $\ell_b < \ell_a$ is $\ell_b = \lambda_b = 0$. However, it might be that given $\ell_b = \lambda_b = 0$, firm A could do better at some strategy where $\ell_a < 1$. I will show that if firm A prefers some $\ell_a < 1$

Suppose that given $\ell_b = \lambda_b = 0$ and some λ_a , firm A earns higher profits at some $\ell_a < 1$ than at $\ell_a = 1$. I will show that if firm A chooses $\ell_a < 1$, then firm B will move to the other side and choose $\ell_b > \ell_a$ rather than $\ell_b = 0$. In other words, there cannot be an equilibrium where $\ell_b = 0 < \ell_a < 1$. Furthermore, firm A would prefer $\ell_b = \lambda_b = 0$ and $\ell_a = 1$ to $\ell_a < \ell_b$. Thus, firm A chooses $\ell_a = 0$.

Using equations (2.14) - (2.16), firm A 's profits to the right of $\ell_b = 0$ are given

by:

$$\pi_a^R(\ell_a, \lambda_a) = \frac{(\frac{\tau}{3}\ell_a(4 - \ell_a) + \lambda(1 - \alpha)\frac{\beta}{3})^2}{2\tau\ell_a + \lambda\frac{\beta}{3}} - \frac{c}{2}\lambda_a^2 \quad (\text{A.15})$$

where R stands for to the right. It can be shown that if π_a^R has a local maximum at some $\ell_a < 1$, then $\frac{d\pi_a^R}{d\ell_a} < 0$ at $\ell_a = 1$. To see this, let $\ell_a^{sc} = -\lambda\frac{\beta}{6\tau}$ denote the value of ℓ_a such that the denominator equals 0 and demand becomes characterized by strong conformity. From the analysis before, we know that since $\alpha > \frac{2}{3}$, π_a^R has at most two extrema in $[\ell_a^{sc}, 1]$. Suppose that there is a local maximum in $[\ell_a^{sc}, 1]$. Applying l'Hôpital's rule, note that $\lim_{\ell_a \rightarrow \ell_a^{sc}+} \pi_a^R = \infty$. Thus, if π_a^R has a local maximum in $[\ell_a^{sc}, 1]$, then it also has a local minimum to the left of it in $[\ell_a^{sc}, 1]$. Since there are at most two local extrema in $[\ell_a^{sc}, 1]$, this implies that $\frac{d\pi_a^R}{d\ell_a} < 0$ at $\ell_a = 1$.

Setting the derivative of firm A 's profits less than zero $\frac{d\pi_a^R}{d\ell_a} < 0$ and simplifying, this is equivalent to $\tau < \lambda\beta(\frac{1}{3} - \alpha)$. In what follows, suppose $\tau < \lambda\beta(\frac{1}{3} - \alpha)$ and firm A chooses some $\ell'_a < 1$. I will show that firm B 's best response is some $\ell_b > \ell'_a$. If firm B chooses $\ell_b \leq \ell_a$, then (as demonstrated) the best it can do is $\ell_b = 0$. At $\ell_b = 0$, $p_b^L = \frac{\tau}{3}\ell'_a(2 + \ell'_a) + \lambda\alpha\frac{\beta}{3}$ and firm B earns some market share less than 1. If firm B chooses an $\ell_b^R > \ell_a$ and sufficiently close to ℓ_a such that $2(\ell_b^R - \ell_a) < -\lambda\frac{\beta}{3}$, then demand is characterized by strong conformity. Furthermore, since $\alpha \geq \frac{2}{3}$, firm B earns all the market share at a positive price $p_b^R = \tau(\ell_b^R - \ell_a)(2 - \ell_a - \ell_b^R) - \lambda\beta(\alpha - \frac{2}{3})$. If ℓ_b^R is arbitrarily close to ℓ_a , then $p_b^R \approx -\lambda\beta(\alpha - \frac{2}{3})$. I will show that $p_b^R > p_b^L$. Since firm B earns greater market share at ℓ_b^R than $\ell_b = 0$, this is sufficient to show that firm B 's best-response is some $\ell_b > \ell'_a$. The inequality $p_b^R > p_b^L$ is equivalent

to $-\lambda\beta(\alpha - \frac{2}{3}) > \frac{\tau}{3}\ell'_a(2 + \ell'_a) + \lambda\alpha\frac{\beta}{3}$. This can be simplified to $\tau < \frac{6\lambda\beta(\frac{1}{3}-\alpha)}{\ell'_a(2+\ell'_a)}$. This inequality must hold, because $\tau < \lambda\beta(\frac{1}{3}-\alpha) < \frac{6\lambda\beta(\frac{1}{3}-\alpha)}{\ell'_a(2+\ell'_a)}$. In other words, there does not exist an equilibrium where $\ell_b = 0 < \ell_a < 1$.

Step 7: It follows from the above arguments that there is an equilibrium where firm A locates at the end with the prestige advantage, $\ell_b^* = 1 - \ell_a^*$, $\lambda_b^* = 0$ and $\lambda^* = 0$ if $\alpha \in (\frac{1}{3}, \frac{2}{3})$. In any other equilibrium, firm A must earn the same amount of profits as in the aforementioned equilibrium. This can occur if neither firm advertises. In this case, there may also be an equilibrium where firm A locates at the end with the prestige disadvantage, firm B locates at the opposite end, and neither firm advertises. $\square$

Claim 4: If $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G' , then $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G .

Proof Claim 4. Suppose $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G' . It will be shown that given the best reply of firm B to $(\ell_a, \lambda_a) \in \Delta$ in the two games, firm A 's profits are higher in game G than game G' . WLOG, suppose $\alpha \leq \frac{1}{2}$. Firm B 's best response to $(\ell_a, \lambda_a) \in \Delta$ in game G' is any (ℓ_b, λ_b) such that $\lambda_b = 0$ since firm B cannot earn positive revenues and minimizes profit loss. By contrast, in game G , it is assumed that firm B does not enter if $(\ell_a, \lambda_a) \in \Delta$.

If $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G' , then firm A must earn positive revenues and take over the market. This implies that at the pricing stage firm A sets a price low enough such that the marginal consumer at $x = 1$ is just indifferent to not purchasing: $p_a^M = v - \tau(1 - \ell_a)^2 + \lambda\beta(\alpha - \frac{2}{3})$. In game G' , firm A must charge a positive price

and take over the market, otherwise it would not have chosen $(\ell_a, \lambda_a) \in \Delta$. Suppose firm B chooses $\ell'_b \geq \ell_a$. In this case, firm A must charge a price low enough such that the marginal consumer at $x = 1$ purchase good a over good b when $p_b = 0$: $p'_a \leq \tau(1 - \ell'_b)^2 - \tau(1 - \ell_a)^2 + \lambda\beta(\alpha - \frac{2}{3})$. Since $v > \tau$ (this follows from our assumption that v is sufficiently large that all consumers make purchases in the price equilibrium for any ℓ_a, ℓ_b and λ), it follows that $p'_a < p_a^M$.

Suppose firm B chooses $\ell_b < \ell_a$. In this case, firm A must charge a price low enough such that the marginal consumer at $x = 0$ purchase good a over good b when $p_b = 0$: $p''_a \leq \tau(\ell_b''^2 - \ell_a^2) - \lambda\beta(\alpha - \frac{1}{3})$. Compare the upper bounds of p'_a and p''_a . Note that $\lambda\beta(\alpha - \frac{2}{3}) \geq -\lambda\beta(\alpha - \frac{1}{3})$ for any $\alpha \leq \frac{1}{2}$. Furthermore, note that $\tau(1 - \ell'_b)^2 - \tau(1 - \ell_a)^2 \geq \tau(\ell_b''^2 - \ell_a^2)$ since $\ell_b'' < \ell_a \leq \ell'_b$. Thus, the upper bound of p''_a is less than or equal to that of p'_a , and $p''_a < p_a^M$.

Thus, given any equilibrium of game G' with $(\ell_a^*, \lambda_a^*) \in \Delta$, firm A charges a strictly higher price for that $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G . Since firm A has identical market shares and cost in both scenarios, firm A 's profits are strictly greater in game G than game G' . It follows that if $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G' , then $(\ell_a^*, \lambda_a^*) \in \Delta$ in game G . $\square$

Claim 5: Consider game G . There exists some $\bar{c} > 0$, such that if $c \leq \bar{c}$, then $(\ell_a^*, \lambda_a^*) \in \Delta$ and firm B does not enter, and if $c > \bar{c}$, then $(\ell_a^*, \lambda_a^*) \notin \Delta$ and firm B enters, yielding the equilibrium described in claim 2.

Proof. If Δ is empty, then the proof follows trivially by setting $\bar{c}' < 0$. Suppose Δ is non-empty.

First, I show that if $c = 0$, then given firm B 's best-response firm A 's profits from deterring firm B 's entry $(\ell_a, \lambda_a) \in \Delta$ are greater than that from not deterring firm B 's entry $(\ell_a, \lambda_a) \notin \Delta$. WLOG, suppose $\alpha \leq \frac{1}{2}$. It can be seen analytically by inequalities (A.10) - (A.13) that there must then exist some $(\ell'_a, \lambda'_a) \in \Delta$ with $\ell'_a \leq \frac{1}{2}$. Firm A 's monopoly price at (ℓ'_a, λ'_a) is:

$$p^M(\ell'_a, \lambda'_a) = v - \tau(1 - \ell'_a)^2 + \lambda'_a \beta(\alpha - \frac{2}{3})$$

as shown in equation (A.1). If firm A chooses $(\ell_a, \lambda_a) \notin \Delta$, then the best it can do is a strategy where $\ell_a = 0$, inducing $\ell_b = 1$ and $\lambda_b = 0$. It's price is then given by $p_a^E = \tau + \lambda_a \alpha \frac{\beta}{3}$. If $\alpha > \frac{1}{3}$, then $\lambda_a = 0$, and if $\alpha < \frac{1}{3}$, then λ_a could be positive but must be less than λ_a (otherwise $(\ell_a, \lambda_a) \in \Delta$). Since $v > \tau$, $p_a^M > p_a^E$. Furthermore, since firm A 's market share is greater given strategy (ℓ'_a, λ'_a) , and firm A 's advertising cost is 0 in both cases, firm A 's profits are higher given strategy (ℓ'_a, λ'_a) . This concludes the proof that when $c = 0$ and Δ is non-empty, firm A deters firm B 's entry.

Next, I complete the proof by showing the existence of a unique cut-off $\bar{c}$.

Firm A 's maximum profits from deterring firm B 's entry are strictly decreasing in c . This follows from the fact that both firm A 's monopoly revenues and Δ are independent of c , while firm A 's cost of advertising is strictly increasing in c for any $\lambda > 0$. Furthermore, as $c \rightarrow \infty$, these maximum profits from entry deterrence approach $-\infty$.

Let's start with the case where $\alpha \in (\frac{1}{3}, \frac{2}{3})$. If c is low enough that firm A would

choose $(\ell_a, \lambda_a) \in \Delta$ even when firm B enters, then $(\ell_a^*, \lambda_a^*) \in \Delta$ (see Claim 3). If c is greater than this amount, then firm A 's maximum profits from accommodating entry $\frac{\tau}{2}$ are independent of c . It immediately follows that there must exist some unique $\bar{c}$ such that $(\ell_a^*, \lambda_a^*) \in \Delta$ if $c \leq \bar{c}$, and $(\ell_a^*, \lambda_a^*) \notin \Delta$ otherwise.

Suppose $\alpha \notin (\frac{1}{3}, \frac{2}{3})$. WLOG, suppose $\alpha \leq \frac{1}{3}$. If deterring firm B 's entry, firm A chooses $\ell_a = 0$ and solves:

$$\begin{aligned} \max_{\lambda_a} \quad & v - \tau + \lambda_a \beta \left(\alpha - \frac{2}{3} \right) - \frac{c}{2} \lambda_a^2 \\ \text{subject to} \quad & (0, \lambda_a) \in \Delta \end{aligned}$$

If firm A accommodates firm B 's entry, then firm B chooses $\ell_b = 1$ and $\lambda_b = 0$, and firm A chooses $\ell_a = 0$ and solves:

$$\max_{\lambda_a} \quad \frac{(\tau + \lambda_a \alpha \frac{\beta}{3})^2}{2\tau + \lambda_a \frac{\beta}{3}} - \frac{c}{2} \lambda_a^2$$

Let Π_a^M and Π_a^E denote firm A 's optimized profits from deterring and not deterring entry respectively. By the envelope theorem, $\frac{d\Pi_a^M}{dc} \geq \frac{d\Pi_a^E}{dc}$ for all c . Thus, there must exist some unique $\bar{c}$ such that $(\ell_a^*, \lambda_a^*) \in \Delta$ if $c \leq \bar{c}$, and $(\ell_a^*, \lambda_a^*) \notin \Delta$ otherwise.

□

Appendix B: Your Success is My Motivation

B.1 Proofs

B.1.1 First Order Conditions

Here, we show that if $\lambda \leq 0$, then $e^{Partner} > e^{Ind}$ where e^{Ind} and $e^{Partner}$ are the (symmetric) equilibria of model (3.1) and model (3.3), respectively. The first order conditions of problems (3.1) and (3.3) respectively are:

$$\begin{aligned} p'(e_i) u(f - ce_i + b) - cp(e_i) u'(f - ce_i + b) - (1 - p(e_i)) c u'(f - ce_i) \\ - p'(e_i) u(f - ce_i) = 0 \end{aligned} \quad (B.1)$$

$$\begin{aligned} p'(e_i) u(f - ce_i + b) - cp(e_i) u'(f - ce_i + b) - (1 - p(e_i)) c u'(f - ce_i) \\ - p'(e_i) u(f - ce_i) + p'(e_i) p(e_j) v(b) - p'(e_i) (1 - p(e_j)) \lambda v(b) = 0 \end{aligned} \quad (B.2)$$

Note that the difference between the left-hand sides of the two F.O.C.s is the last two terms of the F.O.C. (B.2). That is, the marginal expected disutility from having

a different gross payment than a partner:

$$K(e_i, e_j) = p'(e_i) p(e_j) v(b) - p'(e_i) (1 - p(e_j)) \lambda v(b) \quad (\text{B.3})$$

If $\lambda \leq 0$, then $K(e^{Ind}, e^{Ind}) > 0$. Hence, the solution of model (3.1) makes the F.O.C. of model (3.3) positive. That implies and $e^{Partner} > e^{Ind}$.

B.1.2 Independence of Periods

Here, we show that a selfish utility maximizer would choose the same effort in each period when she is paid for one randomly selected period. Consider the decision problem of such an agent in the second period:

$$\max_{e_X} \frac{1}{2} u(\pi_1(X)) + \frac{1}{2} [p(e_X) u(f - ce_X + b) + (1 - p(e_X)) u(f - ce_X)] \quad (\text{B.4})$$

where $X \in \{Success, Failure\}$ denotes the realization of her first period outcome; and based on this outcome, the first term is the utility from the net payoff π_1 earned in the first period which realizes with 50% chance; the second term is the expected utility in the second period where e_X denotes the effort choice in the second period after realization of first period outcome of X . Note that the solution to problem (B.4) above is independent of X , the agent's realized outcome in the first period. Moreover, the effort level that solves problem (B.4) also solves problem (3.1). The equivalence between problems (3.1) and (B.4) would be violated if the agent was

instead paid for her performance in every period (unless she is risk neutral.)

B.2 Additional Tables and Figures

Table B.1: Treatment Balance

	Individual Treatment			Partner Treatment			Diff
	n	mean	sd	n	mean	sd	
Female	244	0.46	0.50	522	0.47	0.50	0.008
Age	244	19.42	1.43	522	19.93	2.08	0.509**
SAT	194	1590.62	328.30	412	1628.10	326.45	37.479
ACT	100	30.44	3.46	214	30.24	3.73	-0.197
GPA	244	3.32	0.78	520	3.29	0.61	-0.035
Math or Econ Major	244	0.16	0.36	522	0.15	0.36	-0.002
Job Experience	244	0.87	0.34	522	0.92	0.28	0.047
Currently Employed	244	0.34	0.48	522	0.43	0.50	0.085
Low Risk Aversion	244	0.57	0.50	522	0.59	0.49	0.024
Efficiency Minded	244	0.05	0.22	522	0.05	0.23	0.004
Selfish	244	0.61	0.49	522	0.63	0.48	0.014
Relative Grading Preference	244	0.34	0.48	522	0.41	0.49	0.062
Team Preference	244	0.52	0.50	522	0.56	0.50	0.039

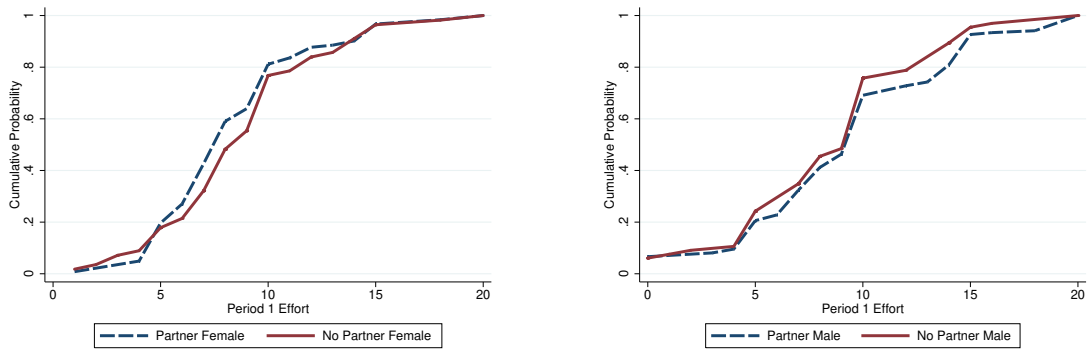
*** p $\leq$ 0.01, ** p $\leq$ 0.05, * p $\leq$ 0.1

n is the number of observations. Difference is the Partner Treatment mean minus the Individual Treatment mean, and p-values report whether that difference is statistically different from zero.

Demographic Variables: Female is a dummy equal to 1 if the subject self-reported as female. Math or Econ major is a dummy equal to 1 if the subject self-reported as either a math or economics major. Job experience is a dummy equal to 1 if the subject answered yes to the question “have you ever been employed in a paid job?” Currently employed is a dummy equal to 1 if the subject self-reported as currently employed either part-time or full-time.

Behavioral Variables: Low Risk Aversion is a dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6. Efficiency Minded is a dummy equal to 1 if the subject chose the efficient outcome in the fairness task. Selfish is a dummy equal to 1 if the subject chose the selfish outcome in the fairness task. Relative Grading Preference is a dummy equal to 1 if the subject is indifferent to, or strictly prefers being graded relatively to individually on a homework assignment. Team preference is a dummy equal to 1 if the subject is indifferent to or prefers working on homework on a team as compared to individually.

Figure B.1: CDFs of Period 1 Effort



Females: Fail to reject the equality of the distributions in Individual vs. Partner Treatments ($p=0.771$).

Males: Fail to reject the equality of the distributions in Individual vs. Partner Treatments ($p=0.870$).

Table B.2: Two-Limit Tobit of Period 1 Effort

	(1) All	(2) Female	(3) Male
Partner Treatment	0.192 (0.493)	-0.399 (0.585)	0.611 (0.780)
Low Risk Aversion	0.555 (0.475)	-0.699 (0.546)	1.557* (0.797)
Efficiency Minded	0.619 (1.083)	-0.661 (1.226)	1.686 (1.792)
Selfish	-0.098 (0.507)	0.182 (0.583)	-0.563 (0.867)
GPA	-0.451 (0.344)	-0.014 (0.398)	-0.689 (0.571)
Relative Grading Preference	-0.195 (0.474)	-0.210 (0.618)	-0.597 (0.744)
Constant	10.261*** (1.292)	9.409*** (1.493)	10.821*** (0.195)
Observations	382	177	202
Log-Likelihood	-1076	-475.2	-577.3

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Censored from below at 0 and above at 20. Partner treatment is a dummy equal to 1 in the Partner Treatment. Low risk aversion is a dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6. Efficiency minded is a dummy equal to 1 if the subject chose the efficient outcome in the fairness task. Selfish is a dummy equal to 1 if the subject chose the selfish outcome in the fairness task. Columns (2) and (3) exclude 3 subjects who self-reported their gender as neither female nor male. These 3 subjects were all in the Partner Treatment.

Table B.3: Individual Treatment, Proportion Revise Effort in Period 2

Period 1 Outcome	Decrease Effort			Increase Effort		
	All	Female	Male	All	Female	Male
Failed	0.14 (0.35) n=85	0.13 (0.34) n=38	0.15 (0.36) n= 47	0.48 (0.50) n=85	0.58 (0.50) n=38	0.40 (0.50) n=47
Succeeded	0.49 (0.51) n=37	0.67 (0.49) n=18	0.32 (0.48) n=19	0.16 (0.37) n=37	0.11 (0.32) n=18	0.21 (0.42) n=19
P-value	0.000	0.000	0.127	0.001	0.001	0.139

Standard deviations in parentheses. n=number of observations.

Table B.4: Individual Treatment, Probit Regressions

(a) Likelihood Increase Effort in Period 2

	(1)	(2)	(3)	(4)	(5)	(6)
	All	All	Female	Female	Male	Male
Failed	0.327*** (0.107)	0.342*** (0.111)	0.516*** (0.170)	0.551*** (0.177)	0.182 (0.139)	0.227 (0.153)
Period 1 Effort	-0.016 (0.011)	-0.016 (0.011)	-0.022 (0.017)	-0.020 (0.018)	-0.012 (0.014)	-0.015 (0.015)
Controlling for Heterogeneity		Yes		Yes		Yes
Observations	122	122	56	56	66	66
Baseline Probability	0.384	0.385	0.426	0.428	0.348	0.349
Pseudo R Squared	0.088	0.108	0.183	0.214	0.037	0.094

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(b) Likelihood Decrease Effort in Period 2

	(1)	(2)	(3)	(4)	(5)	(6)
	All	All	Female	Female	Male	Male
Success	0.284*** (0.078)	0.286*** (0.083)	0.466*** (0.134)	0.455*** (0.139)	0.139 (0.099)	0.109 (1.578)
Period 1 Effort	0.017* (0.009)	0.017* (0.009)	0.027* (0.016)	0.032* (0.017)	0.011 (0.011)	0.009 (0.123)
Controlling for Heterogeneity		Yes		Yes		Yes
Observations	122	122	56	56	66	66
Baseline Probability	0.244	0.243	0.302	0.301	0.196	0.196
Pseudo R Squared	0.142	0.148	0.289	0.302	0.049	0.077

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Probit marginal effects reported (calculated at means of independent variables). In Table B.4a, dependent variable is a dummy equal to 1 if subject increased effort in period 2. In Table B.4b, dependent variable is a dummy equal to 1 if subject decreased effort in period 2. Failed (Succeeded) is a dummy equal to 1 if the subject failed (succeeded) in period 1. Controlling for heterogeneity includes controls for risk preferences (dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6), fairness preferences (dummy for 2 of the 3 possible allocations in the fairness task), a linear term for GPA, and relative grading preferences (dummy equal to 1 if the subject is indifferent to, or strictly prefers being graded relatively to individually on a homework assignment).

Table B.5: Individual Treatment, Mean Period 2 Effort

Period 1 Outcome	All	Female	Male
Failed	9.81 (4.77) n=85	9.97 (4.49) n=38	9.68 (5.04) n=47
Succeeded	9.35 (4.47) n=37	8.89 (3.76) n=18	9.79 (5.12) n=19

Standard deviation in parentheses. n = number of observations.

Table B.6: Individual Treatment, Two-Limit Tobit of Period 2 Effort

	(1) All	(2) All	(3) Female	(4) Female	(5) Male	(6) Male
Failed	1.745** (0.795)	1.857** (0.805)	2.400** (1.052)	2.503** (1.071)	1.039 (1.179)	1.469 (1.207)
Period 1 Effort	0.754*** (0.090)	0.761*** (0.090)	0.657*** (0.131)	0.648*** (0.133)	0.825*** (0.125)	0.832*** (0.124)
Constant	1.654 (1.129)	0.310 (2.139)	2.070 (1.588)	-0.472 (2.834)	1.518 (1.602)	2.295 (3.488)
Controlling for Heterogeneity		Yes		Yes		Yes
Observations	122	122	56	56	66	66
Log-Likelihood	-325.8	-323.2	-148.4	-147.1	-175.7	-172.9

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is period 2 effort. Censored from below at 0 and above at 20. Failed is a dummy equal to one if the subject failed in period 1. Controlling for heterogeneity includes controls for risk preferences (dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6), fairness preferences (dummy for 2 of the 3 possible allocations in the fairness task), a linear term for GPA, and relative grading preferences (dummy equal to 1 if the subject is indifferent to, or strictly prefers being graded relatively to individually on a homework assignment).

Table B.7: Partner Treatment, Two-Limit Tobit of Period 2 Effort

	(1) All	(2) All	(3) Female	(4) Female	(5) Male	(6) Male
Failed	1.689*** (0.649)	1.898*** (0.655)	2.040** (0.867)	2.324*** (0.876)	1.488 (0.969)	2.000** (0.965)
Period 1 Effort	0.742*** (0.076)	0.747*** (0.076)	0.713*** (0.117)	0.733*** (0.116)	0.758*** (0.105)	0.771*** (0.102)
Constant	1.963** (0.957)	0.224 (1.929)	2.127 (1.341)	-0.814 (2.737)	1.708 (1.380)	0.551 (2.692)
Controlling for Heterogeneity		Yes		Yes		Yes
Observations	261	260	122	121	136	136
Log-Likelihood	-722.5	-715.5	-337.2	-332.5	-375.2	-369.2

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is period 2 effort. Censored from below at 0 and above at 20. Failed is a dummy equal to one if the subject failed in period 1, regardless of their partner's outcome. Controlling for heterogeneity includes controls for risk preferences (dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6), fairness preferences (dummy for 2 of the 3 possible allocations in the fairness task), a linear term for GPA, and relative grading preferences (dummy equal to 1 if the subject is indifferent to, or strictly prefers being graded relatively to individually on a homework assignment). Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male. Column (4) excludes 1 subject who did not report a GPA.

Table B.8: Partner Treatment, Mean (Period 2 Effort – Period 1 Effort)

Period 1 Outcome	All	Female	Male
Failed	1.49*** (4.97) n=165	1.71*** (4.66) n=84	1.29** (5.35) n=79
Succeeded	-0.98*** (3.62) n=96	-0.74 (2.86) n=38	-1.25** (4.01) n=57
P-values	0.000	0.003	0.003

Stars indicate whether mean is statistically different from zero in a two-tailed t-test. Standard deviations in parentheses. n=number of observations. Bottom row reports p-values from a two-tailed t-test comparing the mean effort change of subjects who failed and succeeded in a given column. Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male.

Table B.9: Partner Treatment, Proportion Revise Effort in Period 2

(a)

Period 1 Outcome	Decrease Effort			Increase Effort		
	All	Female	Male	All	Female	Male
Failed	0.21 (0.41) n=165	0.25 (0.44) n=84	0.18 (0.38) n=79	0.50 (0.50) n=165	0.63 (0.49) n=84	0.37 (0.49) n=79
Succeeded	0.33 (0.47) n=96	0.39 (0.50) n=38	0.30 (0.46) n=57	0.21 (0.41) n=96	0.21 (0.41) n=38	0.19 (0.40) n=57
P-values	0.031	0.106	0.099	0.000	0.000	0.028

P-values from a two-tailed t-test comparing the mean of those who failed and succeeded in relevant column. Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male.

(b)

Period 1 Outcome (Self, Partner)	Decrease Effort			Increase Effort		
	All	Female	Male	All	Female	Male
(Fail, Fail)	0.24 (0.43) n=99	0.30 (0.46) n=56	0.17 (0.38) n=41	0.45 (0.50) n=99	0.59 (0.50) n=56	0.29 (0.46) n=41
(Fail, Success)	0.17 (0.38) n=66	0.14 (0.36) n=28	0.18 (0.39) n=38	0.56 (0.50) n=66	0.71 (0.46) n=28	0.45 (0.50) n=38
(Success, Fail)	0.32 (0.47) n=66	0.41 (0.50) n=27	0.26 (0.45) n=38	0.26 (0.44) n=66	0.22 (0.42) n=27	0.26 (0.45) n=38
(Success, Success)	0.37 (0.49) n=30	0.36 (0.50) n=11	0.37 (0.50) n=19	0.10 (0.31) n=30	0.18 (0.40) n=11	0.05 (0.23) n=19

Standard deviation in parentheses. n=number of observations. Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male. P-values from a two-tailed t-test comparing the likelihood of increasing effort for subjects with outcome (Fail, Fail) and (Fail, Success): all genders pooled (0.184), females (0.269) and males (0.159). P-values from a two-tailed t-test comparing the likelihood of increasing effort for subjects with outcome (Success, Fail) and (Success, Success): all genders pooled (0.645), females (0.811) and males (0.422).

Table B.10: Comparing Effect of Own Failure in Partner and Individual Treatments, Two-Limit Tobit of Period 2 Effort

	(1)	(2)	(3)	(4)
	Individual Treatment or Partner Succeeded	Individual Treatment or Partner Failed	Individual Treatment or Partner Failed	Individual Treatment or Partner Failed
Failed	1.934** (0.764)	1.856** (0.775)	1.416** (0.632)	1.321** (0.638)
Failed x Partner Treat	1.258* (0.752)	1.333* (0.767)	-0.564 (0.627)	-0.576 (0.630)
Period 1 Effort	0.696*** (0.078)	0.698*** (0.078)	0.779*** (0.064)	0.786*** (0.064)
Constant	1.943* (1.004)	1.924 (2.016)	1.766*** (0.783)	-0.350 (1.510)
Controlling for Heterogeneity		Yes		Yes
Observations	218	218	287	286
Log-Likelihood	-600	-599.5	-773.3	-769.1

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Columns (1) and (2) include all subjects in the individual treatment, and subjects in the partner treatment whose partner succeeded in the first round. Columns (3) and (4) include all subjects in the individual treatment, and subjects in the partner treatment whose partner failed in the first round. Dependent variable is period 2 effort. Censored from below at 0 and above at 20. Failed is a dummy equal to one if the subject failed in period 1. Controlling for heterogeneity includes controls for risk preferences (dummy equal to 1 if the gamble chosen is either gamble 4, 5 or 6), fairness preferences (dummy for 2 of the 3 possible allocations in the fairness task), a linear term for GPA, and relative grading preferences (dummy equal to 1 if the subject is indifferent to, or strictly prefers being graded relatively to individually on a homework assignment). Female and male columns exclude 3 subjects who self-reported their gender as neither female nor male. Column (4) excludes 1 subject who did not report a GPA.

B.3 Instructions

B.3.1 Individual Treatment, Part 1

Instructions

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision-making. You will receive \$7 participation fee if you complete the session. In addition to that if you follow the instructions and are careful with your decisions, you can earn a significant amount of money, which will be paid to you at the end of the session.

During the experiment it is important that you do not talk to any other participants. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all your earnings will be forfeited.

The experiment will last about 60 minutes. The experiment consists of two paying parts. This is the instructions for Part 1.

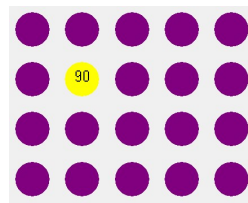
Your earnings in both parts will be calculated in Experimental Currency Units (ECUs). At the end of today's session, all your earnings will be converted to US dollars at a rate of

$$15 \text{ ECUs} = \$1.$$

Part 1 consists of 2 identical decision rounds.

Projects

You will begin each round with 60 ECUs. In each round, you will be given a project. The project can succeed or fail. A project is represented by a box with 20 balls in it. One of the balls is yellow and the rest are purple, as in the example below.



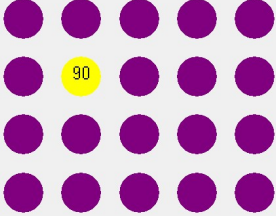
The project succeeds if the yellow ball is randomly drawn from the box. Note that the yellow ball has an equal chance of being drawn in a given try. You will decide how many times you want to try to make your project succeed. Each try costs you 3 ECUs. For each try, the computer will randomly draw one of the balls from the box.

- If the yellow ball is selected on one or more tries, then a project succeeds. The prize for success is 90 ECUs as written on the face of the yellow ball.
- If a purple ball is selected on each and every try, then a project fails. The prize for failure is 0 ECU.

After each try, the computer replaces the ball drawn from the box with an identical colored ball. Thus, the chance of drawing the yellow ball on any given draw is the same as that in any other draw. The computer continues drawing balls until your selected number of tries is exhausted. Note that your project succeeds if at least one of the balls drawn on those tries is yellow. In other words, your project succeeds and you earn the 90 ECUs prize if the computer draws the yellow ball in one or more tries.

Sequence of Actions in a Round

1. First, the computer will display the project, as in the example screen below. In the fields provided below the box, you will be asked to type in the basic information about the project:
 - a. Number of yellow success balls (always equals 1).
 - b. Prize in case of success (always equals 90 ECUs).
 - c. Cost of a single try (always equals 3 ECUs).



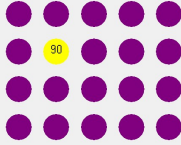
How many of the twenty balls are yellow success balls?

What is the prize in case of success (in ECUs)?

What is the cost of a single try (in ECUs)?

2. Next, you will choose your number of tries. You may choose any number from {0,1,2,3,...,20}. For every possible number of tries, the screen displays:
 - a. The total cost of those tries: $3 \times \text{Number of Tries}$.
 - b. The probability of the project's success.

See the example screen below.



Endowment: 60 ECUs

Number of Tries:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Cost (ECUs)	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
Probability of Success:	0.00%	5.00%	9.75%	14.26%	18.55%	22.62%	26.49%	30.17%	33.66%	36.98%	40.13%	43.12%	45.96%	48.67%	51.23%	53.67%	55.99%	58.19%	60.28%	62.26%	64.15%

Please Select Your Number of Tries:

In this example, the participant happens to have selected 6 tries.

- After you've made your decision, the computer will display your selected number of tries and the outcome of your project. An example screen is shown below.

In this example, the participant selects 6 tries and the project is successful. This means that the yellow ball is drawn in at least one of her 6 tries. Hence, she receives the prize of 90 ECUs, her 6 tries cost her 18 ECUs, and together with her initial endowment of 60 ECUs, her net payoff for the current round is 132 ECUs ($60 + 90 - 18$).

Number of tries chosen	6
Did the project succeed?	YES
Prize received (ECUs)	90
Cost of tries (ECUs)	18
Net Payoff (ECUs) (Endowment + Prize - Cost)	132

- Finally, you will move to the next round where you will encounter a new project.

Final Earnings

Once the experiment is finished, the computer will randomly pick 1 round out of the 2 rounds that you completed. The earnings you made on that round will be your earnings for Part 1 of the experiment. Hence, you should make a careful decision in each round because it might be a paying round.

Are there any questions?

B.3.2 Partner Treatment, Part 1

Instructions

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision-making. You will receive \$7 participation fee if you complete the session. In addition to that if you follow the instructions and are careful with your decisions, you can earn a significant amount of money, which will be paid to you at the end of the session.

During the experiment it is important that you do not talk to any other participants. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all your earnings will be forfeited.

The experiment will last about 60 minutes. The experiment consists of two paying parts. This is the instructions for Part 1.

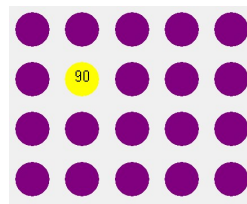
Your earnings in both parts will be calculated in Experimental Currency Units (ECUs). At the end of today's session, all your earnings will be converted to US dollars at a rate of

$$15 \text{ ECUs} = \$1.$$

Part 1 consists of 2 identical decision rounds. At the beginning of each round, you will be randomly paired with another participant in the room. You will be paired with a different participant in each round. These matchings are anonymous and you will not know the identities of the participants you are partnered with.

Projects

You and your partner will each begin a round with 60 ECUs. Furthermore, in each round, you and your partner will be given identical individual projects. Each project can succeed or fail. A project is represented by a box with 20 balls in it. One of the balls is yellow and the rest are purple, as in the example below.



The project succeeds if the yellow ball is randomly drawn from the box. Note that the yellow ball has an equal chance of being drawn in a given try. You will decide how many times you want to try

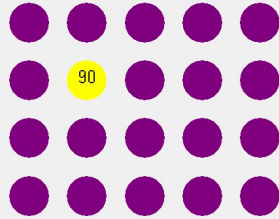
to make your project succeed. Each try costs you 3 ECUs. For each try, the computer will randomly draw one of the balls from the box.

- If the yellow ball is selected on one or more tries, then a project succeeds. The prize for success is 90 ECUs as written on the face of the yellow ball.
- If a purple ball is selected on each and every try, then a project fails. The prize for failure is 0 ECU.

After each try, the computer replaces the ball drawn from the box with an identical colored ball. Thus, the chance of drawing the yellow ball on any given draw is the same as that in any other draw. The computer continues drawing balls until your selected number of tries is exhausted. Note that your project succeeds if at least one of the balls drawn on those tries is yellow. In other words, your project succeeds and you earn the 90 ECUs prize if the computer draws the yellow ball in one or more tries.

Sequence of Actions in a Round

1. First, the computer will display the project, as in the example screen below. In the fields provided below the box, you will be asked to type in the basic information about the project:
 - a. Number of yellow success balls (always equals 1).
 - b. Prize in case of success (always equals 90 ECUs).
 - c. Cost of a single try (always equals 3 ECUs).



How many of the twenty balls are yellow success balls?

What is the prize in case of success (in ECUs)?

What is the cost of a single try (in ECUs)?

2. Next, you will choose your number of tries. You may choose any number from $\{0, 1, 2, 3, \dots, 20\}$. For every possible number of tries, the screen displays:
 - a. The total cost of those tries: $3 \times \text{Number of Tries}$.
 - b. The probability of the project's success.

See the example screen below.

Number of Tries:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Cost (ECUs):	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
Probability of Success:	0.00%	5.00%	9.75%	14.26%	18.55%	22.62%	26.49%	30.17%	33.66%	36.98%	40.13%	43.12%	45.96%	48.67%	51.23%	53.67%	55.99%	58.19%	60.28%	62.26%	64.15%

Please Select Your Number of Tries:

In this example, the participant happens to have selected 6 tries.

- After you and your partner have made your decisions, the computer will display your selected number of tries, the outcome of your project and the outcome of your partner's project. The screen will not display your partner's selected number of tries. An example screen is shown below. A similar screen will be shown on your partner's display.

In this example, the participant selects 6 tries and the project is successful. This means that a yellow ball is drawn in at least one of her 6 tries. Hence, she receives the prize of 90 ECUs, her 6 tries cost her 18 ECUs, and together with her initial endowment of 60 ECUs, her net payoff for the current round is 132 ECUs ($60 + 90 - 18$).

By contrast, the participant's partner's project is unsuccessful. This means that a purple ball is drawn in all of his draws. Note that the participant learns the outcome of his/her partner's project, but not the number of tries the partner selected.

	You	Your Partner
Number of tries chosen	6	-----
Did the project succeed?	YES	NO
Prize received (ECUs)	90	0
Cost of tries (ECUs)	18	-----
Net Payoff (ECUs) (Endowment + Prize - Cost)	132	-----

4. Finally, you will move to the next round where you will be randomly matched with a new participant in the room and encounter a new project.

Final Earnings

Once the experiment is finished, the computer will randomly pick 1 round out of the 2 rounds that you completed. The earnings you made on that round will be your earnings for Part 1 of the experiment. Hence, you should make a careful decision in each round because it might be a paying round.

Are there any questions?

B.3.3 Part 2

Part 2 Instructions

This part of the experiment consists of two activities. Your earnings in each activity depend on your decisions and also on chance. Once you finish an activity you will not be able to go back.

The actual decision you make in each activity is up to you. There is no right or wrong answer. Just choose the one you like best.

Activity 1

In activity 1, you are asked to choose one of the following 6 gambles. The computer will flip a coin to determine your payoff from the gamble chosen as indicated in the below table. The coin turns up heads or tails with 50% chance each.

Gamble	Tails Payoff (ECUs)	Heads Payoff (ECUs)
1	28	28
2	24	36
3	20	44
4	16	52
5	12	60
6	2	70

Activity 2

In Activity 2, you will be randomly matched with one other participant in the room. The matching is anonymous and you will not know the identity of your partner. You are asked to choose one of the following three allocations of ECUs between you and your partner:

Allocation	You Receive (ECUs)	Your Partner Receives (ECUs)
1	35	35
2	20	60
3	50	10

Similarly, your partner will choose one of these three options. After both of you make your choices, the computer will randomly select one of you with equal chances and implement that person's decision.

For example, suppose you picked option 2 and your partner picked option 3. If you are randomly selected by the computer, your chosen option (option 2) will be implemented. Hence, you will receive 20 ECUs and your partner will receive 60 ECUs. However, if your partner's decision is randomly selected to be implemented, then you will receive 10 ECUs and your partner will receive 50 ECUs. The example described here is only for demonstration purposes, and is not meant to suggest how you should make your decision in any way.

Final Earnings

At the end of the experiment, the computer will randomly pick 1 activity out of the 2 activities that you completed in Part 2. You will receive your earnings from the randomly selected activity in Part 2 in addition to the randomly selected round in Part 1. Hence, you should make careful decisions in each activity because it might be a paying activity.

Are there any questions?

Appendix C: Reciprocity versus Reelection

C.1 Reciprocity Theory

Let us define what we mean by an equilibrium. Candidates choose strategies contingent on their type (τ, θ) to maximize their two-period utility. Thus, a candidate of type $(1, \theta)$ and $(2, \theta)$ solves the below programs respectively:

$$\max x_1^\theta x_1^{1-\theta} + \pi(x_1) y_2^\theta y_1^{1-\theta} \quad (\text{C.1a})$$

$$\max x_1^\theta x_2^{1-\theta} + \pi(x_1) y_2^\theta y_2^{1-\theta} \quad (\text{C.1b})$$

such that $x_1 + x_2 = X$ and $y_1 + y_2 = Y$, where $\pi(x_1)$ denotes C 's probability of reelection. $\pi()$ is a function of observed benefits x_1 in the signalling game, while $\pi()$ is necessarily independent of x_1 in the no information game since V_2 cannot base her voting decision on the distribution of benefits in the first election. We denote V_2 's posterior beliefs of a type (τ, θ) contingent on observing benefits x_1 by $p(\tau, \theta|x_1)$, where $p(\tau, \theta|x_1)$ must satisfy Bayes Rule on the equilibrium path (in the signalling game). V_2 maximizes her expected utility given her posterior beliefs.

As in many signalling games, a multiplicity of equilibria arises. From now on, we restrict attention to *pure strategy* Perfect Bayesian equilibria satisfying the following off equilibrium beliefs (henceforth, referred to simply as “equilibria”): $p(1, \theta|x_1) = 0$ for all $x_1 < X - Y$ and all θ . These off-equilibrium beliefs are reasonable since a policy preference 1 candidate always prefers $x_1 = X$ and forego-

ing reelection to $x_1 < X - Y$ (even if doing so implies reelection). They are implied, for example, by the intuitive criterion of [Cho and Kreps \[1987\]](#).

V_1 's behavior is trivial. V_1 votes if and only if the expected benefits of voting are weakly higher than the cost of voting. Since V_1 's behavior is the same in any equilibrium for which this holds, we do not mention V_1 in our characterization of equilibria, focusing instead on behavior after the first election. All proofs are in the next section.

As background, suppose all candidates are selfish, that is, there are only $(1, 0)$ and $(2, 0)$ type candidates.

Proposition 9 (Equilibrium with Selfish Candidates). *In the signalling game with only selfish candidates (i.e. $\theta = 0$), there exists a unique equilibrium where:*

$(1, 0)$: $x_1 = X$ and $y_2 = 0$ if reelected.

$(2, 0)$: $x_1 = 0$ and $y_2 = Y$ if reelected.

V_2 : Vote if $x_1 < X - Y$. Otherwise, abstain.

Next, let's turn to the main motivation of the paper, the case where candidates may be reciprocal and are motivated to signal type. We show that under reasonable conditions we get an equilibrium where the more selfish (low θ) $\tau = 1$ candidates mimic the highly reciprocal (high θ) $\tau = 2$ candidates, and the latter constrain their reciprocity to ensure their reelection.

If reciprocity motives are too low, $\bar{\theta} < \frac{X-Y}{X}$, then $\tau = 1$ candidates have no incentive to mimic a $\tau = 2$ candidate since the latter's first-best $x_1 = \theta X$ is always less than $X - Y$.¹ To allow for mimicking motives, let's assume $\bar{\theta} > \frac{X-Y}{X}$ so that some are willing to mimic highly reciprocal $\tau = 2$ candidates for reelection at the latter's first-best.

Let's call x_1^* ($\geq X - Y$) the value at which some $\tau = 1$ candidates possibly

¹In other words, like in the selfish case, there is a unique equilibrium in which all candidate-types play their first-best.

mimic $\tau = 2$ candidates for reelection. Notice that any $\tau = 1$ candidates who do not pool (who separate) with $\tau = 2$ candidates will choose their first-best $x_1 = X$ and cannot be reelected. Given this, let's define more precisely what we mean by an equilibrium characterized by "constrained reciprocity."

Definition 2 (Constrained Reciprocity Equilibrium). *An equilibrium is characterized by constrained reciprocity at $x_1^* \in [0, X]$ if players' strategies satisfy the following conditions:*

- $(1, \theta)$: $x_1 = x_1^*$ if $\theta < \theta_1$ for some $\theta_1 \in [0, \bar{\theta}]$ and $x_1 = X$ otherwise.
- $y_2 = \theta Y$ if reelected.
- $(2, \theta)$: $x_1 = x_1^*$ if $\theta \geq \frac{x_1^*}{X}$ and $x_1 = \theta X$ otherwise. $y_2 = Y$ if reelected.
- V_2 : Vote if $x_1 \leq x_1^*$. Otherwise, abstain.

Thus far, we have made few assumptions about the distribution $F()$, besides continuity in its support $[0, \bar{\theta}]$ and the existence of selfish candidates $F(0) > 0$. Before proceeding, we make one additional assumption to allow for well-behaved equilibria. We assume that even if mimicking occurs by all $\tau = 1$ candidates who are willing to mimic *some* $\tau = 2$ candidate for reelection, those leftover at $x_1 = X$ are not reelected. Mathematically, we assume $\frac{Y \int_{\bar{\theta}_1}^{\bar{\theta}} \theta dF(\theta)}{1 - F(\bar{\theta}_1)} \leq k$ where $\bar{\theta}_1$ is implicitly defined by $u_{(1, \bar{\theta}_1)}^2(Y - \bar{\theta}_1 Y, \bar{\theta}_1 Y) = \frac{X}{2}$.²

As typical in signalling games, there exists a multiplicity of equilibria. We focus on equilibria satisfying the following intuitive off-equilibrium beliefs: $p(1, \theta | x_1) = 0$ if $x_1 < x_1^*$ for all θ . Since no $\tau = 1$ candidates choose $x_1 < x_1^*$ in a given equilibrium, this is a modest level of sophistication of V_2 's off-equilibrium beliefs and is implied by the intuitive criterion of [Cho and Kreps \[1987\]](#). Still, there is a continuum of semi-separating equilibria since there is a continuum of types. Nevertheless, all

²If this condition is not met, but $Y \int_0^{\bar{\theta}} \theta dF(\theta) < k$ so that *all* type 1 candidates are not reelected at their first-best, then Propositions [10](#) and [11](#) still hold. However, Corollary [1](#) may not hold in this case. If instead $Y \int_0^{\bar{\theta}} \theta dF(\theta) > k$, then there is a unique equilibrium satisfying the intuitive criterion in which all candidate-types play their first-best.

equilibria are characterized by constrained reciprocity.

Proposition 10 (Constrained Reciprocity Equilibria). *For any k , there exists a $\theta_2(k) \in [\frac{X-Y}{X}, \bar{\theta}]$ such that the set of equilibria satisfying the intuitive off-equilibrium beliefs is non-empty and characterized by constrained reciprocity at $x_1^* \in [X - Y, \theta_2(k)X]$.*

In Proposition 10, for a given k , we get a continuum of semi-separating equilibria with $\tau = 2$ candidates facing a reciprocity cut-off at any $x_1^* \in [X - Y, \theta_2(k)X]$. Such a multiplicity of equilibria also arises in Rogoff [1990], and a unique equilibrium is achieved by further requiring dominance by the candidate sending the signal. Similarly, we find the range of equilibria can be drastically reduced (to a unique equilibrium) by focusing on candidate dominant equilibria. We say an equilibrium candidate dominates another equilibrium if it supplies a weakly higher two-period utility to all candidate-types, and a strictly higher two-period utility to some candidate-types.³ In the candidate dominant equilibrium, the cut-off occurs at its upper bound $x_1^* = \theta_2(k)X$, as described in the proposition below.

Proposition 11 (Constrained Reciprocity Equilibrium). *For any k , there exists a unique candidate dominant equilibrium satisfying the intuitive off-equilibrium beliefs characterized by constrained reciprocity at $x_1^* = \theta_2(k)X$.*

Furthermore, since V_2 is less willing to vote as the cost of voting rises, $\tau = 2$ candidates further constrain themselves at a higher cost of voting to ensure their reelection.

Corollary 1 (Constrained Reciprocity and Cost of Voting). *The amount highly reciprocal policy preference 2 candidates constrain themselves in the equilibrium described in Proposition 11 is weakly increasing in the cost of voting.*

³This is a more conservative version of the dominance criterion in Rogoff [1990], given that it requires the dominance of all candidate-types and not just some.

C.1.1 Reciprocity and Altruism Theory

Here we study equilibria under a modified version of the utility function where candidates may be also be altruistic and care about giving to the non-voting voter in an election. In addition to holding reciprocity and policy parameters θ and τ respectively, each candidate is endowed with an altruism parameter α . We assume α is distributed according to some continuous distribution function $G()$ with support $[0, \bar{\alpha}]$, where $G(0) > 0$ and $\bar{\alpha} < 0.5$ so that candidates care more about their self-interest than being altruistic. Furthermore, we assume that $G()$ is independent of $F()$. The utility function of each candidate in the first election is as follows:

$$u_{(1,\theta,\alpha)}^1(x_1, x_2) = x_1^{1-\theta-\alpha} x_1^\theta x_2^\alpha = x_1^{1-\alpha} x_2^\alpha \quad (\text{C.2a})$$

$$u_{(2,\theta,\alpha)}^1(x_1, x_2) = x_2^{1-\theta-\alpha} x_1^\theta x_2^\alpha = x_1^\theta x_2^{1-\theta} \quad (\text{C.2b})$$

A $(1, \theta, \alpha)$ candidate would choose $x_1 = (1 - \alpha)X$ if she were simply maximizing first-period utility, while a type $(2, \theta, \alpha)$ candidate would choose $x_1 = \theta X$.

Similarly, second-period candidate utility is represented as

$$u_{(1,\theta,\alpha)}^2(y_1, y_2) = y_1^{1-\theta-\alpha} y_2^\theta y_1^\alpha = y_1^{1-\theta} y_2^\theta \quad (\text{C.3a})$$

$$u_{(2,\theta,\alpha)}^2(y_1, y_2) = y_2^{1-\theta-\alpha} y_2^\theta y_1^\alpha = y_1^\alpha y_2^{1-\theta} \quad (\text{C.3b})$$

where a type $(1, \theta, \alpha)$ candidate's first-best is $y_2 = \theta Y$, and a $(2, \theta, \alpha)$ candidate's first-best is $y_2 = (1 - \alpha)Y$. We extend the definition of a constrained reciprocity equilibrium to include altruism as follows.

Definition 3 (Constrained Reciprocity with Altruism). *An equilibrium is characterized by constrained reciprocity with altruism at $x_1^* \in [0, X]$ if players' strategies satisfy the following conditions:*

$$(1, \theta, \alpha): x_1 = x_1^* \text{ if } (\theta, \alpha) \in \nabla \text{ for some compact set } \nabla \in [0, \bar{\theta}] \times [0, \bar{\alpha}]$$

and $x_1 = (1 - \alpha)X > x_1^*$ otherwise. $y_2 = \theta Y$ if reelected.

$(2, \theta, \alpha)$: $x_1 = x_1^*$ if $\theta \geq \frac{x_1^*}{X}$ and $x_1 = \theta X$ otherwise. $y_2 = (1 - \alpha)Y$ if reelected.

V_2 : Vote if $x_1 \leq x_1^*$. Otherwise, abstain.

The difference between the equilibrium described above and that in Definition 2 without altruism is that non-mimicking and altruistic $\tau = 1$ candidates give $x_1 < X$, and altruistic $\tau = 2$ candidates select $y_2 < Y$. Thus, there always exists candidates in each election giving to the non-voting voter. The set ∇ defines the mimicking $\tau = 1$ candidates who deviate to x_1^* to be reelected rather than playing their first-best $x_1 = (1 - \alpha)X > x_1^*$ and foregoing reelection.

As in the pure reciprocity model, we need to verify that V_2 prefers not to reelect the $\tau = 1$ candidates who do not mimic (i.e. $\tau = 1$ candidates with $(\theta, \alpha) \notin \nabla$) for the equilibrium to hold. From equation (C.3a), we see that V_2 need only consider a $\tau = 1$ candidate's reciprocity parameter θ when deciding whether to reelect her. All else equal, a $\tau = 1$ candidate has a greater incentive to mimic if she has a higher α because she has to deviate less from her first-best to be reelected. Furthermore, as before, all else equal a $\tau = 1$ candidate has a greater incentive to mimic if she has a lower θ because she has greater utility to gain from reelection. Thus, if V_2 does not reelect a non-mimicking $\tau = 1$ candidate who has the highest possible altruism parameter $\bar{\alpha}$, then she does not mimic any other non-mimicking $\tau = 1$ candidates (because they have even lower θ). This holds if $E(\theta | \theta \geq \hat{\theta}_1) \leq \frac{k}{Y}$ where $\hat{\theta}_1$ is defines as the reciprocity parameter of the most altruistic $\tau = 1$ candidate $(1, \hat{\theta}_1, \bar{\alpha})$ that is indifferent between her first-best and mimicking the most reciprocal $\tau = 2$ candidate $(2, \bar{\theta}, \bar{\alpha})$ for reelection. Mathematically, $\hat{\theta}_1$ is defined implicitly by: $u_{(1, \hat{\theta}_1, \bar{\alpha})}^1(\bar{\theta}X, X - \bar{\theta}X) + u_{(1, \hat{\theta}_1, \bar{\alpha})}^2(Y - \hat{\theta}_1 Y, \hat{\theta}_1 Y) = u_{(1, \hat{\theta}_1, \bar{\alpha})}^1(X - \bar{\alpha}X, \bar{\alpha}X)$. We assume the distributions of θ and α follow the above condition in what follows. Additionally, we assume the distribution is such that if all $\tau = 2$ candidates are mimicked by all

$\tau = 1$ candidates who are willing to mimick at $x_1 = 0$, then V_2 reelects at $x_1 = 0$.

As before, we focus on equilibria satisfying the intuitive off-equilibrium beliefs of [Cho and Kreps \[1987\]](#): $p(1, \theta, \alpha | x_1) = 0$ if $x_1 < x_1^*$ for all θ and α . Under such off-equilibrium beliefs, there exists a continuum of semi-separating equilibria characterized by constrained reciprocity with altruism.

Proposition 12 (Constrained Reciprocity Equilibria with Altruism). *For any k , there exists a $\theta_2(k) \in [0, \bar{\theta}]$ such that the set of equilibria satisfying the intuitive off-equilibrium beliefs is non-empty and characterized by constrained reciprocity with altruism at $x_1^* \in [0, \theta_2(k)X]$.*

Note that allowing for altruism allows us to extend our theoretical results, in the sense that the cut-off x_1^* may be less than $\frac{X-Y}{X}$. This is because altruistic $\tau = 1$ candidates have to deviate less to be reelected, and are thus willing to mimic at lower values of x_1^* .

Furthermore, as before, a unique equilibrium can be found by applying candidate dominance. In the candidate dominant equilibrium, the cut-off occurs at its upper bound $x_1^* = \theta_2(k)X$, as described in the proposition below.

Proposition 13 (Constrained Reciprocity Equilibrium with Altruism). *For any k , there exists a unique candidate dominant equilibrium satisfying the intuitive off-equilibrium beliefs characterized by constrained reciprocity with altruism at $x_1^* = \theta_2(k)X$.*

Moreover, $\tau = 2$ candidates need to constrain their reciprocity more as the cost of voting increases.

Corollary 2. *The amount highly reciprocal policy preference 2 candidates constrain themselves in the equilibrium described in Proposition 13 is weakly increasing in the cost of voting.*

C.1.2 Proofs

Proof of Proposition 9. Suppose $(2, 0)$ chooses $x_1 > 0$. Since $p(2, 0 | x_1 = 0) = 1$, $(2, 0)$ could profitably deviate to $x_1 = 0$. Thus, $(2, 0)$ must choose $x_1 = 0$. Suppose $(1, 0)$ is reelected by pooling with $(2, 0)$ at $x_1 = 0$. This cannot be an optimal strategy since $(1, 0)$ could deviate to $x_1 = X$ and forego reelection, while improving her two-period utility. Since $(1, 0)$ is not reelected in any equilibrium, she must choose her first-best $x_1 = X$. $\square$

Proof of Proposition 10. In order to characterize the set of equilibria, we need to make a couple definitions.

First, for a given $x_1 < X$, we define the set of $\tau = 1$ candidates who gain from deviating to x_1 to be reelected over playing their first-best (and foregoing reelection). For any $x_1 \in [X - Y, X - \frac{Y}{2}]$, let $\tilde{\theta}(x_1)$ be implicitly defined by: $x_1 + Y(\tilde{\theta})^{\tilde{\theta}}(1 - \tilde{\theta})^{1-\tilde{\theta}} = X$. It can be shown that $\Psi(x_1) = \{(1, \theta) | \theta < \tilde{\theta}(x_1)\}$ is the set of $\tau = 1$ candidates who gain from choosing x_1 and being reelected over their first-best without reelection. Furthermore, $\Psi(x_1)$ is monotonically increasing in x_1 ($\Psi(x'_1) \subseteq \Psi(x''_1)$ iff $x'_1 \leq x''_1$), with bounds $\Psi(X - Y) = \{(1, 0)\}$ and $\Psi(X - \frac{Y}{2}) = \{(1, \theta) | \theta \leq \bar{\theta}\}$.

We do not construct a similar deviation set for $\tau = 2$ candidates, because any given $(2, \theta)$ is willing to choose $x_1 < \theta X$ over her first-best ($x_1 = \theta X$) to be reelected (this follows from the assumptions $Y > \frac{X}{2}$ and $\bar{\theta} \leq 0.5$).

Next, note that a $\tau = 1$ candidate would not deviate from her first-best unless it implied her reelection. Thus, we consider V_2 and define the set of x_1 over which type 1 candidates in $\Psi()$ pool with highly reciprocal $\tau = 2$ candidates and are reelected. We define $\theta_2(k)$ as the highest θ such that if type 2 candidates with $\theta \geq \theta_2(k)$ pool with all $\tau = 1$ candidates who gain from mimicking ($\Psi(\theta_2(k)X)$), then V_2 still votes.

Define $\theta_2(k)$ implicitly by $\frac{1-F(\theta_2(k)) + \int_0^{\tilde{\theta}(\theta_2(k)X)} \theta F(\theta)}{1-F(\theta_2(k)) + F(\tilde{\theta}(\theta_2(k)X))} = \frac{k}{Y}$ if it exists, and $\theta_2(k) = \frac{X-Y}{X}$ otherwise.

Note that $\bar{\theta} > \theta_2(k) \geq \frac{X-Y}{X}$ (the first inequality follows from $F(0) > 0$ and the continuity of $F()$, while the second inequality follows from the assumption $k < Y$). With definitions 2 and 3 we can characterize the set of equilibria.

Claim 1. For a given k , the set of equilibria satisfying the intuitive off-equilibrium beliefs $\Gamma(k)$ is non-empty and strictly includes equilibria where:

(1, θ): $x_1 = \hat{\theta}X$ if $\theta < \tilde{\theta}(\hat{\theta}X)$ and $x_1 = X$ otherwise. $y_2 = \theta Y$ if re-elected.

(2, θ): $x_1 = \hat{\theta}X$ if $\theta \geq \hat{\theta}$ and $x_1 = \theta X$ otherwise. $y_2 = Y$ if re-elected.

V_2 strategy: Vote if $x_1 \leq \hat{\theta}X$. Otherwise, abstain.

for any arbitrary $\hat{\theta} \in [\frac{X-Y}{X}, \theta_2(k)]$.

First, we check that the elements of $\Gamma(k)$ constitute equilibria. Each type of C 's strategy is optimal by construction. V_2 's beliefs satisfy the equilibria conditions and could be supported by letting $p(1, 0) = 1$ off the equilibrium path.

While V_2 's strategy is clearly optimal for $x_1 < X$, it remains to be seen that it is optimal at $x_1 = X$. V_2 's strategy must be optimal at $x_1 = X$ for all equilibria given that $\frac{Y \int_0^{\bar{\theta}} \theta F(\theta)}{1-F(\bar{\theta}_1)} < k$, and $\tilde{\theta}(\hat{\theta}X) < \bar{\theta}_1$ for all $\hat{\theta}$ in $\Gamma(k)$.

Next, we show that $\Gamma(k)$ constitutes the entire set of equilibria. One can show that any pooling between $\tau = 1$ and $\tau = 2$ candidates must occur at a single x_1 . Furthermore, it cannot be an equilibrium for $\tau = 1$ and $\tau = 2$ candidates to pool at $x_1 > \theta_2(k)$ because they would not be reelected and some could profitably deviate to their first-bests. It also cannot be an equilibrium for $\tau = 1$ and $\tau = 2$ candidates to pool at $x_1 < \frac{X-Y}{X}$, as $\tau = 1$ candidates could profitably deviate to $x_1 = X$.

Moreover, given that pooling between $\tau = 1$ and $\tau = 2$ must occur at some $\hat{\theta} \in [\frac{X-Y}{X}, \theta_2(k)]$, it cannot be an equilibrium for players to assort themselves in any

other way: $\tau = 2$ candidates with $\theta < \hat{\theta}$ must play their first-bests as the intuitive off-equilibrium beliefs imply it gives them reelection. $\tau = 2$ candidates with $\theta > \hat{\theta}$ must play $x_1 = \hat{\theta}X$ as anything greater implies foregoing reelection, while anything less is suboptimal. Lastly, $\tau = 1$ candidates cannot arrange in any other way by construction.

Finally, note that $\Gamma(k)$ also includes an equilibrium where no $\tau = 1$ candidates pool with $\tau = 2$ candidates in the case of $\hat{\theta} = \frac{X-Y}{X}$. It turns out this is the unique such equilibrium with strict separation between $\tau = 1$ and $\tau = 2$ candidates. $\tau = 2$ candidates cannot separate from $\tau = 1$ candidates and play $x_1 > X - Y$ as some $\tau = 1$ candidates would mimic. Also, $\tau = 2$ candidates cannot constrain to some $x_1 < X - Y$, as intuitive off-equilibrium beliefs imply V_2 reelects at any $x_1 < X - Y$ and $(2, \bar{\theta})$ could profitably deviate. Finally, conditional on $\tau = 2$ candidates choosing $x_1 = X - Y$ and separating from $\tau = 1$ candidates, $\tau = 1$ candidates must choose their first-best $x_1 = X$. Thus, $\Gamma(k)$ constitutes the entire set of equilibria. $\square$

Proof of Proposition 11. The proof of Proposition 10 shows that $\Gamma(k)$ constitutes the entire set of equilibria. Here, we show there is a unique equilibrium with $\hat{\theta} = \theta_2(k)$ and $\theta_1(k) = \tilde{\theta}(\theta_2(k)X)$ that candidate dominates all others in $\Gamma(k)$: each $\tau = 2$ candidate receives a weakly higher two period utility; each $\tau = 1$ candidate receives a weakly higher two period utility; some $\tau = 2$ who deviate from their first-best at other equilibria in $\Gamma(k)$ but not at $\hat{\theta} = \theta_2(k)$ receive a strictly higher two period utility; and some $\tau = 1$ candidates who mimic at $\hat{\theta} = \theta_2(k)$ but not at other other equilibria in $\Gamma(k)$ also receive a strictly higher two period utility. $\square$

Proof of Corollary 1. We want to show that $\frac{d\theta_2(k)}{dk} \leq 0$. Suppose $\theta_2(k) \neq \frac{X-Y}{X}$ (if $\theta_2(k) = \frac{X-Y}{X}$, then $\frac{d\theta_2(k)}{dk} = 0$ and the statement holds arbitrarily). If k increases, then the right hand side of the equation defining $\theta_2(k)$ (see proof of Proposition 10) increases. Thus, the left hand side must increase too. For the left hand side to increase, the ratio of $\tau = 2$ to $\tau = 1$ candidates $(\frac{1-F(\theta_2(k))}{F(\theta_1(k))})$ must increase since the

former give more second election benefits to V_2 . It can be seen that $1 - F(\theta_2(k))$ increases and $F(\theta_1(k))$ decreases when $\theta_2(k)$ decreases. Thus, $\theta_2(k)$ must decrease for the equation to hold. $\square$

Proof of Proposition 12. First, for a given $x_1 < X$, we define the set of $\tau = 1$ candidates who gain from deviating to x_1 to be reelected over playing their first-best (and foregoing reelection). For any $x_1 \in [0, X - \frac{Y}{2}]$, let $\nabla(x_1) \in [0, \bar{\theta}] \times [0, \bar{\alpha}]$ be implicitly defined by (θ, α) such that: $u_{(1, \theta, \alpha)}^1(x_1, X - x_1) + u_{(1, \theta, \alpha)}^2(Y - \theta Y, \theta Y) \geq u_{(1, \theta, \alpha)}^1(X - \bar{\alpha}X, \bar{\alpha}X)$. It can be shown that $\nabla(x'_1) \subseteq \nabla(x''_1)$ if $x'_1 < x''_1$. In other words, the set of $\tau = 1$ candidates who are willing to mimic is decreasing as they must deviate further from their first-bests. Furthermore, it can be shown that $\nabla(x_1)$ is a compact set.

We define $\theta_2(k)$ as the highest θ such that if type 2 candidates with $\theta \geq \theta_2(k)$ pool with all $\tau = 1$ candidates who gain from mimicking $\nabla(\theta_2(k)X)$, then V_2 still votes. Let $H(\theta, \alpha)$ define the joint distribution of θ and α .

Define $\theta_2(k)$ implicitly by $\frac{\int_{\theta_2(k)}^{\bar{\theta}} \int_0^{\bar{\alpha}} (1-\alpha)G(\alpha)F(\theta) + \int_{\nabla(\theta_2(k)X)} \theta H(\theta)}{1 - F(\theta_2(k)) + H(\nabla(\theta_2(k)X))} = \frac{k}{Y}$ if it exists and $\theta_2(k) = \underline{\theta}_1$ otherwise where $\underline{\theta}_1$ is defined as follows. $\underline{\theta}_1 \in [0, \frac{X-Y}{X}]$ is implicitly defined such that the most altruistic $\tau = 1$ candidate with zero reciprocity would be indifferent to mimicking at $x_1 = \underline{\theta}_1 X$: $u_{(1, \underline{\theta}_1, \bar{\alpha})}^1(\underline{\theta}_1 X, X - \underline{\theta}_1 X) + u_{(1, \underline{\theta}_1, \bar{\alpha})}^2(Y, 0) = u_{(1, \underline{\theta}_1, \bar{\alpha})}^1(X - \bar{\alpha}X, \bar{\alpha}X)$.

Claim 2. For a given k , the set of equilibria satisfying the intuitive off-equilibrium beliefs $\Phi(k)$ is non-empty and strictly includes equilibria where:

$$(1, \theta, \alpha): x_1 = \hat{\theta}X \text{ if } (\theta, \alpha) \in \nabla(\hat{\theta}X) \text{ and } x_1 = (1 - \alpha)X \text{ otherwise.}$$

$$y_2 = \theta Y \text{ if re-elected.}$$

$$(2, \theta, \alpha): x_1 = \hat{\theta}X \text{ if } \theta \geq \hat{\theta} \text{ and } x_1 = \theta X \text{ otherwise. } y_2 = (1 - \alpha)Y \text{ if}$$

re-elected.

$$V_2 \text{ strategy: Vote if } x_1 \leq \hat{\theta}X. \text{ Otherwise, abstain.}$$

for any arbitrary $\hat{\theta} \in [\underline{\theta}_1, \theta_2(k)]$.

First, we check that the elements of $\Phi(k)$ constitute equilibria. Each type C 's strategy is optimal by construction. V_2 's beliefs satisfy the equilibria conditions and could be supported by letting $p(1, 0, 0) = 1$ off the equilibrium path. V_2 's strategy is clearly optimal for $x_1 \leq \hat{\theta}X$. Furthermore, V_2 's strategy is optimal at $x_1 > \hat{\theta}X$ because V_2 is unwilling to reelect any non-mimicking $\tau = 1$ candidate. As explained in the text, this follows because $E(\theta | \theta \geq \hat{\theta}_1) \leq \frac{k}{Y}$. Thus, the elements of $\Phi(k)$ are equilibria. The argument that $\Phi(k)$ constitutes the entire set of equilibria follows the same logic as in the proof of Proposition 10. $\square$

Proof of Proposition 13. Here, we show there is a unique equilibrium with $\hat{\theta} = \theta_2(k)$ that candidate dominates all others in $\Phi(k)$: each $\tau = 2$ candidate receives a weakly higher two period utility; each $\tau = 1$ candidate receives a weakly higher two period utility; some $\tau = 2$ who deviate from their first-best at other equilibria in $\Phi(k)$ but not at $\hat{\theta} = \theta_2(k)$ receive a strictly higher two period utility; and some $\tau = 1$ candidates who mimic at $\hat{\theta} = \theta_2(k)$ but not at other other equilibria in $\Phi(k)$ also receive a strictly higher two period utility. $\square$

Proof of Corollary 2. We want to show that $\frac{d\theta_2(k)}{dk} \leq 0$. Suppose $\theta_2(k) \neq \underline{\theta}_1$ (if $\theta_2(k) = \underline{\theta}_1$, then $\frac{d\theta_2(k)}{dk} = 0$ and the statement holds arbitrarily). If k increases, then the right hand side of the equation defining $\theta_2(k)$ (see proof of Proposition 12) increases. Thus, the left hand side must increase too. For the left hand side to increase, the ratio of $\tau = 2$ to $\tau = 1$ candidates must increase since the former give more second election benefits to V_2 . As $\theta_2(k)$ decreases, the mass of $\tau = 2$ candidates $1 - F(\theta_2(k))$ increases and the mass of $\tau = 1$ candidates $H(\nabla(\theta_2(k)X))$ decreases. Thus, $\theta_2(k)$ must decrease for the equation to hold. $\square$

C.2 Instructions

C.2.1 Treatment SLC

INSTRUCTIONS

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision making. You will receive \$7.00 participation fee if you complete the session. In addition to that if you follow the instructions and are careful with your decisions, you can earn a significant amount of money, which will be paid to you at the end of the session.

During the experiment it is important that you do not talk to any other subjects. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all your earnings will be forfeited.

The experiment will last about 60 minutes. The experiment consists of 5 identical decision rounds.

ROLES AND TYPES

At the beginning of the experiment you will be randomly assigned a role. The three possible roles you can be assigned are “**Voter 1**,” “**Voter 2**” or “**Candidate**.” Your role will stay fixed throughout all 5 rounds of the experiment.

At the beginning of each round, you will be randomly sorted into groups of 3 people. Each group will consist of a Voter 1, a Voter 2 and a Candidate. You will be matched with different participants in each round. No participant will ever be informed about the identities of the participants they are paired with, neither during nor after the experiment.

Furthermore, in each round, Candidate is assigned a type. The computer randomly assigns Candidate to be either “**Type 1**” or “**Type 2**,” with equal probability of being assigned either type. Candidate’s type is fixed just for that round, and is assigned independently and randomly in each round. While Candidate will know his/her type, Voter 1 and Voter 2 will never learn Candidate’s type at any point.

SEQUENCE OF ACTIONS IN A ROUND

At the beginning of each round, Voter 1, Voter 2 and Candidate are given \$6.00 each. A round consists of two possible (sequential) elections, with Voter 1 voting in the first election and Voter 2 voting in the second election.

The sequence of events in a round is as follows.

1) Matching and Type Assignment:

First, you are randomly matched with two other participants in the room.

If you are Candidate, then you learn your randomly assigned type: Type 1, or Type 2. Candidate has an equal chance of being assigned either type. It is important to note that Voter 1 and Voter 2 do not learn Candidate’s type but may try to infer them from Candidate’s choices.

An example Voter 2 screen is shown below.

This is Round 1.

Your designated role is **Voter 2**. You will keep this role throughout all rounds of the experiment.

You are randomly matched with two other participants in the room. You are given an endowment of **\$6.00** for this round.

Following, you continue to the first election.

2) First Election:

The first election proceeds as follows.

A) Voter 1 decides to **vote** for Candidate or **not vote**. Voting costs Voter 1 **\$1.00** while not voting is **costless**.

An example Voter 1 screen is shown below.

Round 1 First Election Role: Voter 1

Please make your decision about whether to vote for Candidate or not vote.

As a reminder, voting for Candidate costs **\$1.00**. Not voting is **costless**.

☐ Vote for Candidate
☐ Do not vote

B) Next, Candidate and Voter 2 learn about Voter 1's voting decision. If Voter 1 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

An example screen is shown below. In this example, Voter 1 happens to elect Candidate. This is just an example and is not to suggest how you should make your decision if you are Voter 1.

Voter 1 voted for Candidate.

C) If elected, Candidate is given **\$15.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$15.00. Candidate can divide the \$15.00 in any amount {\$0.00, \$0.01, \$0.02, \$0.03, ..., \$15.00} between Voter 1 and Voter 2.

Furthermore, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

An example Candidate screen is shown below.

Since you were elected by Voter 1, you have been given **\$15.00** to divide between Voter 1 and Voter 2. As a reminder, you keep **\$0.01** for every **\$0.01** shared with the voter of your type.

Please enter how much you would like to give Voter 1.

Please enter how much you would like to give Voter 2.

D) Finally, if Candidate is elected, Voter 1 and Voter 2 learn about Candidate's allocation of the \$15.00.

An example screen is shown below. In this example, Candidate happens to distribute \$11.51 to Voter 1 and \$3.49 to Voter 2. This is just an example and is not to suggest how you should make your decision if you are Candidate.

Candidate shared **\$11.51** of the **\$15.00** with Voter 1.

Candidate shared **\$3.49** of the **\$15.00** with Voter 2.

This concludes the first election.

The second election now begins.

If Candidate is elected in the first election, then you continue to the second election. Otherwise, the round is over.

3) Second Election:

The second election proceeds as follows. The example screens are left out as they are similar to the respective screens in the first election.

A) Voter 2 decides to **vote** for Candidate or **not vote**. Voting costs Voter 2 **\$1.00** while not voting is **costless**.

B) Next, Candidate and Voter 1 learn about Voter 2's voting decision. If Voter 2 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

C) If elected, Candidate is given **\$10.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$10.00. Candidate can divide the \$10.00 in any amount $\{ \$0.00, \$0.01, \$0.02, \$0.03, \dots, \$10.00 \}$ between Voter 1 and Voter 2.

As in the first election, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

D) Finally, if Candidate is elected, Voter 1 and Voter 2 learn about Candidate's allocation of the \$10.00 and the round ends.

Once the round ends, you proceed to the next round where you will be matched with new partners and receive a new \$6.00 endowment.

SUMMARY: POTENTIAL EARNINGS PER ROUND

$$\begin{aligned}
 \text{Voter 1} &= \begin{cases} \$6.00 - \$1.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 1 first election} \\ + \text{Allocation to Voter 1 second election} \\ \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 1 first election} \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \text{Voter 2} &= \begin{cases} \$6.00 - \$1.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 2 first election} \\ + \text{Allocation to Voter 2 second election} \\ \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 2 first election} \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \text{Type 1 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 1 second election} \\ \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in first election only} \\ \$6.00 & \text{if unelected} \end{cases} \\
 \text{Type 2 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 2 second election} \\ \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in first election only} \\ \$6.00 & \text{if unelected} \end{cases}
 \end{aligned}$$

FINAL EARNINGS

Once the experiment is finished, the computer will randomly pick 1 round out of the 5 rounds that you completed. The earnings you made on that round will be your earnings for the experiment. Hence, you should make careful decisions in each round because it might be a paying round.

Are there any questions?

C.2.2 Treatment SHC

INSTRUCTIONS

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision making. You will receive \$7.00 participation fee if you complete the session. In addition to that if you follow the instructions and are careful with your decisions, you can earn a significant amount of money, which will be paid to you at the end of the session.

During the experiment it is important that you do not talk to any other subjects. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all your earnings will be forfeited.

The experiment will last about 60 minutes. The experiment consists of 5 identical decision rounds.

ROLES AND TYPES

At the beginning of the experiment you will be randomly assigned a role. The three possible roles you can be assigned are “**Voter 1**,” “**Voter 2**” or “**Candidate**.” Your role will stay fixed throughout all 5 rounds of the experiment.

At the beginning of each round, you will be randomly sorted into groups of 3 people. Each group will consist of a Voter 1, a Voter 2 and a Candidate. You will be matched with different participants in each round. No participant will ever be informed about the identities of the participants they are paired with, neither during nor after the experiment.

Furthermore, in each round, Candidate is assigned a type. The computer randomly assigns Candidate to be either “**Type 1**” or “**Type 2**,” with equal probability of being assigned either type. Candidate’s type is fixed just for that round, and is assigned independently and randomly in each round. While Candidate will know his/her type, Voter 1 and Voter 2 will never learn Candidate’s type at any point.

SEQUENCE OF ACTIONS IN A ROUND

At the beginning of each round, Voter 1, Voter 2 and Candidate are given \$6.00 each. A round consists of two possible (sequential) elections, with Voter 1 voting in the first election and Voter 2 voting in the second election.

The sequence of events in a round is as follows.

1) Matching and Type Assignment:

First, you are randomly matched with two other participants in the room.

If you are Candidate, then you learn your randomly assigned type: Type 1, or Type 2. Candidate has an equal chance of being assigned either type. It is important to note that Voter 1 and Voter 2 do not learn Candidate’s type but may try to infer them from Candidate’s choices.

An example Voter 2 screen is shown below.

This is Round 1.

Your designated role is **Voter 2**. You will keep this role throughout all rounds of the experiment.

You are randomly matched with two other participants in the room. You are given an endowment of **\$6.00** for this round.

Following, you continue to the first election.

2) First Election:

The first election proceeds as follows.

A) Voter 1 decides to **vote** for Candidate or **not vote**. Voting costs Voter 1 **\$6.00** while not voting is **costless**.

An example Voter 1 screen is shown below.

Round 1 First Election Role: Voter 1

Please make your decision about whether to vote for Candidate or not vote.

As a reminder, voting for Candidate costs **\$6.00**. Not voting is **costless**.

☐ Vote for Candidate
☐ Do Not Vote

B) Next, Candidate and Voter 2 learn about Voter 1's voting decision. If Voter 1 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

An example screen is shown below. In this example, Voter 1 happens to elect Candidate. This is just an example and is not to suggest how you should make your decision if you are Voter 1.

Voter 1 voted for Candidate.

C) If elected, Candidate is given **\$15.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$15.00. Candidate can divide the \$15.00 in any amount {**\$0.00**, **\$0.01**, **\$0.02**, **\$0.03**, ..., **\$15.00**} between Voter 1 and Voter 2.

Furthermore, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

An example Candidate screen is shown below.

Since you were elected by Voter 1, you have been given **\$15.00** to divide between Voter 1 and Voter 2. As a reminder, you keep **\$0.01** for every **\$0.01** shared with the voter of your type.

Please enter how much you would like to give Voter 1.

Please enter how much you would like to give Voter 2.

D) Finally, if Candidate is elected, Voter 1 and Voter 2 learn about Candidate's allocation of the \$15.00.

An example screen is shown below. In this example, Candidate happens to distribute \$11.51 to Voter 1 and \$3.49 to Voter 2. This is just an example and is not to suggest how you should make your decision if you are Candidate.

Candidate shared **\$11.51** of the **\$15.00** with Voter 1.

Candidate shared **\$3.49** of the **\$15.00** with Voter 2.

This concludes the first election.

The second election now begins.

If Candidate is elected in the first election, then you continue to the second election. Otherwise, the round is over.

3) Second Election:

The second election proceeds as follows. The example screens are left out as they are similar to the respective screens in the first election.

A) Voter 2 decides to **vote** for Candidate or **not vote**. Voting costs Voter 2 **\$6.00** while not voting is **costless**.

B) Next, Candidate and Voter 1 learn about Voter 2's voting decision. If Voter 2 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

C) If elected, Candidate is given **\$10.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$10.00. Candidate can divide the \$10.00 in any amount $\{ \$0.00, \$0.01, \$0.02, \$0.03, \dots, \$10.00 \}$ between Voter 1 and Voter 2.

As in the first election, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

D) Finally, if Candidate is elected, Voter 1 and Voter 2 learn about Candidate's allocation of the \$10.00 and the round ends.

Once the round ends, you proceed to the next round where you will be matched with new partners and receive a new \$6.00 endowment.

SUMMARY: POTENTIAL EARNINGS PER ROUND

$$\begin{aligned}
 \text{Voter 1} &= \begin{cases} \$6.00 - \$6.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 1 first election} \\ + \text{Allocation to Voter 1 second election} \\ \$6.00 - \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 1 first election} \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \text{Voter 2} &= \begin{cases} \$6.00 - \$6.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 2 first election} \\ + \text{Allocation to Voter 2 second election} \\ \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 2 first election} \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \text{Type 1 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 1 second election} \\ \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in first election only} \\ \$6.00 & \text{if unelected} \end{cases} \\
 \text{Type 2 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 2 second election} \\ \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in first election only} \\ \$6.00 & \text{if unelected} \end{cases}
 \end{aligned}$$

FINAL EARNINGS

Once the experiment is finished, the computer will randomly pick 1 round out of the 5 rounds that you completed. The earnings you made on that round will be your earnings for the experiment. Hence, you should make careful decisions in each round because it might be a paying round.

Are there any questions?

C.2.3 Treatment NILC

INSTRUCTIONS

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision making. You will receive \$7.00 participation fee if you complete the session. In addition to that if you follow the instructions and are careful with your decisions, you can earn a significant amount of money, which will be paid to you at the end of the session.

During the experiment it is important that you do not talk to any other subjects. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all your earnings will be forfeited.

The experiment will last about 60 minutes. The experiment consists of 5 identical decision rounds.

ROLES AND TYPES

At the beginning of the experiment you will be randomly assigned a role. The three possible roles you can be assigned are “**Voter 1**,” “**Voter 2**” or “**Candidate**.” Your role will stay fixed throughout all 5 rounds of the experiment.

At the beginning of each round, you will be randomly sorted into groups of 3 people. Each group will consist of a Voter 1, a Voter 2 and a Candidate. You will be matched with different participants in each round. No participant will ever be informed about the identities of the participants they are paired with, neither during nor after the experiment.

Furthermore, in each round, Candidate is assigned a type. The computer randomly assigns Candidate to be either “**Type 1**” or “**Type 2**,” with equal probability of being assigned either type. Candidate’s type is fixed just for that round, and is assigned independently and randomly in each round. While Candidate will know his/her type, Voter 1 and Voter 2 will never learn Candidate’s type at any point.

SEQUENCE OF ACTIONS IN A ROUND

At the beginning of each round, Voter 1, Voter 2 and Candidate are given \$6.00 each. A round consists of two possible (sequential) elections, with Voter 1 voting in the first election and Voter 2 voting in the second election.

The sequence of events in a round is as follows.

1) Matching and Type Assignment:

First, you are randomly matched with two other participants in the room.

If you are Candidate, then you learn your randomly assigned type: Type 1, or Type 2. Candidate has an equal chance of being assigned either type. It is important to note that Voter 1 and Voter 2 do not learn Candidate’s type.

An example Voter 2 screen is shown below.

This is Round 1.

Your designated role is **Voter 2**. You will keep this role throughout all rounds of the experiment.

You are randomly matched with two other participants in the room. You are given an endowment of **\$6.00** for this round.

Following, you continue to the first election.

2) First Election:

The first election proceeds as follows.

A) Voter 1 decides to **vote** for Candidate or **not vote**. Voting costs Voter 1 **\$1.00** while not voting is **costless**.

An example Voter 1 screen is shown below.

Round 1 First Election Role: Voter 1

Please make your decision about whether to vote for Candidate or not vote.

As a reminder, voting for Candidate costs **\$1.00**. Not voting is **costless**.

☐ Vote for Candidate
☐ Do not vote

B) Next, Candidate and Voter 2 learn about Voter 1's voting decision. If Voter 1 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

An example screen is shown below. In this example, Voter 1 happens to elect Candidate. This is just an example and is not to suggest how you should make your decision if you are Voter 1.

Voter 1 voted for Candidate.

C) If elected, Candidate is given **\$15.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$15.00. Candidate can divide the \$15.00 in any amount $\{ \$0.00, \$0.01, \$0.02, \$0.03, \dots, \$15.00 \}$ between Voter 1 and Voter 2.

Furthermore, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

An example Candidate screen is shown below.

Since you were elected by Voter 1, you have been given **\$15.00** to divide between Voter 1 and Voter 2. As a reminder, you keep **\$0.01** for every **\$0.01** shared with the voter of your type.

Please enter how much you would like to give Voter 1.

Please enter how much you would like to give Voter 2.

D) Finally, if Candidate is elected, Voter 1 learns about Candidate's allocation of the \$15.00.

An example Voter 1 screen is shown below. In this example, Candidate happens to distribute \$11.51 to Voter 1 and \$3.49 to Voter 2. This is just an example and is not to suggest how you should make your decision if you are Candidate.

Round 1 First Election Role: Voter 1

Candidate shared **\$11.51** of the **\$15.00** with Voter 1.

Candidate shared **\$3.49** of the **\$15.00** with Voter 2.

This concludes the first election.

The second election now begins.

In contrast, Voter 2 does not learn about Candidate's allocation of the \$15.00 until the round ends. An example Voter 2 screen is shown below.

Round 1 First Election Role: Voter 2

Candidate has divided the **\$15.00** between Voter 1 and Voter 2. You will learn the allocation at the end of the second election.

This concludes the first election.

The second election now begins.

If Candidate is elected in the first election, then you continue to the second election. Otherwise, the round is over.

3) Second Election:

The second election proceeds as follows. The example screens are left out as they are similar to the respective screens in the first election.

A) Voter 2 decides to **vote** for Candidate or **not vote**. Voting costs Voter 2 **\$1.00** while not voting is **costless**.

B) Next, Candidate and Voter 1 learn about Voter 2's voting decision. If Voter 2 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

C) If elected, Candidate is given **\$10.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$10.00. Candidate can divide the \$10.00 in any amount $\{ \$0.00, \$0.01, \$0.02, \$0.03, \dots, \$10.00 \}$ between Voter 1 and Voter 2.

As in the first election, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

D) Finally, Voter 2 learns about Candidate's allocation of the \$15.00 in the first election. Furthermore, if Candidate is elected, Voter 1 and Voter 2 learn about Candidate's allocation of the \$10.00 in the second election. This concludes the round.

Once the round ends, you proceed to the next round where you will be matched with new partners and receive a new \$6.00 endowment.

SUMMARY: POTENTIAL EARNINGS PER ROUND

$$\begin{aligned}
 \text{Voter 1} &= \begin{cases} \$6.00 - \$1.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 1 first election} \\ + \text{Allocation to Voter 1 second election} \\ \\ \$6.00 - \$1.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 1 first election} \\ \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \\
 \text{Voter 2} &= \begin{cases} \$6.00 - \$1.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 2 first election} \\ + \text{Allocation to Voter 2 second election} \\ \\ \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 2 first election} \\ \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \\
 \text{Type 1 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 1 second election} \\ \\ \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in first election only} \\ \\ \$6.00 & \text{if unelected} \end{cases} \\
 \\
 \text{Type 2 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 2 second election} \\ \\ \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in first election only} \\ \\ \$6.00 & \text{if unelected} \end{cases}
 \end{aligned}$$

FINAL EARNINGS

Once the experiment is finished, the computer will randomly pick 1 round out of the 5 rounds that you completed. The earnings you made on that round will be your earnings for the experiment. Hence, you should make careful decisions in each round because it might be a paying round.

Are there any questions?

C.2.4 Treatment NIHC

INSTRUCTIONS

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision making. You will receive \$7.00 participation fee if you complete the session. In addition to that if you follow the instructions and are careful with your decisions, you can earn a significant amount of money, which will be paid to you at the end of the session.

During the experiment it is important that you do not talk to any other subjects. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all your earnings will be forfeited.

The experiment will last about 60 minutes. The experiment consists of 5 identical decision rounds.

ROLES AND TYPES

At the beginning of the experiment you will be randomly assigned a role. The three possible roles you can be assigned are “**Voter 1**,” “**Voter 2**” or “**Candidate**.” Your role will stay fixed throughout all 5 rounds of the experiment.

At the beginning of each round, you will be randomly sorted into groups of 3 people. Each group will consist of a Voter 1, a Voter 2 and a Candidate. You will be matched with different participants in each round. No participant will ever be informed about the identities of the participants they are paired with, neither during nor after the experiment.

Furthermore, in each round, Candidate is assigned a type. The computer randomly assigns Candidate to be either “**Type 1**” or “**Type 2**,” with equal probability of being assigned either type. Candidate’s type is fixed just for that round, and is assigned independently and randomly in each round. While Candidate will know his/her type, Voter 1 and Voter 2 will never learn Candidate’s type at any point.

SEQUENCE OF ACTIONS IN A ROUND

At the beginning of each round, Voter 1, Voter 2 and Candidate are given \$6.00 each. A round consists of two possible (sequential) elections, with Voter 1 voting in the first election and Voter 2 voting in the second election.

The sequence of events in a round is as follows.

1) Matching and Type Assignment:

First, you are randomly matched with two other participants in the room.

If you are Candidate, then you learn your randomly assigned type: Type 1, or Type 2. Candidate has an equal chance of being assigned either type. It is important to note that Voter 1 and Voter 2 do not learn Candidate’s type.

An example Voter 2 screen is shown below.

This is Round 1.

Your designated role is **Voter 2**. You will keep this role throughout all rounds of the experiment.

You are randomly matched with two other participants in the room. You are given an endowment of **\$6.00** for this round.

Following, you continue to the first election.

2) First Election:

The first election proceeds as follows.

A) Voter 1 decides to **vote** for Candidate or **not vote**. Voting costs Voter 1 **\$6.00** while not voting is **costless**.

An example Voter 1 screen is shown below.

Round 1 First Election Role: Voter 1

Please make your decision about whether to vote for Candidate or not vote.

As a reminder, voting for Candidate costs **\$6.00**.
Not voting is **costless**.

☐ Vote for Candidate
☐ Do Not Vote

B) Next, Candidate and Voter 2 learn about Voter 1's voting decision. If Voter 1 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

An example screen is shown below. In this example, Voter 1 happens to elect Candidate. This is just an example and is not to suggest how you should make your decision if you are Voter 1.

Voter 1 voted for Candidate.

C) If elected, Candidate is given **\$15.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$15.00. Candidate can divide the \$15.00 in any amount { $\$0.00$, $\$0.01$, $\$0.02$, $\$0.03$, ..., $\$15.00$ } between Voter 1 and Voter 2.

Furthermore, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

An example Candidate screen is shown below.

Since you were elected by Voter 1, you have been given **\$15.00** to divide between Voter 1 and Voter 2. As a reminder, you keep **\$0.01** for every **\$0.01** shared with the voter of your type.

Please enter how much you would like to give Voter 1.

Please enter how much you would like to give Voter 2.

D) Finally, if Candidate is elected, Voter 1 learns about Candidate's allocation of the \$15.00.

An example Voter 1 screen is shown below. In this example, Candidate happens to distribute \$11.51 to Voter 1 and \$3.49 to Voter 2. This is just an example and is not to suggest how you should make your decision if you are Candidate.

Round 1 First Election Role: Voter 1

Candidate shared **\$11.51** of the **\$15.00** with Voter 1.

Candidate shared **\$3.49** of the **\$15.00** with Voter 2.

This concludes the first election.

The second election now begins.

In contrast, Voter 2 does not learn about Candidate's allocation of the \$15.00 until the round ends. An example Voter 2 screen is shown below.

Round 1 First Election Role: Voter 2

Candidate has divided the **\$15.00** between Voter 1 and Voter 2. You will learn the allocation at the end of the second election.

This concludes the first election.

The second election now begins.

If Candidate is elected in the first election, then you continue to the second election. Otherwise, the round is over.

3) Second Election:

The second election proceeds as follows. The example screens are left out as they are similar to the respective screens in the first election.

A) Voter 2 decides to **vote** for Candidate or **not vote**. Voting costs Voter 2 **\$6.00** while not voting is **costless**.

B) Next, Candidate and Voter 1 learn about Voter 2's voting decision. If Voter 2 votes for Candidate, then Candidate is elected. Otherwise, Candidate is not elected and the round immediately ends.

C) If elected, Candidate is given **\$10.00** to distribute in any proportion between Voter 1 and Voter 2. Candidate must distribute all of the \$10.00. Candidate can divide the \$10.00 in any amount $\{ \$0.00, \$0.01, \$0.02, \$0.03, \dots, \$10.00 \}$ between Voter 1 and Voter 2.

As in the first election, if Candidate is of Type 1, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 1. Similarly, if Candidate is of Type 2, then Candidate is given an additional \$0.01 to keep for every \$0.01 distributed to Voter 2.

D) Finally, Voter 2 learns about Candidate's allocation of the \$15.00 in the first election. Furthermore, if Candidate is elected, Voter 1 and Voter 2 learn about Candidate's allocation of the \$10.00 in the second election. This concludes the round.

Once the round ends, you proceed to the next round where you will be matched with new partners and receive a new \$6.00 endowment.

SUMMARY: POTENTIAL EARNINGS PER ROUND

$$\begin{aligned}
 \text{Voter 1} &= \begin{cases} \$6.00 - \$6.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 1 first election} \\ + \text{Allocation to Voter 1 second election} \\ \\ \$6.00 - \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 1 first election} \\ \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \\
 \text{Voter 2} &= \begin{cases} \$6.00 - \$6.00 & \text{if Candidate elected in both elections} \\ + \text{Allocation to Voter 2 first election} \\ + \text{Allocation to Voter 2 second election} \\ \\ \$6.00 & \text{if Candidate elected in first election only} \\ + \text{Allocation to Voter 2 first election} \\ \\ \$6.00 & \text{if Candidate unelected} \end{cases} \\
 \\
 \text{Type 1 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 1 second election} \\ \\ \$6.00 + \text{Allocation to Voter 1 first election} & \text{if elected in first election only} \\ \\ \$6.00 & \text{if unelected} \end{cases} \\
 \\
 \text{Type 2 Candidate} &= \begin{cases} \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in both elections} \\ + \text{Allocation to Voter 2 second election} \\ \\ \$6.00 + \text{Allocation to Voter 2 first election} & \text{if elected in first election only} \\ \\ \$6.00 & \text{if unelected} \end{cases}
 \end{aligned}$$

FINAL EARNINGS

Once the experiment is finished, the computer will randomly pick 1 round out of the 5 rounds that you completed. The earnings you made on that round will be your earnings for the experiment. Hence, you should make careful decisions in each round because it might be a paying round.

Are there any questions?

Bibliography

- ABERNETHY, A. M. AND G. R. FRANKE (1996): “The Information Content of Advertising: A Meta-Analysis,” *Journal of Advertising*, 25, 1–17.
- AKIN, Z. AND E. KARAGÖZOĞLU (2017): “The Role of Goals and Feedback in Incentivizing Performance,” *Managerial and Decision Economics*, 38, 193–211.
- ALBÁK, S. AND P. B. OVERGAARD (1992): “Upstream Pricing and Advertising Signal Downstream Demand,” *Journal of Economics & Management Strategy*, 1, 677–698.
- AMALDOSS, W. AND S. JAIN (2005a): “Conspicuous Consumption and Sophisticated Thinking,” *Management Science*, 51, 1449–1466.
- (2005b): “Pricing of Conspicuous Goods: A Competitive Analysis of Social Effects,” *Journal of Marketing Research*, 42, 30–42.
- ANDERSON, D. C., C. R. CROWELL, S. S. SPONSEL, M. CLARKE, AND J. BRENCE (1983): “Behavior Management in the Public Accommodations Industry: A Three-project Demonstration,” *Journal of Organizational Behavior Management*, 4, 33–66.
- ANDRADE, E. B. AND G. IYER (2009): “Planned Versus Actual Betting in Sequential Gambles,” *Journal of Marketing Research*, 46, 372–383.
- ARIELY, D., A. BRACHA, AND S. MEIER (2009): “Doing Good or Doing Well? Image Motivation and Monetary Incentives in Behaving Prosocially,” *American Economic Review*, 99, 544–55.
- AVRAHAM, J. AND Y. KAREEV (2011): “The Role of Impulses in Shaping Decisions,” *Journal of Behavioral Decision Making*, 24, 515–529.
- BAGWELL, K. (2007): “The Economic Analysis of Advertising,” *Handbook of Industrial Organization*, 3, 1701–1844.
- BAGWELL, K. AND G. RAMEY (1988): “Advertising and Limit Pricing,” *The Rand Journal of Economics*, 59–71.

- (1990): “Advertising and Pricing to Deter or Accommodate Entry when Demand is Unknown,” *International Journal of Industrial Organization*, 8, 93–113.
- BAGWELL, L. S. AND B. D. BERNHEIM (1996): “Veblen Effects in a Theory of Conspicuous Consumption,” *The American Economic Review*, 349–373.
- BAIN, J. S. (1956): *Barriers to New Competition: Their Character and Consequences in Manufacturing Industries*, Harvard University Press Cambridge, MA.
- BANDIERA, O., I. BARANKAY, AND I. RASUL (2010): “Social Incentives in the Workplace,” *The Review of Economic Studies*, 77, 417–458.
- BANDIERA, O., V. LARCINESE, AND I. RASUL (2015): “Blissful Ignorance? A Natural Experiment on the Effect of Feedback on Students’ Performance,” *Labour Economics*, 34, 13–25.
- BARRETT, G. F. AND S. G. DONALD (2003): “Consistent Tests for Stochastic Dominance,” *Econometrica*, 71, 71–104.
- BARTLING, B. (2011): “Relative Performance or Team Evaluation? Optimal Contracts for Other-regarding Agents,” *Journal of Economic Behavior & Organization*, 79, 183–193.
- BARTLING, B. AND F. A. VON SIEMENS (2010): “The Intensity of Incentives in Firms and Markets: Moral Hazard with Envious Agents,” *Labour Economics*, 17, 598–607.
- BAYE, M. R., J. MORGAN, AND P. SCHOLTEN (2006): “Information, Search, and Price Dispersion,” *Handbook on Economics and Information Systems*, 1, 323–375.
- BECKER, G. S. (1991): “A Note on Restaurant Pricing and Other Examples of Social Influences on Price,” *Journal of Political Economy*, 99, 1109–1116.
- BECKER, G. S. AND K. M. MURPHY (1993): “A Simple Theory of Advertising as a Good or Bad,” *The Quarterly Journal of Economics*, 108, 941–964.
- BELLEFLAMME, P. AND M. PEITZ (2015): *Industrial Organization: Markets and Strategies*, Cambridge University Press.
- BÉNABOU, R. AND J. TIROLE (2006a): “Incentives and Prosocial Behavior,” *American Economic Review*, 96, 1652–1678.
- (2006b): “Incentives and Prosocial Behavior,” *American Economic Review*, 96, 1652–1678.
- (2011): “Identity, Morals, and Taboos: Beliefs as Assets,” *The Quarterly Journal of Economics*, 126, 805–855.

- BERLIN, N. AND M.-P. DARGNIES (2016): “Gender Differences in Reactions to Feedback and Willingness to Compete,” *Journal of Economic Behavior & Organization*, 130, 320–336.
- BERNHEIM, B. D. (1994): “A Theory of Conformity,” *Journal of Political Economy*, 102, 841–877.
- BESLEY, T. AND S. COATE (1997): “An Economic Model of Representative Democracy,” *The Quarterly Journal of Economics*, 112, 85–114.
- BINDER, S. A. (1997): *Minority Rights, Majority Rule: Partisanship and the Development of Congress*, Cambridge University Press.
- BOLTON, G. E., E. KATOK, AND A. OCKENFELS (2004): “How Effective are Electronic Reputation Mechanisms? An Experimental Investigation,” *Management science*, 50, 1587–1602.
- BOLTON, G. E. AND A. OCKENFELS (2000): “ERC: A Theory of Equity, Reciprocity, and Competition,” *American Economic Review*, 90, 166–193.
- BOLTON, P. AND M. DEWATRIPONT (2005): *Contract Theory*, MIT press.
- BORDER, K. C. (1985): *Fixed Point Theorems With Applications to Economics and Game Theory*, Cambridge University Press.
- BÖRGERS, T. (1988): “Robustness of Bertrand’s Equilibrium in a General Model of Product-Differentiation,” *Mimeo*.
- BRAITHWAITE, D. (1928): “The Economic Effects of Advertisement,” *The Economic Journal*, 38, 16–37.
- BRANDTS, J. AND N. FIGUERAS (2003): “An Exploration of Reputation Formation in Experimental Games,” *Journal of Economic Behavior & Organization*, 50, 89–115.
- BREZA, E., S. KAUR, AND Y. SHAMDASANI (2018): “The Morale Effects of Pay Inequality,” *The Quarterly Journal of Economics*, 133, 611–663.
- BROCK, J. M., A. LANGE, AND E. Y. OZBAY (2013): “Dictating the Risk: Experimental Evidence on Giving in Risky Environments,” *American Economic Review*, 103, 415–37.
- BRONNENBERG, B. J., S. K. DHAR, AND J.-P. DUBÉ (2007): “Consumer Packaged Goods in the United States: National Brands, Local Branding,” *Journal of Marketing Research*, 44, 4–13.
- BRONNENBERG, B. J., S. K. DHAR, AND J.-P. H. DUBÉ (2009): “Brand History, Geography, and the Persistence of Brand Shares,” *Journal of Political Economy*, 117, 87–115.

- (2011): “Endogenous Sunk Costs and the Geographic Differences in the Market Structures of CPG Categories,” *Quantitative Marketing and Economics*, 9, 1–23.
- BUEHLER, S. AND D. HALBHEER (2012): “Persuading Consumers with Social Attitudes,” *Journal of Economic Behavior & Organization*, 84, 439–450.
- BULL, C., A. SCHOTTER, AND K. WEIGELT (1987): “Tournaments and Piece Rates: An Experimental Study,” *Journal of Political Economy*, 95, 1–33.
- CADSBY, C. B., M. FRANK, AND V. MAKSIMOVIC (1998): “Equilibrium Dominance in Experimental Financial Markets,” *The Review of Financial Studies*, 11, 189–232.
- CAMERER, C. AND K. WEIGELT (1988): “Experimental Tests of a Sequential Equilibrium Reputation Model,” *Econometrica*, 1–36.
- CAMERER, C. F. AND E. FEHR (2006): “When Does “Economic Man” Dominate Social Behavior?” *Science*, 311, 47–52.
- CAMPBELL, A., D. MAYZLIN, AND J. SHIN (2017): “Managing Buzz,” *The RAND Journal of Economics*, 48, 203–229.
- CHARNESS, G., U. GNEEZY, AND A. IMAS (2013a): “Experimental Methods: Eliciting Risk Preferences,” *Journal of Economic Behavior & Organization*, 87, 43–51.
- CHARNESS, G. AND B. GROSSKOPF (2001): “Relative Payoffs and Happiness: An Experimental Study,” *Journal of Economic Behavior & Organization*, 45, 301–328.
- CHARNESS, G., D. MASCLET, AND M. C. VILLEVAL (2013b): “The Dark Side of Competition for Status,” *Management Science*, 60, 38–55.
- CHARNESS, G. AND M. RABIN (2002): “Understanding Social [references with Simple Tests,” *The Quarterly Journal of Economics*, 117, 817–869.
- CHIOVEANU, I. (2008): “Advertising, Brand Loyalty and Pricing,” *Games and Economic Behavior*, 64, 68–80.
- CHO, I.-K. AND D. M. KREPS (1987): “Signaling Games and Stable Equilibria,” *The Quarterly Journal of Economics*, 102, 179–221.
- CLARK, L. (2010): “Decision-making During Gambling: An Integration of Cognitive and Psychobiological Approaches,” *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365, 319–330.
- CLINGINGSMITH, D. AND R. M. SHEREMETA (2018): “Status and the Demand for Visible Goods: Experimental Evidence on Conspicuous Consumption,” *Experimental Economics*, 21, 877–904.

- COHN, A., E. FEHR, B. HERRMANN, AND F. SCHNEIDER (2014): “Social Comparison and Effort Provision: Evidence from a Field Experiment,” *Journal of the European Economic Association*, 12, 877–898.
- COLE, H. L., G. J. MAILATH, AND A. POSTLEWAITE (1992): “Social Norms, Savings Behavior, and Growth,” *Journal of Political economy*, 100, 1092–1125.
- COLEMAN, J. S. (1990): *Foundations of Social Theory*, Harvard University Press.
- COOPER, D. J. AND M. REGE (2011): “Misery Loves Company: Social Regret and Social Interaction Effects in Choices Under Risk and Uncertainty,” *Games and Economic Behavior*, 73, 91–110.
- CORNEO, G. AND O. JEANNE (1997): “Conspicuous Consumption, Snobbism and Conformism,” *Journal of Public Economics*, 66, 55–71.
- COX, G. W. (2010): “Swing Voters, Core Voters, and Distributive Politics,” in *Political Representation*, ed. by I. Shapiro, S. C. Stokes, E. J. Wood, and A. S. Kirshner, Cambridge University Press, chap. 13, 342–357.
- COX, J. C., D. FRIEDMAN, AND S. GJERSTAD (2007): “A Tractable Model of Reciprocity and Fairness,” *Games and Economic Behavior*, 59, 17–45.
- CROSON, R. AND U. GNEEZY (2009): “Gender Differences in Preferences,” *Journal of Economic Literature*, 47, 448–74.
- DASGUPTA, P. AND E. MASKIN (1986): “The Existence of Equilibrium in Discontinuous Economic Games, I: Theory,” *Review of Economic Studies*, 53, 1–26.
- D’ASPREMONT, C., J. J. GABSZEWICZ, AND J.-F. THISSE (1979): “On Hotelling’s “Stability in Competition,”” *Econometrica*, 47, 1145–1150.
- DAVE, C., C. C. ECKEL, C. A. JOHNSON, AND C. ROJAS (2010): “Eliciting Risk Preferences: When is Simple Better?” *Journal of Risk and Uncertainty*, 41, 219–243.
- DEMOUGIN, D., C. FLUET, AND C. HELM (2006): “Output and Wages with Inequality Averse Agents,” *Canadian Journal of Economics*, 399–413.
- DILLENBERGER, D. AND K. ROZEN (2015): “History-dependent Risk Attitude,” *Journal of Economic Theory*, 157, 445–477.
- DIXIT, A. AND V. NORMAN (1978): “Advertising and Welfare,” *The Bell Journal of Economics*, 90, 1–17.
- DOHMEN, T. AND A. FALK (2011): “Performance Pay and Multidimensional Sorting: Productivity, Preferences, and Gender,” *American Economic Review*, 101, 556–90.

- DOHMEN, T., A. FALK, K. FLIESSBACH, U. SUNDE, AND B. WEBER (2011): “Relative Versus Absolute Income, Joy of Winning, and Gender: Brain Imaging Evidence,” *Journal of Public Economics*, 95, 279–285.
- DRAZEN, A. AND M. ESLAVA (2013): “Programmatic Targeting,” Working Paper.
- DRAZEN, A. AND E. Y. OZBAY (2019): “Does “Being Chosen to Lead” Induce Non-selfish Behavior? Experimental Evidence on Reciprocity,” *Journal of Public Economics*, 174, 13–21.
- DUTCHER, G., T. SALMON, AND K. J. SARAL (2015): “Is ‘Real’ Effort More Real?” *Working Paper*.
- ECKEL, C. C. AND P. J. GROSSMAN (2002): “Sex Differences and Statistical Stereotyping in Attitudes Toward Financial Risk,” *Evolution and Human Behavior*, 23, 281–295.
- ENEMARK, D., C. C. GIBSON, M. D. MCCUBBINS, AND B. SEIM (2016): “Effect of Holding Office on the Behavior of Politicians,” *Proceedings of the National Academy of Sciences*, 113, 13690–13695.
- ENGELMANN, D. AND M. STROBEL (2004): “Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments,” *American Economic Review*, 94, 857–869.
- ENGLMAIER, F. AND A. WAMBACH (2010): “Optimal Incentive Contracts under Inequity Aversion,” *Games and Economic Behavior*, 69, 312–328.
- ERIKSSON, T., A. POULSEN, AND M. C. VILLEVAL (2009): “Feedback and Incentives: Experimental Evidence,” *Labour Economics*, 16, 679–688.
- FALK, A. AND A. ICHINO (2006): “Clean Evidence on Peer Effects,” *Journal of Labor Economics*, 24, 39–57.
- FEHR, E., G. KIRCHSTEIGER, AND A. RIEDL (1993): “Does Fairness Prevent Market Clearing? An Experimental Investigation,” *The Quarterly Journal of Economics*, 108, 437–459.
- FEHR, E. AND K. M. SCHMIDT (1999): “A Theory of Fairness, Competition, and Cooperation,” *The Quarterly Journal of Economics*, 114, 817–868.
- (2006): *The Economics of Fairness, Reciprocity and Altruism — Experimental Evidence and New Theories*, Elsevier, vol. 1, chap. 8, 615–691.
- FERSHTMAN, C. AND Y. WEISS (1993): “Social Status, Culture and Economic Performance,” *Economic Journal*, 103, 946–59.
- FINAN, F. AND L. SCHECHTER (2012): “Vote-buying and Reciprocity,” *Econometrica*, 80, 863–881.

- FISCHBACHER, U. (2007): “z-Tree: Zurich Toolbox for Ready-made Economic Experiments,” *Experimental Economics*, 10, 171–178.
- FRANK, R. H. (1985): “The demand for Unobservable and other Nonpositional Goods,” *American Economic Review*, 75, 101–116.
- (2005): “Positional Externalities Cause Large and Preventable Welfare Losses,” *American Economic Review*, 95, 137–141.
- FREY, B. S. AND F. OBERHOLZER-GEE (1997): “The Cost of Price Incentives: An Empirical Analysis of Motivation Crowding-out,” *American Economic Review*, 87, 746–755.
- GÄCHTER, S., L. HUANG, AND M. SEFTON (2018): “Disappointment Aversion and Social Comparisons in a Real-Effort Competition,” *Economic Inquiry*, 56, 1512–1525.
- GILL, D. AND V. PROWSE (2012): “A Structural Analysis of Disappointment Aversion in a Real Effort Competition,” *American Economic Review*, 102, 469–503.
- (2014): “Gender Differences and Dynamics in Competition: The Role of Luck,” *Quantitative Economics*, 5, 351–376.
- GNEEZY, U. AND A. RUSTICHINI (2000): “Pay Enough or Don’t Pay at All,” *The Quarterly journal of economics*, 115, 791–810.
- GRILO, I., O. SHY, AND J.-F. THISSE (2001): “Price Competition when Consumer Behavior is Characterized by Conformity or Vanity,” *Journal of Public Economics*, 80, 385–408.
- GROSSKOPF, B. AND R. SARIN (2010): “Is Reputation Good or Bad? An Experiment,” *American Economic Review*, 100, 2187–2204.
- GROSSMAN, G. M. AND C. SHAPIRO (1984): “Informative Advertising with Differentiated Products,” *The Review of Economic Studies*, 51, 63–81.
- GURYAN, J., K. KROFT, AND M. J. NOTOWIDIGDO (2009): “Peer Effects in the Workplace: Evidence from Random Groupings in Professional Golf Tournaments,” *American Economic Journal: Applied Economics*, 1, 34–68.
- HAHN, V. (2009): “Reciprocity and Voting,” *Games and Economic Behavior*, 67, 467–480.
- HANNAN, R. L., R. KRISHNAN, AND A. H. NEWMAN (2008): “The Effects of Disseminating Relative Performance Feedback in Tournament and Individual Performance Compensation Plans,” *The Accounting Review*, 83, 893–913.
- HARRIS, C. (1985): “Existence and Characterization of Perfect Equilibrium in Games of Perfect Information,” *Econometrica*, 53, 613–628.

- HART, E., Y. KAREEV, AND J. AVRAHAMI (2016): “Good Times, Bad Times: Reversal of Risk Preferences,” *Decision*, 3, 132.
- HEFFETZ, O. AND R. H. FRANK (2011): “Preferences for Status: Evidence and Economic Implications,” in *Handbook of Social Economics*, Elsevier, vol. 1, 69–91.
- HELLWIG, M. AND W. LEININGER (1987): “On the Existence of Subgame-Perfect Equilibrium in Infinite-Action Games of Perfect Information,” *Journal of Economic Theory*, 43, 55–75.
- IMAS, A. (2016): “The Realization Effect: Risk-taking After Realized Versus Paper Losses,” *American Economic Review*, 106, 2086–2109.
- INQUIRER, P. (November 8, 2012): ““Will Philly Reap Rewards for Big Obama Turnout?”,” .
- IRELAND, N. J. (1994): “On Limiting the Market for Status Signals,” *Journal of Public Economics*, 53, 91–110.
- ITO, H. (2004): “Moral Hazard and Other-regarding Preferences,” *The Japanese Economic Review*, 55, 18–45.
- KAREEV, Y., J. AVRAHAMI, AND K. FIEDLER (2014): “Strategic Interactions, Affective Reactions, and Fast Adaptations,” *Journal of Experimental Psychology: General*, 143, 1112.
- KARNI, E. AND D. LEVIN (1994): “Social Attributes and Strategic equilibrium: A Restaurant Pricing Game,” *Journal of Political Economy*, 102, 822–840.
- KIRKLAND, J. H. AND R. L. WILLIAMS (2014): “Partisanship and Reciprocity in Cross-chamber Legislative Interactions,” *The Journal of Politics*, 76, 754–769.
- KRÄHMER, D. (2006): “Advertising and Conspicuous Consumption,” *Journal of Institutional and Theoretical Economics*, 162, 661–682.
- KUHNEN, C. M. AND A. TYMULA (2012): “Feedback, Self-esteem, and Performance in Organizations,” *Management Science*, 58, 94–113.
- KUKSOV, D. AND K. WANG (2013): “A Model of the “it” Products in Fashion,” *Marketing Science*, 32, 51–69.
- KUKSOV, D. AND Y. XIE (2012): “Competition in a Status Goods Market,” *Journal of Marketing Research*, 49, 609–623.
- LAHNO, A. M. AND M. SERRA-GARCIA (2015): “Peer Effects in Risk Taking: Envy or Conformity?” *Journal of Risk and Uncertainty*, 50, 73–95.
- LANE, W. J. (1980): “Product Differentiation in a Market with Endogenous Sequential Entry,” *The Bell Journal of Economics*, 237–260.

- LANGER, T. AND M. WEBER (2008): “Does Commitment or Feedback Influence Myopic Loss Aversion?: An Experimental Analysis,” *Journal of Economic Behavior & Organization*, 67, 810–819.
- LAZEAR, E. P. AND S. ROSEN (1981): “Rank-order Tournaments as Optimum Labor Contracts,” *Journal of Political Economy*, 89, 841–864.
- LEIBENSTEIN, H. (1950): “Bandwagon, Snob, and Veblen Effects in the Theory of Consumers’ Demand,” *The Quarterly Journal of Economics*, 64, 183–207.
- LEVINE, D. K. (1998): “Modeling Altruism and Spitefulness in Experiments,” *Review of Economic Dynamics*, 1, 593–622.
- LINDE, J. AND J. SONNEMANS (2012): “Social Comparison and Risky Choices,” *Journal of Risk and Uncertainty*, 44, 45–72.
- (2015): “Decisions Under Risk in a Social and Individual Context: The Limits of Social Preferences?” *Journal of Behavioral and Experimental Economics*, 56, 62–71.
- LINNEMER, L. (1998): “Entry Deterrence, Product Quality: Price and Advertising as Signals,” *Journal of Economics & Management Strategy*, 7, 615–645.
- LIST, J. A., C. D. BAILEY, P. J. EUZENT, AND T. L. MARTIN (2001): “Academic Economists Behaving Badly? A Survey on Three Areas of Unethical Behavior,” *Economic Inquiry*, 39, 162–170.
- LIU, Y.-J., C.-L. TSAI, M.-C. WANG, AND N. ZHU (2010): “Prior Consequences and Subsequent Risk Taking: New Field Evidence from the Taiwan Futures Exchange,” *Management Science*, 56, 606–620.
- LIU, Z., P. YILDIRIM, AND Z. J. ZHANG (2019): “A Theory of Minimalist Luxury,” *Working Paper*.
- MACCRIMMON, K. R. AND D. M. MESSICK (1976): “A Framework for Social Motives,” *Behavioral Science*, 21, 86–100.
- MALMENDIER, U., V. L. TE VELDE, AND R. A. WEBER (2014): “Rethinking Reciprocity,” *Annual Review of Economics*, 6, 849–874.
- MARTORANO, N. (2004): “Cohesion or Reciprocity? Majority Party Strength and Minority Party Procedural Rights in the Legislative Process,” *State Politics & Policy Quarterly*, 4, 55–73.
- MAS, A. AND E. MORETTI (2009): “Peers at Work,” *American Economic Review*, 99, 112–45.
- MELLSTRÖM, C. AND M. JOHANNESSON (2008): “Crowding Out in Blood Donation: was Titmuss Right?” *Journal of the European Economic Association*, 6, 845–863.

- MILLER, G. (2011): *The Mating Mind: How Sexual Choice Shaped the Evolution of Human Nature*, Anchor.
- MOORMAN, C. (2019): “The CMO Survey August 2019: Highlights & Insights Report,” Accessed: 2019-10-23.
- MULL, A. (2019): “How Fancy Water Bottles Became a 21st-Century Status Symbol,” Accessed: 2019-10-23.
- MUNRO, C. (2018): “When Did Reusable Water Bottles Become A Status Symbol?” Accessed: 2019-10-23.
- NEILSON, W. S. AND J. STOWE (2010): “Piece-rate Contracts for Other-regarding Workers,” *Economic Inquiry*, 48, 575–586.
- NELSON, P. (1974): “Advertising as Information,” *Journal of Political Economy*, 82, 729–754.
- NERAL, J. AND J. OCHS (1992): “The Sequential Equilibrium Theory of Reputation Building: A Further Test,” *Econometrica*, 1151–1169.
- NEVEN, D. (1985): “Two Stage (Perfect) Equilibrium in Hotelling’s Model,” *The Journal of Industrial Economics*, 33, 317–325.
- NEVEN, D. J. (1987): “Endogenous Sequential Entry in a Spatial Model,” *International Journal of Industrial Organization*, 5, 419–434.
- NICHOLS, L. M. (1985): “Advertising and Economic Welfare,” *The American Economic Review*, 75, 213–218.
- NIELSEN, K. (2019): “Dynamic Risk Preferences Under Realized and Paper Outcomes,” *Journal of Economic Behavior & Organization*, 161, 68–78.
- NIZA, C., B. TUNG, AND T. M. MARTEAU (2013): “Incentivizing Blood Donation: Systematic Review and Meta-analysis to Test Titmuss’ Hypotheses,” *Health Psychology*, 32, 941.
- OCKENFELS, A., D. SLIWKA, AND P. WERNER (2014): “Bonus Payments and Reference Point Violations,” *Management Science*, 61, 1496–1513.
- OSBORNE, M. J. AND A. SLIVINSKI (1996): “A Model of Political Competition with Citizen-candidates,” *The Quarterly Journal of Economics*, 111, 65–96.
- OZBAY, E. Y. AND O. TONGUC (2018): “Vote Buying with and without Binding Promises,” Working Paper.
- PESENDORFER, W. (1995): “Design Innovation and Fashion Cycles,” *The American Economic Review*, 771–792.

- PRESCOTT, E. C. AND M. VISSCHER (1977): "Sequential Location Among Firms with Foresight," *The Bell Journal of Economics*, 378–393.
- PROMBERGER, M. AND T. M. MARTEAU (2013): "When do Financial Incentives Reduce Intrinsic Motivation? Comparing Behaviors Studied in Psychological and Economic Literatures," *Health Psychology*, 32, 950.
- RAYO, L. (2013): "Monopolistic Signal Provision," *The BE Journal of Theoretical Economics*, 13, 27–58.
- RESNIK, A. AND B. L. STERN (1977): "An analysis of Information Content in Television Advertising," *Journal of Marketing*, 41, 50–53.
- ROGOFF, K. AND A. SIBERT (1988): "Elections and Macroeconomic Policy Cycles," *The Review of Economic Studies*, 55, 1–16.
- ROGOFF, K. S. (1990): "Equilibrium Political Budget Cycles," .
- ROHDE, I. M. AND K. I. ROHDE (2011): "Risk Attitudes in a Social Context," *Journal of Risk and Uncertainty*, 43, 205–225.
- SAITO, K. (2013): "Social Preferences Under Risk: Equality of Opportunity Versus Equality of Outcome," *American Economic Review*, 103, 3084–3101.
- SCHLESINGER, J. A. (1994): *Political Parties and the Winning of Office*, University of Michigan Press.
- SCHMALENSEE, R. (1983): "Advertising and Entry Deterrence: An Exploratory Model," *Journal of Political Economy*, 91, 636–653.
- SCHNEIDER, S. L., S. KAUFFMAN, AND A. RANIERI (2016): "The Effects of Surrounding Positive and Negative Experiences on Risk Taking," *Judgment and Decision Making*, 11, 424.
- SCHWERTER, F. (2019): "Social Reference Points and Risk Taking," Working Paper.
- SELTEN, R. (1978): "The Chain Store Paradox," *Theory and Decision*, 9, 127–159.
- SELTEN, R. AND J. BUCHTA (1998): "Experimental Sealed Bid First Price Auctions with Directly Observed Bid Functions," DV Budescu, I. Erev, R. Zwick, eds. *Games and Human Behavior: Essays in Honor of Amon Rapoport*.
- SELTEN, R. AND R. STOECKER (1986): "End Behavior in Sequences of Finite Prisoner's Dilemma Supergames A Learning Theory Approach," *Journal of Economic Behavior & Organization*, 7, 47–70.
- SHAKED, A. AND J. SUTTON (1987): "Product Differentiation and Industrial Structure," *The Journal of Industrial Economics*, 36, 131–146.

- SHIV, B., G. LOEWENSTEIN, AND A. BECHARA (2006): “The Dark Side of Emotion in Decision-making: When Individuals with Decreased Emotional Reactions Make More Advantageous Decisions,” *Cognitive Brain Research*, 23, 85–92.
- SIMON, L. K. (1987): “Games with Discontinuous Payoffs,” *The Review of Economic Studies*, 54, 569–597.
- SJÖSTRÖM, T., L. ULKU, AND R. VADOVIC (2019): “Free to Choose: Testing the Pure Motivation Effect of Autonomous Choice,” Working Paper.
- SMITH, G., M. LEVERER, AND R. KURTZMAN (2009): “Poker Player Behavior after Big Wins and Big Losses,” *Management Science*, 55, 1547–1555.
- SOBEL, J. (2005): “Interdependent Preferences and Reciprocity,” *Journal of Economic Literature*, 43, 392–436.
- SUTTON, J. (1991): *Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration*, MIT press.
- THALER, R. H. AND E. J. JOHNSON (1990): “Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice,” *Management Science*, 36, 643–660.
- TIROLE, J. (1988): *The Theory of Industrial Organization*, MIT press.
- TOM, G., S. CALVERT, R. GOOLKATSIAN, AND A. ZUMSTEG (1984): “An Analysis of Information Content in Television Advertising: An Update,” *Current Issues and Research in Advertising*, 7, 159–165.
- TSERENJIGMID, G. (2019): “History-Dependent Risk Aversion, the Reinforcement Effect, and Dynamic Monotonicity,” Working Paper.
- VEBLEN, T. (1899): *Theory of the Leisure Class*, Transaction Publishers.
- VERBRUGGEN, F., C. D. CHAMBERS, N. S. LAWRENCE, AND I. P. MCLAREN (2017): “Winning and Losing: Effects on Impulsive Action,” *Journal of Experimental Psychology: Human Perception and Performance*, 43, 147.
- VIKANDER, N. (2017): “Advertising to Status-Conscious Consumers,” *Working Paper*.
- VON DER FEHR, N.-H. M. AND K. STEVIK (1998): “Persuasive Advertising and Product Differentiation,” *Southern Economic Journal*, 113–126.
- WAGNER, K. (2019): “Digital Advertising in the US is Finally Bigger than Print and Television,” Accessed: 2019-10-23.
- WEBER, M. (1978): *Economy and Society*, University of California Press.

- WEINGAST, B. R. (1979): “A Rational Choice Perspective on Congressional Norms,” *American Journal of Political Science*, 23, 245–262.
- XIA, L. (2018): “Luck or Skill: How Women and Men Attribute Successes and Failures,” Working Paper.
- YILDIRIM, P., Z. LIU, AND Z. J. ZHANG (2016): “Conspicuous Consumption on the Long Tail: How Can Luxury Brands Benefit from Counterfeits?” *Working Paper*.