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Olli Lappalainen

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University of Turku

Turku School of Economics
Department of economics
Subject – Economics
Doctoral Programme of Turku School of Econonomics

Supervised by

Professor Hannu Salonen
Turku School of Economics
Finland

Professor Kaisa Kotakorpi
Turku School of Economics/VATT
Finland

Reviewed by

Professor Topi Miettinen
Hanken School of Economics
Finland

Professor Arthur Schram
Amsterdam School of Economics of
the University of Amsterdam
the Netherlands

Custos

Professor Hannu Salonen
Turku School of Economics
Finland

Opponent

Professor Topi Miettinen
Hanken School of Economics
Finland

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ABSTRACT

The collection of essays included herein studies different forms of reciprocal behavior, voluntary contributions towards a public project, and price setting and trading behavior in monopolistic asset markets.

In paper 1, we examine reciprocity in an experiment using a sequential dictator game where the first round recipient becomes the second round dictator. We separate between three types of reciprocity: Direct reciprocity occurs when the second round dictator responses directly to the first round dictator. A second round dictator shows indirect reciprocity when she has not taken part in the first round play, but yet reacts to it when deciding how much to allocate to the first round dictator. In generalized reciprocity, the second round dictator has possibly received allocation in the first round but responses to someone else than the first round dictator. Our results show evidence of strong reciprocity in all three cases, in particular direct and generalized reciprocity are equally intense.

In paper 2, we examine the effect of distributional and reciprocal motivation on the behavior. We conduct an experiment with a two round dictator game. In our baseline treatment, the first round game is a standard dictator game. In the second round, we introduce a third player who will decide how to allocate her endowment and the endowments of the first round players between these three players. We also run a treatment in which the first round allocation is replaced by a random division. In both treatments, on the average, the second round dictators redistributed one half of the first round endowment to themselves, keeping almost two thirds of the total endowment. We find that intentions matter in the case of extremely unfair first round allocation.

In paper 3, I study experimentally a voluntary contribution game in which returns from the private project have diminishing marginal benefits and the contributions to the joint project exhibit pairwise strategic complementarities. As a control I use a public good game with an identical private production, but standard public good aggregation. A significant over-contribution is observed in both settings when the group size is 5, but it is much higher under the complementary technology, and drops drastically when the group size is reduced.

In paper 4, we study the price setting behavior of monopolist sellers and bids made by buyers. The buyers receive private information about the fundamental value of an asset and make a bid for it in an exogenously and randomly determined order. We find that the sellers failed to update their prices both upwards and downward after receiving new information. This sluggish updating strategy turned out beneficial, as theoretically optimal higher prices assuming common knowledge of rationality among traders trades would have led to fewer trades, and the higher price would not have been enough to offset the losses incurred from trades forfeited.

Keywords: Experimental economics, behavioral economics, dictator game, reciprocity, public goods, monopolistic behavior

TIIVISTELMÄ

Tämä esseekokoelma sisältää artikkeleita, joissa tutkitaan vastavuoroista käyttäytymistä, yhteishankkeisiin osallistumista ja hintojen määräytymistä sekä kaupankäyntiä monopolistisilla markkinoilla.

Esseessä 1 tutkimme vastavuoroisuuden eri muotoja toistetun diktaattoripelin avulla. Määrittelemme kolme eri vastavuoroisuuden muotoa: suora vastavuoroisuus on kyseessä kun toisen periodin diktaattori vastaa suoraan 1. kierroksen diktaattorin tekoihin. Epäsuorassa vastavuoroisuudessa toisen kierroksen pelaaja ei ole ottanut osaa 1. kierroksen peliin, mutta on tietoinen sen tuloksista ja reagoi niihin. Yleistetyn vastavuoroisuuden käsittelyssä toisen kierroksen pelaaja on ollut vastaanottajana 1. kierroksella, mutta hänen oma toimintansa kohdistuu johonkin kolmanteen osapuoleen, joka ei osallistunut 1. kierrokseen. Havaitsimme että vastavuoroisuus on voimakasta kaikissa näissä muodoissa, erityisesti suora ja yleistetty vastavuoroisuus ovat yhtä vahvoja.

Esseessä kaksi tutkimme distributionaalisen ja vastavuoroisen motivaation vaikutusta käytökseen. Toteutimme kokeen, jossa kaksikierroksisen diktaattoripelin toisen kierroksen diktaattori saattoi päättää, kuinka toteuttaa rahajako hänen itsensä ja kahden ensimmäisen kierroksen pelaajan välillä. Kontrollikäsittelyssä 1. kierroksen jako korvattiin satunnaisella allokaatiolla kahden pelaajan välillä. Kummassakin käsittelyssä toisen kierroksen diktaattorit pitivät itsellään keskimäärin 2/3 kokonaissummasta ottaen 1. kierroksen pelaajilta noin puolet näiden allokaatiosta. 1. kierroksen diktaattorin maineella oli vaikutusta toisen kierroksen jakoon, jos 1. kierroksen jako oli ollut erityisen epäoikeudenmukainen.

Esseessä 3 tutkin julkishyödyke- ja yhteistuotospelejä, kun yksityishyödykkeen kulutuksessa on aleneva rajahyöty ja yhteistuotannossa esiintyy parittaisia komplementaarisuuksia pelaajien panostusten välillä. Kontrollina suoritin kokeen, jossa yksityishyödykkeen kulutus oli samanlainen, mutta julkishyödyke määräytyi koehenkilöiden panosten summana. Kummassakin käsittelyssä kontribuutioaste oli tasapainotasoa suurempi – erityisesti komplementaarisen käsittelyn alaisuudessa, kun ryhmäkoko oli 5. Toisaalta ryhmäkokoa pienennettäessä ylituotannon määrä laski huomattavasti komplementaarisen tuotannon käsittelyssä.

Paperissa 4 tutkimme monopolistin hinnoittelua ja ostotarjouksia. Ostajat saavat informaatiota kaupankäynnin kohteena olevasta arvopaperista ja tekevät ostotarjouksensa ennalta määrätyssä satunnaisessa järjestyksessä. Tuloksiemme nojalla myyjät eivät päivittäneet hintojaan optimaalisella tavalla saatuaan uutta informaatiota, mutta jähmeähkö päivitystahti osoittautui kuitenkin hyödylliseksi, sillä optimaalinen hinnoittelu olisi johtanut lukumäärältään vähempiin kauppoihin, ja toteutunut korkeampi myyntihinta ei olisi korvannut menetettyjen kauppojen myötä hävittyjä tuloja.

Asiasanat: Kokeellinen taloustiede, behavioraalinen taloustiede, diktaattoripeli, vastavuoroisuus, julkishyödykkeet, monopolistinen käyttäyminen

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But that's counterfactual talk. What I can know for sure is that it has been truly a pleasure to have been able to get to know, take advice from, or collaborate with so many well versed and helpful scholars. Speaking of which, I would like to take this opportunity to thank the pre-examiners of my doctoral dissertation, professor Arthur Schram and professor Topi Miettinen. Their constructive feedback have undoubtedly made my work better.

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Olli Lappalainen

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PART I
INTRODUCTION

1 INTRODUCTION

This dissertation is a work in experimental and behavioral economics, in which strategic behavior is studied in a controlled laboratory setting by observing choices made by monetarily incentivized human subjects. The research questions presented herein involve studying the behavioral aspects of choice behavior that may or may not deviate from the predictions made by the standard model of expected utility. In particular, this dissertation consists of essays whose main themes are *generalized* reciprocity*, voluntary contributions to team production, and price setting and herd behavior in monopolistic markets.*

This collection of essays (4) contributes to the existing literature by employing novel combination of methods (paper 1), by extending an existing experimental setup by increasing the number of players involved (papers 1 and 2), by extending the choice set to include negative actions (paper 2), and by employing either a new payoff function in otherwise standard experimental game (paper 3), or by first time operationalizing a particular theoretical model of monopoly into an experimental monopolistic market (paper 4).

In this introduction, I will first briefly summarize where within the field of experimental and behavioral economics my work lies. Also, in the respective subsections I will succinctly review the theoretical models of relative importance to each respective paper. An overview of the results and summary of each respective paper will conclude this introduction. First, I begin by clarifying what is actually meant by experimental and behavioral economics in the context of this dissertation.

As a reader could readily observe by perusing current economics textbooks, or by checking the growth in the volume of experimental and behavioral papers published in top journals, the field has grown remarkably during the past few decades. As a consequence, the economics profession has come to acknowledge it as a legitimate method of inquiry of its own, even if the view about its role, scope, and usefulness may be far from unified.

In my dissertation, I make the following distinction between the terms experimental and behavioral economics, along the lines of Bardsley et al. (2010): I use the term ‘experimental economics’ to refer to a method of economic inquiry, that is, to all forms of experimental research in economics, and the term ‘behavioral economics’ to refer to research that uses psychological hypotheses to explain economic behavior, which may or may not utilize the tools of experimental methods in hypothesis testing and pursuit of scientific knowledge.

It is obvious that a short treatment such as this introductory chapter cannot by any means do justice and offer a comprehensive view of a diverse field into which behavioral economics has grown, and consequently, instead of trying to offer unreasonably short and superficial brush at the historical developments, my focus here is rather to define where within the field my contributions fall and which questions they address.

The reader will also not find included a philosophical discussion about scientific revolution, or manifestos about how the behavioral approach will topple the standard model of economic science. It is assumed that a reader picking up this collection of essays is already sympathetic to the behavioral approach, and that the arguments for the relative merits and downsides of the standard mainstream approach and for the behavioral deviations from it, respectively, are better had in arenas specifically dedicated to this purpose.

The general applicability or external validity of the results reported is, however, discussed, as is their potential relevance for pertinent domains of inquiry. My personal agenda is that of an agnostic: I believe that both the parsimonious standard view and the expanded or more specific behavioral approach both serve their purpose, and it is upon the domain of application that dictates which approach has more chances to successfully explain the observed phenomena. Suffice to say, it is my sincere belief that the *research questions* posed in this thesis are, if not always, at least considerable amount of time best answered with the help of a controlled laboratory setting.

Naturally, departure from the received standard view presents the modeler with a problem: what kind of less than fully rational behavior to choose as a foundation for describing behavior of an economic agent, as "[u]sually, there is only one way to be fully rational, but there are many ways to be less rational" (Holland & Miller, 1991).

How to model such an agent who is motivated by other things than material payoffs only is discussed in subsections 1.1 to 1.4. More specifically, subsection 1.1 introduces the standard expected utility model of economic decision making, presents a concise typology of different strands of research within behavioral economics, and positions this collection of essays within the field. Following this, subsection 1.2 reviews theoretical literature on social preferences and reciprocity that attempts to explain certain deviations from the standard model, and subsection 1.3 reviews the empirical research pertinent to reciprocity studies (papers 1 and 2) more closely. Subsections 1.4 and 1.5 introduce the relevant literature for essays 3 and 4, respectively. Further, subsections from 1.6 to 1.9 summarize the scientific contributions of the included essays and finally subsection 1.10 concludes the introduction with a discussion about the perennial question of external validity.

1.1 The standard model and behavioral deviations

For this endeavor to be successful we must first broadly define what is meant by behavioral economics; a natural way to proceed is to describe what assumptions of the standard model are relaxed under the framework of behavioral economics.

According to DellaVigna (2009) (cf. also Rabin, 1998), the research in behavioral economics suggests that agents deviate from the standard model in three respects, that is, behavioral models make assumptions belonging to following categories: (1) nonstandard preferences, (2) nonstandard beliefs, and (3) nonstandard decision making.

DellaVigna (2009) further distinguishes with several subclasses of each of these three dimensions; insofar as the essays included in this dissertation can be classified within this framework, we can roughly state that essays 1-3 treat questions of (1) nonstandard preferences, in particular social preferences, and to some extent they also deal with nonstandard decision making, in particular social pressure and emotions. Essay 4, in contrast, deals mostly with (2) nonstandard beliefs and (3) nonstandard decision making. Furthermore, the effect of the subjects' risk attitudes on behavior is examined in essays 3 and 4.

Having now established in which areas within the behavioral literature and research program my contributions are approximately located, a brief in-depth look at the standard model and the respective deviations is warranted. After defining a stylized version of the standard utility maximizing model, I will proceed with a slightly more extended review of the theoretical literature dealing with the deviations from the standard model pertinent to essays 1 and 2 in subsection 1.2, and review briefly the respective empirical literature on altruism and reciprocity in subsection 1.3.

In the stylized version of the standard model (DellaVigna, 2009; Rabin, 2002), individual *i* at time *t=0* maximizes the expected utility subject to a probability distribution *p(s)* of the states of the world $s \in S$:

$$max_{x_i^t \in X} \sum_{t=0}^{\infty} \delta^t \sum_{s_t \in S_t} \mathrm{p}(s_t) U(x_i^t | s_t). \quad (1)$$

The utility function $U(x|\mathrm{s})$ is defined over the payoff x_i^t and the future utility is discounted with a discount factor δ. This model is used as a benchmark, as we briefly go over the behavioral models posited to explain observations not in line with the standard assumptions.

1.2 Nonstandard Preferences – Theoretical Models

I will begin my review on research topics pertinent to my dissertation, in particular to essays 1 and 2, by summarizing central theoretical results obtained in research on non-standard preferences, and in particular, social preferences.

DellaVigna (2009) makes a distinction between three dimensions of nonstandard preferences: (i) time preferences (ii) risk preferences, and (iii) social preferences. Given the nature of my work reported in the essays, I omit discussing literature on (i) completely, and touch literature on (ii) briefly, and concentrate on (iii) in more depth. It is also the strand of literature with which I begin.

One of the most prominent forms of behavior resulting from social preferences is reciprocity. It has a significant role in many areas of economic behavior, including labor supply, tax compliance and voting. The results obtained in a large volume of laboratory and field experiments show robust evidence of a willingness to share with others, even when there are no pecuniary gains from sharing, which is in conflict with the standard model assuming purely monetarily self-interested preferences. In response to this evidence, economists have developed models of preferences that can account for reciprocal behavior. These models can be sorted into three broad classes (i) outcome based, (ii) type-based and (iii) intention based.

Outcome based models assume that individuals seek to maximize well-defined preferences, but allow preferences to depend on the consumption of the others. As a consequence, individuals are typically assumed to trade off their personal material gains and fair allocations (Malmendier, te Velde, & Weber, 2014).

As in the standard model above, let x_i denote the material payoff of agent *i*. With such interdependent preferences, agents may care about the distribution of the material allocations and not just their own payoff. In other words, the utility function may accept other players' x_j $(j \neq i)$ material payoff as its argument, or $U(x_i, x_j|\mathrm{s})$.

For instance Sobel (2005) defined periodic utility function for agent *i* with social preferences as follows:

$$u_i(x) = x_i + \sum_{j \neq i} \lambda_{ij}(x_i - x_j)x_j \qquad (2)$$

As noted by Sobel, the simplest form of interdependent preferences arises when $\lambda_{ij}(\cdot)$ is constant. A positive $\lambda_{ij}(\cdot)$ reflects altruism, and a negative $\lambda_{ij}(\cdot)$ reflects spite, respectively. An altruistic agent is willing to decrease his own consumption in order to increase the consumption of another agent, whereas a spiteful agent is ready to forego consumption in order to decrease another agent's consumption.

Fehr & Schmidt (1999) and Charness & Rabin (2002) define specific utility functions reflecting social preferences that are special cases of (2). Both papers assume that $\lambda_{ij}(\cdot)$ is independent of *i* and *j* and depends only on the sign of $x_i - x_j$.

In Charness & Rabin (2002), $\lambda_{ij}(\cdot)$ is an average of functional forms that place positive weight on the monetary payoff x_i, the monetary payoff received by the least well off agent, and the total payoff. This means that $\lambda_{ij}(\cdot) > 0$, but is greater when $x_i > x_j$. That is, individual *i* always has positive weight for the material payoffs (consumption) of others, but weights the payoffs of poorer individuals than he is more than those who are richer than him.

In the model specified by Fehr & Schmidt (1999), $\lambda_{ij}(\cdot)$ is positive if $x_i > x_j$ and negative if $x_i < x_j$, reflecting the assumed inequality aversion of the agents. Under this specification, an agent cares about his own payoff and would like to reduce the inequality of payoffs between the two players.

Finally, Bolton & Ockenfels (2000), has a similar approach towards inequality in payoffs, but the utility function posited by them has a different functional form. In their model, agent *i's* preferences are an increasing function of his payoff x_i and his relative income $\left(\frac{x_i}{\sum_{j=1}^{N} x_j}\right)$.

As the label of the category describes, in the outcome based models it is assumed that players maximize a preference relation over outcomes. The process through which an outcome is reached does not matter. However, in the type and the intentions based models, the context through which the agents arrive at the final outcome matters, that is, preferences over outcomes may change over the course of play, depending on the actions of the agents involved.

In the type-based models category, the preferences are assumed to be interdependent. That is, an agent is assumed to treat kind people kindly, or everyone is nicer to nice people. David K. Levine (1998) assumes that individual *i* maximizes:

$$u_i(x) = x_i + \sum_{j \neq i} \frac{\alpha_i + \beta_i \alpha_j}{1 + \beta_i} x_j, \tag{3}$$

where α_i is the altruism parameter of player *i* and β_i is the weight player *i* places on player *j's* preferences. In case player *i* does not care about player *j's* altruism, β_i=0 and the weight *i* places on *j's* material payoff is independent of *j's* altruism. Otherwise, the placed weight increases in j's altruism parameter.

In contrast to outcome based models, the weight placed on the material payoff of another player depends on the identity of that player. Levine assumes that the individuals are uncertain about each other's preferences, in particular their altruism parameters, and in order for the players to be nice to nice individuals, they need to identify altruistic or high α people. From this, a type of reciprocity arises in equilibrium; if players with higher αs choose nicer strategies, then their payoff receive more weight, because playing nice really signals that you are nice, and the model treats reciprocity as a product of a signaling game.

Finally, in the intentions based models, the players maximize a utility function, that accepts both material payoffs and reciprocal kindness (spite) as its arguments.

The kindness (spitefulness) of an action is not only defined over what actions are available to an agent, but also agent's beliefs enter directly into the utility function. Rabin (1993) uses the theory of psychological games (Geanakoplos, Pearce, & Stacchetti, 1989) in his formulation of a model of equilibrium behavior in which beliefs enter directly into utility. The kindness of an action is defined not only over available actions, but also by the agent's beliefs about what the other player will do. Formally, Rabin proposes that agent *i* picks his strategy in order to maximize a function of the form:

$$u_i(k_i, k^*) = v_i(O(k)) + \alpha_i^G(k^*)v_j(O(k)), \quad (4)$$

where *G* is the game played, $k^* = (k_i^*, k_j^*)$, $v_i(\cdot)$ denotes the player i's utility over the outcomes and *O(k)* is the outcome if the players play *k*. In Rabin's model, k_i is the strategy choice of player *i*, k_j^* is player i's beliefs about player *j*'s strategy choice, and k_i^* is what player *i* believes that player *j* believes about player i's strategy choice. In equilibrium beliefs are accurate, so that *j* plays k_j^* and $k_i = k_i^*$. The utility function features i's preferences over his strategies (k_i) conditioned on the expected behavior (k^*).

1.3 Nonstandard Preferences – Empirical Results

The models mentioned in the previous subsection were partly motivated by the need to accommodate the observational data ensuing from a large body of experimental research yielding results not in line with the monetary payoff maximizing predictions of the standard model.

The game of choice for studying altruism in the experimental laboratory is the well-known Dictator Game, in which the subjects are randomly paired, and one of the players (the dictator) will decide how the initial endowment is allocated between her and an anonymous recipient. Engel (2011) reviews the experimental results in his meta-analysis of 131 papers on dictator games. Studying the giving distributions rather than mean amount given, he finds out that real money induces more generous dictator behavior. This is also the case when the dictators are identified. Averaged over all of the studies included, about two thirds of subjects (63.89%) made a positive contribution. The grand average of the amount given over all studies was 28.35%. The results reported in our paper 1 are in line with the meta-analysis, the amount sent on the first round of the two-stage dictator game was 27%, on average.

In papers 1 and 2 instead of the regular two player setup in dictator games, we either have another round (paper 1) or a second round and multiple recipients (pa-

per 2). Engelmann and Strobel (2007) review evidence from dictator games involving more than two players. They find that the results on multiplayer dictator games point at a relatively high sensitivity to procedural details, subject pool and specifics of the games in questions. It appears that a large variety of distributional motives, e.g. maximin preferences, efficiency concerns, inequality aversion, and competitiveness, have an impact on choices. In an experiment implementing a design pertinent to our paper 1, Ben-Ner et al. (2004) study generalized reciprocity (where the recipient of the dictator allocation is someone else than the original actor) experimentally by a two part dictator game. They find lower correlation between amounts received and amounts given to the other player in the case of generalized reciprocity than in the case of direct reciprocity. Servátka (2009, 2010) explores how reputation, social influence, and identification affect subjects' behavior in a two-stage dictator game. Servátka's results indicate that reputation has a stronger impact on second stage dictator behavior than social influence and identification.

However, more common designs for studying reciprocal behavior in particular, rather than general altruism, are the well-known trust game or the gift-exchange game. Of the different designs implementing or trust game, the version first employed by Berg at al. (1995), has been replicated across numerous countries, often with slightly different experimental parameters. As we deliberately chose dictator game instead of trust game in order to rule out potential efficiency gains, our design in papers 1 and 2 could be described as a trust game without a multiplier, in particular the baseline treatment of paper 1. Nonetheless, this experimental literature is obviously relevant to our research and warrants a brief review.

Johnson and Mislin (2011) conduct a meta-analysis of 162 replications of trust games. With respect to our experimental design, the most interesting part of their analysis is the rate of return variable, which is the multiplier by which the experimenter multiplies the allocations sent by the first round decision maker to the second round recipient. They compare multipliers 2 and 3, and find that that increasing the multiplier on amount sent by the first stage decision making decreases the amount of money returned by the second round decision maker. However, it does not have significant effect on the first round decision making. Their interpretation is that second movers take into account the total size of the pie and adjust the return share of the allocation accordingly. Interestingly, they also find that on average, the more is sent by the first stage decision maker, the more is returned in the second stage. We find that the subjects in our experiment exhibit similar behavior reported in paper 1.

In a study particularly relevant to our paper 1, Stanca (2009) compares direct, indirect and generalized reciprocity by a two-stage gift-exchange game. He observes generalized reciprocity more often than direct or indirect reciprocity.

1.4 Voluntary Contribution Mechanism Games

Before reviewing the results obtained in the literature covering experimental public good or voluntary contribution mechanism games (VCM for short), it is useful to remind ourselves how voluntary provision of public goods is modelled theoretically[1].

Let x_i denote agent *i*'s material payoff or private consumption as in previous subsection, *G* the total provision of the public good. Furthermore, let g_i be individual i's contribution to the public good, and suppose *G* is an aggregate of individual contributions. In the standard case, this aggregation is the simple unweighted sum of individual contributions towards the public good, or: $G = \sum_{i=1}^{n} g_i$. Once we denote i's income by w_i and normalize prices so that $p_G = p_x = 1$, the budget constraint for *i* is: $x_i + g_i \leq w_i$. Assume that i's preferences are represented by a continuous and strictly quasiconvave function $U_i(x_i, G)$, *i*'s preferred level of provision is given by

$$G^* = q(w_i, +G_{-i}) \tag{5}$$

where G_{-i} is the total amount of provision by other agents than *i*. The demand function q is the Engel curve for the public good. It is known that there exist a unique equilibrium $g^* = (g_1^*, g_2^*, \ldots, g_n^*)$ when both the public and the private good are normal goods, and that i's contribution is given by

$$g_i^* = \max\{0, -G_{-i} + q(w_i, +G_{-i})\}. \tag{6}$$

The standard free-rider problem ensues and equilibrium contributions are inefficiently low.

1.4.1 Linear VCM in experiments

In experimental research, linear contribution mechanism is the most common public goods institution, as noted by Croson et al. (2005). In the linear public setup, the Voluntary Contribution Mechanism (VCM for short) is specified so that for a material payoff maximizing individual, either contributing everything or contributing nothing to a group activity is the dominating strategy.

Normally in the public good experiments (see Ledyard, 1995; Chadhuri, 2010 for a review), the subjects are divided into subgroups that play the same game for a finite number of periods, or the groups are reshuffled after each period, and the game take places within the new groups each period. In each period, every subject

[1] A standard reference for micro theoretic treatise of public goods is Mas-Colell et al. (1995).

is endowed with an income of w_i, which the subject must allocate between a contribution to a private x_i that yields a constant return to themselves only, and a contribution to a public account g_i where the payoffs accrue to all group members. Mathematically, the payoff from the VCM game is defined as:

$$u_i(x) = \alpha x_i + \beta \sum_{j=1}^{n} \mathrm{g}_j \tag{7}$$

where α and β are typically constants over the course of the game (see e.g. Ledyard, 1995). The subjects maximize (7), subject to a budget constraint ($x_i + g_i = w_i$), a public goods identity ($G = \sum_{j=1}^{n} \mathrm{g}_j$), and a non-negativity constraint ($g_i \geq 0$).

After each round, the subjects typically learn the contributions of the other group members. In the standard setup, α and β are specified so that that for a monetary payoff maximizer the dominant strategy is to contribute nothing, and to reach the Pareto-optimum, every group member should donate everything to the public good.

The results from these games with optimal choice at the (lower) boundary of the action set are naturally sensitive to the design parameters. Zelmer (2003) provides a meta-analysis in which she finds that the marginal per capita return, communication, constant group composition over the session, positive framing, and the children as subjects had a positive and significant effect on the contributions to the public good; whereas heterogeneous endowments to subjects, experienced participants, and soliciting subjects' beliefs regarding other participants' behavior prior to the start of the session/period had a negative and significant effect.

1.4.2 Nonlinear VCM in experiments

Whilst there are literally hundreds of studies employing a linear VCM setup[2], experiments with nonlinear payoff function are considerably less common. The nonlinearity can be implemented either by designing a private good with diminishing marginal benefits, or by a nonlinear Social Composition Function (SCF), by which we mean the way the individual contributions are aggregated to the public good.

As noted by Laury & Holt (2008), the simplest way to introduce a non-linearity is to have a private good with diminishing marginal benefits by using a quadratic function.

[2] For instance, Zelmer (2003) lists 349 potentially relevant studies in her meta-analysis of linear public good games.

$$u_i(x) = \alpha(w - x_i) - b(w - x_i)^2 + \beta G^3, \quad (8)$$

where $\alpha, b > 0$. Maximizing monetary payoffs yields interior dominating strategy equilibrium:

$$x_i = \frac{\beta - \alpha}{2b} + w \quad (9)$$

assuming everyone has equal initial endowment, ($w_i = w$), for all i. Keser (1996) is the first one to implement this design. She found that dominant strategy contributions were a modal action, but that on average the contributions were greater than the equilibrium choice. Furthermore, average contributions declined over 25 repetitions of the game, but were still some 15% higher in the last five rounds.

Unlike Keser (1996), whose groups remained the same between periods, Van Dijk, Sonnemans, & van Winden (2002) employed random matching protocol with an interior equilibrium. They observe also over-contribution, but less decline in contributions than Keser, apart from a larger end-round effect. Sefton & Steinberg (1996) compared a dominant strategy interior equilibrium setup with non-dominant strategy setting. In their experiment, the contributions are above the Nash-level in both treatments, but the average contributions are somewhat lower in the dominant strategy environment, than when there is no dominant strategy.

The other way of implementing an interior Nash action is to introduce diminishing marginal benefits from the public good. Laury & Holt (2008) survey the results also from these experiments, and note that there are multiple individual equilibria, which adds complexity to the decision making not present in the dominant strategy setup.

Sefton & Steinberg (1996) found high variance in contributions in a non-dominant strategy environment than in a dominant strategy setup with the same payoff structure in terms of Pareto-optimal contributions and deviation costs. Isaac & Walker (1998) compared how the location of the aggregate Nash-equilibrium affects the contribution level by specifying three equilibrium settings: “low-Nash”, “middle-Nash“, and “high-Nash”. They found out that in the low condition the contributions were considerably greater than the equilibrium level, whereas the opposite was true in the high condition, but that the upward bias in the low condition being significantly greater than the downward bias in the high condition. In the middle condition the contributions tracked the equilibrium level initially, but dropped below Nash-level in the final rounds.

Moreover, Andreoni (1993) employed an integer-approximation of a Cobb-Douglas payoff function, and Chan et al. (2002) added a Cobb-Douglas component

[3] Observe that here action x_i denotes the contribution towards the public good, unlike in (7) where it showed the amount allocated to private consumption. This is of course just relabeling, as ($x_i + g_i = w_i$).

to the linear public good specification, and both found that the average contributions were less than the Nash-prediction. However, SCF in both setups is highly non-linear and complex, and thus it is hard to make the payoffs easily digestible to the subjects, Laury & Holt (2008) suspect that part of the under-contribution may arise from this difficulty to notice the positive externality from the public good. Laury et al. (1999) provided the subjects with and without a table showing the constant benefit from the private good and diminishing marginal benefit from the public good, depending on the treatment group, and found that providing such additional information lead to declining contributions towards the public good.

These experiments indicate that moving the equilibrium from the boundary to the interior of the action set is not alone sufficient to induce Nash behavior in VCM experiments. Further, there is less variation, when the interior equilibrium is also a dominant strategy equilibrium; however, the most important factor determining the size and direction of the contributions is the location of the equilibrium with respect to the lower and upper boundary of the action set: A significant over-contribution is expected when the location is closer the lower bound, and the opposite is the case when it is located closer to the upper boundary.

1.4.3 Design Parameters of the VCM Experiments

Among factors affecting of the contribution behavior in public good experiments are both the matching protocol used, that is, whether the members of the subgroups are matched repeatedly (partner matching), or whether the subgroups are reshuffled after each period is completed (stranger matching). Another feature is the form of feedback provided to the subjects, in terms of contributions of the other group members and possibly their respective earnings. The subjects can be either provided only the aggregate or average contributions of the other group members, or they can be informed of the individual contributions (and/or earnings) of each group member. Furthermore, the decision to contribute can be either framed as taking from the common account or as contributing towards the joint project, in either case the payoff function is actually exactly the same.

In my experiment, I employed stranger matching and reported to each group member how much income she gained from each respective project, the individual investments made by the group members (including her own investment) in a random order, and also the average of these investments and their total amount.

Andreoni (1988) finds that in the strangers design, the subjects give more on average, this result is also found by Palfrey & Prisbrey (1996), and by Burlando & Hey (1997) in Italy, but not in UK where partners gave more, on average. Brandts et al. (2004) find that strangers give more in their experiment in Spain, but the opposite is true in the US. However there is no difference to be found in their

experiment in Japan or in Netherlands, and the differences in behavior across countries are minor. Brandts & Schram (2001) find no difference, and in Croson (1996), Keser & Van Winden (2000), and Sonnemans et al. (1999) partners design was more conducive to cooperative behavior. Andreoni & Croson (2008) provides a discussion on the results. As is expected no satisfactory and definite conclusion can be drawn from the results surveyed, and they note that "if a prediction is based on a single-shot equilibrium, then a Strangers condition will be most appropriate." This is also the rationale for us choosing the strangers design.

In terms of feedback provided the subjects, in experiments with stranger design, the evidence is also mixed. Weimann (1994) finds no effect, whereas in experiment by Carpenter (2004) an aggregate level feedback resulted subjects making higher contributions to the public good. Cox & Stoddard (2015) run a $2 \times 2 \times 2$ design varying framing (Give vs. Take), matching (Partners vs Strangers) and feedback (Individual vs. Aggregate). They find that in Partners setup with Give framing, there is significantly more free-riding with Individual feedback compared to Aggregate feedback, however no such difference is found in the Strangers setup, which is closer to our design.

In paper 3, I conduct a VCM experiment, in which I compare two VCM mechanism, that both have diminishing marginal benefits from the private good. In the control treatment I employ a standard a linear SCF to aggregate individual inputs into a public good, whereas in the treatment condition the SCF is a pairwise complementary function. I employ stranger matching protocol, and report the individual contributions (anonymous) in a given group to every member of that group in each period.

1.5 Informational Cascades and Herding

Many areas of economic activity, such as the adoption of new products and technologies or job search in labor markets are permeated by an important phenomenon called observational or social learning. By such learning is meant a situation where an imperfectly-informed agent, such as an investor or a consumer, is able to observe other agents making a similar decision as she is about to make. Observing what these others do enables the agent to deduce what she believes. Supposing the other agents are well-informed, what they believe is in turn informative about the state of the world. Thus an agent can learn by observing others' behavior. In fact, if the observed actions of others are informative enough, a rational decision-maker may ignore his private information and decide simply to do whatever the others are doing.

This phenomenon is usually referred to as rational herding or as an informational cascade. Such cascades may arise in many different settings and environments, ranging from consumer behavior (e.g. product adoption) to the decisions of financial market professionals, or adapting of previously unfamiliar social norms (cf. social influence treatment in paper 1). In particular, if we define informational herding more generally as convergent behavior based on observing others' actions as source of information for appropriate course of action in a given situation (Bicchieri, 2005), it is easy to see how this concept is partially related to the research questions presented in papers 1 and 2. In particular, as one of our research questions, we ask whether reciprocal motivation has an effect on the choices of the subjects, or are their actions mostly just a product of social influence: Having been set up with a completely new task in an unfamiliar environment, the subjects might just mimic each other in an attempt to find out what kind of behavior is acceptable.

Typically in models of social learning, the agents are assumed to be located within some (directed or symmetric) social network g consisting of n agents (see Hirshleifer & Hong Teoh (2003) for a review). Two agents are said to be connected, if there exist a link *(i, j)* between them. There is some true state of the world $s^* \in S$. The state is usually either some binary variable or a continuous variable. Every agent in the network receives some realized signal θ_i about the state of the world, which is usually discrete.

Each agent's objective is to form beliefs and learn about the true state of the world as accurately as possible. Time is usually discrete, and the agents move in an exogenously determined and possibly random order. Each agent is able to observe the actions of those agents who moved before she does, if there is a link or a chain of links between her and her predecessors. Typically the action set available for the agents is coarse (typically two actions).

In the pioneering observational learning models by Banerjee (1992) and Bikhchandani et al. (1992), the decision makers move in an exogenously determined sequence. In other words, they form a line, where an agent moving at time t observes the action taken by her predecessor at time *(t-1),* and all the other previous actions, but cannot see what the subsequent agents might choose. There are two equiprobable states of the world*, (H)* and *(L).* The agents choose a binary action $a_i \in \{H, L\}$ in every period. The action pays *1* if it matches the state of the world, *0* otherwise.

If the signals the agents receive have bounded informativeness, the agents' actions will almost surely converge when t approaches infinity while their private beliefs do not. That is, the early decisions of a certain number individuals have accumulated such a convincing body of evidence that subsequent decision makers rationally herd without regard to their own information. This phenomenon is called an information cascade. In an information cascade, choices no more reveal private information and social learning stops completely.

To see why this happens, suppose that the signal of is informative with the precision of $p=2/3$, meaning that each agent moving at time t observers a correct private signal θ_t, matching the realized state of the world with probability two times out of three, on average.

$$Pr(\theta_t = h | s_t = H) = Pr(\theta_t = l | s_t = L) = 2/3 \quad (10)$$

Now, consider the chain of decisions: Agent 1, moving first follows her signal. Agent 2 can infer agent 1's signal from her action, assuming rationality on the part of the first mover. If the agent 2's private signal indicates the same state of the world as agent 1's action, she follows that and takes the same action. If it is the signal indicating the opposite state of the world than agent 1's action, she is indifferent between the two actions. In her turn, the third agent either sees two same choices or two different choices; in the latter case she chooses the action based on her private signal as the two opposing actions cancel each other, but in the former case she will follow and choose the same action as the two first agents, irrespective of what her own signal is and an information cascades start.

More generally with this parametrization, whenever in the decision history, the difference in the count each action has been taken is 2, an information cascade should arise.

Starting from Anderson & Holt (1997), substantial amount of the previous experimental work analyzes herding behavior within this type of fixed setup. Anderson & Holt (1997) study an experiment with three cascade treatments. They find clear evidence that information cascades occur, though participants do not always rationally ignore their private signal. Kübler & Weizsäcker (2004) extend Anderson and Holt's baseline experiment by introducing costly signals at small non-zero cost. In equilibrium, only the first mover should buy information, but the participants tend to buy too many signals.

Goeree et al. (2007) examine the robustness of long sequences (20, 40) and two values of signal accuracy (5/9, 6/9). They find that pure cascades are rarely observed, and that cascades are almost always broken by individuals with contradictory signal. However, longer cascades provoke more herding. Ziegelmeyer et al. (2010) study cascade games with low-informed and high-informed subjects. They find that the behavior of the high-informed participants deviates from equilibrium behavior in situations where Bayesian approach predicts a guess consistent with one based on only on the private signal. In other words, cascades become rapidly more robust as the number of identical guesses increases.

However, if the decision the agents face involves markets and prices, this changes the situation considerably. Avery & Zemsky (1998) study a theoretical financial market, where the price is efficiently set by a market maker. They show that the presence of an efficient price mechanism renders informational cascades

theoretically impossible. The history of past trades is correctly aggregated and this information should be reflected in the price of the traded asset.

The model by Avery & Zemsky (1998) is studied with the help of an extensive Internet experiment by Drehmann et al. (2005). In their experiment, investors move sequentially in some exogenous order, with each investor moving only once and deciding what to buy, each investor receives a private, informative signal. In the baseline setup, corresponding to Bikhchandani et al. (1992) model, the investors simply choose which asset to buy with fixed price. They observe the private signal and the buying decisions of the previous traders. In the Avery Zemsky-treatment, this model is enrichened by introducing an asking price, and the market maker is played by the computer.

Depending on the experimental parameters, Drehmann et al. (2005) find that the share of the decisions that can be classified as correct while assuming common knowledge of rationality varies between from 50% to 60% depending on the experimental parameters. Even when the whole action and signal history is made available to the subjects making the trading decision, this share is merely 72%, even if in this case she does not have to worry about the rationality of other decision makers.

In a similar vein, Cipriani & Guarino (2005) operationalize a model by Glosten & Milgrom (1985), where the asset is traded by a sequence of traders interacting with a market maker. They compare the experimental results under fixed price, flexible price and no-history setups, the last of which was a control experiment where the subjects could not observe the previous trading decisions. In addition they had an endogenous price setting treatment, were the price was set as in Avery & Zemsky (1998), where the market makers (2 in each session) were also human subjects. The market makers chose the prices simultaneously and the traders could trade at the better of the two prices set (either sell at higher or buy at lower). After this the market makers would update the prices again.

Cipriani & Guarino (2005) find that under flexible prices, herding was not a significant source of informational inefficiency which is in line with the theory, whereas in the fixed price treatment the subject engaged in an informational cascade 52% of the time when it was rational to do so. However, in some cases the subjects decided not to use their private information and chose not the trade, whereas in other cases they ignored their private information to trade against the market, in other words, acted as contrarians.

In the theoretical model of Bose, et al. (2008) there are monopolistic markets: There is one asset class traded by a monopolistic seller who interacts with a sequence of buyers. The seller has capacity to sell one unit of the asset for each buyer, one at a time. He has as many units as there are buyers. As in the models mentioned previously, time is represented by a countable set of trading periods

The model is a dynamic game between a long-run seller and sequence of short run buyers. Buyer *t's* strategy is simply to buy if and only if the asking price is weakly lower than the expected value conditional on privately observed signal. The seller does not receive any private signal, and has to gather information through the trading decisions of the buyers. When setting the asking price, the seller faces a tradeoff between immediate payoffs from the a trade conducted at the current period and the future profits which are the expected discounted profits from the next period onwards conditional on the present information.

Depending on the parametrization and signal realizations, for the seller it is optimal either to choose a pooling price, after which the price updating process stops, and traders with both low and high signals will buy the asset and a purchase cascade is triggered, or a separating price which is the highest possible price under which a buyer with high signal realization will buy the asset, but a buyer with low signal will refuse the trade. Furthermore, after certain realized trading histories, the optimal asking price can be so high that from that point on, no buyer will buy the asset. This asking price is called an *exit price*, and the respective cascade an *exit cascade*.

To my knowledge he experiment whose results are reported in paper 4 is the first one implement this particular model in an experimental laboratory.

1.6 Summary of the Results and Scientific Contribution of Essay 1

Both essay 1 and 2 study reciprocal behavior of monetarily incentivized subjects. The standard workhorses studying such questions are the ultimatum and trust games. Instead, to exclude any efficiency gains from interaction, we use the two player dictator game, where one of the players how to allocate a certain sum of money between him and an anonymous, randomly chosen partner. However, in both of the experiments, reported in the respective papers, we extend the existing literature research by examining the considerably less studied situation, where instead of the standard setup of two players, a group of three people is involved in an allocation decision. In both experiments, we examine reciprocity using a sequential dictator game where the first round recipient becomes the second round dictator.

Both experiments consist of two treatments: We follow Blount (1995) in comparing the behavior of responders facing a decision made by a random number generator with the behavior of responders facing an allocation decision made by an actual player.

In paper 1, the experiment is designed to study whether reciprocity can be observed when efficiency gains or strategic motivations are not present, i.e. when

sending money in the first round is due to certain types of distributional preferences but is not multiplied by any coefficient as in the trust game. As a key research question we ask how second round dictators *respond* to first round dictators' kind or unkind actions. We define strong reciprocity as behavior where the agent is willing to sacrifice recourses to reward or punish others' behavior even if this is costly and provides no material rewards for the reciprocator. Furthermore, we separate between three types of reciprocity called direct, indirect and generalized, in order to see whether the less studied indirect and generalized forms of reciprocity are equally intense as its direct form.

Direct reciprocity occurs when two actors interact directly, i.e. A hurts/benefits B first and later B reciprocates A. In indirect reciprocity, the return comes from someone else than the recipient of the original action (Alexander, 1987). In generalized reciprocity, the return is directed to someone else than the original actor. Generalized reciprocity occurs when A hurts/benefits B first, and subsequently B reciprocates C. In the social influence treatment, each second round dictator was informed about an allocation decision of a randomly chosen first round dictator. Neither the second round dictator nor her/his recipient had taken part in the first round play.

We posit the following hypotheses in paper 1:

(HP1) states that the dictators keep all of their endowment. The standard monetary payoff maximizing hypothesis. If the HP1 is rejected, we assume (HP2).

(HP2) states that strong reciprocity is observed, i.e. we assume that in the direct, generalized and indirect reciprocity treatments there is a statistically significant association between the first and second round dictator giving. Furthermore, if support is found, we assume a particular form of reciprocity, stated by (HP3).

(HP3) states that the association between first and second round dictator giving is stronger in the direct reciprocity treatment than in the generalized reciprocity treatment.

Additionally, (HP4a) states the association between first and second round dictator behavior does not depend on how the first round allocation was decided, whereas opposing (HP4b) says that the second round dictator behavior is more responsive to the first round allocations in generalized and indirect reciprocity treatments than in the respective control treatments gen-r (generalized reciprocity with a random 1st round allocation) and indir-r (indirect reciprocity with a random 1st round allocation).

Finally, we assume (HP5) that the association between the first and second round dictator giving is stronger in the direct, generalized and indirect reciprocity treatments than in the social influence treatment.

In each experimental session, subjects engaged in the sequential dictator game of two rounds. All second round dictators made their allocation decision in a strategy method sheet, where they made a comprehensive allocation plan, matching an integer amount of money [0,16] they were willing to give away for every feasible donation made by the first round dictator.

In the direct reciprocity treatment, the first round recipient became a dictator in the second round and sent back an amount to the first round dictator. In the generalized reciprocity treatment, the second round dictator sent the allocation to a third, unrelated person instead of the first round dictator. In the indirect reciprocity treatment, the first round dictator became a second round recipient, but her/his second round allocation was decided by a third person, instead of the first round recipient. This third person was informed about the first round allocation. The control treatments generalized-random (gen-r) and indirect-random (indir-r) replace the intended first round decision with a random allocation.

We observe the following results: Result 1) The first round dictators sent on average positive amounts, so we reject (HP1), the material payoff maximizing hypothesis. Result 2) (HP2) is accepted: Strong reciprocity is observed, i.e. reciprocal behavior is observed with a double blind procedure and without strategic incentives to behave reciprocally. Result 3) Contrary to our hypothesis (HP3), we do not observe statistically significant differences between direct and generalized reciprocity. Result 4) We do not observe statistically significant differences between indirect and generalized reciprocity and their respective random controls, indicating that, outcome distributions seem to be more relevant than intentions, leading us to accept (HP4a), and Result 5) there is no indication of social influence, giving support for different forms of reciprocity as independent patterns of behavior, meaning that (HP5) is accepted.

Paper 1 contributes to the existing literature by studying the reciprocal behavior in the simplest possible means available to experimental economics, by employing a dictator game. *Methodologically, part of our contribution comes from employing a dual blind method*, where the subjects are located in physically separate rooms, and *from the utilization of strategy method*, in order to obtain a complete mapping of individual responses to any feasible first round allocation. In terms of results, *our contribution lies in further illuminating the roles of different forms of reciprocity with respect to social preferences.*

1.7 Summary of the Results and Scientific Contribution of Essay 2

In paper 2, we investigate the motivation behind reciprocal behavior by employing a sequential three–player dictator game. In particular, we examine the effect of distributional and reciprocal motivation on the behavior or self-interested dictators, or "stake-holders".

In our control treatment, the first round game is a standard dictator game between a recipient and a dictator. In the second round, we introduce a third player, who will act as a dictator, and decide how to allocate her endowment between herself and the two first round participants. Paper 2 can be seen as complementary to paper 1, as it extends the choice set of the second round decision maker to include also negative allocations. In other words, the second round dictator can also decrease and reallocate the endowments of the first round players. As in paper 1, we compare the behavior of responders facing a decision made by a random number generator with the behavior of dictators facing an allocation decision made by an actual player.

We test whether second stage dictators punish, i.e. take more money away from the first stage dictators because of an unfair first stage distribution compared to random allocation treatment. In our analysis, we treat a first round allocation as unfair if it is less than the focal point of equal split.

We contribute to the existing literature by testing the impact of distributional/intentional concerns when opportunities to punish are indirect and the choice set includes an option to take, which to our knowledge has not been done in a three player setting.

We test the following hypotheses concerning the second stage play:

(H0): Payoff maximization: Participants maximize their monetary rewards from the experiment, i.e. second stage allocation to other players equals 0. In other words, the second round dictator keeps the whole allocation given to her group to herself.

(H1): Second stage allocations to other players are different from 0.

(H2a): The association between the allocation made by the first round dictator and a second round allocation given to her is positive (i.e. the association between the share of the initial endowment kept by first round dictator and the share received in the second stage is negative)

(H2b): The association is stronger or more frequent in the intentional treatment than in the random allocation control.

(H3): The second stage dictators are more willing punish 'unfair' first round behavior in the intentional decision treatment, i.e. there is a difference in mean conditional money allocations between the two experimental treatments.

We observe the following results: Result 1: The monetary payoff maximizing (narrow self-interest) hypothesis (H1) can be rejected also in our experiment, both on the part of the first and second round dictators.

Result 2a: The association between first and second round dictator allocations is positive in the decision treatment, while on average, the dictator decisions in the control treatment do not exhibit sensitivity with respect to first round random allocation.

Result 2b: Based on individual correlations, we cannot detect any differences in the strength of the association between the treatments.

Result 3: The second stage dictators are more willing punish 'unfair' first round behavior in the intentional decision treatment only in the case of maximally disparate first round allocation, when the first round dictator keeps everything to herself.

To summarize the results of paper 2, we note that a positive association between first and second round dictator allocations was observed, but the second round dictators were not more inclined to punish first round A players, except in the case of extremely unfair first round allocation. But this result may be party result due to the confounding effect of the selfish motives of the second round dictators.

1.8 Summary of the Results and Scientific Contribution of Essay 3

Paper 3 reports results from two different team production games. In the treatment group private consumption has diminishing marginal benefits and the individual contributions to the joint project exhibit pairwise strategic complementarities, meaning that the production technology is essentially a Cobb-Douglas function with increasing returns to scale. In the baseline control treatment, the function determining returns from private consumption are determined by the same quadratic payoff function as in the treatment group, but the aggregation technology is a standard social composition function, which is linear, i.e. the unweighted sum of the individual contributions. The game utilized is a VCM game with random matching, which is repeated 20 periods. The observed behavior under strategic complementarities is compared to the baseline treatment.

The contribution in terms of modelling in paper 3 stems from the fact that in *both settings, partial contribution is a unique equilibrium action*. In the previous experimental literature, this has been only the case with the linear social composition function (cf. Keser 1996), but when the social composition function has been

nonlinear, there have been multiple Nash equilibria (see for instance Andreoni (1993) and Chan et al. (2002)). In Paper 3, the equilibrium is unique *even when both the private and the public parts of the payoff function are nonlinear*.

I specify coefficient for the return from the public good in the linear setup and the degree of complementarity between actions in the game with strategic complements in such manner that the respective payoffs from both the minimal action and the maximal action profiles, and the equilibrium contribution level to the joint project are the same under both production technologies.

The treatment variables are the group size (n=2, vs. n=5) and the SCF form (linear vs. pairwise complementary).

Hypotheses in paper 3 according to the standard payoff maximizing model state that:

(H1) We should observe lower contribution levels in smaller groups, when the SCF is pairwise complementary.

(H2) We should observe no change in behavior when the group size decreased from 5 to 2 and the production technology is the standard linear SCF.

The results of the paper 3 are as follows: In both treatments, I find that the contribution levels are far above their equilibrium levels when the group size is n=5 subjects, but that the rate of over-contribution is considerably higher in the complementarity treatment. However, when the group size is decreased to n=2, the average contributions in the complementary treatment approach their Nash-level, whereas there's only slight decrease in the linear control treatment. As such, our experiment provides further empirical evidence that the group size effect is also present in a VCM game with an interior equilibrium.

1.9 Summary of the Results and Scientific Contribution of Essay 4

In paper 4, we implement a monopolistic market with flexible prices. A feature distinguishing our work and part of our contribution is that whereas in the previous studies with flexible price system (Cipriani & Guarino, 2005; Drehmann et al., 2005) the market was competitive with at least two sellers; our market has only one monopolistic seller with several potential buyers.

In particular, the focus of our exercise is on examining the pricing behavior of a monopolistic seller when the buyers make buying decisions sequentially and learn from each other's decisions. Our model is an empirical adaptation of the theoretical model by Bose et al. (2008). In our experimental market, there is one asset class traded by a monopolistic seller who interacts with a sequence of buyers. The

seller has capacity to sell one unit of the asset for each buyer, one at a time. He has as many units as there are buyers.

We observe that setting prices in our experimental monopolistic markets was hard, despite the risk attitudes of the subject not distorting their probability estimates about the state of world systematically. In particular, the sellers failed to update their prices both upwards and downward after receiving new information.

On the other hand, this sluggish updating strategy turned out to beneficial for the sellers, as they made almost 10 percentage units more trades (or a 20% higher success rate) than what would have ensued with optimal behavior under assumption of common knowledge of rationality. This was also beneficial in terms of monetary gains, as the higher prices of the trades conducted while assuming common knowledge of rationality would not have been enough to offset the losses incurred from trades forfeited.

1.10 Discussion and the Question of External Validity

By going through the results reported essays 1-4 we observed that the behavior of human subjects even under ideal conditions in terms of information and protocol are not always in line with the standard model of modern economics. We noticed that the subjects are not merely motivated by the pecuniary payoff, and that reciprocity matters. Moreover, processing information and assessing probabilities is challenging. Without context, these results are, of course, nothing new as these studies are not the first ones to report such violations from the standard model, but they seem to be rather rule than an exception.

However, this raises the question, as to how justified we are to hold the current theory intact, and how much practical value it has, if its predictions would seem to fail even under ideal conditions. Before jumping to any drastic conclusions, lest I be guilty of naïve falsificationism, we have to ask how and to which extent the experimental results obtained are related to the world outside the lab.

Levitt & List (2007) note that the results obtained in an experimental economics lab depend not only on the financial motivations of the subjects, but on the nature and degree of others' scrutiny, the context of the decision, and the manner in which participants are recruited. They point out that because a lab systematically differs from most naturally occurring environments on these dimensions, experiments may not always yield results that are readily generalizable.

Their criticism is addressed by Camerer (2011) who argues that generalizability of lab results is an exaggerated concern among non-experimenters for three possible reasons. According to Camerer, A typical experiment therefore has no specific target for “external validity"; the “target" is the general theory linking economic

factors to behavior; like for all empirical methods the goal for experimental economics is to try to accumulate regularity about how behavior is generally influenced by individual characteristics, incentives, rules, norms, and other factors.

Secondly, when it comes setups where external validity might be low, for example because the subjects are low skilled or inexperienced, with low power incentives as opposed to self-selected skilled agents with high stakes, more experiments can always be run to see how these background characteristics affect the observed behavior. That is, we do not have to settle for a setup that seems to provide results that are hard to generalize, as experiments with different design parameters can be always conducted.

Specifically, with respect to our dictator game findings which corroborate earlier studies, we can take solace in Camerer (2011) pointing out that the dictator game has never been specifically designed to predict everyday sharing from earned income. Evidence accumulated suggests that instead of pure altruism, the dictator game measures a willingness to conform to a perceived social norm of appropriate sharing of unearned income.

He also points out that, the extreme control in the lab suggests it is an ideal setting in which to learn about influences on sharing. Which is exactly what we do in the experiments reported in papers 1 and 2 by manipulating how the dictators obtain part of their initial endowment. This also has been the guideline in papers 3 and 4: The possible loss of realism and generalizability is more than offset by the increased control and high *internal validity* of the between subjects design.

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