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To my grandfather, Cyiza Rwiyereka Pancrace, the first sociologist of my family.

May his soul rest in peace.

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ABSTRACT

This dissertation addresses the relationship between prosociality and economic behavior. The study of prosociality (and related concepts like altruism) has long been intertwined with broader concerns about the accumulation and circulation of material resources, from the empirical literature on the management of common pool resources and public goods, to the theoretical literature on social dilemmas. The chapters of this dissertation shed new light on the relationship between prosociality and economic behavior through empirical studies and mathematical modelling. The introductory chapter begins with a theoretical critique of what I call “consequentialist prosociality”, the conception of prosociality that is most commonly used in the literature: actions taken by one set of agents that cause another set of agents to experience some benefit. After exploring the paradoxes of this approach, I propose that we reconceptualize prosociality as a set of local and dynamic relations between persons, relations that involve the extension of an agent’s self-concern to include other agents. This reconceptualization lays the groundwork for the remaining three chapters.

The first chapter uses network data collected from 75 villages in Karnataka, a state in southwestern India, to assess the relationship between individual villager-level bank account ownership and the likelihood that villagers report ties that cross caste boundaries. The results of this chapter provides evidence that more market-integrated villagers are more likely to establish relations across caste boundaries. The second chapter contains the results of a pilot study for a social exchange experiment: I randomly assign Prolific participants to participate in two forms of dyadic exchange (reciprocal and negotiated) and then randomly re-pair them to play an iterated prisoner’s dilemma. Given that different forms of economic organization differentially prioritize these two forms of dyadic exchange, the results of the full experiment will give us some indication of what mechanisms may drive the relationship between changes in economic organization and changes in social patterns of trust and cooperation. Finally, the third chapter contains an analysis of a formal model of social preferences. I prove that if agents in a group can have utility functions that weigh the outcomes of themselves and other group members, and if those weights sum to unity and obey transitive closure, then certain structural properties of the matrix of weights lead to sociologically

interesting equilibrium distributions of other-regard in the group. All of these chapters push forward a research agenda for prosociality that emphasizes the mechanisms that drive local patterns of concern, trust, and cooperation.

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CHAPTER 1

PROSOCIALITY: AGAINST CONSEQUENTIALISM AND TOWARD RELATIONALITY

1.1 Introduction

The causes and consequences of prosociality have been central concerns of sociology since its inception (Durkheim 1960; Simpson and Willer 2015; Steiner 2019). Prosociality is also a topic of interdisciplinary concern, with contributions coming from psychology (Penner et al. 2005), economics (Crawford 2019), anthropology (Ibbotson 2014), evolutionary biology (Hruschka and Henrich 2006), and increasingly from artificial intelligence (Dafoe et al. 2021). Like many important concepts used in sociology, it has been measured and operationalized in many different ways. Even so, there is a broad consensus that prosocial behaviors are acts that an agent performs that benefit at least one other agent, at a cost to the agent who performed the act (Lindenberg 2006; Simpson and Willer 2015; Wittek and Bekkers 2015). I refer to this definition of prosociality as the “consequentialist” definition, and to this understanding of prosociality as “consequentialist prosociality”, as it makes the defining feature of prosocial behavior its ability to *cause* the recipient of the act to experience some sort of benefit. It follows from this definition that an act is not prosocial if another agent failed to benefit from the act. This definition therefore highlights the causal role of the prosocial act in providing a benefit to another agent or agents.

This introductory chapter will argue that the consequentialist definition of prosociality is unstable. Under this definition, it is either impossible to determine which acts are prosocial and which are antisocial (that is, causing at least one other agent to experience a harm); or it allows us to classify the same act as both prosocial and antisocial, thereby emptying the category of meaning. This conceptual instability does not necessarily undermine the empirical findings of research in this area, but it does force us to reinterpret our findings, and it prompts us to ask how we should be conceptualizing our task. I explain the paradoxes that arise from the consequentialist definition of prosociality, and I outline how sociologists interested in prosociality should conceptualize their

task going forward. I then briefly summarize how the chapters of this dissertation contribute to this agenda.

1.2 The Instability of Consequentialist Prosociality

1.2.1 Riding The Wave of Benefit and Harm

If prosocial behavior is that which benefits others, then we must know what the terms “benefit” and “cost” mean. As one might guess from the use of cost-benefit language, the most straightforward way of understanding benefits and costs in prosociality is through what March (1994) would call a logic of consequences. The logic of consequences models human action with four basic factors: the possible actions an agent can take, the expected future consequences of those possible actions, the values of those consequences for the agent, and the decision rule that compares those values to produce an action. In this scheme, both the costs and the benefits of the prosocial act involve the values of the consequences of performing the action. In the case of costs, the agent that performs the prosocial act must anticipate some negative value of the consequences. They must stand to lose something, at least in the short-term, in order for the act to involve some cost for them. In the case of benefits, the agent that is the recipient of the prosocial act must positively value the consequences of the act.

The simplest and most widely used version of the logic of consequences is the rational choice model, which posits that agents follow a decision rule where they take actions that produce the outcome with the highest possible value, where “value” is usually the quantity of their personally held resources. When applied to prosociality, we ask what would cause an agent oriented toward more highly valued consequences to act prosocially. Under certain conditions, this question is easy to answer. Research that uses the logic of consequences in the study of non-economic social exchange finds that there are strategic settings, such as under conditions of mutual monitoring and sanctioning (Coleman 1990; Piskorski and Gorbatai 2017), that can promote long-term, mutually beneficial behaviors. This starting point also produces the obvious puzzle of why agents act prosocially in sit-

uations where there is a genuine conflict between individual and other-regarding interests, i.e. when agents face collective action problems (also called social dilemmas, Kollock 1998).

Despite the successes and insights of the logic of consequences, its strict versions, particularly ones that posit strict self-interest, suffer from well-known empirical weaknesses in explaining prosocial behavior (Alfano and Marwell 1980; Butts and Rode 2007; Henrich et al. 2001; Sally 1995). I will not rehash these weaknesses here, as there are more sophisticated versions of the logic of consequences that escape these critiques, such as those coming from the bounded rationality tradition (Simon 1996). The point of discussing the logic of consequences here is that it captures certain aspects of mental and social life that are essential to consequentialist prosociality, such as the idea of “benefit” as depending on the agent’s subjective valuation of an outcome. That is, when we ask whether an agent benefited from an action, we must ask whether the agent *subjectively* valued the outcome of the action¹.

Rather than re-litigate theoretical debates from half a century ago, I want to follow a similar strategy to Granovetter’s (1979) critique of the concept of social or economic “development”. I want to critique the consequentialist definition of prosociality on a logical basis, by exploring the paradoxes that arise from focusing on the beneficial consequences of an action for another agent². This critique, therefore, is not undermined by more realistic and sophisticated models of decision-making. My critique pertains less to the idea of rational decision-making, bounded or otherwise, than it does to the inherent difficulties of classifying a kind of action by the consequences it produces for others. I think the best way to begin this critique is to reflect on an ancient Taoist proverb, one which is worth quoting in full (Yuan, Tang, and Geiss 2017: 113-118):

1. We can only reject this approach if we posit that there is some *objective* good for agents that they may be mistaken about. While this would make for a very interesting concept of prosociality, it would require us to become far more comfortable with Aristotelian ideas than we are currently.

2. Interestingly, the aspect of *cost* in this definition is far less problematic, and remains untouched in my critique. There is something delightful about this from a philosophical point of view, and more of its implications for the logic of consequences have been noted elsewhere (Martin 2015: 152-157).

Among the people near the frontier, there was one skilled at prognostication. For no reason, his horse ran off into the territory of the northern barbarians; the other people all consoled him. His father said: "As for this, why then can't it become good fortune?"

After several months had passed, his horse returned leading some fine barbarian horses; the other people all congratulated him. His father said: "As for this, why can't it become misfortune?"

There were many good horses in the household: his son liked to ride, fell off a horse, and broke his thighbone; the other people all consoled him. His father said: "As for this, why can't it become good fortune?"

After a year, the barbarians mobilized on a large scale and entered the frontier; all the adult males took up their bows to do battle. Of the people near the frontier, nine out of ten died. Because of the son's being lame, in this family alone were father and son still together safe and sound.

Thus, as to how fortune becomes misfortune and how misfortune becomes fortune, the ultimate ending of this transformation is unascertainable; it is of unfathomable depth.

This proverb invites us to reflect on how the consequences of one event can oscillate between beneficial and detrimental, and that this oscillation may never stop. This insight can be applied to social action, as it highlights the difficulty in determining when an observed action is prosocial or not, in the consequentialist sense we are discussing. Suppose the first horse did not simply run off into foreign territory on a whim, but that an enemy snuck onto the family's property and released the horse. We would say that the enemy had engaged in antisocial behavior, having harmed another agent by depriving him of a functioning horse. However, when the lost horse returns with a pack of fine horses in tow, we would then have to conclude that the enemy engaged in prosocial behavior, as the consequences of his action caused a benefit to the family. We would have to flip our assessment

again after the son falls off the horse and breaks his femur, and *again* when the son is spared from the horrors of war due to his broken leg, and so on and so forth indefinitely, or at least until the son's death. Let us call this the "oscillation problem", to indicate how the pro- or anti-sociality of a given act seems to oscillate over time due to the unknown causal structure of the environment. At best, we could only determine whether an observed action was prosocial after all the intended targets of the act had died, an impossible standard to achieve in our empirical research. We are generally interested in the more local benefits produced by an action, even if the explicit definition of consequentialist prosociality does not allow for this arbitrary demarcation.

One strategy for avoiding the oscillation problem is appealing to time preferences. We might say that the enemy in our modified proverb performed an antisocial action because the short-term harm the family experiences from losing their horse outweighs the long-term benefit the family experiences when they receive more horses from the wild, and any other subsequent benefits. While time discounting is a real feature of intertemporal decision-making (Frederick, Loewenstein, and O'Donoghue 2002; Loewenstein and Thaler 1989), this fact does not dispel the conceptual problem. We often disregard the time preferences of the recipients of prosocial action, and justifiably so.

For example, we usually consider vaccinating one's child against deadly and infectious diseases to be an instance of prosocial behavior toward the child, regardless of whether or not they are afraid of needles, or whether they value the long-term health benefits (both to themselves and to others) more than they dislike the short-term pain. We assume that even if a vaccination has a negative expected value for the child right now, because he heavily discounts the future, it is still a prosocial act to vaccinate the child, because in the future he will appreciate the health benefits of getting vaccinated as a child. Indeed, convincing people to take vaccines, regardless of their personal vaccine hesitancy, has been an area of prosociality research in recent years (Böhm and Betsch 2022; Cucciniello et al. 2022)³. In this and other cases, we treat the concept of prosocial behavior as logically independent of the time preferences of the recipients of the behavior, making appeals

3. This logic holds for cases of vaccine hesitancy that are not caused by skepticism about the efficacy of vaccines. The issue of potentially mistaken beliefs about the beneficial or harmful consequences of our actions will be handled later in this chapter.

to such preferences irrelevant to the oscillation problem.

There is a special case of the oscillation problem where the distance in time between the benefit and harm (or vice versa) is negligible, due to some rapid change in the agent that is caused by the act. We have so far assumed that the actions that agents take toward one another leave them as essentially the same agent as they were before the action. In other words, we have assumed that the agent remains a stable entity despite what they have experienced in a given prosocial act. We can assume, for example, that the family members described in the proverb have stable preferences for economic security and good health. We can also assume that immunity to infectious disease is always a benefit for human beings. Even so, there are large classes of experiences that fundamentally reshape our concerns, desires, and needs, and to the extent that those experiences can be the effects of others' actions, it becomes even more difficult to discern whether such actions are prosocial.

I will borrow a thought experiment from the work of L.A. Paul (2014): suppose that you were bitten by a vampire against your will, and subsequently became a vampire. While you would have loathed the idea of avoiding sunlight and subsisting on the blood of living prior to the bite, you now find such activities deeply rewarding, far more rewarding than your previous sun-walking life. Did the vampire that bit you behave prosocially? In this case it is hard to tell, because, in an important sense, the bite transformed you into a different person. What was a harm prior to this bite became a benefit after the bite. Perhaps it was antisocial of the vampire to sink his teeth into your flesh, but became prosocial for him to release his bite and complete your transformation into a fanged creature of the night.

Although this may strike the reader as a silly thought experiment, a merely fictional difficulty for the consequentialist concept of prosociality, this thought experiment is used by Paul and Healy (2018) to explicate the problem of transformative treatments for causal inference in the social sciences. To summarize their argument, there are cases where we have no principled way of distinguishing between treatments that *reveal* the preferences of agents from treatments that *replace* the preferences of agents, a problem that exists even in randomized controlled trials. There may also be actions performed by one agent that create a benefit for another agent, but only because it has

transformed the recipient of the act into an agent that would benefit from it, and we would have no way of knowing if this was the case.

The consequentialist definition of prosociality frames it as behavior that benefits another at a cost to oneself. This definition is equivalent to saying that one agent must act in a way that causes another agent to benefit in some way, a framing that explains the literature's focus on what factors may cause an agent to make a decision that benefits another agent. The problem with this definition is that our actions have consequences that ripple throughout the universe forever, and there is no principled basis on which to decide that the rippling has gone too far, that we may begin to count the pluses and minuses. Even worse, there are actions that transform the recipient of the act into one that benefits from it, making its status as prosocial impossible to determine in those cases.

1.2.2 Success and Failure, Usually The Latter

The oscillation problem arises from the fact that we can determine that an action has caused a benefit, and then a harm, and so and so forth indefinitely. A closely related problem is our inability to determine that an action has, in fact, caused a benefit. In his famous essay on perception, Gilbert Ryle (2015 [1954]) makes a distinction between verbs that indicate the successful termination of a process, and verbs that do not. He notes that basic perception verbs (e.g. to see, to hear) are a case of the former; they indicate that the agent has *succeeded* in an investigative process, in discerning some aspect of the world. Ryle considered the inherently normative nature of such verbs to be a problem for scientific accounts of human perception, and there is an analogous difficulty with consequentialist prosociality.

“Acts that benefit another agent” assumes that the act *succeeded* in benefiting the other agent. We would not categorize an act that *failed* to benefit the agent as a prosocial act; for example, we do not think that holding a good intention towards another person or group, on its own, causes them to experience some benefit. However, given the above considerations, particularly the difficulty of predicting the consequences of our actions, we often find ourselves in situations where what we previously categorized as prosocial action turned out to be anti-social action, and vice versa. This

possibility of retrospective cancellation threatens to undo the edifice of our knowledge about this phenomenon, and should give us pause on our *current* claims about prosociality. Let us explore two examples of potentially prosocial behavior to see the problem more clearly.

It is a common finding in the broader prosociality literature that prosocial dispositions are related to pro-environmental dispositions (Kaiser and Bryka 2011; Kroker and Lange 2024; Neaman et al. 2022), with some work finding that pro-environmental decisions and prosocial behavior have the same neural correlates (Corbi, Taşkıran, Soutschek 2025). Research in this domain tends to find that pro-environmental behavior can be driven by eliciting prosocial motives or values (Evans et al 2013; Sanderson and McQuilkin 2017), or by a system of norms that limit behavior that would be detrimental to the environment (Ostrom 2015). While many pro-environmental actions are considered in this literature, let us focus on the case of recycling, which has also been studied as a case of prosocial action (Wollbrant, Knutsson, and Martinsson 2022).

For the sake of argument, suppose that recent critics of plastic recycling are correct, and that the actual outcome of plastic recycling with our current infrastructure is taking plastic on a long and expensive journey to the landfill at best, or the incinerator at worst (Allen et al 2024; OECD 2022; Tierney 2015). If this turned out to be the case, then what would previous studies of recycling have taught us about prosocial behavior? Given that it would no longer be the case that recycling was an action that produced a benefit for others at the cost of extra effort on the part of the consumer, we would have to radically recontextualize the findings of previous research. We would be forced to conclude that we learned something about the success of a *social movement*, perhaps, and on those terms we would have gained useful sociological knowledge. However, we would have to erase those findings from our understanding of the causes of *prosocial* behavior, as we would have only learned strategies for encouraging people to join a campaign that demands time and effort from them, regardless of whether the campaign had any beneficial effects on others.

Let us consider another example, that of “ban-the-box” initiatives. Many employers ask job applicants about their criminal histories, usually by having a box to check on application forms indicating if the applicant has a criminal history. Research suggests that a criminal history makes

it more difficult for applicants to find jobs, and that this difficulty is more pronounced for young black men (Pager 2008). Out of concern for formerly incarcerated people, and formerly incarcerated people of color in particular, activists and politicians made a variety of attempts to improve opportunities for those with criminal histories, including ban-the-box policies that removed questions about criminal convictions from job applications (LaPlant and Vuolo 2021; Solinas-Saunders and Stacer 2015). The first ban-the-box law was passed on the state level in Hawaii in 1998, and since then 26 states have followed suit (Hartman 2021). Despite the prosocial goal of these efforts (giving those who are disproportionately marginalized by the criminal justice system a fair chance at future employment), critics argue that ban-the-box policies have the unintended consequence of hurting the employment opportunities of black people in particular through statistical discrimination (Doleac and Hansen 2020; Raphael 2021).

Imagine a scenario where (a) sociologists interested in prosocial behavior studied efforts to enact ban-the-box as a case of prosocial behavior, perhaps finding that we can activate prosocial norms to get citizens involved in these efforts, or that those with a prosocial orientation are more likely to support such efforts; and (b) the critics are correct that ban-the-box policies hurt the very populations that its advocates are intending to help. We would once again find ourselves in a situation where we are forced to radically recontextualize our findings. We would have found some useful tools for social movement organization, but those tools would apply just as much to movements that we consider to be prosocial (e.g. those that attempt to combat oppression against marginalized people) as they would to movements that we consider to be antisocial (e.g. those that attempt to reinforce the hegemony of dominant groups).

The point of these examples is not to argue that recycling is not a prosocial action, or that collective organizing for ban-the-box policies does not consist of prosocial actions. My goal here is to give us pause about our current claims that we are studying prosocial action from a consequentialist point of view. There are plausible arguments on multiple sides of the phenomena we attempt to study under consequentialist prosociality, and history suggests that we should be wary of overconfidence in our beliefs about the beneficial consequences of social action. A little over a century ago,

it was not uncommon for sociologists to conceive of nations as having a moral duty to advance their imperial projects abroad, and proponents of this view would classify citizen contributions to these endeavors as prosocial, as advancing the welfare of the conquering nations and the human race as a whole (see, e.g. Maurenbrecher 1900). The more common result of these efforts was the suffering and death of millions of colonized people. All these considerations force us to confront the weakness of conceiving of prosociality as that which benefits others, i.e. as that which *succeeds* in causing others to experience a benefit. It is difficult to trace the consequences of our actions, a difficulty which will force us to regularly reclassify our findings in the study of prosociality into findings about other sociological phenomena.

At this point the reader may have the following objection: what is wrong with having to reclassify our findings? Is not the point of science that we regularly update our beliefs about the world? The answer to this objection is that there is a subtle distinction between the kind of revision that is healthy for a science, and the kind that has been discussed here. While the history of science occasionally involves radical redefinitions of the phenomena at hand (Kuhn 2012 [1962]), normal science can not and should not proceed that way. In order for us to have a cumulative science of some phenomenon, we must have a stable idea of what entities it includes, and a phenomenon defined in terms of what other phenomena it causes down the road is a less stable conception than one that does not inherently include such causal relations. We know a lot about water, for example, because it is a stable concept: one oxygen atom with covalent bonds to two separate hydrogen atoms. Whether the molecule preserves life through drinking, or destroys life through flooding, the water molecule is what it is. Our current concept of prosociality enjoys no such stability, as it requires, for its validity in the present, a verdict from the future that may never come.

1.2.3 Conflicts of Interest (or, Who is the Other?)

The previous arguments have explored two ways in which we may be unable to determine the benefits of an act for others. Even if we set these difficulties aside we are still left with a problem that we regularly encounter in social research. Consequentialist prosociality requires that the act

benefits “another”, so who is this “other”? Can anyone, or any subset of the population, be the beneficiary of the act, or must everyone benefit? The latter condition seems far too stringent. For example, it is unclear how everyone benefits from any particular blood donation. Even so, because the recipient benefits from the donation, and donating blood is personally costly to the donor, we are comfortable studying blood donations as an example of prosocial behavior (Callero, Howard, and Piliavin 1987; Mellström and Johannesson 2008; Stutzer, Goette, and Zehnder 2011). Generalizing this somewhat, it seems that we should be comfortable with “others” being any subset of the population, a subset that can include, but must not be limited to, the agent performing the act.

Unfortunately, this definition of “others” produces an instability as to what counts as prosocial behavior, one that arises from the commonplace reality that different sets of people have conflicting interests. An illustrative example comes from Shibutani’s (1978: 82-83) discussion of the “aloha” system of Hawaii, a system of norms whereby, when Shibutani was writing, refusal to join others in some activity was taken as a sign of selfishness. Sometimes these activities were straightforwardly prosocial under the consequentialist definition, like working together with friends and giving to the needy. However, sometimes these activities were the exact opposite, such as joining in to help physically assault an outsider. If I take a personally costly act to benefit my friends in strength of numbers as they attack another person, have I committed a prosocial act? In the general case, if I commit a personally costly act that benefits my in-group and harms my out-group, have you committed a prosocial act? Is it a *net* prosocial act if my in-group is larger than my out-group?

One might try to avoid this repugnant conclusion by expanding the scope of beneficiaries beyond one’s own group, but this solution contains new problems. The first problem is the over-expansion of the circle of beneficiaries, which, at its absolute limit, means that an act is prosocial if and only if it benefits the entire world. Very few, if any, of these actions have ever occurred in human history, and it is unwise to build a social science on extremely rare phenomena (Tarde 1969). The second problem is that the repugnancy of the conclusions we can generate from this definition of prosociality does not necessarily decrease with the size of the circle of beneficiaries. Countries, for example, are rather large groups of people that could be the target of prosocial ac-

tion, and they sometimes subsume smaller groups that would otherwise be in conflict with each other. Unfortunately, allowing acts that benefit any one country to count as prosocial can produce counterintuitive results. We could easily, for example, frame the behavior of SS officers in a way that qualifies as prosocial action: they committed acts that benefited others (the Nazi regime, Adolf Hitler) at a cost to themselves (physiological, psychological, eventually political). While we could take Eichmann's strategy during his trial (Arendt 2006) and argue that those who complied with the Nazi regime were simply following a prosocial duty to their country, this would leave us in a curious position where actions that directly led to the suffering and death of millions of people count as prosocial. It would seem that the boundary between prosocial behavior (that which is beneficial to others) and antisocial behavior (that which is harmful to others) would have disappeared entirely.

1.3 Picking Up The Pieces

The most commonly used definition of prosociality in sociology, and the social sciences more broadly, requires that we know that the actions of some agents have caused benefits for other agents, and this knowledge is usually unavailable for three reasons. The first reason is the oscillation problem: an act can cause a benefit, and then a harm, and cycle in that way indefinitely. The second reason is the ordinary situation where, even at a snapshot in time, we cannot tell if an action has benefited or harmed other agents. The third reason is that, even if the previous two problems can be overcome, we often study situations where a benefit for one set of agents is necessarily a harm for another set of agents, making actions that are prosocial for one set of agents simultaneously antisocial for the other set. If these arguments have convinced the reader that the consequentialist approach to prosociality is untenable for empirical research, where does that leave us as sociologists interested in prosociality? As discussed earlier, a wide variety of behaviors have been studied under this rubric, and it is not clear how they can be seen as a unity without the consequentialist definition of prosociality.

The only way forward is to take a new look at our research findings. We are usually interested in social interactions and relations that occur at a more local level (e.g. resource sharing within and

between groups), or in processes that bring people together and drive them apart (Coley, Raynes, and Das 2020), regardless of whether such interactions, relations, or processes *cause* social agents to experience some subjectively valued outcomes. One example of this approach is to search for interesting exchange structures in relational data (e.g. Bearman 1997). Whether any given movement in the structure causes its occupants to experience some subjectively valued outcome is less important than the structure itself, and how that structure interacts with other structures. We may be drawn to studying structures of relations that involve some sort of positive attachment towards and between persons, or the circulation of valued resources, but we must never confuse this interest with an interest in causal patterns of benefit and harm. In other words, we must think of prosociality as a specific relation (or family of relations) between sets of persons, one that may be *intended* to cause some sort of benefit for the recipient, but does not *logically depend* on such a causal power.

If we think of prosociality research in this way, we will be drawn toward further study of three aspects of social life. First, we will be interested in the way that we are open to attachment to other persons. Second, we will be interested in how the structure of the relations in which we are embedded prompts us to extend concern and assistance towards others. Third, we will be led to theorize the specific nature of this prompting, the logic that maps the experience of being in a certain situation to taking a particular action towards another person or social entity. Decades of sociological research and theorizing have gone into each of these aspects. My only task here is to organize previous work and point to a promising way forward.

1.3.1 The Dynamic Boundaries of the Self

The establishment and potential reciprocation of prosocial relations is possible because human beings are fundamentally open to influence from, and affective attachment to, other human beings. Whether we are studying the establishment of trust, which requires that we make ourselves vulnerable to others (Schilke et al 2021), or we are studying empathic concern with others' welfare (Cipriani 2021), we are studying the ways in which people entangle their interests with the interests of other people. These entanglements are dynamic; they shift through the course of social interac-

tion. Most importantly for this section, I argue that these shifts in interpersonal interest-taking can be well understood as changes in how agents extend the boundaries of the self towards other agents (Martin and Lembo 2020). Understanding how exactly these shifts occur will aid us in understanding the dynamics of relations we consider to be prosocial. Two theorists can guide us in our efforts to study this: William James, the American pragmatist philosopher, and James Coleman, the arch-rational choice theorist of sociology. I will briefly describe their ideas as well as recent social scientific evidence that supports their approaches.

James conceptualized the self as a collection of objects in an organism's perceptual field, objects with which the organism is especially preoccupied (1983 [1890]: 304). This preoccupation, for James, produces a feeling of ownership or possession in the organism towards those objects with which it is preoccupied, and these possessed phenomenological objects constitute the self. Developmentally, the first of these objects is the organism's own body and the objects that satisfy the body's needs, but eventually other objects in the perceptual field come to be associated with the self, thereby enlarging the scope of objects that are under its purview (*ibid.* 308). James splits this group of objects in the stream of consciousness into three parts: the material self, the social self, and the spiritual self. For James, the material self consists of one's body, one's clothes, one's family, one's home, and one's property, in that order. The social self consists of the ways that we are perceived by others. Finally, the spiritual self is a person's inner (or subjective) being, their particular mental faculties and dispositions. Each of these are collections of objects in the perceptual field over which the self feels ownership, and each generates its own feelings of desire and (dis)satisfaction.

Coleman made similar arguments in his *Foundations of Social Theory* (1990). Although much of his work analyzes scenarios where a selfish rational actor theory holds true, he also discusses ways in which the object self, the self that receives signals from the environment and experiences satisfaction (Coleman 1990: 507), can come to include other social entities in its interest. Beginning with the primary needs of the organism (e.g. food, water), an object self may learn to value other objects through association with primary needs (i.e. secondary reinforcement in learning theory).

Beyond that, Coleman proposes that, if an actor stands to gain something by identifying with other social entities, she will expand her interest to include theirs. Coleman's examples of this include children and servants learning to identify with, respectively, their parents and masters.

The Jamesian and Colemanian accounts of the self have very important similarities, perhaps the primary one being that selfhood, for them, involves a sense of ownership or "mine-ness" over certain objects in experience⁴. Both argue that the inclusion of objects into the self's ownership is related to feelings of satisfaction and desire; that, in a sense, you identify with things because you love them, and not the other way around (James 1983 [1890]: 304). The primary difference between James and Coleman here is that James includes a richer set of motivating emotions vis-a-vis self-related objects than Coleman⁵, who understands this relation as strictly dependent on the rational expectation of future reward.

The Jamesian and Colemanian accounts of the self have found support in psychological and sociological literature on the self (Belk 1988). Arthur and Elaine Aron's research program highlights the ways in which people in close relationships develop overlapping self-concepts (Aron et al. 2013; Aron, Aron, and Smollan 1992), as measured in experimental game behavior (Aron et al. 1991, 1997), and difficulty in disentangling self- and other-related stimuli (Aron and McLaughlin-Volpe 2001). There is also evidence that higher degrees of self-other overlap predict cooperation in social dilemmas (De Cremer and Stouten 2003). We also experience the pain of close others using the same neurological systems we use to experience our own pain (Cheng et al. 2010), and these neurological processes may be relevant to costly collective action (Zak and Barraza 2013).

This approach to theorizing the self with respect to prosociality is related to the concept of empathy. Multifaceted as it is (Maibom 2012), empathy has been a subject of inquiry for sociologists for over a century (Piliavin and Charng 1990; Ruiz-Junco 2017, 2021), and entails both a cognitive

4. Coleman (1990: 45) gives an example of a WWII veteran who purchases a small plot of land, but discovers that various rights to the land (to its minerals, to control over whether a road can be built through it) are not actually his. The land he used to own with pride now brings him less enjoyment, "because he's not sure what he owns."

5. "Although it is true that a part of our depression at the loss of possessions is due to our feeling that we must now go without certain goods that we expected the possessions to bring in their train, yet in every case there remains, over and above this, a sense of the shrinkage of our personality, a partial conversion of ourselves to nothingness, which is a psychological phenomenon by itself." (James 1983 [1890]: 281)

ability to take others' perspectives (Declerck and Bogaert 2008) and an affective connection to the outcomes of others (Davis and Love 2017). What is essential for our purposes is that empathy also entails some degree of self-other overlap on the neurological level (McCaffree 2020); our neurological systems respond to the activation of emotional and affective states observed in others with similar states in ourselves (Decety and Jackson 2006; Preston and Hofelich 2012; Riečanský et al 2020). This capacity for empathizing predicts altruistic motivation (Davis 2015) and cooperation in social dilemmas (Batson and Moran 1999).

The concept of empathy is amenable to the re-orientation described here for another reason: its locality in social life. Empathy is an affective relation between *particular* sets of persons. Empathy can entail harm towards persons that are outside the purview of one's empathic concern (Batson, Lishner, and Stocks 2015; Segovia Nieto and Ramírez Velandia 2019), and non-empathic motives can be more reliable predictors of helping behavior (Wilhelm and Bekkers 2010). Empathy can lead to expanding one's relational field to more dissimilar others (Baggio 2016), and it can just as easily reinforce us-and-them boundaries (Firat and Hitlin 2012). Respecting the limited and particularistic nature of empathy leaves us the task of studying how specific patterns of empathy manifest in society.

1.3.2 Embeddedness in a Structure of Relations

Given our tendency to entangle our selves and our interests with others, a productive way of explaining patterns of prosocial relations is by studying how those relations are embedded in other patterns of social relations. The potential in this approach can be seen in prosociality research that uses the logic of consequences. Even if consequentialism does not work as a *definition* of prosociality, it is useful as a heuristic that points us toward aspects of social situations that are relevant for behavior. If we model social agents as purposive in any sense, we are confronted by the fact that social life produces real conflicts of interest between agents, and that the structural features of social life

provide the strategic setting in which agents act⁶. This insight has inspired extensive and profound work on the the social structure in which agents are embedded⁷. One simple example comes from Hausken (1995), who demonstrates that it may be rational for a selfish agent to contribute to a public good if they are in a group which is competing against another group. Adding more groups and more layers of interaction further changes what is expected of rational agents (Wilson, Ostrom, and Cox 2013).

Even so, the relational approach I have outlined here is applicable beyond the framework of decision theory. Robert Braun's *Protectors of Pluralism* (2019), a study of the clandestine rescue of Jews in the Netherlands and Belgium during the Holocaust, is an excellent exemplar of this approach. When comparing the differences in rescue efforts between Protestants and Catholics, Braun finds that neither religious denomination nor location were enough to explain the different rates of rescue. Instead, he finds that Protestants in Catholic-dominated areas, and Catholics in Protestant-dominated areas, were the most likely to attempt and succeed at rescuing Jews from the Holocaust. In other words, members of Christian denominations that were a minority in their locale were the most likely to perform rescue efforts of Jews. Braun convincingly attributes this finding to two mechanisms. First, the small and dense networks that characterize minority religious groups afford the mutual trust and secrecy necessary to perform clandestine rescue operations. Second, and more important for this chapter, members of minority churches were more likely to have empathy for other minorities. In other words, the social position of minority denominations made it easier for those churches to extend their concern to other religious minorities.

Braun's account highlights the empathetic disposition of rescuers as a necessary (but not sufficient) condition for risking life and limb to rescue Jews, and how this disposition was facilitated by their own minority position in the social structure of the Low Countries. Neither Catholics

6. For example, if there is imperfect monitoring and information about others' actions, then cooperation may not even be likely in an iterated prisoner's dilemma (Bendor and Mookherjee 1987). For another example, payoff uncertainty can change the playing field of collective action in ways that are starkly counterintuitive, like public signals from revolutionaries *lessening* the likelihood of a revolt rather than increasing it (Shadmehr and Bernhardt 2011).

7. For example, see Harrell and Wolff (2023) for a recent study on how social structure interacts with information sharing capacity to shape norm enforcement and contributions to public goods.

nor Protestants were more likely to rescue, but Catholics surrounded by Protestants, and Protestants surrounded by Catholics, were more likely to rescue than those of any majority religion. The mechanisms for this that Braun elucidates are both structural: their structural position as minorities led to their cultivation of empathy towards other religious minorities (in their case, Jews), and their structural position as minorities also afforded them the secrecy and mutual trust necessary for clandestine rescue operations.

What may be the most attractive feature of this relational approach to prosociality, from a sociological point of view, is that attending to patterns of relations gives us a strong basis for appraising the strengths and limitations of theories of prosociality that originate from other social sciences. Consider the theory of social value orientations (SVO), one of the most widely accepted theories of social preferences. SVO theory posits that humans have a stable personality trait (their SVO) that determines how they weigh another's outcomes into their own utility (Au and Kwong 2004; Balliet, Parks, and Joireman 2009; Bogaert, Boone, and Declerck 2008). For example, it is thought that there is a "prosocial" SVO, a preference for maximizing joint gains and minimizing inequities in outcomes, as well as "individualist" and "competitor" SVOs. The promising psychometric and predictive properties of different SVO measures have led researchers to conclude that SVO is stable over time, across situations, and across possible interaction partners (Fernandes, Bakker, and Dijkstra 2022; Murphy and Ackermann 2014; Yamagishi et al. 2013).

Despite these empirical successes, there is counter-evidence to the view that SVO is a stable trait. It is hard to square the stability of SVO across situations and interaction partners with the observed differences in prosocial behavior across social divides such as race and ethnicity (Triplet 2012). In addition, one's position in a power-dependence structure may be able to reduce the effect of SVO on exchange outcomes (Lewis and Willer 2017), and the measurement of SVO can vary by whether a person is currently being primed with a vignette about a power position they hold (Cohen and Hertz 2020). This dissertation cannot adjudicate between these claims; it is enough for our purposes to point out that taking a close look at how the effect of SVO is mediated by patterns of social relations, especially those associated with social divisions and inequality, would be an

important and distinctly sociological contribution to research on prosociality.

1.3.3 The Logic of Appropriateness

We now have two elements: our tendency to invest ourselves and our interests in others, and the potential of structures of relations to prompt specific behaviors and sentiments from us. A useful way of framing how the structure of a situation affects our action is through what March (1994) would call a logic of appropriateness. The logic of appropriateness frames agents as making decisions by answering the following question: “what does a person like me do in a situation like this?” The three components at work here are the agent’s identity (“a person like me”), a recognition of the current situation (“in a situation like this”), and a behavioral rule that obtains when the two are co-present (“what...do”; Weber, Kopelman, and Messick 2004). When applied to prosociality, this approach seeks out features of situations, and subjective understandings of situations, that activate identities in ways that motivate prosocial behavior (Simpson 2006; Simpson and Macy 2004). These identities can be linked to groups that one belongs to (Aksoy 2015; Baldassarri and Grossman 2013), leading to behavior that maximizes in-group gains while minimizing in-group inequalities (Simpson 2006). Other more personal identities, such as one’s own moral self-image, can also promote prosocial behavior (Simpson, Harrell, and Willer 2013) or inhibit it (Frey and Oberholzer-Gee 1997; Mellström and Johannesson 2008; Simpson, Irwin, and Lawrence 2006).

The logic of appropriateness has two main strengths with respect to understanding prosociality. First, it easily explains why people engage in costly collective action, such as the Salvadoran insurgents studied by political scientist Elisabeth Jean Wood (2003). In that context, involvement in risky collective action was driven by moral commitments and identities rather than any plausible expectation of reward. The second main strength of the logic of appropriateness is its ability to explain framing effects. Experimental research has found that strategically irrelevant changes to how games are framed to experimental participants (for example, calling it a “community game” or “Wall Street game”) cause them to play in different ways (Liberman, Samuels, and Ross 2004). Perhaps the earliest demonstration of this came from Pruitt (1967) who constructed and imple-

mented a Decomposed Prisoner's Dilemma (DPD), a prisoner's dilemma (PD) where each player has a payoff table for how their actions will affect both them and the other person immediately after their individual action is taken, rather than with the joint outcome table usually seen for PD games. Pruitt's experimental subjects cooperated more when playing a DPD than a PD game, even when the games were algebraically identical in terms of payoffs.

The logic of appropriateness has two weaknesses in explaining the creation and patterning of prosocial relations. The first is that, on its own, it is a frame that explains norm-governed behavior in general, both behavior that we would consider prosocial and antisocial. Some identity-based norms actively prescribe antagonistic relations, or proscribe friendly relations, towards those who do not share one's identity, as one can see from research on parochial altruism (Bernhard, Fischbacher, and Fehr 2006; De Dreu, Balliet, and Halevy 2014; Romano et al. 2021) and the historical record of intergroup violence (racial, ethnic, national, religious, or otherwise). Indeed, we have observed cases in which agents will be sanctioned by their peers precisely because they are being more helpful than what is normative (Eriksson et al. 2014; Irwin and Horne 2013; Kitts 2006; Rand and Nowak 2011).

The second weakness of the logic of appropriateness is that multiple norms can govern the same situation, and sometimes these norms conflict (Cowan et al 2022). This is apparent in classic work on role conflicts, situations where the norms that come from the multiple roles a person holds can be contradictory (Montgomery 2007; Stryker and Macke 1978). The most clear use of the logic of appropriateness requires an agent that has, in mathematical terms, a function that maps situations to actions, i.e. when a given person has, for every situation, exactly one prescribed response. If a situation activates an identity that demands more than one course of action, or if an agent has multiple situation-relevant identities that demand different courses of action, then the norm-following agent cannot determine what course she will take. There is an inherent difficulty in explaining prosociality on the basis of inconsistent prosociality norms.

While it is difficult to specify, in the abstract, what aspects of situations strike agents as salient for their identity, research on this issue continues to develop (Mifune 2022; Schulz 2016). We

continue to find evidence that how agents perceive their interdependencies with other agents plays a strong role in how they behave in situations (Columbus, Munich, and Gerpott 2020; Gerpott, Thielmann, and Balliet 2021; Waldfogel, Dittman, and Birnbaum 2024). These interdependencies are usually framed in terms of explicit payoffs (Kelley et al 2003), but research that studies scenarios that lack explicit payoffs would be a wonderful contribution to the logic of appropriateness approach. The answer may be found, as Mische and White (1998) argue, in the tumult of switches between meaningful signals that compose the fields of interaction we live in.

1.4 The Following Chapters

The purpose of this chapter has been to analyze the concept of prosociality and to introduce the themes that will be explored in the chapters of this dissertation. This dissertation is a small contribution to the goal of increasing our understanding of how prosocial relations are patterned, and how those patterns might change over time. In particular, this dissertation focuses on the relationship between *economic* behavior and prosocial relations⁸. Each chapter pushes this agenda forward, each using a different method. Many of the threads that I have proposed in this chapter are not pursued here; the full fleshing out of this perspective must be left to future work.

1.4.1 Chapter 2

In the second chapter, I use cross-sectional egocentric network data collected from 75 villages in Karnataka, a southwestern state of India, collected from a team of economists in 2006. The network questionnaire asked villagers to name up to 8 other villagers with whom they had a variety of relations, such as visiting, advice giving, and friendship. The data include a rich set of demographic covariates, including caste identification, and household- and individual-level economic

8. The relational account of prosociality I have outlined in this introductory chapter is not limited to the economy; we can ask similar questions about every institution that is of interest to sociologists. For example, George Herbert Mead (1934: 286-292) thought that participating in the democratic political processes teaches citizens to understand each other and take the role of a Generalized Other, in a similar way that (he thought) economic exchange teaches participants to take each other's roles by understanding their needs.

information. This dataset gave me an opportunity to look at the relationship between bank account ownership, a key indicator of trust and participation in the market economy, and patterns of intra- and inter-group tie formation, in a setting where there is high variance on bank account ownership (in the average village, only 40% of sampled villagers had a bank account). By fitting log-linear models to the directed network data, I find important relationships between bank account ownership and whether ties such as lending and socializing take place across caste boundaries, contributing to our understanding of how economic context interacts with patterns of social relations, particularly those that cross group boundaries. The chapter pushes forward the agenda I have set out in this introduction by attending to the relationship between economic context and the likelihood that relations will cross salient group boundaries.

1.4.2 Chapter 3

The second chapter sets up the study in the third chapter. When considering the relationship between economic relations and trust relations, it is imperative that we understand the mechanisms that underly the relationship between economic position and trust or positive intergroup relations. Does the experience of successful exchange with one person lead to a generalized expectation that others are reliable, or does successful exchange with one person only lead to increased trust in that particular person? How does variation in the form of exchange change this relationship? The study in this chapter compares two different forms of direct (i.e. dyadic) social exchange, negotiated and reciprocal exchange, and assesses their potential in producing cooperation towards people outside of the exchange dyad. In negotiated exchange, two agents engage in a joint decision-making process on the terms of the exchange, and resources only change hands if the participants mutually agree to the terms; reciprocal exchange is a form of direct exchange where agents unilaterally decide whether to give some resource to their partner, and in what amount.

To test which form of exchange better produces extra-dyadic cooperation, I have designed and implemented a study where respondents recruited on Prolific, a crowdsourcing platform for research participants, are randomly paired against each other, engage in multiple rounds of either

reciprocal or negotiated exchange for real money, followed by questionnaire asking them to rate their feelings of trust in, affective regard toward, and solidarity with their exchange partner on a 7-point Likert scale. After this, participants were matched with a new partner and played a one-shot prisoner's dilemma, an experimental game where players have the opportunity to cooperate and maximize their mutual benefit, despite the incentive to maximize their own individual gains at the expense of their partner, i.e. to defect in the game. The results of the experiment will shed light on which form of exchange more reliably produces cooperation outside of a previous exchange context, and how the differences in measured trust, affective regard, and solidarity mediate the effect of the exchange types in producing cooperation in a new context.

1.4.3 Chapter 4

I devote the fourth chapter to analysis of a mathematical model of other-regarding preferences, a model in which agents take interest in each other's outcomes when faced with a situation of strategic interdependence. Whereas the prior two chapters assessed the effect of economic behavior and context on cooperation, this chapter analyzes the relationship between these from the opposite direction, deriving conclusions from a model for how other-regarding or prosocial preferences can shift the strategic landscape of behavior and transform an economic situation from one affording conflict to one affording cooperation, and vice versa. I begin from a model of other-regarding preferences where each agent has a finite amount of concern they can place on the outcomes of other agents. For example, an agent can place all of her concern on her own outcomes, only caring about how much she gains from a situation, or an agent can place an equal amount of concern for the outcomes of herself and everyone else in the group, or any other allocation of her concern. The concern that agents allocate to each other can be represented as a number between 0 and 1, and, because that concern is finite, the ways that agents allocate their concern can be represented as a weighted graph, corresponding to a matrix W where each row sums to 1. Where this model becomes interesting from a sociological perspective is that, given their initial allocations of concern, agents act according to their transitively-implied concern as far as possible (i.e. if I value person A some

amount, and person A values person B some amount, then I must also value person B some amount; and if person B values person C some amount, I must then value person C some amount as well).

With this model we can ask, given an initial distribution of concern between agents in a group, will the agents come to a stable consensus on how much to value each other agent, and what will that consensus be? This is the same thing, in mathematical terms, as asking whether the limit of W^k , as k approaches infinity, exists, and what that limit will be. While the mathematical conditions for the existence of the limit and its closed form solution are known, my innovation in this chapter is to show how structural properties of the weight matrix tell us something more specific about the equilibrium distribution of concern. For example, matrices representing partial orders, hierarchical structures where concern only goes *up* the hierarchy, lead to a distribution of concern where everyone places all their weight on the highest ranked members; and symmetric matrices, structures where each pair of agents hold an equal amount of concern to each other, lead to egalitarian distributions of concern where everyone weighs everyone's outcomes equally, generalizing the mutual concern from each dyad into the group as a whole.

We can apply these equilibrium weights to social dilemmas. For example, it can be proven that, under a symmetric weight matrix in equilibrium, the dominant strategy for agents in a prisoner's dilemma switches from defection to cooperation. For another example, it can be proven that under a partially ordered weight matrix with one highest ranked member, the linear public goods game, a setting where the dominant strategy from a selfish point of view is to contribute nothing to the public good while reaping its benefits, switches to a setting where the dominant strategy for agents is to put all their personal resources into the public good, with the exception of highest ranked member who contributes nothing while still gaining from the public good. In other words, we find that symmetric or mutual relations tend to produce egalitarian distributions of concern, whereas hierarchical relations tend to produce inequitable distributions of concern, a mathematical finding that is ripe for future empirical research. Importantly, this model gives us some indication of how structures of other-regarding preferences can transform economic situations in ways that afford mutual benefit or mutual betrayal, and a wide range of outcomes in between.

CHAPTER 2

MARKET INTEGRATION AND INTERGROUP RELATIONS: EVIDENCE FROM KARNATAKA, INDIA

2.1 Introduction

Sociologists are concerned with the relationship between the economic organization of a society and its moral order, i.e. between the social processes that govern the allocation of material resources (Swedberg 2003) and those that define what is good, legitimate, or appropriate behavior (Fourcade and Healy 2007: 301). One important aspect of this relationship is how economic relations shape relations between social groups, a pressing concern in increasingly diverse societies (Baldassarri and Abascal 2020). One of the primary ways that societies have varied in their economic organization is in the degree to which actors are constrained in their exchanges with particular classes of others. Classic work in economic sociology and anthropology highlights how forms of economic exchange shaped intergroup relations in pre-industrial societies (Mauss 1923). In more recent times, scholars have debated how the historical transition from the fixed patterns of economic exchange described in those classic works, to the dynamic patterns of economic exchange described by theorists of global capitalism (Robinson 2012), affects moral conceptions of intergroup relations.

This distinction in modes of economic organization parallels Tönnies' ([1887] 2001) distinction between societies based on *Gemeinschaft* and *Gesellschaft*, the former being based in affective bonds between similar people grounded in a shared context (e.g. kinship, shared history) and the latter being based in expectations of mutual utility among dissimilar people considered as abstracted individuals (e.g. commercial contracts). While Tönnies thought that all societies contained elements of each, his work traces how *Gemeinschaft* systems were eroded by the expansion of civil society (i.e. market society), which relies on *Gesellschaft* to function on a broad scale. Although this process leads to disintegration at the level of social groups, as Marx and Engels famously argued (1978: 476), we can also view this process as a form of *integration* at the level of individuals, where individuals are increasingly linked to and dependent on increasingly globalized and inter-

connected markets for their livelihood (Robinson 2012). There is an interdisciplinary literature on the effect of market integration on intergroup relations suggesting that individually integrating into the more dynamic economic structures characteristic of the global market economy produces a disposition that is open to intergroup cooperation, due to the necessity of developing norms that promote mutually beneficial exchanges with strangers (Hruschka and Henrich 2015). In contrast, there is a pessimistic literature that suggests that integration into the global market economy can exacerbate the salience of group boundaries and intergroup competition (Kaya and Karakoç 2012).

This chapter contributes to the widespread and longstanding debates on the moral effects of an economic organization dominated by market competition (Ergen and Kohl 2022) by analyzing one way in which market integration is associated with intergroup relations. To do this, we study an empirical case with heterogeneity in individual-level market integration, and a moral order that makes intergroup relations unlikely. In particular, we analyze data from villages in Karnataka, a state in southwestern India, a setting with high variance in bank account ownership and strong informal restrictions on inter-caste socialization. We examine the network, demographic, and economic factors that predict the presence of social ties that cross caste boundaries. For ties in general, and ties representing the lending of economic resources in particular, we test whether the bank account ownership of ego (the villager reporting the tie) and alter (the villager that is reported by ego) is associated with their out-degree (the number of ties that a villager sends to other villagers). We also use choice models to ascertain what characteristics of alter, and the ego-alter dyad, predict whether ego reports a tie to alter. Finally, we use log-linear models to compare how money-based ties and ties based in the exchange of material goods vary in their likelihood of crossing caste boundaries, differentiating the role of money and other economic goods in overcoming the boundaries to inter-caste relations. Overall, we find that the evidence is consistent with viewing market integration (via bank account ownership) as facilitating intergroup trust and connections.

2.2 Economic Organization, Moral Order, and Trust

Defining the boundaries between groups is an important aspect of a society's moral order (Firat and Hitlin 2012). Scholarship in sociology and anthropology attests to the deep interconnection between a society's morality with the society's economic organization (Sachweh and Hilmar 2020). Classic work in economic anthropology suggests that ritual gift exchange between corporate groups (e.g. families, clans) was a dominant aspect of pre-capitalist economic organization (Bell 1991). In these between-group exchanges, representatives of each group would usually exchange resources according to scripted rituals¹, where every exchange participant had their fixed interaction partner in the exchange, rather than in a decentralized, ad-hoc fashion (Malinowski 1932: 25; Sahlins [1972] 2017). In the terms of social exchange theory (Emerson 1976), what characterizes the economic organization of these societies is a set of *commitment relations*, stable and continuing exchange relationships that emerge as a response to the uncertainty of intergroup exchange. This method of organizing economic exchange is based on what Polanyi ([1957] 1992) called "reciprocity", in contrast to our current global capitalist economy, which is based on what he would call "exchange". Reciprocity-based economic organization, in Polanyi's view, requires stable relationships between groups (usually kin groups), whereas exchange-based organization requires a market with a price system and allows goods and services to circulate among a shifting set of persons, facilitated by currency that is (in principle, but never quite in reality) perfectly fungible (Carruthers 2010; Simmel [1978] 2004).

All forms of economic organization are undergirded by moral orders (Boltanski and Thévenot 2006), but the moral orders of these forms qualitatively differ from each other. For example, in reciprocity-based economic organization, violation of the expectations that come with established commitment relations are sanctioned against heavily (Gurven 2004), which of course does not produce perfect compliance with those expectations (Berman 2020). In exchange-based economic

1. Even in modern capitalist economies, scripted rituals are part of the process whereby arm's-length business ties become closer, more friendly business ties (Montgomery 1998; Uzzi 1996). Even so, there is a qualitative difference between the centrality of such rituals in market-dominated economic organization and in other kinds of economic organization.

organization the ever-present risk of creditors defaulting on loans has prompted strategies for assessing the trustworthiness of creditors, a process that relies on moralization (Polillo 2011). In both cases, the form of economic organization requires strategies for managing the uncertainty that comes with social and economic relations between groups, and this uncertainty management depends on a moral order that determines who it is appropriate to trust (Zucker 1986).

Although the concept of trust is used and measured in many different ways (McEvily and Tortorello 2011; Mizrahi, Drori, and Anspach 2007), we focus here on the sort of trust that involves expectations that the trustee (the one who is trusted) will act in a way that is beneficial to the trustor (the one who trusts; Cook, Hardin, and Levi 2005). We can view trust as having a *range*, extending from classes of persons that are near to the trustor in social space to classes of persons that are far (where we imagine this extension traversing an interpersonal “distance” represented by concentric circles, with the trustor in the middle, close friends and family at the next smallest layer, and so on; Sztompka 1999)², and this range is related to the kinds of uncertainties that a society faces. The fixed economic ties described by economic anthropologists were a response to the uncertainty and risk of interacting with strangers (Inglehart 2018), a strategy that we observe in the modern economy both descriptively (Kollock 1994) and experimentally (Carrarini and Mengel 2016). The benefit of commitment relations is that monitoring and sanctioning misbehavior is relatively easier³; the downsides are that they can have steep opportunity costs from leaving other potential relationships aside (Yamagishi, Cook, and Watabe 1998; Yamagishi 2011), and the habits of cooperation and trust that are learned in commitment relations do not reliably generalize to new interaction partners (Burt, Opper and Holm 2022; Ermisch et al. 2023). We will see that there are

2. One way of understanding the range of trust is to distinguish between particularized and generalized trust. While sensible as a first approximation, sociologists have been correct to point out the ambiguity of this distinction and highlight their continuity (Glanville and Paxton 2007; Paxton and Glanville 2015; Schilke, Reimann, and Cook 2021). Knowing that trust is “particularized” does not tell us *which* class of particular persons it applies to (Robbins 2023), and knowing that trust is “generalized” does not tell us how far this generalization extends (Delhey, Newton, and Welzel 2011; van Hoorn 2014).

3. Malfeasance can still take place in commitment relations, both because a close tie can fail to be embedded in other ties that allow sanctioning (Finlay and Coverdill 2000), and because actors may find it difficult to sanction their close ties (Flache and Macy 1996). To make matters worse, the trust engendered by personal relations can *increase* the opportunity for malfeasance by exploiting the goodwill generated from such relations (Granovetter 1985; Shulman and Grayson 2023).

parallels in how modes of economic organization handle uncertainty (e.g. through dependence on commitment relations) and how moral orders adapt to uncertainty.

2.3 Morality and Responses To Uncertainty

One side of the relationship between economy and morality is the well-studied role of moral orders in undergirding economic orders, but we should consider the other side of this relationship: the role of the economic order in driving changes in the moral order. This possibility should be especially salient for aspects of the moral order that govern our feelings of trust and trustworthiness, given the evidence that our extension of trust can be modified by our experiences of economic exchange (Harkness et al. 2022; Nee, Holm, and Oppen 2018). From this we can infer that economic experiences can afford a transformation in moral judgements that make intergroup relations easier, and that the economic structures of a society will tell us something about how that society sets the quality and likelihood of intergroup interaction. For example, in Banfield's (1958) classic work on southern Italian peasants, he characterized their political culture as "amoral familism": everyone would work to support the immediate material advantage of their own family, and assumed that all others would do the same. All outsiders, including friends and neighbors, were seen as "not only potentially costly but potentially dangerous as well" (Banfield 1958: 115). These moralized group boundaries were related to the structure of economic relations in that context. The peasantry were largely in the position of tenant farmers whose surplus was extracted by absentee landlords, leading to a fundamental conception of economic and political relations as jointly based on the model of robbery. Other societies whose economic relations are based on patron-client pyramids have similar dynamics: they pit the clients of one patron against the clients of another, and they restrict economic exchange between clients and patrons (Bloch 2014; Bokanga, Rohr, and Martin 2025).

In contrast, Scottish enlightenment figures may have been correct in supposing that the dominance of markets sharply delineates friendship from self-interest (Silver 1990), allowing friendly relations to cross previously salient group boundaries. This idea is related to the *market integration thesis*, the hypothesis that interaction with, and daily dependence on markets induces a morally

universalistic and cooperative disposition that applies across situations and potential interaction partners (Agneman and Chevrot-Bianco 2023; Baldassarri 2020). The market integration thesis is a continuation of the historical *doux commerce* thesis (meaning “sweet commerce” or “gentle commerce”), a belief that emerged in early modern Europe. The thesis held that markets were a powerful civilizing agent, habituating people into being honest, cooperative, and kind (Hirschman 1982). Montesquieu (1748) was a famous proponent of this, arguing that commerce would align the interests of different nations and their mutually suspicious citizens.

Some classical sociological theorists were sanguine about the ability of commerce to produce the positive effects Montesquieu claimed. Simmel (1964), for example, argued that market competition attunes people to the needs of others, because making a better offer to third parties helps you defeat your competitors. Another interesting sociological argument for *doux commerce* comes from George Herbert Mead (1934), who argued that in commerce we train our ability to take the role of the other⁴, and that we eventually generalize this role-taking in a way that facilitates cooperation on a broader scale. The market integration and *doux commerce* theses are in agreement with research showing that sustained and mutually beneficial cooperation with dissimilar others will reduce outgroup discrimination and prejudice (Pettigrew and Tropp 2006). They are also consistent with work on trust and solidarity in contemporary and historical South Asia (Jha 2013; Sanyal 2009).

On the other hand, there is evidence suggesting that the transitory and voluntaristic forms of exchange characteristic of a market economy can undermine non-economic social relations, interpersonal trust, and cooperation. This evidence is compatible with what Zelizer (1988) calls the “boundless market” model. Marx is arguably the most famous proponent of this understanding, arguing that the dilution of all relations into the “cash nexus” would reduce all relations to those of self-interest and financial calculation ([1844] 1988: 211). This critique was sustained by Polanyi (2001 [1944]) in his study of liberalizing market reforms and their effect on English society, and

4. Mead argued that in commerce we observe that, for example, we value an item A less than we value another person’s item B, and also observe that the reverse is true for the other person.

became the basis for his theory of the double movement of marketization and resistance against marketization. These scholars point to cases where market competition incentivizes untrustworthy behavior (Shleifer 2004), and argue that the benefits of market competition depend on a moral order that market competition cannot provide on its own (Etzioni 1985).

Recent research in this area finds associations between market integration, selfishness, and rationalistic cost-benefit thinking about social relations and moral questions (Cao 2024). This can be a problem for a moral order with low barriers to intergroup interaction, due to the risk that a selfish rational actor will exploit the uncertainty of such interactions to procure gains at the other's expense (Yan 2009). There is also the persistent risk that in an unequal market economy, generalized trust and prosocial attitudes diminish in those occupying marginal economic positions (Gallego 2016; Kevins 2019; Polillo 2012). Finally, in the Indian context, market integration may have no effect one way or another on the salience of inter-group boundaries, specifically inter-caste boundaries. India has already undergone profound economic and political changes in the last century, yet caste remains an indelible feature of social life (Ikegame 2013; Jodhka 2016). Perhaps we should expect caste boundaries to remain robust to the changing prospects and pitfalls of leaving established commitment relations.

To summarize, scholars agree that there is a relationship between a society's economic organization and its moral boundaries around intergroup relations. Scholars also agree that the global market economy, as a mode of economic organization, is related to trust, and therefore to how people moralize intergroup relations. Even so, there is disagreement over whether this relationship facilitates intergroup relations by providing opportunities to develop a more generalized trust, whether it makes intergroup relations more fraught by exacerbating intergroup competition, and under what conditions one, both, or neither of these effects takes place. There are many ways to address these questions, and this analysis can only focus on one aspect of economic organization and intergroup relations. This chapter focuses on the context of villages in Karnataka, India, at a time where there was high individual-level variation on one aspect of market integration, and where caste boundaries on interaction remain a significant aspect of the moral order.

2.4 Data and Methods

2.4.1 *The Context: Karnataka*

To address one aspect of the debates discussed above, we study a context in which there is variation in market integration and a moral order that places barriers on intergroup interactions. Studying these phenomena in the so-called WEIRD countries (Western, Educated, Industrialized, Rich, and Democratic, to quote Henrich, Heine, and Norenzayan 2010) is difficult, because most people are at the ceiling of market integration, making it difficult to compare individuals along that dimension. To avoid this difficulty, we use survey and network data collected from 75 villages spread across 5 districts in Karnataka, a state on the southwest coast of India (see Figure 2.1 for a map of India with Karnataka highlighted). These data were originally collected by the economist Abhijit Banerjee and his colleagues (2013). The 75 villages were not chosen by the original team, but by Bharatha Swamukti Samsthe (BSS), a microfinance company that was planning to roll out their microfinance program in those 75 villages. In 2006, six months prior to BSS's program implementation, the authors administered a village questionnaire to gauge the presence of pre-existing village leadership, NGOs, and savings self-help groups (SHGs); and a baseline survey of every household in all 75 of the villages (about 200 households per village). The baseline survey collected demographic information (religion of the household head and caste of the house); GPS coordinates (censored in the published data); household amenities like roofing material, electricity and plumbing access, and number of rooms; and ownership/renting status of the house.

The data on interpersonal relations were collected in a follow-up survey given to a random subsample of households that had a woman between the ages of 18 and 50 living there, stratified by geography and household head's religion. Individuals in those houses were asked various questions about social relationships, demographics, language, work history, and other matters. The individual survey given to about 46% of households per village. In each household, the survey was completed by the head of the household, his/her spouse, other adult women aged 18-50, and spouses of these women if available. For non-Hindu (i.e. Christian or Muslim) households, all households were

selected when the group was only a small fraction of the village.



Figure 2.1: A map of India with Karnataka highlighted, borrowed from Kaup et al (2017) under the Creative Commons Attribution License.

2.4.2 *The Variables*

2.4.2.1 Dependent Variables

The outcomes we are concerned with in this chapter are social relations and whether they cross caste boundaries, so we now describe the network and caste data. The individual survey asked respondents to name, for each the following relationships, up to eight people *in the same village* with whom they have that relationship: visiting the respondents' home, hosting the respondent in *their* home, kin in the village, non-relatives with whom the respondent socializes, receiving medical advice, borrowing and lending money, borrowing and lending kerosene and/or rice, getting advice, giving advice, and going to pray with at the same temple/church/mosque. This produces directed graphs for 10 different kinds of relationships for each village. The fixed-choice design of the survey (8 alters could be named at the most) leaves the possibility of missing some relationships, but it

was very rare for respondents to use all eight of their nominations.⁵

This study focuses on three relations: what we call a “social tie”, the union of all of the relation types (i.e. respondent has a “social tie” with another villager if the respondent names that villager in *any* of the 12 relations); the *lend money* relation, in which respondents were asked “*who do you trust enough that if he/she needed to borrow [50 rupees] for a day you would lend it to him/her?*”; and the *lend kerosene/rice* relation, in which respondents were asked “*Who would come to you if he/she needed to borrow kerosene or rice?*” We focus on social ties to assess villagers’ tendencies to report a variety of relations with other villagers, and we focus on the money and kerosene/rice ties to compare lending relations with two different kinds of resource.⁶ It is important to note that 50 rupees at this time was roughly a third of the daily per capita income (Jackson, Rodriguez-Barraquer, and Tan 2012), making 50 rupees a non-trivial amount of money to trust someone with.

The data on caste (also known as “jati”) were elicited by an open-response question, organized by the original research team into 50 castes, which we collapsed into 46.⁷ Caste determines who a person can marry (endogamy is prescribed), who one can share food with, and, in general, regulates social and political life in India (Dumpala 2022; Ingole 2019, 2021). There are prohibitions against higher castes and lower castes eating in the same homes, eating with the same plates and utensils, shaking hands, and other basic forms of social interaction (Maruthi and Peter 2018). Alongside these prohibitions, there are long-standing prescribed forms of interaction between castes. Castes operate by very local logics of interdependence, at the level of one or a few linked villages. Historically, this interdependence was based on very fine-grained occupational differentiation, though this differentiation has lessened over time (Gang, Sen, and Yun 2017). This historical interdependence should not be mistaken for harmony; it was, and currently is, common for different factions of upper caste patrons and lower caste clients to compete for economic resources and political power

5. Only two villagers used all eight of their nominations. In both cases it was only for the naming of non-relatives with whom the villager socializes.

6. Although the wording of the lending money question and the lending kerosene/rice question differ somewhat (“*who do you trust enough that...*” versus “*who would come to you if...*”), it is not clear to us how this difference would lead to bias in our results.

7. We thank Naveen Bharati for informing us on which castes could be grouped together.

(Sana 1993). Some villagers reported religions like “Muslim” or “Roman Catholic” as their caste, perhaps indicating that they perceive their group identity as based on a religious community that is outside of the Hindu caste system. Even so, some of the more important rules of caste, such as marriage endogamy and restrictions on social interaction, still apply both within and between religions in this setting (Sana 1993; Sobin and Shrinidhi 2017).

A villager’s caste fits into one of four official categories: Scheduled Caste, Scheduled Tribe, Other Backwards Class (OBC), and General (see Figure 2.2 for the distribution of villagers in these categories). These categories were created by the Indian government for the purpose of determining welfare allocations. Scheduled Castes are castes that were historically disadvantaged due to their low position in the caste hierarchy (e.g. dalit castes). Scheduled Tribes are tribes that were and still remain outside of the mainstream Hindu social order, and are economically and socially disadvantaged (Kumar 2005). OBCs are other castes that are neither Scheduled Caste nor Scheduled Tribe, but still receive aid from the government. “General” is the category for castes that do not receive any caste-based welfare, and contain many of the higher castes such as the brahmin castes. These caste categories will be called “government categories”, or *GCs* for short, to distinguish them from specific castes.

For our analyses, we nest the 46 castes into their respective GCs (see Figure 2.3 for the distribution of villagers in the castes, Figure 2.4 for an example of the nesting of castes into GCs, and Appendix A for details on nesting castes into GCs). GC determines both welfare from the government and spatial position within the village, as there is a high degree of caste-based segregation (Singh, Vithayathil, and Pradhan 2019; see Figure 2.5 for an example). This follows a pattern observed in other empirical settings: moral orders often correspond to spatial boundaries and other features of the material environment that inhibit interaction (Tavory 2016).

Not surprisingly, caste is an important social cleavage in this context (Ingole 2019). Village networks are characterized by strong caste homophily⁸, and this homophily is stronger among higher

8. Consistent with prior literature on rural India, there is a high degree of GC and caste homophily in the reported ties, most taking place within GC and caste. See the heat maps in Appendix B1 for visual evidence of caste homophily in these data.

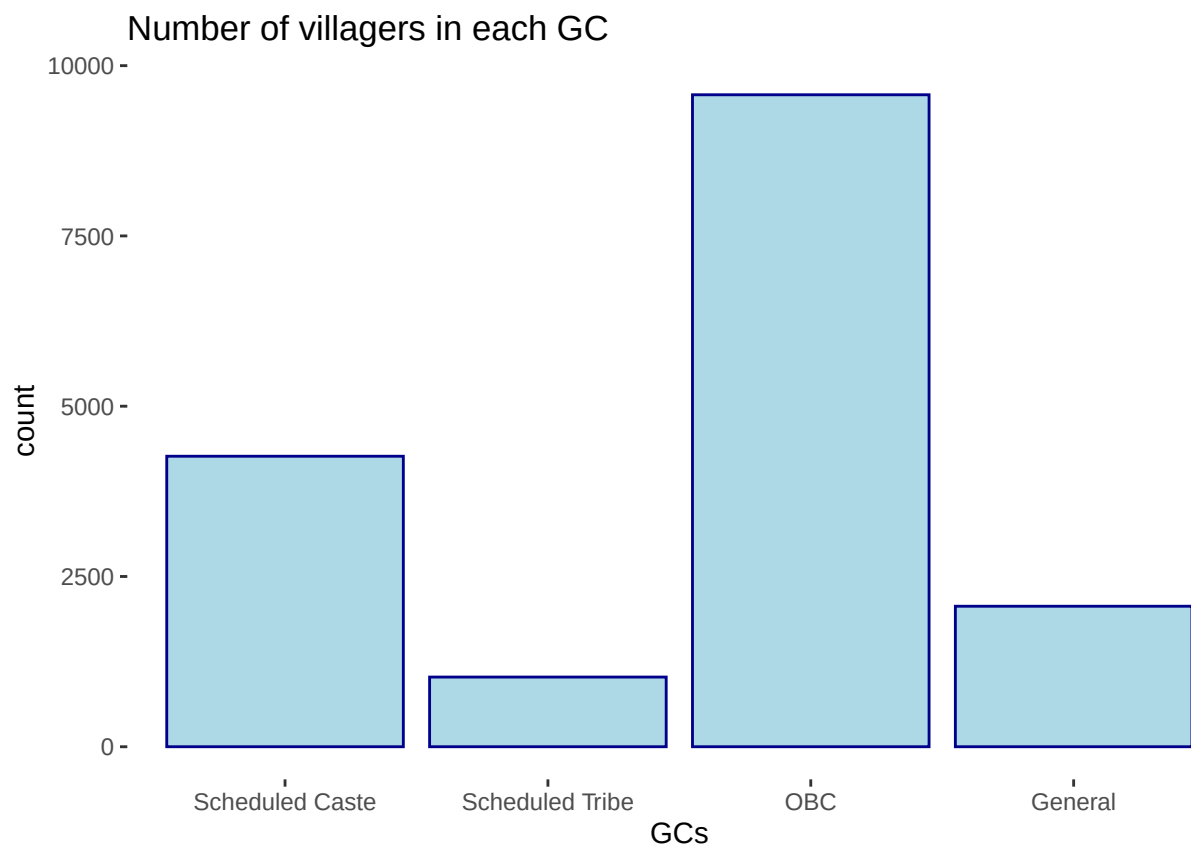


Figure 2.2: The distribution of villagers in the government categories (GCs)

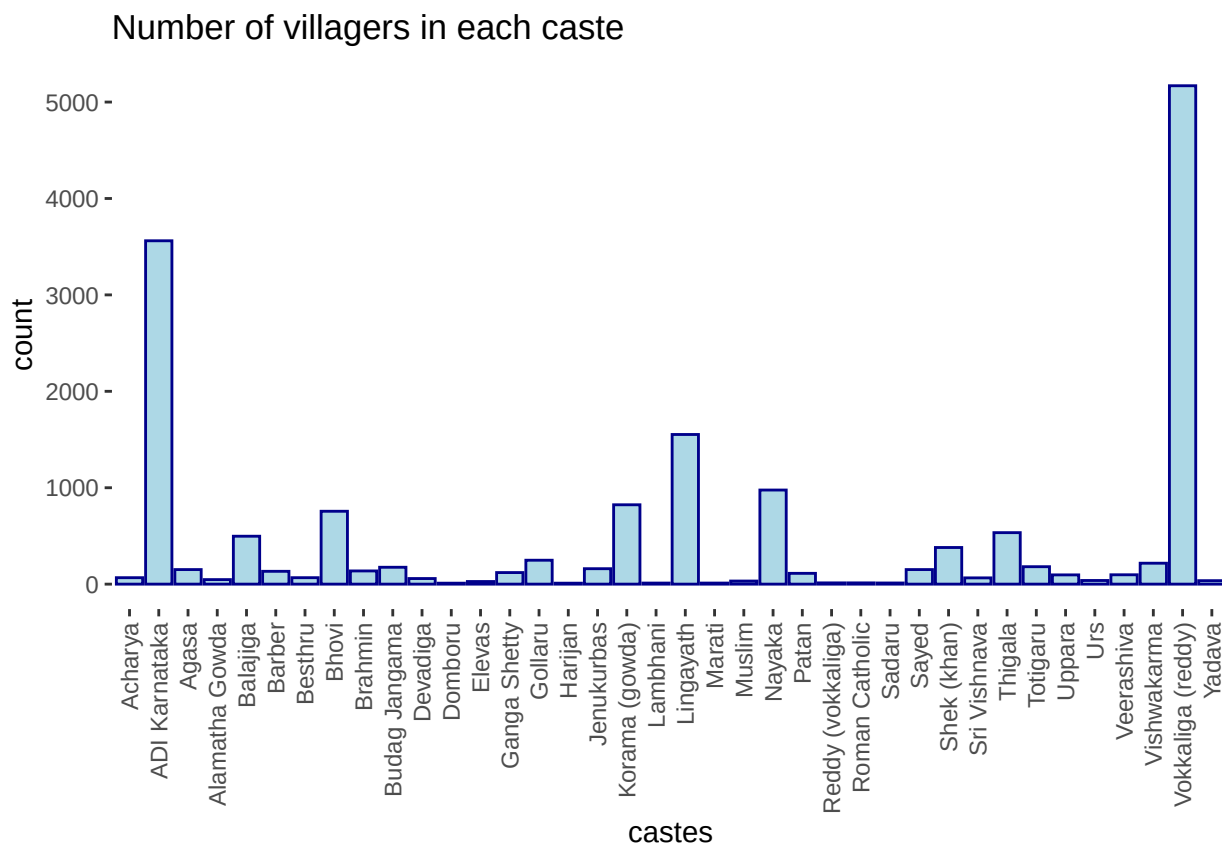


Figure 2.3: The distribution of villagers in castes

Government Categories	Castes
Scheduled Caste	Adi Karnataka
	Bhovi
Scheduled Tribe	Nayaka
	Valmiki
Other Backwards Class	Kuruba
	Balajiga
General	Brahman
	Vishwakarma

Figure 2.4: Nesting of a sample of castes into their GCs

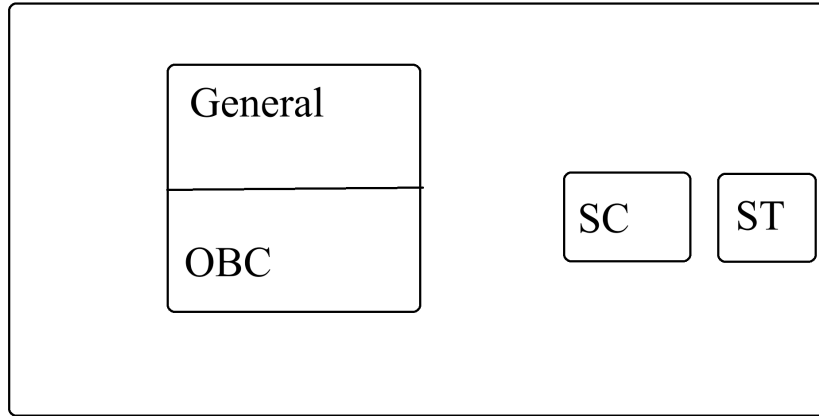


Figure 2.5: Geographic diagram of a village, and which GCs reside in which parts of the village (SC = Scheduled Caste; ST = Scheduled Tribe; OBC = Other Backwards Caste). We thank Shriram Venkatraman for providing us with this example diagram

castes (Davidson 2018). Caste is the strongest determinant of dyad- and community-level assortativity, as well as assignment to (algorithmically obtained) communities (Montes, Jimenez, and Onnela 2018). These features of the Indian caste system as a moral order, one that heavily influences social interaction between castes (Cheruvalath 2016), make these data a good place to study the relationship between the market integration and intergroup relations. Our dependent variables will include whether a villager from one caste or GC reports a tie to another caste or GC. All cross-caste ties in these models are ties where ego and alter are in different castes, *but within the same GC*, in order to distinguish between cross-GC ties (because all ties between villagers in different GCs are necessarily cross-caste ties as well).

2.4.2.2 Independent Variable

Our theoretically central independent variable is bank account ownership. Over time, more people in India are holding their money in private savings accounts, in part due to the growing working age population (Jain and Goli 2022). Between 2011 and 2014, bank account ownership in India in-

creased from 35% to 53%, and the increase was seen across age, gender, and socioeconomic groups (Demirgüç-Kunt et al. 2015). Figure 2.6 shows the variation across villages in the percentage of villagers with bank accounts. Bank account ownership is an indicator of one's integration in formal financial institutions, and such integration is not a given; important sociological work has documented the process of debate and interpersonal influence that determines engagement with these institutions (Doering and McNeill 2020). Indeed, many villagers in our data have *not* opened a bank account. Despite large-scale programs to promote bank savings, like the microfinance program that originally motivated the original data collection efforts, informal saving methods (e.g. accumulating gold) continue to persist in rural south India (Goedecke et al. 2018). For these reasons, we are treating bank account ownership as a plausible and theoretically justified, though imperfect, indicator of market integration.

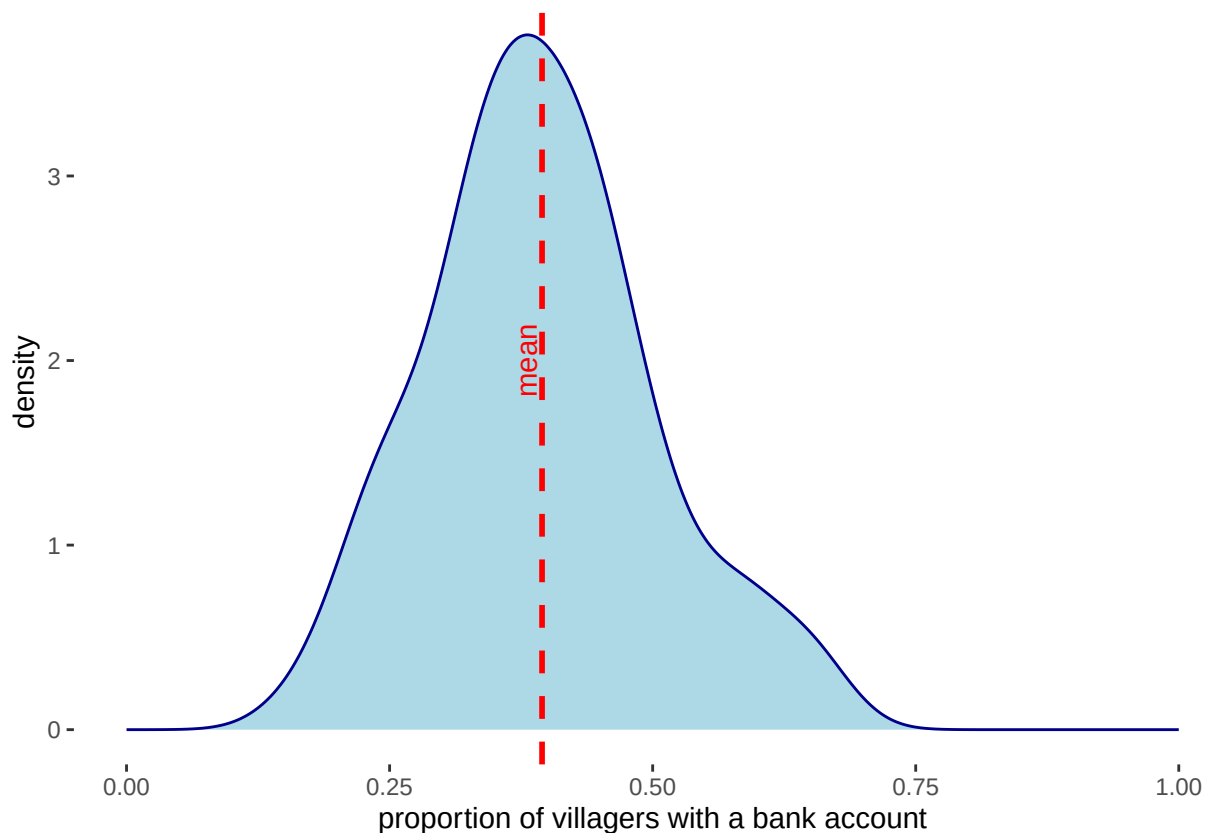


Figure 2.6: The distribution of villagers in terms of their bank account prevalence

2.4.2.3 Control Variables

We use the reported roof quality of the respondent's household to separate the effect of economic standing from market integration (which we measure with bank account ownership). While income is a commonly used measure of socioeconomic status, many villagers in this context have very inconsistent employment (Inglis 2018), making an income question at a snapshot in time a very poor measure of economic standing. For this reason, the survey did not include an income question. Roof quality serves as a plausible control for household-level wealth, providing evidence that the effects of bank account ownership are not solely attributable to wealth.

We observe that higher ranked castes tend to have higher quality roofs, which helps assure us that this is a plausible control variable (see Appendix B2). There are six roof material categories in these data: thatch, tile, stone, sheet metal, reinforced cement concrete (RCC), and "Other" (an open-response category consisting mostly of options that are at least as cheap and low quality as thatch). Thatch and "Other" are the cheapest and RCC is the most expensive, with the other three (tile, stone, and sheet) being in the middle. Across villages, most villagers have roofs made of tile, stone, or sheet, indicating an intermediate level of household wealth. The six roof materials were grouped together into a 3-point scale, with thatch and other at level 1; tile, stone, and sheet at level 2; and RCC at level 3.

We also control for recent work status, a binary variable for whether the respondent worked in the last week, as a control variable. This variable acts as a short-term measure of intergroup exposure and market integration, allowing us to control for the opportunity for recent, transitory encounters. The distribution of roof quality in these villages can be seen in Figure 2.7, and the distribution of recent work status can be seen in Figure 2.8. By including all of these economic variables in the model, all of which are correlated with each other, we are, in effect, *over-controlling* for market integration, thereby subjecting the role of the bank account variable to a more conservative test.

We also control for three demographic variables: gender, age, and education. Women in rural southern India have limited opportunities for informal interaction with people outside their kin

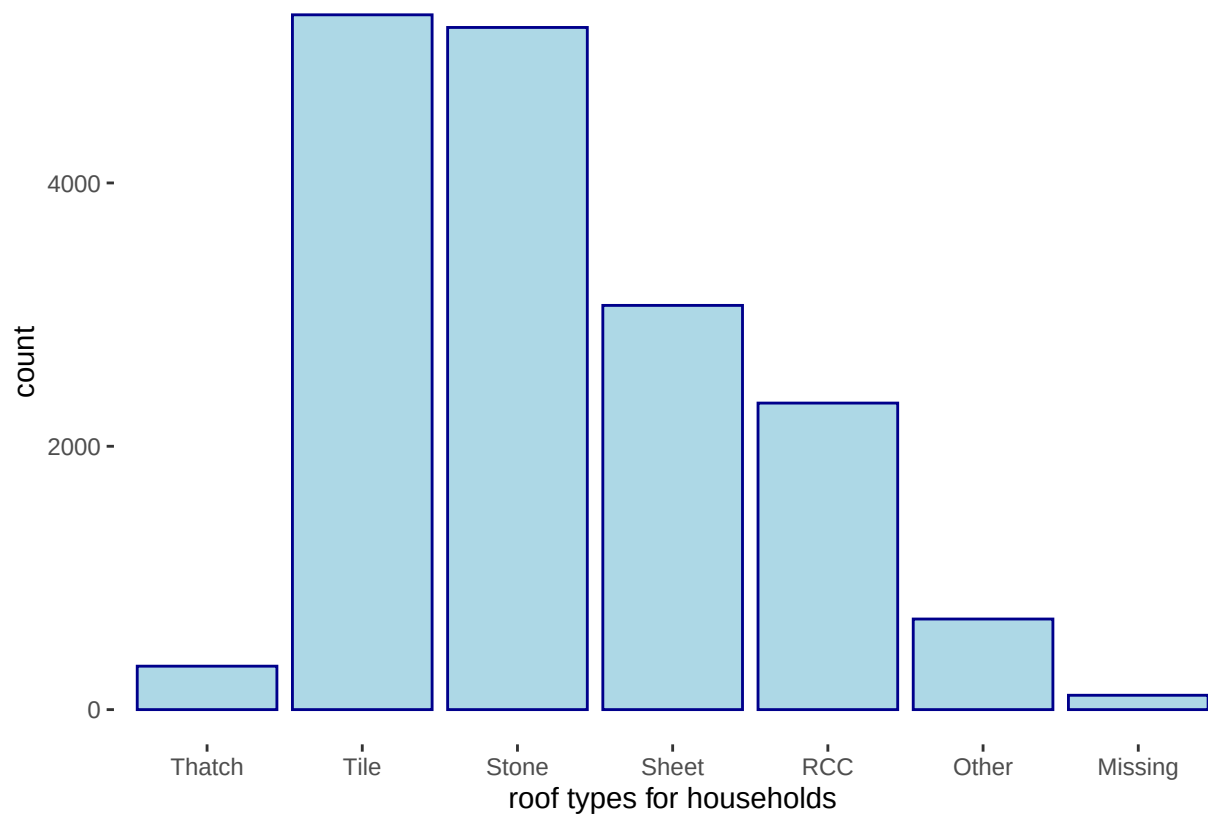


Figure 2.7: The roof type distribution of households

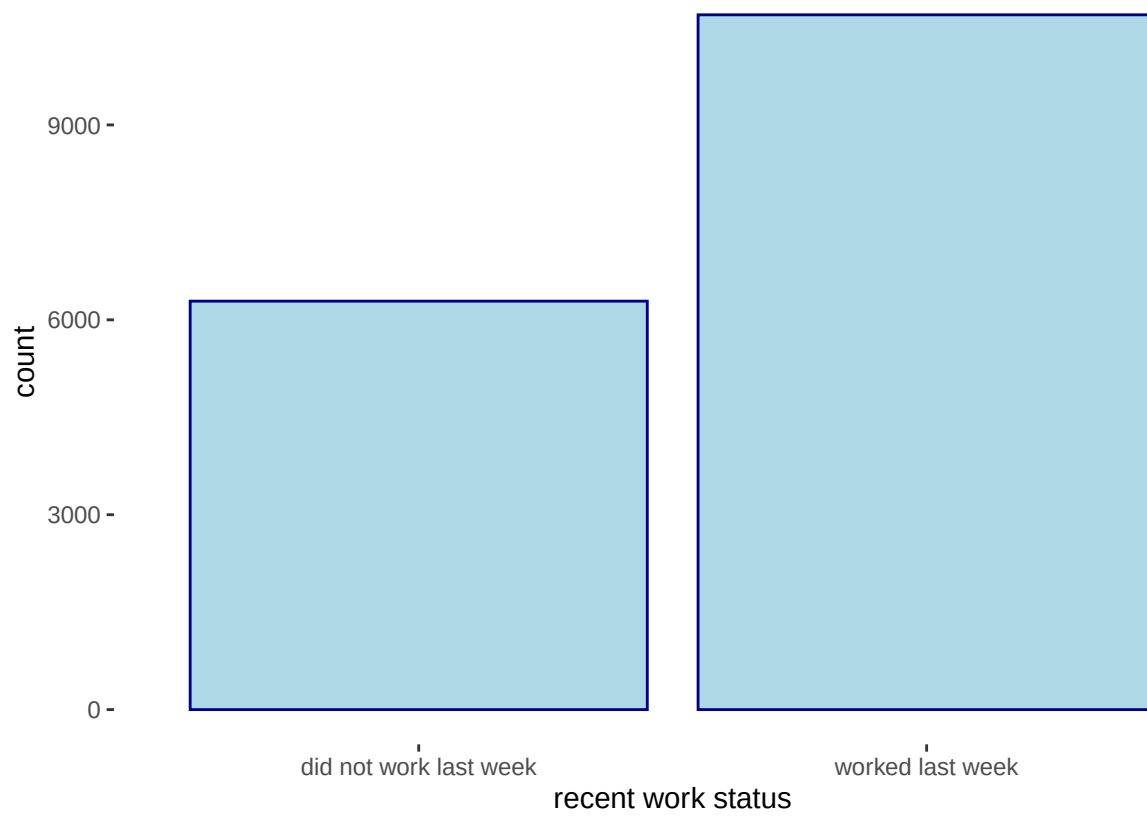


Figure 2.8: The recent work status distribution of villagers

groups compared to men (Davidson and Sanyal 2017). Although women are only slightly more likely to have bank accounts than men, the relationship between occupation and gender is far more stark. 82% of those who did not report working in the previous week were women. This suggests a gendered dimension to work, with women having less consistent employment. We therefore control for the effects of gender, as it is likely to influence both market integration and inter-caste tie formation. We also control for age and education, two factors that may influence the strength of caste boundaries (Alam 2023; see Figures 2.9 and 2.10 for the age and education distributions, respectively).

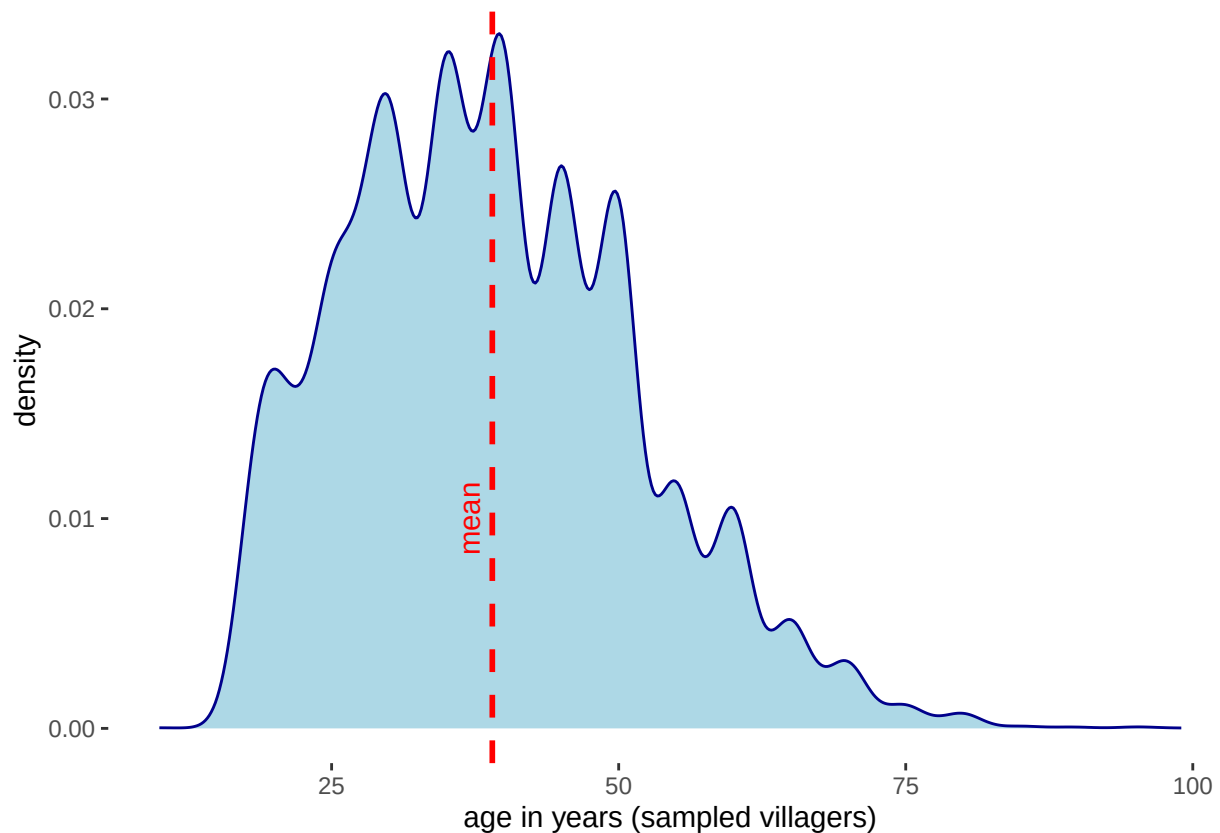


Figure 2.9: The age distribution of villagers

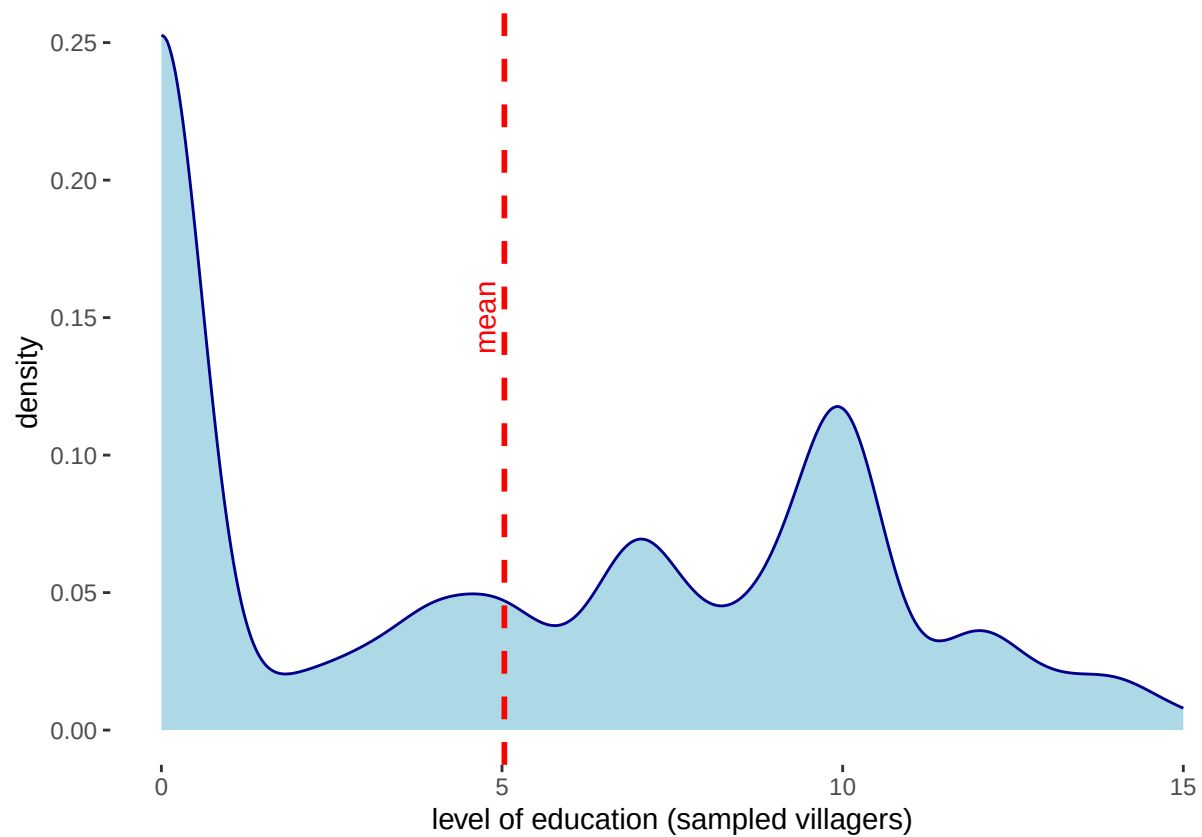


Figure 2.10: The distribution of the education levels of villagers (0 = none; 1-9 = years 1-9 of standard education; 10 = Secondary School Leaving Certificate; 11 = 1st Pre-University Course; 12 = 2nd Pre-University Course; 13 = incomplete degree; 14 = degree or above; 15 = other diploma)

2.4.3 *Analytic Strategy*

The variance on the economic variables, coupled with the strength of the boundaries on inter-caste interaction, make these data a fruitful setting for exploring the relationship between market integration and the likelihood of intergroup relations. In order to do this, we estimate a series of models that assess what factors are associated with the presence of inter-GC and inter-caste ties, whether they be social ties in general or lending ties in particular. We analyze these associations both at the level of villagers and at the level of dyads, in order to learn about both the villagers and the factors that are related to inter-GC and inter-caste ties. Since castes are nested in GCs, cross-GC ties are necessarily cross-caste ties. Therefore, whenever we discuss the association between the independent and control variables on the presence or number of cross-caste ties, we mean those cross-caste ties *that take place within the same GC*. The dependent variables are out-degree of ties (social ties, lending money ties, or lending kerosene/rice ties), dummy variables of ties between egos and alters in these villages, and dummy variables for whether those ties are endogamous or exogamous with respect to GC or caste. Figure 2.11 provides a visualization of the nesting of ties with respect to their crossing of GC and caste boundaries.

First, we use hierarchical linear models to assess the relationship between villager-level variables and villagers' out-degree of ties, i.e. the number of ties that a villager reports to others. We repeat this analysis for the different kinds of ties (social ties, lending money ties, lending kerosene/rice ties), and for ties that are between-GC and between-caste. This gives us a sense of whether villagers report more relations overall, particularly relations that cross GC and caste boundaries, depending on their personal level of market integration, net of other factors. If villagers with bank accounts report more relations that cut across these group boundaries, then we have found evidence that is compatible with the thesis that market integration can promote intergroup relations; if we find the opposite, then we have found preliminary evidence against this claim.

Second, we fit discrete choice multinomial logit models to estimate which alter and dyad properties predict ego's decision to name an alter for a social tie, and to name an alter among their social

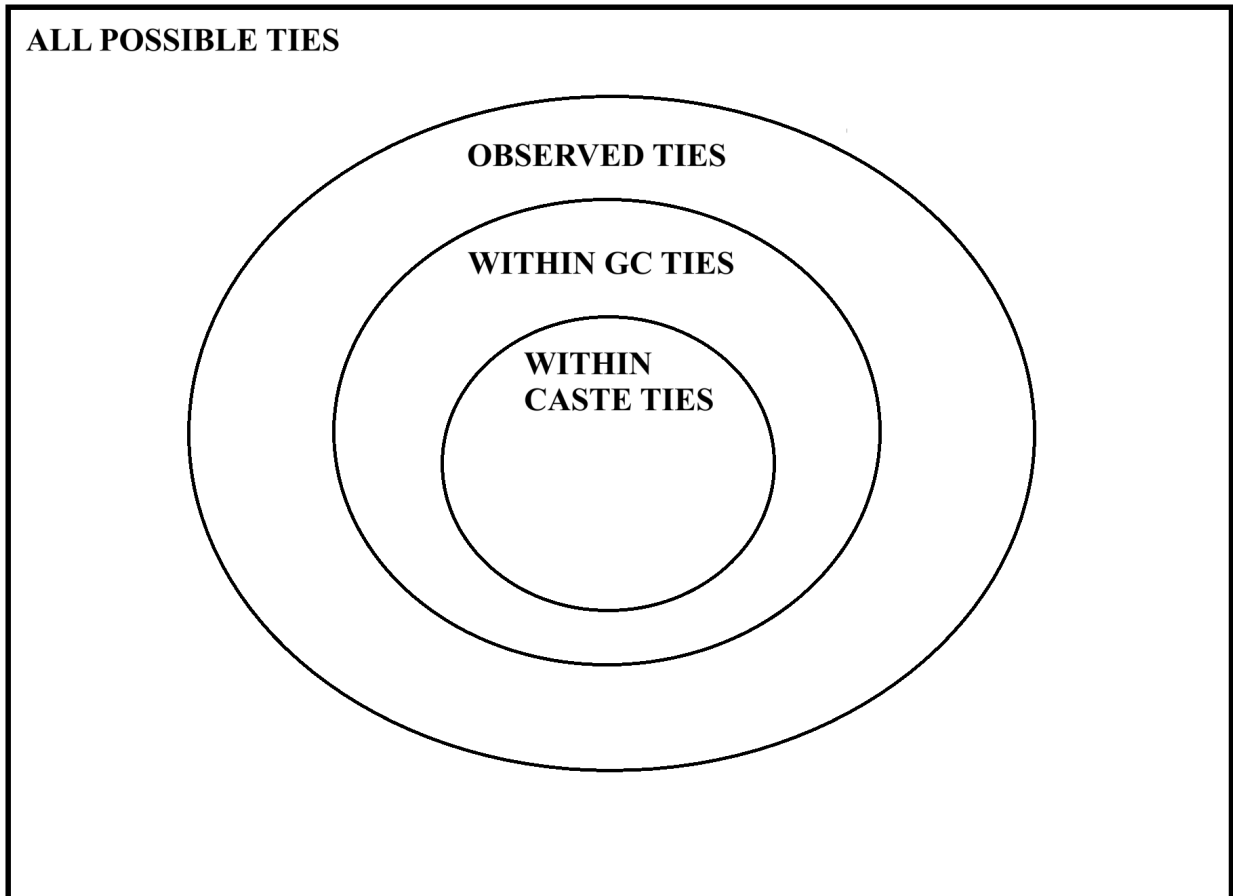


Figure 2.11: Diagram of the nesting of ties

ties for a lending money tie (corresponding to Models 0 and 1 in Figure 2.12).⁹ Every variable in these models is categorical¹⁰, so their joint distribution can be represented as a contingency table counting the number of dyads at each combination of ego, alter, and dyadic variables. It is well known that logistic and multinomial regression are special cases of the log-linear model for contingency tables (Agresti 2008). The log-linear modeling approach has also been used to model egocentric network data, particularly the conditional log-linear model (see Koehly, Goodreau, and Morris 2004). The log-linear model includes the multinomial logit model as a special case, which allows us to interpret tie formation as a discrete choice process generated by a random utility model (Glasgow 2022; McFadden 1977), an intuitive approach for modeling the factors that are associated with a villager choosing to claim relations with others (Overgoor, Benson, and Ugander 2020; Overgoor, Pakapol Supaniratisai, and Ugander 2020).¹¹ This approach allows us to ask, given that one villager is picked for a tie, from a set of villagers that are possible recipients of the tie (what we call the “choice set” of villagers), what variables are associated with a villager being chosen?

In the first multinomial logit model (Model 0 in Figure 2.12), the full choice set for a villager is the set of all her other co-villagers, but estimating the model with choice sets that large is computationally infeasible. Instead, we employ negative sampling, where for each choice we generate a smaller choice set out of the observed choice and a set of unchosen villagers uniformly at random. Parameter estimates made with negatively sampled choice sets are known to be consistent with those made from the full choice sets (Jarvis 2019). In the second multinomial logit model (Model 1 in Figure 2.12), we model the choice of a villager to report a lend money tie to co-villagers with whom they have *some* social tie (i.e. one out of any of the 12 relations). In all of our multinomial logit models, ego variables can only contribute to the outcome via an interaction with an alter variable, i.e. as a dyadic trait, due to the differing choice sets of villagers and the collinearity that would be introduced if we used ego variables.¹²

9. This approach is similar to Snijders’ (1996) stochastic actor-oriented models.

10. We omit age and education from the remaining models.

11. We use the “clogit” function of the “survival” R package to fit these models.

12. In each choice situation, alter variables differ while ego variables remain the same, which produces collinearity

The results of these models supplement the results of the out-degree models. The multinomial logit model assumes that villagers are making choices about who to lend money to, given some reasonably small set of plausible villagers to trust with their money. Conditional on this choice taking place, the model gives us estimates on the relationship between alter's characteristics (or the characteristics of the ego-alter dyad) and the probability that an alter is chosen. This uses a different set of assumptions from the linear regression models used to predict villager degree, allowing us to examine, from a different angle, the relationship between market integration and whether a relation takes place across GC and caste boundaries. Agreement between the multinomial logit models and the linear regression models is a form of triangulating evidence that market integration is related to the strength of the moral order that inhibits intergroup interaction.

Thirdly, we fit logistic regression models to the observed lending money dyads to see which ego, alter, and dyadic properties predict the existence of a cross-GC and cross-caste tie. First, we estimate the association between a cross-GC dummy variable and the independent variables, which is equivalent to the conditional log-linear model on the subset of the contingency table where a lend money tie has already been reported (Model 2 in Figure 2.12). Second, we estimate the association between a cross-caste dummy variable and the independent variables, now equivalent to the conditional log-linear model on the subset of the contingency table where a lend money tie has already been reported and the tie is within-GC (Model 3 in Figure 2.12). By conditioning on the existence of a lending money tie, or a cross-GC lending money tie, these models show us the association between the market integration variables and whether the tie crosses these group boundaries. These models can tell us, given the existence of a tie, what factors make it more likely that the tie crosses group boundaries (or, conditional on the tie crossing GC boundaries, what factors make it more likely to further cross caste boundaries)? If the market integration variables are related to the boundary crossing status, this provides another point of evidence for the relationship between market integration and the strength of the moral order that inhibits intergroup interaction.

Lastly, we fit three log-linear models (Models A, B, and C in Figure 2.13) to the data. In each of

if not handled appropriately.

Conditional/Multinomial Logit Models

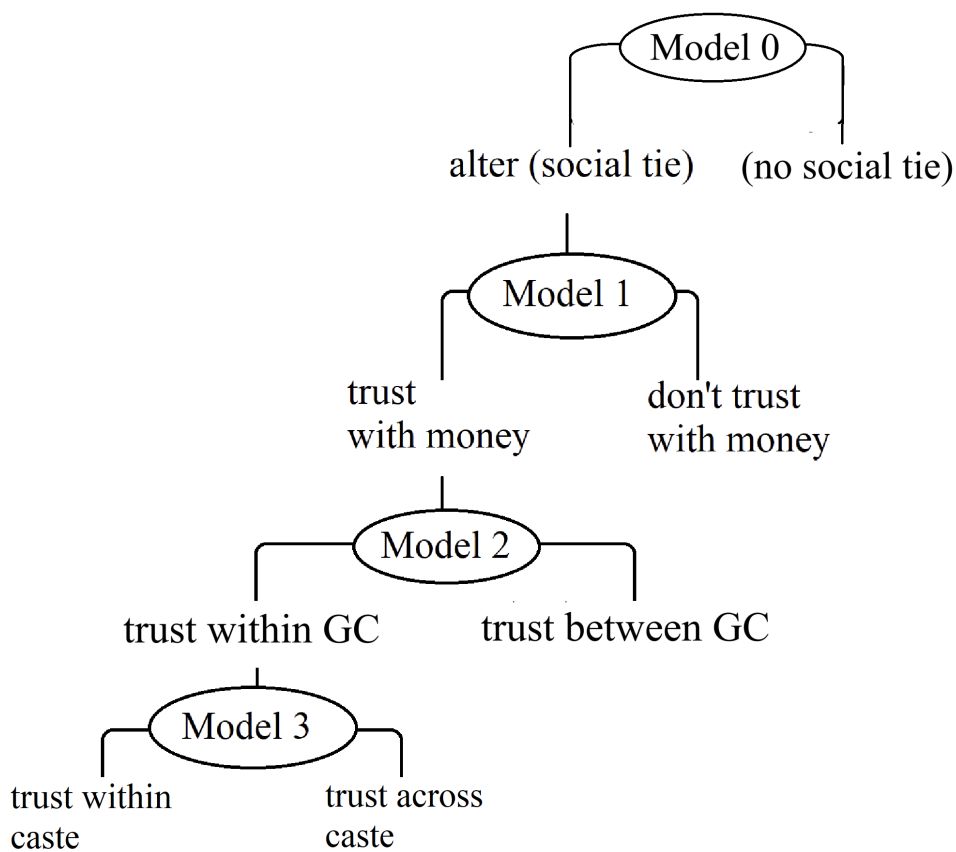


Figure 2.12: Diagram showing the conditional nesting of the multinomial logit and conditional log-linear models

these models, the dependent variable is a dummy variable for whether ego reports a lending tie to alter, and the primary independent variable is a dummy variable for whether that lending tie involves money or kerosene/rice. Each model conditions on the outcome of the previous model, as can be seen in Figure 2.13. This allows us to model the relative likelihood of money and kerosene/rice ties existing between villagers in general, and between villagers in different GCs and castes in particular. The interpretation of these models is similar to those discussed above: we can claim that, conditional on the existence of a tie, there is some relationship between the material involved in the tie and whether it crosses some group boundary.¹³

Conditional logit models

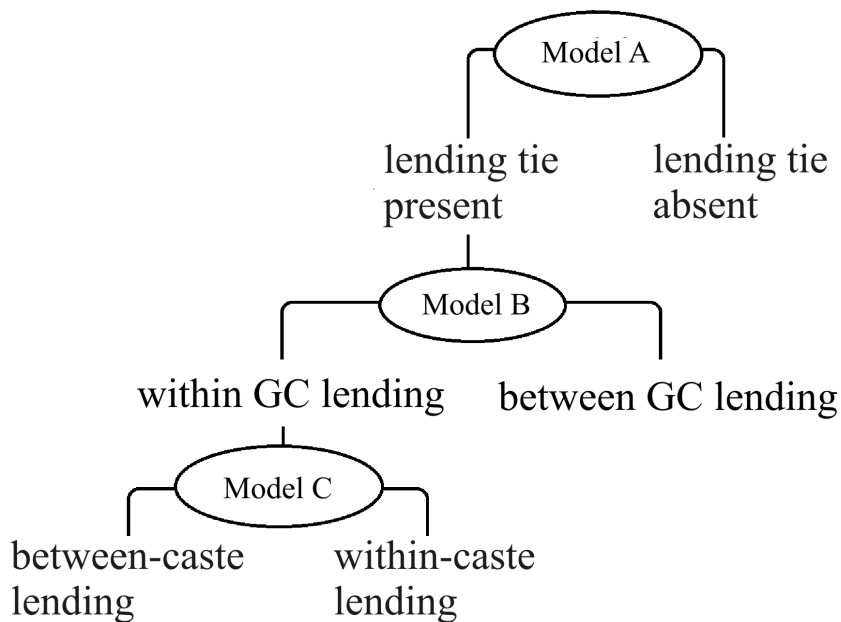


Figure 2.13: Diagram showing the conditional nesting of the three conditional logit models for tie presence

We use a subset of the network data in all our analyses. The reason for this is that egos are randomly sampled, and are mostly non-missing on their covariates, but egos *nominate alters* in a non-random fashion. In other words, despite the random sampling of respondents, the *dyads* are

13. The reader who finds this counterintuitive is directed to Appendix D for an explanation.

not a random sample of the network. Figure 2.14 illustrates this with a 2×2 table showing the possible dyads based on ego/alter sampling. This produces two problems for alters that were not themselves surveyed: they are missing on their outgoing ties and their demographic variables, and we cannot safely assume that this missingness is random. Because of this, analysis is restricted to dyads that can take place between egos and alters that are also egos, that is, alters that were themselves sampled for the network survey. These dyads are in Cell A of Figure 2.14. Some castes only have a few members in the data, making intergroup behavior difficult to compare with villagers from more populous castes; therefore, we restrict all analyses to castes that have at least 10 sampled members, leaving us with 38 castes containing 98.6% of the villagers in our sample. Descriptive statistics for villagers' demographic and network variables (within those 38 castes) can be found on Tables 2.8 and 2.9 in Appendix B3.

2.5 Results

2.5.1 *Market Integration And Sending Ties*

First, we fit hierarchical linear models to estimate the association between having a bank account and villager's out-degree of social ties (i.e. the number of alters with whom ego claims any of the 12 relationships), with a random effect for the village. We also model the out-degree of social ties that are reported to alters outside of ego's GC, and ties that are reported to alters that are within ego's GC but outside of ego's caste. In Table 2.2.1, we see a positive association between villagers having a bank account and their out-degree of social ties, controlling for wealth and for their having worked in the last week. In other words, villagers who have bank accounts, net of other factors, report more ties to other villagers, including villagers outside of their GC and caste. We also see evidence that villagers who report having worked in the last week report more ties in general and more cross-GC ties. Aside from this, we see evidence that corroborates earlier findings on the role of gender in rural southern Indian social networks, as men are more likely to report more inter-GC and inter-caste ties. However, men do not seem to have significantly higher out-degree than women

		alter	
		sampled	not sampled
ego	sampled	Cell A	Cell B
	not sampled	Cell C	Cell D

Table of Possible Dyads, by Ego and Alter Sampling

Figure 2.14: This table displays the combinations of possible dyads, and whether the ego and alter are respondents in the survey (i.e. were surveyed by the original researchers). Cell A is composed of dyads where both ego and alter were respondents in the survey. Cell B is composed of dyads where ego was a respondent in the survey, and named an alter that was not a respondent in the survey. Cell C is composed of dyads where ego was not in the survey, but would have named an alter that was a respondent in the survey. Cell D is composed of dyads where neither ego nor alter were respondents in the survey. Dyads in Cell C and Cell D are completely missing from our data, since the ego did not respond to the survey. We observe dyads in Cell B, but we have no demographic information about the *alters* in those dyads because they did not respond to the survey.

in general.

These results are compatible with the idea that villagers with bank accounts are more willing to reach out to villagers in different GCs and castes, which suggests that the traditional moral order preventing intergroup interaction holds less sway for them. It seems that villagers with bank accounts are more expansive with their ties in general, and this expansiveness spills over beyond GC and caste boundaries. We see a similar results when we focus on the out-degree of the lending money ties specifically: Table 2.2 shows that bank account ownership is positively associated with lending money out-degree, including out-degree of cross-GC and cross-caste ties, in contrast with lending kerosene/rice (Table 2.3) where bank account ownership does not have a significant association with cross-GC or cross-caste out-degree. This is evidence that the boundary crossing effect of bank account ownership works for lending money ties, but not for lending kerosene/rice ties.

This finding may simply be due to villagers with bank accounts having more cash on hand to lend to others, net of other factors, whereas bank account ownership is less directly related to kerosene/rice relations after controlling for wealth. Even so, we should not confuse immediate availability of cash with overall economic security or wealth. One might think that bank account ownership indicates wealth and that roof quality is an imperfect wealth control. However, if the bank account ownership effect were strictly a result of wealth, we would expect that the roof quality effect would also be significant, but we observe the opposite. This finding is further evidence consistent with the idea that something specific to market integration, rather than wealth in general, is responsible for this association.

Table 2.1: Predicting Number of Social Ties, Including Cross-GC and Cross-Caste Social Ties

	Dependent Variable: Out-degree of Social Ties		
	total out-degree	cross-GC out-degree	cross-caste out-degree
bank account	0.422*** (0.039)	0.068*** (0.020)	0.063*** (0.017)
roof: tile/stone/sheet	0.034 (0.080)	0.108** (0.041)	−0.012 (0.034)
roof: RCC	0.147 (0.094)	0.056 (0.049)	0.001 (0.040)
worked last week	0.111* (0.044)	0.063** (0.023)	−0.049** (0.019)
male	−0.013 (0.046)	0.103*** (0.024)	0.043* (0.020)
Constant	4.500*** (0.148)	0.570*** (0.081)	0.315*** (0.057)
Observations	16,591	16,591	16,591
Log Likelihood	-37,830.260	-26,897.170	-23,720.500
Akaike Inf. Crit.	75,680.510	53,814.340	47,461.000
Bayesian Inf. Crit.	75,757.680	53,891.500	47,538.160

Note:

*p<0.05; **p<0.01; ***p<0.001

reference category for roof is thatch/other

reference category for gender is female

controls for age and education

Table 2.2: Predicting Number of Lending Money Ties, Including Cross-GC and Cross-Caste Social Ties

Dependent Variable: Out-degree of Lending Money Ties			
	total out-degree	cross-GC out-degree	cross-caste out-degree
bank account	0.128*** (0.013)	0.021** (0.008)	0.021*** (0.006)
roof: tile/stone/sheet	0.009 (0.028)	0.036* (0.016)	0.008 (0.012)
roof: RCC	0.045 (0.032)	0.034 (0.018)	0.019 (0.014)
worked last week	0.073*** (0.015)	0.020* (0.009)	0.0001 (0.007)
male	-0.020 (0.016)	0.005 (0.009)	0.001 (0.007)
Constant	0.801*** (0.044)	0.091*** (0.025)	0.054** (0.018)
Observations	16,591	16,591	16,591
Log Likelihood	-20,119.890	-10,587.650	-6,545.391
Akaike Inf. Crit.	40,259.780	21,195.290	13,110.780
Bayesian Inf. Crit.	40,336.950	21,272.460	13,187.950

Note:

*p<0.05; **p<0.01; ***p<0.001

reference category for roof is thatch/other

reference category for gender is female

controls for age and education

Table 2.3: Predicting Number of Lending Kerosene/Rice Ties, Including Cross-GC and Cross-Caste Social Ties

Dependent Variable: Out-degree of Lending Kerosene/Rice Ties			
	total out-degree	cross-GC out-degree	cross-caste out-degree
bank account	0.073*** (0.015)	0.002 (0.008)	0.011 (0.007)
roof: tile/stone/sheet	-0.012 (0.030)	0.029 (0.017)	-0.002 (0.014)
roof: RCC	0.026 (0.035)	0.040* (0.019)	0.016 (0.016)
worked last week	0.050** (0.016)	-0.006 (0.009)	-0.016* (0.008)
male	-0.048** (0.017)	-0.004 (0.010)	-0.011 (0.008)
Constant	1.252*** (0.050)	0.172*** (0.028)	0.125*** (0.021)
Observations	16,591	16,591	16,591
Log Likelihood	-21,483.070	-11,675.290	-8,573.107
Akaike Inf. Crit.	42,986.140	23,370.570	17,166.220
Bayesian Inf. Crit.	43,063.310	23,447.740	17,243.380

Note:

*p<0.05; **p<0.01; ***p<0.001

reference category for roof is thatch/other

reference category for gender is female

controls for age and education

2.5.2 *Market Integration And Being Chosen For A Social Tie*

We found that those that are more market integrated tend to send more social ties and lending money ties, including to villagers in different GCs and castes. This indicates that more market integrated villagers are more expansive with their relations. We now turn our attention to whether more market integrated villagers are more attractive as recipients of social ties, a question that the hierarchical linear models above cannot answer for us. We use multinomial logit models, modeling tie formation as a discrete choice process, to assess the role of the market integration variables on the decision for ego to report a tie to alter, given that the alter is one among a manageably small number of options. In other words, we are now trying to assess what factors lead to a villager being chosen for a social tie, *given that a tie is being made* and the villager is one among a few villagers who could receive that tie (i.e. from the choice set of the villager making the decision to form a tie). The following models can show us, given that a relation is being made, what characteristics of the villagers make them more likely to be chosen for this relationship (and how those characteristics interact with characteristics of the decision-maker). If we find a relationship between the market integration variables and the likelihood of a villager being chosen for a tie, then we can gain traction on how market integration is related to intergroup relations. The unit of observation in these models is the choice situation: a villager, the other villager she has chosen for a social tie, and a randomly chosen set of 7 villagers she could have chosen but did not; the number of such observations is equal to the number of observed tie choices plus, for each observed tie choice, the 7 dyads representing the unchosen options.

First, we model the villagers reporting *social* ties to others in their village, where a “social tie” refers to ego reporting any of the ten kinds of relations to alter (visiting the respondents’ home; hosting the respondent in their home; kin in the village; non-relatives with whom the respondent socializes; receiving medical advice; borrowing and lending money; borrowing and lending kerosene and/or rice; getting advice; giving advice; or going to pray with alter at the same temple, church, or mosque). The results in Table 2.4 (corresponding to Model 0 in Figure 2.12; diagram is reproduced in Appendix C) suggest that alter’s bank account ownership, roof quality, and recent work status all

positively correlate with being chosen. We also find a positive interaction between ego and alter's bank account status and recent work status. These results suggest that a villager being more market integrated makes them more attractive as a recipient for a social tie, and that this effect is enhanced if ego is also more market integrated (as measured by ego having a bank account).

Table 2.4: Predicting Being Chosen For Social Ties Among Co-Villagers

Dependent Variable: Log-Odds of Being Chosen For A Social Tie		
	chosen	
potential alter has bank account	0.282*** (0.008)	0.131*** (0.011)
potential alter roof: tile/stone/sheet	0.081*** (0.018)	0.083*** (0.018)
alter roof: RCC	0.158*** (0.020)	0.151*** (0.021)
potential alter worked last week	0.297*** (0.009)	0.094*** (0.014)
both villagers have bank account		0.361*** (0.017)
both villagers worked last week		0.349*** (0.018)
Observations	623,687	606,305
R ²	0.020	0.021
Max. Possible R ²	0.400	0.400
Log Likelihood	-153,120.900	-148,607.200
Wald Test	11,599.070*** (df = 5)	11,913.070*** (df = 7)
LR Test	12,331.030*** (df = 5)	12,801.210*** (df = 7)
Score (Logrank) Test	12,093.920*** (df = 5)	12,476.290*** (df = 7)

Note:

*p<0.05; **p<0.01; ***p<0.001

reference category for roof is thatch/other

controls for shared gender

2.5.3 *Market Integration And Receiving A Loan of Money*

The following results take the same approach as the multinomial logit models above, but the conditioning that produces the choice set is different. In these models, we show the association between a villager being chosen for a lending money tie, and the characteristics of the alters and dyads. The choice set for each ego is the set of alters with whom ego has a *social* tie (i.e. any of the 12 relations enumerated above). These results can tell us, given that a decision is being made to choose a villager to lend money to, who among ego's social ties will ego decide to trust with their money. We use villagers' social ties as the choice set in this case because it is plausible that villagers, if they are to make the decision to lend money, are likely to lend to someone with whom they have *some* sort of ongoing relationship.

The results of Table 2.5 (corresponding to Model 1 in Figure 2.12) show that alter's roof quality is negatively associated with the decision to trust with money, while alter's recent work status and its interaction with ego's recent work status are positively associated with a trust decision. Alter's bank account status and interaction with ego's bank account status are no longer statistically significant. These results imply that, if villagers are making lending money decisions among their social ties, the bank account status of villagers does not seem to make a difference as to whether a villager is chosen or not. Furthermore, it seems that alter being wealthier makes them less attractive as a recipient of a lending money tie, which perhaps reflects the tendency of villagers to decline lending money to someone who is already well off. These results discourage a rational choice interpretation of our findings (i.e. that people are lending to others on the basis of expected return), and it also suggests that the expansiveness of more market integrated villagers is not a result of reciprocity, of lending to others because they themselves are more likely to be the recipients of loans.

Table 2.5: Predicting Being Chosen For A Lending Tie Among Social Ties

Dependent Variable: Log-Odds of Being Chosen For A Lending Money Tie		
	chosen	
alter has bank account	−0.009 (0.020)	−0.033 (0.027)
alter roof: tile/stone/sheet	−0.044 (0.045)	−0.048 (0.045)
alter roof: RCC	−0.255*** (0.052)	−0.256*** (0.053)
alter worked last week	0.094*** (0.023)	0.022 (0.035)
both have bank account		0.058 (0.041)
both worked last week		0.118* (0.046)
Observations	89,759	87,372
R ²	0.049	0.049
Max. Possible R ²	0.432	0.432
Log Likelihood	-23,099.130	-22,484.290
Wald Test	3,124.800*** (df = 5)	3,046.550*** (df = 7)
LR Test	4,507.380*** (df = 5)	4,406.461*** (df = 7)
Score (Logrank) Test	3,757.330*** (df = 5)	3,667.913*** (df = 7)

Note:

*p<0.05; **p<0.01; ***p<0.001

reference category for roof is thatch/other

controls for shared gender

2.5.4 *Market Integration And The Boundary-Crossing Status of Lending Money*

We have found that the market integration variables make villagers more attractive as recipients of *social* ties, but, given that they have already been chosen for social ties, we have failed to find evidence that market integration makes villagers more attractive for lending money ties. This helps assure us that the market integration variables do not simply work by making villagers with bank accounts a more rational choice to trust with money, and that something beyond self-interested calculation is at work here. To assess what factors are related to lending money ties that cross GC and caste boundaries, we condition our data on a lending money tie being reported between villagers (corresponding to Models 2 and 3 in Figure 2.12). That is, *given* that there is a lending money tie, we can use logistic regression to estimate the association between ego's and alter's characteristics and the probability that the observed tie crosses the boundary of GC. We can further condition on cross-GC ties, and then estimate the association between ego's and alter's characteristics and the probability that the tie crosses the boundary of *caste*. In other words, we can make claims about the likelihood of boundary-crossing ties taking place among villagers with certain characteristics, the most important of which being bank account ownership.

The results of the logistic regression models in Table 2.6 (corresponding to Models 2 and 3 in Figure 2.12) show no significant association between ego's bank account ownership and cross-GC ties. We also see a negative interaction effect between ego's and alter's bank account status in the case of cross-GC ties. We observe that cross-GC ties have a stronger positive association with ego's roof quality. This implies that the cross-GC ties are more likely to be reported between pairs of villagers that do not have bank accounts, and more likely to be reported between villagers who are wealthier and have worked in the previous week. However, when we look at cross-caste ties within the same GC, we find a significant positive association with ego's bank account ownership, as well as ego's wealth effects. However, we still see a negative bank account interaction, implying that when ego and alter both have bank accounts, it is not more likely that the observed tie crosses a caste boundary. In other words, we find that, within the same GC, cross caste ties are more likely to take place when *only* ego (and not alter) has a bank account and both villagers are relatively wealthy. In

summary, we have learned two things about lending money in this context: that between GC ties are not more likely to involve more market oriented villagers (though they are more likely to involve wealthier villagers) and that between caste ties (within the same GC) are more likely to involve a more market integrated sender (but not involve a more market integrated sender *and* receiver).

Table 2.6: Predicting Whether Lending Money Ties Cross GC And Caste Boundaries

Dependent Variable: Log-Odds of Boundary-Crossing Status of Lending Money		
	cross-GC tie	cross-caste-tie
ego has bank account	0.111 (0.059)	0.224** (0.076)
alter has bank account	0.058 (0.056)	0.107 (0.073)
both have bank account	−0.240** (0.084)	−0.242* (0.108)
ego roof: tile/stone/sheet	0.177 (0.094)	0.198 (0.120)
ego roof: RCC	0.222* (0.107)	0.285* (0.137)
alter roof: tile/stone/sheet	0.054 (0.091)	−0.343** (0.107)
alter roof: RCC	0.004 (0.107)	−0.155 (0.126)
Observations	14,677	11,708
Log Likelihood	-7,377.627	-4,781.128
Akaike Inf. Crit.	14,779.250	9,586.257

Note:

*p<0.05; **p<0.01; ***p<0.001

results control for gender, language, and recent work status

reference category for roof is thatch/other

2.5.5 *Lending Type (Money or Kerosene/Rice) And Lending Tie Presence*

Finally, we look at the association between lending tie type and tie presence, and how this association changes between lending ties in general, those that take place between GCs, and those that take place between castes (but within the same GC). These models can show us which type of lending is more likely to occur, conditional on the group boundary that is being crossed and the characteristics of villagers. If we find that lending money is more likely to occur across group boundaries than lending kerosene/rice, then we have found evidence that money plays a stronger role in facilitating intergroup relations than kerosene/rice; if we find no effect or the opposite, then we have found evidence that money is relatively corrosive of intergroup relations.

We will discuss the results of these models from least to most conditional (see Figure 2.13 and Appendix C for a reminder of the ordering of conditions). We first look at all of the possible lending ties, regardless of the GCs and castes of ego and alter (the results for these ties can be seen in the left-most column of Table 2.7, corresponding to Model A of Figure 2.13). We find that a lending money tie is less likely to be reported between villagers than a lending kerosene/rice tie, and that this difference is less pronounced for villagers with a bank account. We also find positive main effects of ego's and alter's bank account ownership on lending, and negative effects of alter's wealth and both ego's and alter's recent work status. From these results we can infer that a lending tie is more likely to be reported between more market integrated villagers, but less likely to be reported between villagers who are wealthier and have worked recently. However, these lending ties are more likely to be lending kerosene/rice than they are to be lending money. Moving to the shared GC nesting level (the middle column of Table 2.7, corresponding to Model B in Figure 2.13), the model predicts that existing lending ties that cross GC boundaries are more likely to involve money than they are to involve kerosene/rice. This suggests that inter-GC lending relationships are more likely to occur through money than through material goods like kerosene and rice, a finding that provides evidence for the claim that market integration (as manifested through relations of money rather than kerosene/rice) weakens the moral order that limits intergroup interaction. Finally, at the cross-caste level (as seen on the right-most column of Table 2.7, corresponding to Model C in

Figure 2.13), the model predicts that, *within* a GC, cross-caste lending ties are *not* more likely to involve money rather than kerosene/rice. In addition, they are no more likely to involve villagers with bank accounts. It seems that the only significant indicator of a within-GC lending tie crossing the caste barrier is villager wealth.

Table 2.7: Predicting The Presence Of Lending Ties

	Dependent Variable: Log-Odds of Tie Presence		
	tie presence	cross-GC tie presence	cross-caste tie presence
tie type: lend money	−0.291*** (0.015)	0.168*** (0.038)	0.067 (0.049)
ego has bank account	0.070*** (0.015)	−0.034 (0.040)	0.066 (0.049)
alter has bank account	0.346*** (0.011)	−0.054 (0.029)	0.006 (0.037)
ego roof: tile/stone/sheet	−0.014 (0.023)	0.095 (0.064)	0.106 (0.081)
ego roof: RCC	−0.002 (0.027)	0.191** (0.074)	0.221* (0.092)
alter roof: tile/stone/sheet	0.018 (0.023)	0.028 (0.063)	−0.284*** (0.074)
alter roof: RCC	−0.137*** (0.028)	−0.081 (0.075)	−0.112 (0.088)
lend money × ego bank account	0.071** (0.022)	0.036 (0.058)	0.063 (0.073)
Constant	−7.224*** (0.039)	−1.123*** (0.100)	−0.672*** (0.120)
Observations	7,505,384	33,695	27,512
Log Likelihood	−204,377.700	−15,563.540	−10,391.040
Akaike Inf. Crit.	408,783.500	31,155.080	20,810.070

Note:

*p<0.05; **p<0.01; ***p<0.001

results control for gender, language, and recent work status

reference category for roof is thatch/other

2.6 Discussion and Limitations

The theoretical question we have addressed in this chapter is the relationship between market integration and the moral order influencing intergroup relations. Prior literature was divided on this question, with some scholars claiming that market integration facilitates intergroup relations, others claiming that it makes intergroup relations more fraught, and others making more specific claims about the conditions that would point the relationship one way or the other. To improve our understanding of one facet of this relationship, we used data from an empirical setting where there is substantial variation on individual-level market integration and a long-standing moral order that discourages intergroup relations in several tangible ways. We fit a series of models to the data to reveal the relationships between market integration and reported intergroup relations, and found converging evidence that can help clarify our understanding of how market integration is related to the likelihood of intergroup relations.

Let us take stock of the findings. We found that more market integrated villagers report more ties in general, and more to villagers in different GCs and castes. We found this effect for lending money ties specifically, but not for lending kerosene/rice ties. When considered as a choice process, we found that more market integrated villagers were more attractive choices for social ties, especially when the chooser also owned a bank account, but bank account ownership did not make villagers more attractive for lending money nominations when choosers were deciding amongst their social ties. These findings help assure us that, when villagers are choosing whom to trust with money amongst their social ties, they are not simply choosing recipients on the basis of a rational expectation of return, or a normative expectation of reciprocity. We also found that lending money ties were more likely to cross caste (but not GC) boundaries when the sender of the tie had a bank account.

Now we summarize our findings of the comparison between lending money and lending kerosene/rice. We found that lending ties in general were more likely to involve kerosene/rice than money, and that lending ties were more likely to involve more market integrated villagers. We found that the cross-GC lending ties were not more likely to involve more market integrated

villagers, but were more likely to take place with money rather than kerosene/rice. Finally, we failed to find evidence that lending ties within the same GC that crossed caste boundaries were more or less likely to occur between more market integrated villagers. In other words, we found that lending ties were more common among market integrated villagers, and that inter-GC lending more often involved money rather than material goods, highlighting the special role of money in this context. None of the coefficients have a high magnitude, nor would it be realistic for them to have a high magnitude, given the strength of caste homophily in this setting. Even so, the findings are consistent with the idea that market integration can make inter-caste relations more likely.

These findings are consistent with the hypothesis that market integration, as measured by bank account ownership, facilitates intergroup trust and relations, and therefore that market integration can weaken a moral order that limits intergroup exchange. More market integrated villagers sent out more ties, and were more attractive options for receiving social ties (but not lending ties specifically). We consistently found that lending money ties were overrepresented in cross-GC and cross-caste ties in a way that we did not find for lending kerosene/rice ties, highlighting the specific role of money as a lubricant of intergroup interaction over and above other economic goods. Even so, there are multiple ways that the associations we find here can be confounded.

One pathway for confounding comes from our finding of baseline differences in expansiveness. The results of the out-degree models may indicate that some villagers are simply more outgoing than others, and this may make them more likely to open bank accounts and establish relations across caste boundaries. A related possibility is that individual-level generalized trust is a confounder between bank account ownership, intergroup trust, and social ties. There is evidence from other research that individuals that report higher levels of generalized trust are more likely to report trust in banks and open a bank account (Buriak et al. 2019; Fungáčová, Hasan, and Weill 2019). If it is simply the case that some villagers are more trusting than others, and they are both more likely to open a bank account and trust someone in another caste or GC with money, then the relationship between these two variables will be confounded. Despite these concerns, there are *some* potential confounders that we have reason to reject on the basis of these data. For example, the proportions

of lending ties that go to wealthy alters is roughly equal to the proportion of such ties that go to less wealthy alters. This is evidence against the interpretation that the lending ties are simply charity from wealthier upper caste villagers to poorer lower caste villagers, or an extraction of funds from lower to upper castes (see Appendix E).

One might also question the validity of the variables as indicators of market integration or controls for wealth. While this may be an issue, standard measures such as income are less appropriate in settings like Karnataka, where employment is unstable for most people. Roof quality, while imperfect, is one of the best measures of long-term economic standing available in this setting, and yet we do not see consistent roof effects on lending or social tie formation. Another potential slippage between the variables and our interpretation comes from the distinction between bank account ownership and bank account *usage*. Demirgüç-Kunt and colleagues (2015) found that, between 2011 and 2014, bank account ownership in India increased from 35% to 53%, but the dormancy rate of bank accounts was 43% (dormancy defined as making no deposit or withdrawal in the past 12 months). We find this potential bias un concerning for two reasons. First, it would be a *conservative* bias. If the number of actively used bank accounts is lower than reflected in our data, then we have obtained these effects with what is an absolute *minimum* of market integration (mere bank account ownership rather than usage), and the true effect of bank account usage is likely to be even more pronounced. Secondly, the high dormancy rate found in their study most likely reflects the large number of newly opened accounts that had not been used yet, an artifact of the efforts of NGOs and the Indian government to promote financial inclusion. Such efforts were not well established when our data were collected in 2006.

2.7 Conclusion

In this study, we found that market integration can play a role in promoting intergroup relations. We found that villagers who are more integrated into the market economy reported more ties in general and across caste boundaries. We also found evidence for the particular role of money as a medium of exchange that can more easily cross group boundaries. Finally, we found that the role of market

integration in producing these more expansive networks is not reducible to the effects of wealth, rational calculation, or the expectation of reciprocity. Taken together, these findings suggest that market integration can weaken a moral order than restricts intergroup interaction. These findings also present interesting possibilities for future research.

One possibility is that bank account ownership is a product of “developmental idealism”, a set of cultural values and beliefs that promotes economic growth, education, gender equality, and smaller families as the path to prosperity and happiness (Thornton, Dorius, and Swindle 2015). There is evidence that, particularly in South Asia, those who report more developmentally idealist values are more likely to eschew arranged and caste-endogamous marriage, and embrace more individualistic lifestyles (Allendorf and Thornton 2015). It would be interesting if the experience of market integration pushed individuals in the direction of developmental idealism, or any set of individualist values that predict more generalized trust (Gheorghiu, Vignoles, and Smith 2009). Another possibility is that market integration goes hand-in-hand with societal differentiation and an increase in Weberian formal rationality (Marsh 2014), thereby making people mutually predictable and reducing the uncertainty of intergroup relations. Bank account ownership, then, may indicate a general attitude or disposition towards the world that matches that described by modernization theorists. This possibility would vindicate a similar point that Simmel ([1903] 2003) made about the nature of freedom in a metropolis: that the seemingly greater freedom afforded by urban life was only possible by collective subordination to an authority larger than one’s local community. In a similar fashion, the role of market integration in developing a more generalized trust could be due to it shifting our trust from local institutions (e.g. family) to globally networked economic institutions (e.g. banks).

Finally, if bank account ownership in settings like rural Karnataka *does* indicate some general orientation towards intergroup interaction facilitated by money, or if bank account ownership truly has a causal effect on intergroup interaction, it could be the case that the mechanism producing this effect is entirely geospatial. Given the segregation of castes in rural India, the act of going to the bank to deposit and withdraw money could place villagers in close physical proximity with

co-villagers in castes that they would otherwise rarely encounter. Importantly for sociology, propinquity, in tandem with other factors, could play a role in weakening the moral order of caste that discourages intergroup interaction. It could therefore contribute to “distributive effervescence” as the basis of social solidarity (McCaffree and Shults 2022), a basis that works in heterogeneous societies without relying on scripted interactions.

We would like to conclude this study by returning to Adam Smith’s work in political economy. His works grappled with world-historical economic changes, the concrete processes that drove these changes (e.g. trade flows, the accumulation of wealth), and the moral orders that were transformed through these processes. Smith’s economic ideas in the *Wealth of Nations* ([1776] 1977) and the moral philosophy in his *Theory of Moral Sentiments* ([1790] 2002) were two strands of the same chord: an account of agricultural capitalism as morally uplifting, financial speculation as morally debasing, and the division of labor reducing workers to a simplistic, robotic mode of being. Regardless of the veracity of his conclusions, future research should follow his example: tracing how concrete matters of market integration are related to the development of solidarity across group boundaries, a moral issue that grows more pressing with every passing day (Oosterlynck et al 2016).

2.8 Appendices

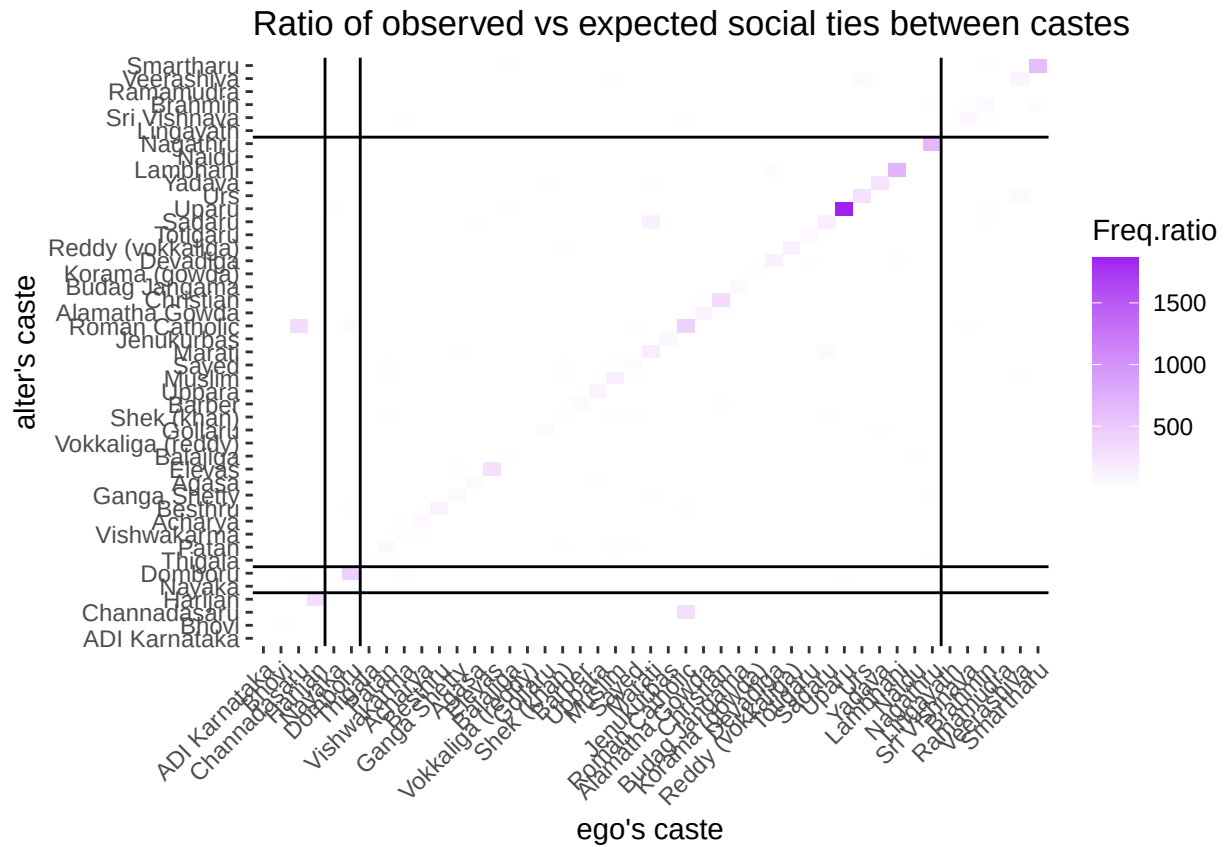
2.8.1 *Appendix A: Nesting Castes Into GCs*

The GC and caste data have some complications that must be taken into account. GC and caste identification does not always match official records, because some villagers claim a GC that does not fit their caste (e.g. Acharis and Lingayats in Karnataka are OBC according to the government, but, in these data, some members of these castes claim to be in the General category). In addition, the nesting of castes into GCs is not perfect, because members of the same caste will sometimes claim different GCs (e.g. some Acharis claim OBC status, while some claim General). We clean the caste and GC nesting by uniquely nesting each caste into the GC that the majority of villagers in that caste report. For example, if the majority of those who claim “Lingayath” caste reported being in the OBC GC, then all Lingayath villagers would be coded as belonging to OBC. On average, 90% of the villagers in a caste agree on their GC, making this imputation relatively harmless.

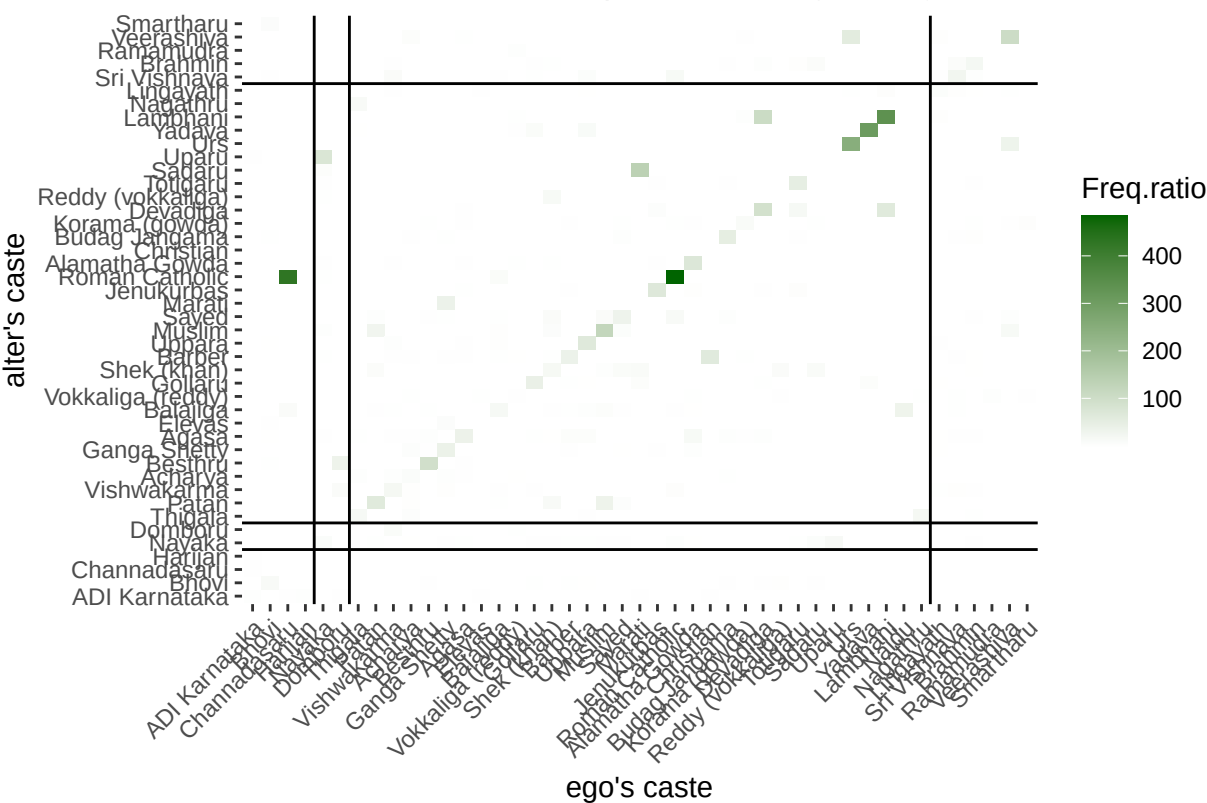
2.8.2 *Appendix B: Descriptive Statistics*

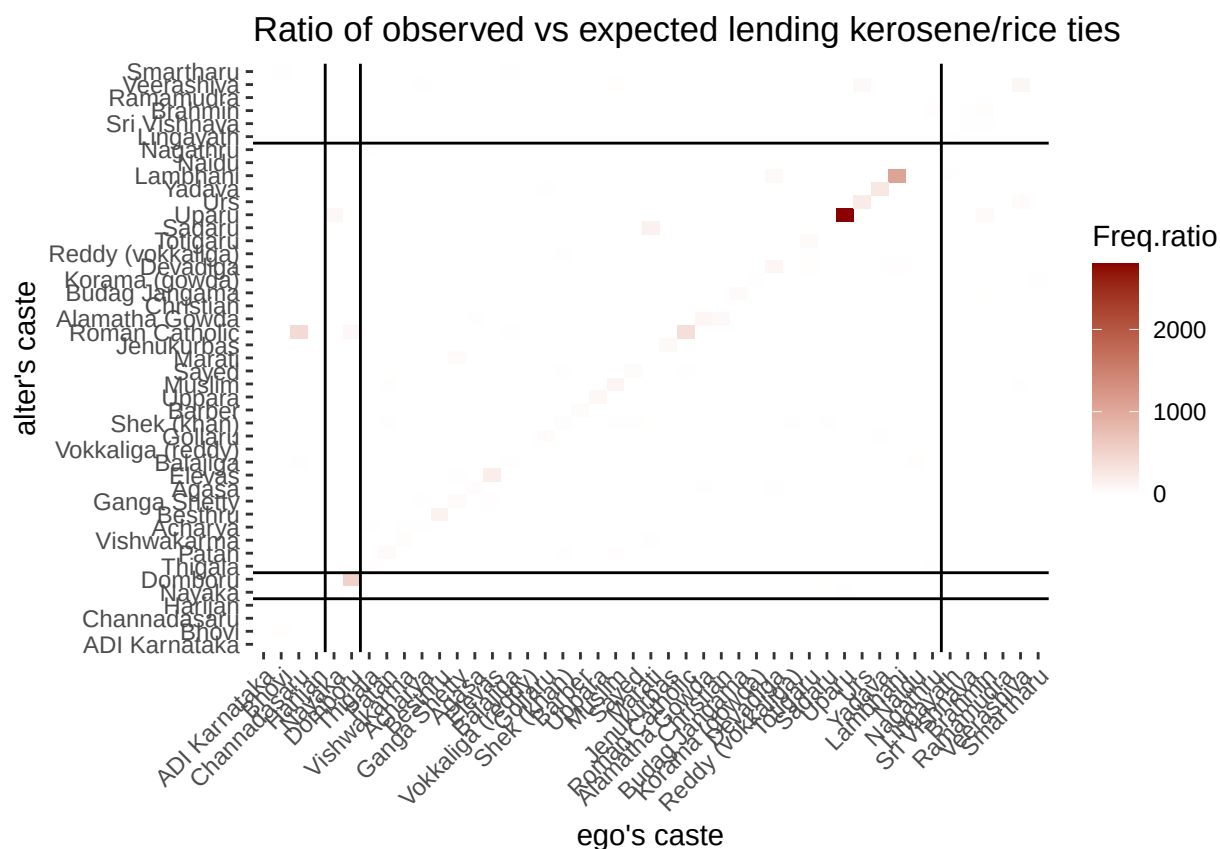
2.8.2.1 Appendix B1: Inter-GC and Inter-Caste Heat Maps

Below are heat maps indicating the ratio of observed and expected ties in each cell of the sender and receiver table for castes. We compute the expected number of ties from caste A to caste B by taking the total number of ties sent by caste A and allocating them to caste B according to caste B’s proportion in the population. We show heat maps for all social ties, lending money ties, and lending kerosene/rice ties, and use a grid to demarcate how the castes are nested into GCs. The diagonal blocks of the resulting grid contain the majority of the observations, and within each grid the diagonal blocks contain the majority of the observations. These heat maps therefore indicate high levels of GC and caste homophily in social ties and lending.



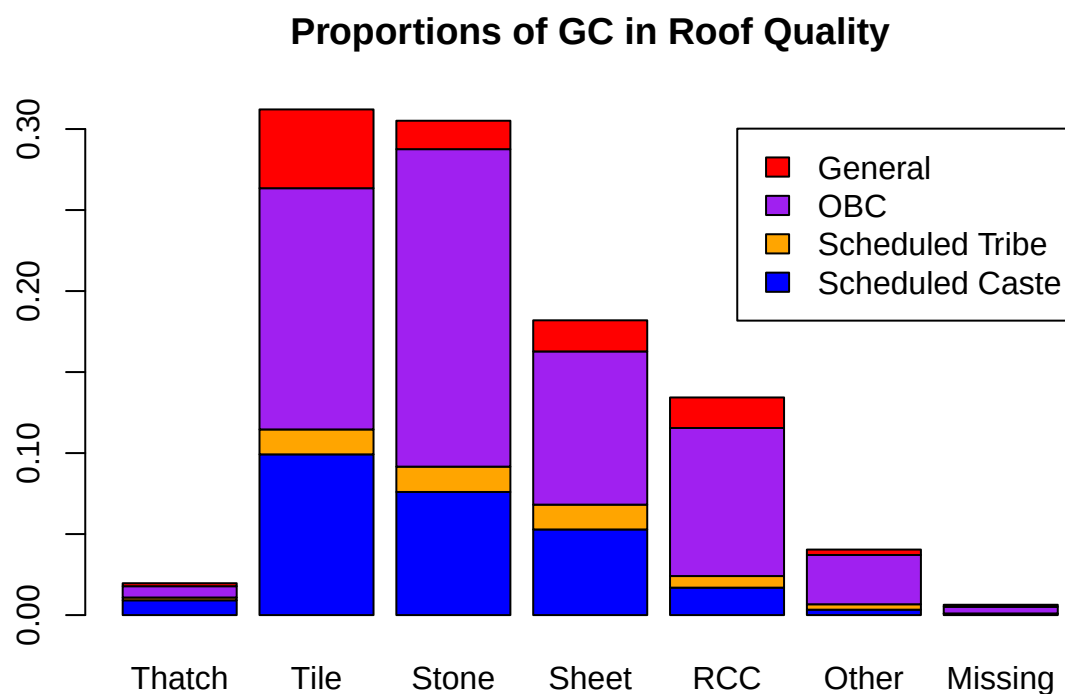
Ratio of observed vs expected lending money ties





2.8.2.2 Appendix B2: GC and Roof Quality

Here we present evidence that the different GCs have different distributions of roof quality, and therefore that GC membership is indicative of one's level of economic wealth. We see that the higher GCs form a larger percent of the villagers with high quality roofs.



2.8.2.3 Appendix B3: Descriptives Statistics For Villager-Level Demographic and Network Variables

Descriptive statistics for villagers' demographic and network variables (within the 38 castes that have at least 10 members) are displayed in Tables 8 and 9, respectively

Table 2.8: Summary Statistics For Villager-Specific Variables

Statistic	Mean	St. Dev.
bank account ownership	0.396	0.489
worked last week	0.631	0.483
years of age	39.071	12.687
years of education	5.005	4.655
roof quality: thatch/other	0.061	0.239
roof quality: tile/stone/sheet	0.805	0.396
roof quality: RCC	0.135	0.341
gender: female	0.553	0.497
gender: male	0.447	0.497

Table 2.9: Summary Statistics For Villager-Specific Variables

Statistic	Mean	St. Dev.
outdegree of social ties	4.752	2.527
outdegree of cross-GC social ties	0.828	1.317
outdegree of within-GC and cross-caste social ties	0.475	1.046
outdegree of money lending ties	0.961	0.837
outdegree of cross-GC money lending ties	0.191	0.469
outdegree of within-GC and cross-caste money lending ties	0.112	0.363
outdegree of kerosene/rice lending ties	1.243	0.913
outdegree of cross-GC kerosene/rice lending ties	0.207	0.506
outdegree of within-GC and cross-caste kerosene/rice lending ties	0.138	0.411

In all cases, "outdegree" means the total number of ties that a villager reports in that category

2.8.3 *Appendix C: Model Diagrams*

Below are the diagrams explaining the conditional nesting structure of models 0-3 and A-C. We reproduce them here for the ease of the reader:

Conditional/Multinomial Logit Models

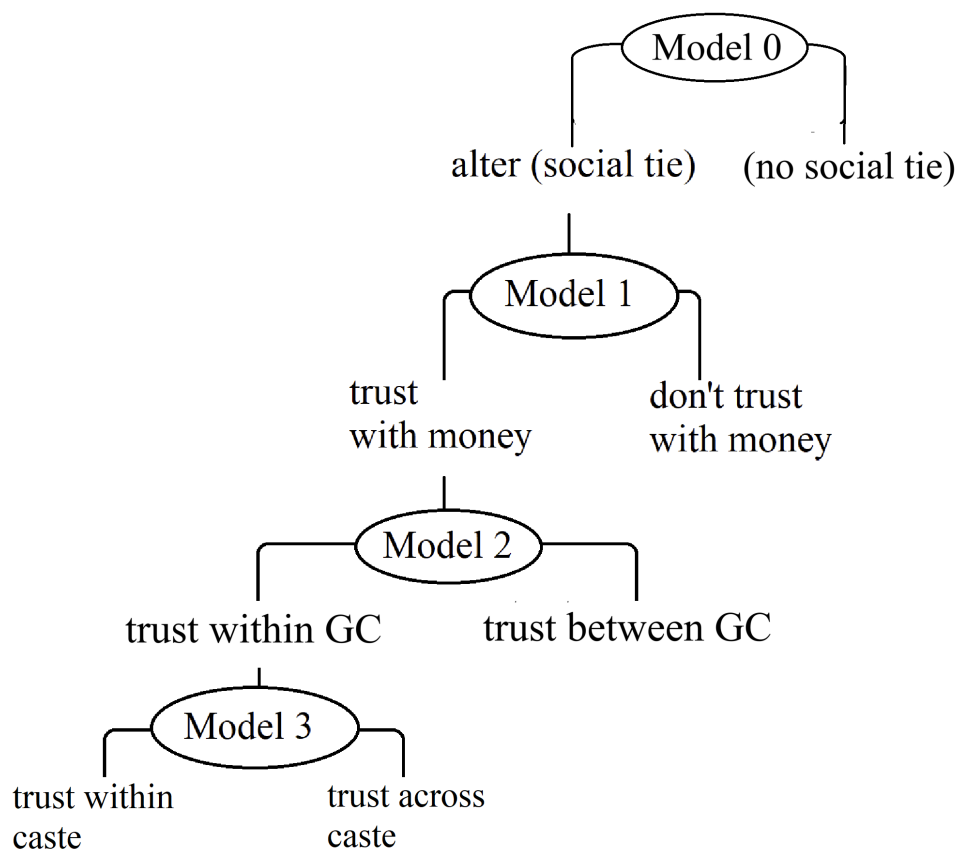


Figure 2.15: Diagram showing the conditional nesting of the multinomial logit and conditional log-linear models

Conditional logit models

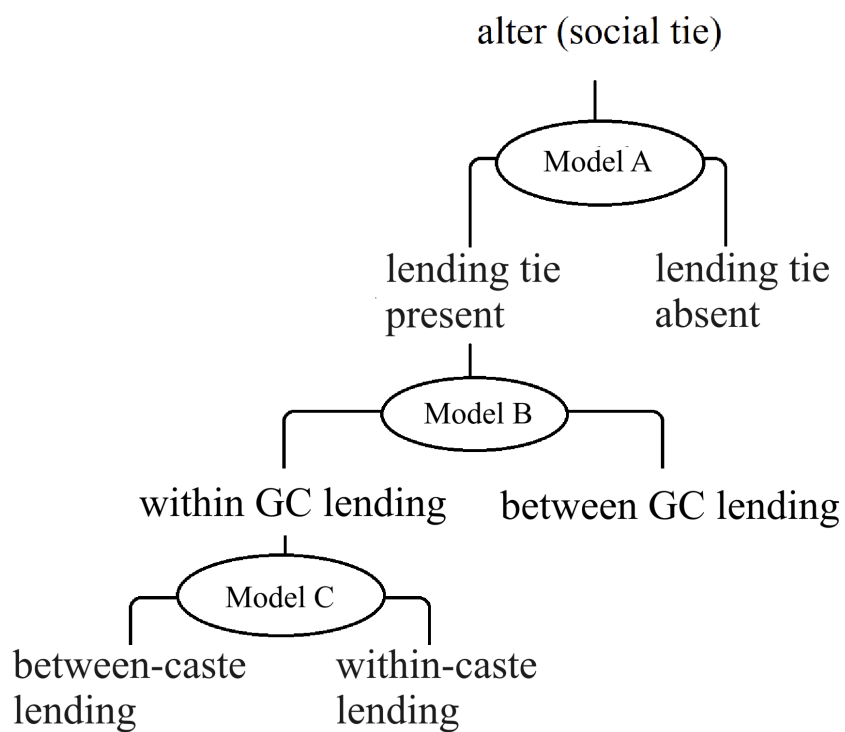


Figure 2.16: Diagram showing the conditional nesting of the three conditional logit models

2.8.4 Appendix D: On Models A, B, and C

It may seem counterintuitive to have both tie presence and tie type be variables in some of our models, as it may be confusing to think of what it means for a tie type variable to have any value when the tie is absent (i.e. when the tie presence variable is 0). These confusions can be dispelled by analyzing this problem from the log-linear modeling perspective. For simplicity, we will use the example of a log-linear model for 2×2 contingency tables. Consider the contingency table for cross-GC tie and ego having a bank account, conditional on ego having reported a lending money tie to alter:

	no bank account	has bank account
in same GC	1795	1399
in different GC	7174	5591

This is a table that, for every observed lending money tie, counts whether it is a within- or cross-GC tie, and whether ego has a bank account or not. In the log-linear framework, we are interested in modeling the probability of an observed tie being in each cell of the table, or, equivalently, the expected number of observations in each cell. Under the assumption that these counts are independent observations of Poisson distributions, it is straightforward to test the association between the two variables with a chi-square test, and in this case the test would fail to reject the null hypothesis of no association ($p = 1$). The substantive interpretation is that we cannot reject the claim that ego's having a bank account is independent of whether his lending money ties stay within his caste or cut across caste. Now consider the following table:

	tie is absent	tie is present
lending kerosene/rice	4182453	21123
lending money	4187249	16327

This is a table that, for every *possible* reported lending tie, counts both whether it is actualized

and whether it is a lend money tie or a lend kerosene/rice tie. Importantly, the rows only indicate the type of tie being considered, and not whether it is realized. The reason that the entries in the tie absent column are non-zero is because they display the number of possible lending ties of that type that are not actualized in the data. Here the chi-square test would reject the null hypothesis of no association ($p < 0.01$). The substantive interpretation is that lend money ties and lend kerosene/rice ties are not equally likely to be reported between villagers in these data. In both cases, adding more variables introduces more layers of interpretation (by conditioning on more variables in a contingency table), but the essential interpretation of the association between tie type and tie presence would remain the same.

2.8.5 *Appendix E: Is This Just A Rich-To-Poor Transfer of Resources?*

One way to interpret inter-GC and inter-caste lending is as a transfer of resources from better off to less well off groups. We contest this interpretation by presenting the proportion of ties that go to an alter that has a better, equal, and worse quality roof. Most ties are to someone with the same quality roof, and the better and worse quality roof proportions are very similar. We find this result for both lending money and lending kerosene/rice.

ego roof relative to alter (lending money)	Freq
alter has better roof	0.1325197
alter has same quality roof	0.7234372
alter has worse roof	0.1440431

ego roof relative to alter (lending kerosene/rice)	Freq
alter has better roof	0.1262956
alter has same quality roof	0.7317179
alter has worse roof	0.1419866

CHAPTER 3

THE EFFECTS OF TWO DIFFERENT FORMS OF SOCIAL EXCHANGE ON PROSOCIALITY BEYOND THE DYAD - A PILOT STUDY

3.1 Introduction

The exchange of valued resources between persons is one of the building blocks of society, and the focus of social exchange theory (Cook et al. 2013). Beyond the material benefits of such exchange, social exchange theorists have studied the emotional and affective results of social exchange processes (Lawler, Thye, and Yoon 2000; Lawler 2001), and the ways in which any particular exchange dyad is affected by its embedding in other exchange relations. These themes are relevant to the goal of this dissertation: contributing to our understanding of how the exchange of resources is related to interpersonal affective bonds. This chapter reports the results of an experiment that compares two different forms of direct (i.e. dyadic) social exchange, negotiated and reciprocal exchange, and tests their ability to produce prosocial behavior towards people outside of the original dyad (what will be called *extra-dyadic* prosocial behavior).

Participants will be randomly assigned to engage in either reciprocal or negotiated exchange with a fixed partner. After performing a series of social exchanges, participants will be randomly paired with a new partner and play an iterated prisoner's dilemmas, an experimental game where players have the opportunity to cooperate and maximize their mutual benefit, despite an individual incentive to not do so (i.e. to defect in the game). This chapter presents the results of a pilot study, where the full study will provide evidence for which of the two dyadic exchange forms is more likely to produce extra-dyadic prosocial behavior. The results will also demonstrate how the effect of exchange type on extra-dyadic prosocial behavior is mediated by the affective outcomes characteristic of the exchange types.

3.2 Literature Review

The relationship between the structure of economic relations and individual behavior is one of the oldest concerns of our discipline (Weber 2013 [1930]). This chapter experimentally studies the relationship between certain forms of economic exchange and individual prosocial behavior, joining recent work that takes a similar approach (Nee, Holm, and Oppen 2018). While much research on this relationship follows the Weberian approach, studying how cultural phenomena such as ideas and sentiments drive changes in economic behavior (Bokanga, Rohr, and Martin 2025), this chapter follows the social exchange tradition in examining the other side of this relationship: the way in which economic exchange produces sentiments. Social exchange has been shown to generate norms of reciprocity (Fehr et al. 1998) and feelings of trust and solidarity (Harkness et al. 2022), both of which contribute to extending one's concern and cooperation toward broader sets of possible interaction partners (Baldassarri and Abascal 2020; Yamagishi 2011). The tools of the social exchange paradigm have the potential to discern the mechanisms that explain the correlations between market integration and cooperation in experimental social dilemmas (Henrich et al 2005).

This chapter compares negotiated and reciprocal exchange. Negotiated exchange is a form of direct exchange where two actors engage in a joint decision-making process on the terms of the exchange, and resources only change hands if the participants mutually agree to the terms. Reciprocal exchange is a form of direct exchange where two actors unilaterally decide whether to give some resource to their partner, and in what amount (Cook et al. 2013; Molm 2003). Although present in other social contexts, negotiated exchange is characteristic of most modern day economic exchanges that are not over goods with a fixed price (Kuwabara 2011; Molm 2003, 2006). Reciprocal exchange is important for building trust and solidarity (Molm, Takahashi, and Peterson 2000), but it usually takes the form of scripted rituals in a way that market exchange often does not, especially when it is the primary basis of a society's economic organization (Lévi-Strauss 1944; Mauss 1923; Ringel 1979). Given this difference, exposure to negotiated exchange should be a better proxy for the experience of market exchange than exposure to reciprocated exchange. In particular, negotiated exchange is characteristic of the forms of market exchange that regularly occur in the

Global South contexts that were originally studied by market integration researchers (Ensminger 2004; Henrich 1997; McElreath 2004).

Despite some conflicting findings (Lawler, Thye, and Yoon 2008), the weight of the evidence from social exchange research suggests that reciprocal exchange produces stronger feelings of trust and attachment within a dyad than negotiated exchange (Molm, Collett, and Schaefer 2007; Molm, Melamed, and Whitham 2013; Molm, Schaefer, and Collett 2009; Molm, Whitham, and Melamed 2012; Molm, Schaefer, and Collett 2007), in part because networks of reciprocal exchange are more likely to be perceived by participants as *groups* to which they belong (Savage and Sommer 2016). While this can reliably produce prosocial behavior within a given dyad, it is unclear what effects this has on prosocial behavior towards those outside of that dyad. There is little evidence that the trust and solidarity built in reciprocal exchange persists into new forms of exchange, much less into new relations (Cheshire, Gerbasi, and Cook 2010). In particular, the production of feelings of group belonging can actively harm extra-dyadic relations. Evidence from multiple social science disciplines suggests that in- and out-group boundaries are a barrier to cooperation (Aksoy 2020; Balliet, Wu, and De Dreu 2014; Chen and Li 2009; Tarrant et al. 2012; Triplett 2012), so it could be that the affective attachments produced by reciprocal exchange are precisely what hamper extra-dyadic prosocial behavior. However, it could also be the case that perceptions of interpersonal conflict that are adaptive for negotiated exchange (Kuwabara 2011) are carried into other interactions in a way that hampers extra-dyadic prosocial behavior (Peysakhovich and Rand 2016).

To supplement the study of how extra-dyadic factors affect exchange (van Assen 2010; Borgatti and Everett 1992; Harrell and Quinn 2023; Robbins et al. 2014; Skvoretz and Lovaglia 1995), this chapter studies the extra-dyadic outcomes of exchange in a slightly different way than previous literature. While the social exchange literature has so far focused on the effects of exchange network structure on dyadic outcomes (Bonacich and Bienenstock 2009; Cook, Cheshire, and Gerbasi 2006; Emerson 1962), and the effect of the multiplexity of dyadic ties on their outcomes (Kuwabara, Luo, and Sheldon 2010), this chapter studies the effect of a dyadic relationship on behavior outside of a previous exchange context, in a setting with different situational properties (Kelley et al. 2003).

The structure of negotiated exchange is quite different from that of a prisoner’s dilemma, while a reciprocal exchange is similar to a prisoner’s dilemma with the exception that players have more than two options.

Leveraging the tools of social exchange theory allows us to experimentally manipulate the conditions of resource exchange, a luxury that observational research in this domain does not have. Market integration of persons, for example, is a deeply non-random process, and comparisons of game behavior in settings that differ in their level of market integration is informative but not conclusive. In addition, this non-randomness makes it difficult to untangle the effect of embeddedness in a particular form of economic organization from other variables like income, wealth, or differences in the expected benefits of cooperating with strangers in societies that vary in how much markets dominate economic organization (Banfield 1958; Polanyi 2001 [1944]; Swedberg 2003). This chapter exploits the benefits of experimental research, employing a design strategy very similar to Peysakhovich and Rand (2016): I immerse the experimental participants in artificial settings that mimic the features of the real world process of interest (i.e. exchange of resources via reciprocal or negotiated exchange), and then use another experimental situation to compare the behavior of the two treatment groups. Although this doesn’t guarantee the external validity of findings, this approach, if internally valid, can generate insights that could be tested in more realistic settings.

3.3 Data and Methods

3.3.1 Data Collection

This chapter reports the results of a pilot study that submits 8 experimental participants to the experimental procedures that are described below. The goal of the full study will be to compare the effects of negotiated and reciprocal exchange on cooperation in a novel setting. The full study will recruit 500 experimental participants on Prolific, an online crowdsourcing that allows researchers to cheaply recruit human participants to perform experiments. All of the participants in the pilot study are from the United States, and the full study will form a representative sample of the country.

To ensure data quality, only participants with an approval rate of at least 95% will be allowed to participate in the full study. The experiment was coded in oTree, a Python-based framework that is commonly used for online behavioral experiments, and then deployed to Heroku, a commercial cloud hosting provider. In the experiment, participants move through a series of webpages and make their decisions by clicking options on the webpage or typing amounts to exchange into a text box. The recruited participants filled out an initial demographic survey, and then randomly paired with each other and subjected to either reciprocated or negotiated exchange. The social exchange phase of the experiment is called Phase 1. After Phase 1, and the post-phase 1 affect survey (which will be described below), the participants move to Phase 2, where they play an iterated prisoner's dilemma with a new partner, one with whom the participant did not exchange in Phase 1.

3.3.2 Experimental Procedures

The initial demographic survey asked for information on the following individual-level covariates: age, gender, and years of education. These control variables were chosen because they are either likely to predict cooperation in social dilemmas (Brañas-Garza, Capraro, and Rascón-Ramírez 2018; Peshkovskaya, Babkina, and Myagkov 2019; Sell 1997), or because they are likely to predict factors that are associated with cooperation in social dilemmas, like trust (Alesina and La Ferrara 2002; Simpson, McGrimmon, and Irwin 2007). After the survey, the participants began Phase 1. In both Phase 1 conditions, at the start of each round, participants are given an initial endowment of one of two different resource types (labelled X and Y), both worth a certain amount of points which are redeemable for real money at the end of the experiment. In both cases, there is a conversion rate between the two resource types that makes exchange potentially more valuable than simply keeping the original endowment. In the negotiated exchange condition, participants are given the opportunity to exchange their respective resources at whatever quantities they mutually determine. They are given one minute to come to an agreement, otherwise an exchange does not occur that round. Any remaining resources that the participants did not exchange are also included in their final payoff. In the reciprocated exchange condition, players take turns choosing to give some

amount of their resource (possibly none) to their partner. For both exchange types, participants played four practice rounds to learn how the exchange interface works, followed by sixteen rounds for real money.

The negotiated exchange condition described here departs from how it is usually operationalized. It is common for players in negotiated exchange studies to simultaneously negotiate the division of a fixed pool of money (Lawler and Yoon 1993; Molm, Peterson, and Takahashi 1999, 2001; Molm, Takahashi, and Peterson 2003). However, fixed pool divisions are theoretically and practically different from negotiated exchanges (Dijkstra and Van Assen 2008). Taking this into account, this chapter uses, following Harkness and her colleagues (2022), a pure exchange operationalization. This operationalization provides a more realistic simulation of negotiated exchange as it occurs in economic life.

After the social exchange rounds, participants completed a series of 7-point Likert scales on feelings of trust in, affective regard toward, and solidarity with their exchange partner, as is common in social exchange research (Harkness et al. 2022; Kuwabara 2011; Lawler and Yoon 1996; Molm et al. 2012). The trust questions included how much the participant trusted their partner, and how trustworthy and reliable they found their partner. The affective regard questions included how positively they felt toward their partner, and how nice and cooperative they found their partner to be. The solidarity questions included to what degree they found their exchange relationship to involve conflicting interests, and the degree to which they found their partner's *motives* to be cooperative. For each of the three outcomes considered here (trust, affective regard, and solidarity), factor analysis was used on the responses to confirm that the questions load on the same dimension.

After Phase 1 and the 7-point Likert scales, Phase 2 begins. In Phase 2, participants played an iterated prisoner's dilemma game with a randomly assigned new partner. The prisoner's dilemma (PD) is a strategic game where both players have the option to take an action that could lead to maximum mutual benefit or minimum personal benefit ("cooperate"); or take an action that could either lead to maximum individual benefit or lead to minimum mutual benefit (see Table 3.1 for an example visualization). From the perspective of a selfish player, no matter what the other player

does, it is always better to defect than to cooperate. The PD is, therefore, a measure of player willingness to perform an action that could possibly lead to maximum mutual benefit, when selfishness would dictate that they take the action that is guaranteed to maximize individual benefit regardless of the other player's choice, even if that would result in the other player receiving the worst possible outcome. In other words, the effect of the exchange type treatment on player choice in the PD can be interpreted as the effect of a certain exchange type on a player's prosocial behavior to a novel interaction partner. This study differs from the work of Harkness and her colleagues (2022) by using the standard prisoner's dilemma rather than Yamagishi and colleagues' (2005) prisoner's dilemma with variable dependence, as the latter is a setting in which it is easier for humans to cooperate.

Table 3.1: Example prisoner's dilemma; payoff ordering is $T > R > P > S$; every cell is an ordered pair showing (Agent A's payoff, Agent B's payoff) as a result of both agent's choices

	Cooperate	Defect
Cooperate	(R,R)	(S,T)
Defect	(T,S)	(P,P)

3.3.3 Hypotheses

While previous literature makes competing predictions as to which form of dyadic exchange will produce more cooperation in Phase 2, the literature is more clear on which form of exchange will produce more trust, affective regard, and dyadic solidarity. The first hypothesis, therefore, pertains to which form of exchange will produce higher levels of these relational outcomes. The remaining hypotheses pertain to the effect of the exchange types on cooperation in Phase 2, and how trust, affective regard, and dyadic solidarity are related to the effect of the exchange types.

H1: Reported trust, affective regard, and dyadic solidarity will be higher for participants who engaged in reciprocal exchange than for those who engaged in negotiated exchange (i.e. those in the reciprocal exchange condition will have a higher average score on the Likert scales of reported trust, affective regard, and dyadic solidarity)

H2a: Participants who engaged in reciprocal exchange will cooperate in more rounds of the iterated PD than those who engaged in negotiated exchange (i.e. the main effect of reciprocal exchange on PD cooperation will be positive)

H2b: Participants who engaged in negotiated exchange will cooperate in more rounds of the iterated PD than those who engaged in reciprocal exchange (i.e. the main effect of reciprocal exchange on PD cooperation will be negative)

H3: The effect of exchange type in Phase 1 on cooperation in Phase 2 will be mediated by the trust, affective regard, and dyadic solidarity measures.

3.3.4 Analysis Plan

This chapter reports an experiment with one binary treatment. To analyze the experimental data, the frequency of cooperation, a variable indicating the number of rounds in which a participant cooperates in the iterated prisoner's dilemma of Phase 2, will be modeled using cross-classified hierarchical linear regression, with an indicator variable for the participant's Phase 1 exchange type condition being the independent variable of interest, and accounting for the nesting of participants into exchange dyads and prisoner's dilemma dyads. Phase 1 earnings, relational outcomes from the post-Phase 1 survey, and individual demographics from the post-Phase 2 survey will also be used as control variables. The model coefficients will be used to test the hypotheses.

3.4 Results

As stated before, this chapter reports the results of an 8 person pilot study. When the data from the full study are collected, some of the results will resemble the following table and chart. Figure 3.1 and Table 3.2 use the pilot study sample.

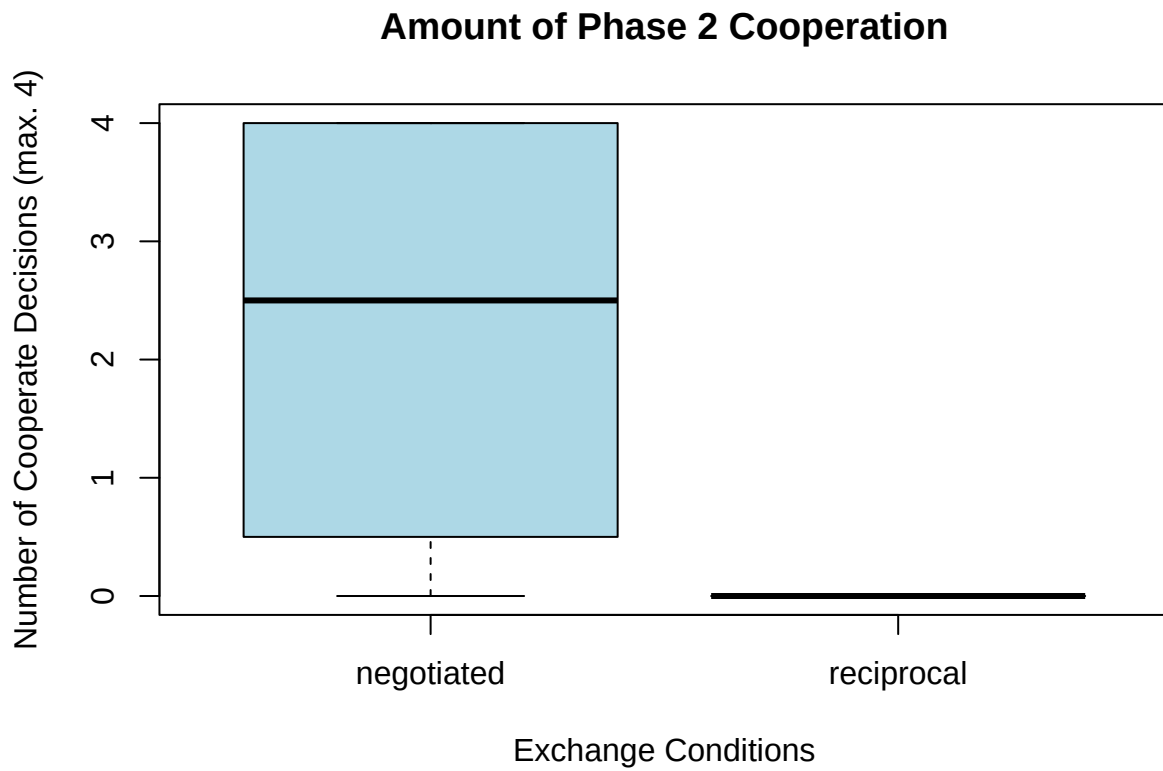


Figure 3.1: Example box plot with pilot study data

Table 3.2: Example Regression Table With Pilot Study Data

	Dependent Variable - Amount of Phase 2 Cooperation		
	number of cooperate decisions		
	(1)	(2)	(3)
treatment: reciprocal	-2.250 (1.031)	0.449 (1.773)	-0.193 (1.979)
phase 1 earnings (in dollars)			-0.012 (0.013)
age (in years)		-0.139 (0.109)	-0.160 (0.116)
gender: male		1.077 (1.176)	1.513 (1.316)
gender: non-binary or other		3.375 (1.749)	3.921 (1.920)
Constant	2.250* (0.729)	6.310 (4.441)	9.065 (5.527)
Observations	8	7	7
R ²	0.443	0.830	0.908
Adjusted R ²	0.350	0.491	0.446
Residual Std. Error	1.458 (df = 6)	1.348 (df = 2)	1.407 (df = 1)
F Statistic	4.765 (df = 1; 6)	2.446 (df = 4; 2)	1.964 (df = 5; 1)

Note:

*p<0.05; **p<0.01; ***p<0.001

CHAPTER 4

ON THE STRUCTURE OF OTHER-REGARDING PREFERENCES

4.1 Introduction

Both in real life and in experimental studies, people behave prosocially and cooperate in social dilemmas more than a model of completely rational self-interest would suggest (Camerer and Fehr 2006; Henrich et al 2005; Marwell and Ames 1981). This discrepancy between theory and observation has prompted social scientists to posit social preferences, preferences that take into account the material outcomes of others (Andreoni 1995; Cooper and Kagel 2016). Social or distributional preferences are crucially important for the outcome of social dilemmas and collective action scenarios, as has been demonstrated theoretically (Fehr and Fischbacher 2002) and empirically (Moisan et al 2018; Murphy and Ackermann 2015). However, scholars continue to debate the degree to which social preferences are stable and trans-situational, such as the theory of social value orientations (Au and Kwong 2004; Murphy and Ackermann 2014) would suggest, or unstable and situationally dependent. Research in the latter camp suggests that some actors won't, for example, have a general preference for equitable outcomes regardless of the situation and who they are interacting with (Chen and Li 2009; Cohen and Hertz 2020).

The literature on social value orientations (or SVO: Bogaert, Boone, and Declerck 2008), presents us with a collection of experimental and observational findings that purport to establish that every person has a stable set of weights that they allocate to self's and other's outcomes in an interaction. Those weights trade off against each other in a way that allows an individual to be placed on the circle in Figure 4.1. SVO theory claims that individuals have a stable personality trait (Van Lange et al 1997) that defines where they exist on this circle of tradeoffs between self- and other-payoffs. Previously studied SVO categories, such as altruistic, cooperative, individualistic, and competitive (Deutsch 1960; McClintock 1972), are special cases that exist on specific points on the SVO circle. While SVO can be measured in many different ways (Au and Kwong 2004; Bakker and Dijkstra 2022), the different measurement methods can still be conceptualized as

placing respondents on the same SVO circle.

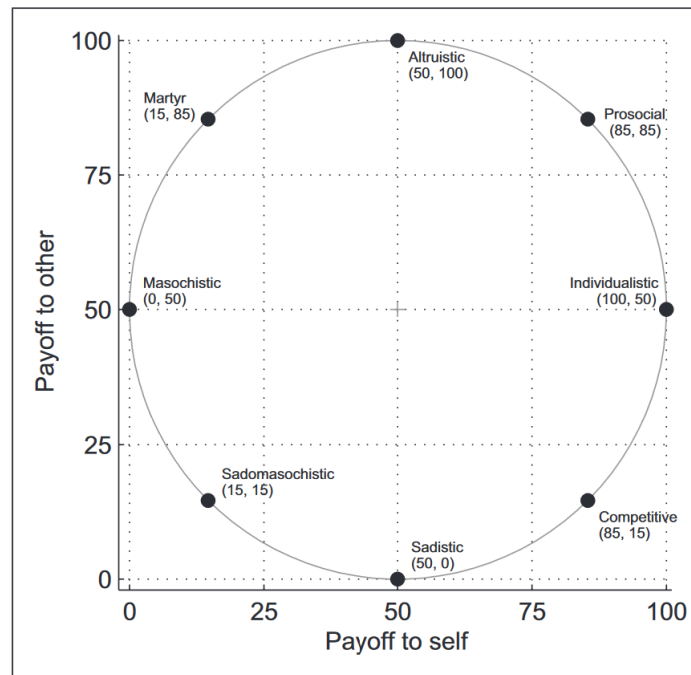


Figure 4.1: Graphical representation of Social Value Orientation (SVO) from Murphy and Ackermann (2014)

The claim that SVO is a stable personality trait is mainly inferred from two bodies of evidence. First, SVO has been shown to have very high test-retest reliability (Fernandes, Bakker, and Dijkstra 2022 find an intra-class correlation coefficient of 0.78 in a 6-month long study of monthly SVO measurements). Second, SVO has been shown to predict many aspects of prosociality. It generally predicts cooperation in social dilemmas (Balliet, Parks, and Joireman 2009; Yamagishi et al 2013), the use of more prosocial heuristics in exchange settings (De Dreu and Boles 1998), preferences for fair distributions of outcomes (van Dijk, De Cremer, and Handgraaf 2004), empathy and mind-reading (Declerck and Bogaert 2008), patterns of information search with respect to self and other's outcomes (Van Lange et al 1997), and outside-the-lab behaviors such as commuting via public transit or driving a personal car (Van Vugt, Meertens, Van Lange 1995; Van Vugt, Van Lange, Meertens 1996). SVO has been shown to moderate the effect of time pressure on cooperation (Mischkowski and Glockner 2016), contributing to findings that pertain to how quickly we default to cooperation in interdependent situations (Alós-Ferrer and Garagnani 2020; Rand 2016).

Despite these impressive findings, there is evidence that even measured SVO can vary by factors that are known to affect prosocial behavior. For example, Aksoy finds that measured SVO can depend on whether a person is interacting with an alter in their in-group or their out-group (Aksoy 2019, 2020). This finding is consistent with a broader literature on the effect of group boundaries on prosocial behavior, such as race (Chen and Li 2009; Saucier 2015; Triplett 2012) and political party (Kranton and Sanders 2017). Social preferences have also been shown to vary by individual beliefs about how others will behave (Aksoy and Weesie 2012, 2013a, 2013b, 2014), decisions made by interaction partners (Ackermann and Murphy 2019), and how the individual perceives the interdependence of her own and others' outcomes in a situation (Gerpott et al 2018). There is also evidence that measured SVO doesn't impact exchange behavior when subjects occupy different power positions (Lewis and Willer 2017).

These contrary findings imply that, while people *can* hold stable social preferences, the weighting of others' outcomes are different across persons, and this differential weighting is likely to be a function of the different ways in which people are interdependent (e.g. the dependence of an individual to their group, as against other groups). However, there is a further aspect of interdependence that matters for social preferences that has received less attention in the literature, and that is the transitive nature of other-regarding. To take a simple example, if person A values the utility of person B, and person B values the utility of person C, then person A must, to some degree, value the utility of person C, (because C's utility matters for B, and B's utility matters for A). If agents find themselves in a network of other-regard, and they are computing their utilities in a way that respects transitive closure, how will that network of other-regard change over time, under what conditions will it reach an equilibrium, and how will that equilibrium be shaped by the structure of the initial distribution of concern among the agents? This chapter will answer these questions by proposing a simple model of interdependent preferences, analyzing the equilibria for a few simple classes of concern distribution, and applying those equilibria to two well-studied social dilemmas.

4.2 The Model

This chapter builds on Coleman's (1990) idea of the expansion of self-interest and Krackhardt's (1998) model of endogenous preference change. Coleman discusses ways in which the object self, the self that receives signals from the environment and experiences satisfaction, can come to include other social entities in its interest, thereby increasing the alignment between the environment and the agent's interests. A straightforward way to model this is by using Krackhardt's model of preference change. Krackhardt's model is simple: allow an individual's utility for a given good or outcome to be a weighted function of their personal utility and a weight from the utility of some set of alters in a network. More formally, an individual i 's utility for a good or outcome at time t , $U_t(i)$, is influenced by $W_{i,j}$, where j is some alter. All together:

$$U_t(i) = \sum W_{i,j} U_{t-1}(j)$$

The utilities for all actors at time t can be expressed as a vector weighted by the weight matrix W . Over time, W continues to influence the vector of utilities U , which is represented by exponentiation, allowing us to see how actors' utilities for outcomes or goods evolve as a result of other-regard. Given an initial set of utilities U_0 , we can determine if the influence process leads to a steady state for the utilities:

$$\lim_{k \rightarrow \infty} U_k = \lim_{k \rightarrow \infty} W^k U_0$$

Thus we have a weighted network of interpersonal concern, where the nodes are agents in a social group that have a limited amount of concern to spread between themselves and others (see Figure 4.2 for an example network). We represent the finitude of every agent's concern with what is called a "row-stochastic" matrix W , a matrix where the rows sum to unity. Furthermore, the agents update the concern they place on other agents by applying transitive closure to their distribution of concern (represented by matrix exponentiation), and this updating process may or may not reach

some steady state. We go on to review some of the well-known mathematics that determine the existence of the steady state before discussing some novel results on how the structure of the weight matrix determines how other-regard will be distributed in the steady state.

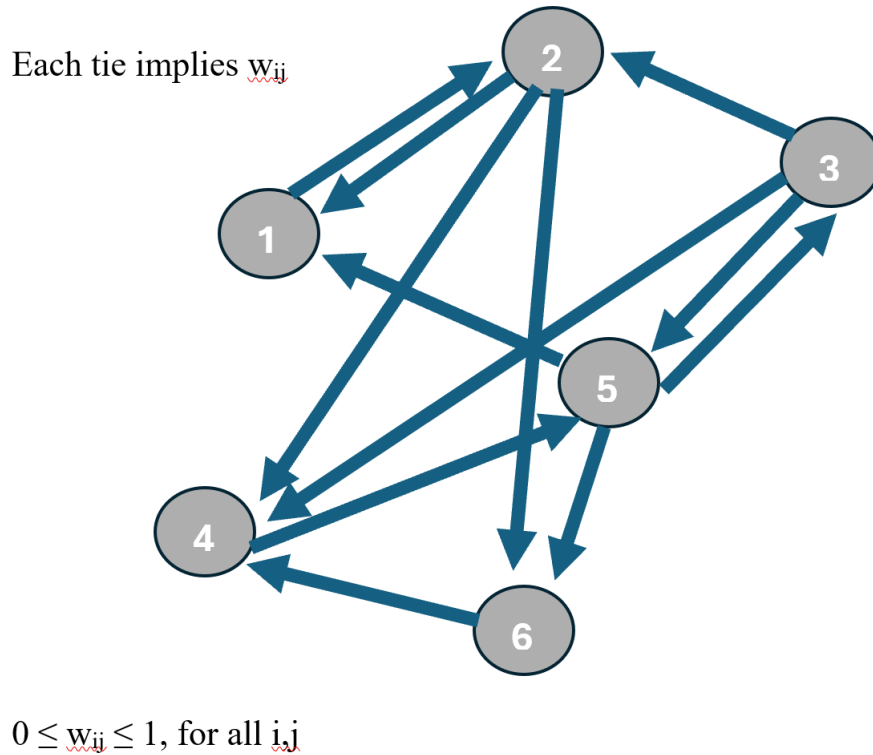


Figure 4.2: Example of a weighted network of interpersonal with 6 nodes

4.3 Known Results

While we don't have to interpret the updating process as an *influence* process per se, we can borrow some well-known mathematics of influence processes to understand the limiting behavior of the updating process. We are interested in finding $\lim_{k \rightarrow \infty} W^k$, which we may refer to as W^∞ . In order to find this, it is helpful to find a *diagonalization* for W such that $W = CDC^{-1}$, where C is invertible and D is a diagonal matrix. This is computationally easier to exponentiate, as $(CDC^{-1})^k = CD^kC^{-1}$ and the diagonal entries of D^k are $d_{i,i}^k$ for $i = 1, \dots, n$. The eigendecomposition of the matrix is a privileged example of this, where we find that $W = SAS^{-1}$, where

S is a matrix whose columns are the eigenvectors of W , and Λ is a diagonal matrix where the diagonal elements are the eigenvalues of W . Diagonalization is closely related to the eigensystem of a matrix because in order for a matrix to be diagonalizable, it must have a basis consisting of its eigenvectors, i.e. it must have a set of linearly independent eigenvectors that span its respective vector space (Axler 2024: 165). Unfortunately, not all stochastic matrices are diagonalizable, as there is no guarantee that a stochastic matrix will have such a set of eigenvectors. If the eigenvectors of a stochastic matrix aren't all linearly independent, then the matrix S won't be invertible, making it impossible to obtain $S\Lambda S^{-1}$.

The next best thing is to use the Jordan form of the matrix, which is a generalization of diagonalization. In this case, we would have $W = PJP^{-1}$ where P is a matrix whose columns are the *generalized* eigenvectors of W . As a reminder, an eigenvalue λ of a matrix M is a root of M 's characteristic polynomial, a solution to $\det(M - \lambda I) = 0$. For a given eigenvalue λ of a matrix M , the eigenvectors of λ are the vectors v that satisfy $Mv = \lambda v$, or, equivalently, $(M - \lambda I)v = 0$. In other words, the set of eigenvectors of an eigenvalue λ is the *nullspace* of $M - \lambda I$ (which we write as $N(M - \lambda I)$), the set of vectors that, when multiplied to $M - \lambda I$, produce 0. For this reason, $N(M - \lambda I)$ is also called the *eigenspace*. In contrast, the *generalized* eigenvectors are those that, for a given eigenvalue λ , are the vectors v that satisfy $(M - \lambda I)^k v = 0$, for some positive integer k . It is the generalized eigenvectors that form the columns of P , and these are guaranteed to be linearly independent, as they form a basis of $N((M - \lambda I)^k)$ (Axler 2024: 303; Meyer 2000: 594). The matrix J in the Jordan form decomposition of W is as follows:

$$P^{-1}WP = J = \begin{pmatrix} J(\lambda_1) & 0 & \cdots & 0 \\ 0 & J(\lambda_2) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & J(\lambda_p) \end{pmatrix}$$

Each of those $J(\lambda_i)$ terms is a *Jordan segment*, which corresponds to an eigenvalue. However, eigenvalues can be repeated, so $J(\lambda_i)$ further decomposes into k *Jordan blocks*:

$$J(\lambda_i) = \begin{pmatrix} J_1(\lambda_i) & 0 & \cdots & 0 \\ 0 & J_2(\lambda_i) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & J_k(\lambda_i) \end{pmatrix}$$

Where the k is the dimension of $N(W - \lambda_i I)$.

In other words, each eigenvalue has a number of Jordan blocks that corresponds to the number of dimensions spanned by its respective eigenvectors. Each of the Jordan blocks has the form:

$$J_*(\lambda_j) = \begin{pmatrix} \lambda_i & 1 & & \\ & \lambda_i & 1 & \\ & & \ddots & 1 \\ & & & \lambda_i \end{pmatrix}$$

Where the largest Jordan block in the Jordan segment $J(\lambda_i)$ has a number of rows and columns equal to the index of λ_i .

It is important to note that while P is the matrix of generalized eigenvectors, the value of k for which the eigenvector is a basis for $N((W - \lambda I)^k)$ is not the same for each eigenvalue. In fact, $\lambda = 1$ is privileged for row-stochastic matrices. $\lambda = 1$ is always an eigenvalue, and it is a semi-simple eigenvalue (Meyer 2000: 696). This means that its algebraic multiplicity (its exponent in the characteristic polynomial) and its geometric multiplicity (the dimension of $N(M - \lambda I)$) are equal. The index of λ is the size of the largest Jordan block corresponding to λ . An eigenvalue gets one Jordan block per dimension of its eigenspace. This means that the Jordan form will have n blocks for that eigenvalue, and each block be a 1×1 block with that eigenvalue, making the Jordan segment for $J(\lambda = 1)$ the identity matrix, making the Jordan form of a row-stochastic matrix the following:

$$J = \begin{pmatrix} I_{p \times p} & 0 \\ 0 & K \end{pmatrix}$$

Where K is a block corresponding to all the Jordan segments for eigenvalues that aren't 1.

The question, then, for whether J converges, is whether K^k converges, and here we can borrow the well-known results that K converges if it contains eigenvalues that are less than 1, in which case it converges to zero. Otherwise, it will contain eigenvalues that are greater than 1, and it will not converge (Meyer 2000: 617). This gives us a closed form expression for $\lim_{k \rightarrow \infty} W^k$:

$$\lim_{k \rightarrow \infty} W^k = \lim_{k \rightarrow \infty} P \begin{pmatrix} I_{p \times p} & 0 \\ 0 & K^k \end{pmatrix} P^{-1} = P \begin{pmatrix} I_{p \times p} & 0 \\ 0 & 0 \end{pmatrix} P^{-1}$$

To simplify this further, we can partition P and P^{-1} according to the columns (and rows) which correspond to $\lambda = 1$: $P = \left(P_1 \mid P_2 \right)$ and $P^{-1} = \begin{pmatrix} Q_1 \\ Q_2 \end{pmatrix}$. This gives us:

$$P \begin{pmatrix} I_{p \times p} & 0 \\ 0 & 0 \end{pmatrix} P^{-1} = \left(P_1 \mid P_2 \right) \begin{pmatrix} I_{p \times p} & 0 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} Q_1 \\ Q_2 \end{pmatrix} = P_1 Q_1 = G$$

We have established that $W^\infty = G$. We can treat G as a projection matrix that maps the initial utility vector U_0 onto the nullspace of $(M - \lambda I)$. Given two complementary subspaces X and Y of vector space V , there exists a unique linear operator (represented by a matrix P), such that any $v \in V$ can be uniquely expressed as $v = x + y$, where $x \in X$ and $y \in Y$, and where $Pv = x$, which is called the projector onto X along Y (Meyer 2000: 386). The subspaces X and Y of V are complementary if V is a *direct sum* of X and Y , which means that every $v \in V$ can be expressed as the sum of *unique* vectors $x \in X$ and $y \in Y$, and that $X \cap Y = 0$. The projector P also has a *complementary* projector $I - P$, which projects onto Y along X , i.e. that $(I - P)v = y$.

In the case of G , we can to express $\mathbb{R}^n$, the set of all n -dimensional vectors of real numbers, as the direct sum of the nullspace corresponding to our eigenvectors, $N(W - I)$, and the set of all vectors spanned by the columns of $(W - I)$, which is called the *range* of $(W - I)$ and denoted

as $R(M - I)$ (Axler 2024: 299). In other words, $W^\infty = G$ is the projection matrix that will take any U_0 and map it onto $N(W - I)$. This is intuitive for two reasons. First, projection matrices are idempotent (they are equal to their squares), which expresses the fact W^∞ is the convergence of the limit as $k \rightarrow \infty$. If W^∞ represents the steady state of the weight updating process, then it must be the case that exponentiating W further must not change W , a property that is assured by the idempotency of W^∞ as a projection matrix. Second, it is known that the projector is similar to the original matrix (i.e. $P = M^{-1}WM$ where M is an invertible matrix), meaning that the projector has the same characteristic polynomial (and therefore the same eigenvalues) as the original matrix. We will exploit these facts to derive closed form solutions for the equilibria.

A row-stochastic matrix W can be reducible (i.e. not representing a strongly connected graph), or irreducible (i.e. representing a strongly connected graph). If W is irreducible, then $\lim_{k \rightarrow \infty} W^k$ exists if and only if W is primitive, meaning it must have only one eigenvalue on its spectral circle. In this case, the Perron-Frobenius theorem guarantees that the limit will be $\frac{pq^T}{q^T p}$, where p is the leading eigenvector of W and q is the leading eigenvector of W^T (Meyer 2000). For non-negative row-stochastic matrices, this means that an irreducible matrix is primitive if it only has one eigenvalue with an absolute value of 1. The Perron-Frobenius theorem doesn't give guarantees on convergence if W is reducible, so determining convergence (or the lack thereof) requires permuting the matrix such that it can be divided into blocks of row-stochastic sub-matrices in the so-called canonical form: $W = \begin{pmatrix} T_{1,1} & T_{1,2} \\ 0 & T_{2,2} \end{pmatrix}$.

The canonical form is obtained in the following way. The weight matrix W can be symmetrically permuted using permutation matrix Q such that $W \sim Q^T W Q = \begin{pmatrix} W_{1,1} & W_{1,2} \\ 0 & W_{2,2} \end{pmatrix}$, where $W_{1,1}$ and $W_{2,2}$ are both square. This procedure is equivalent to relabeling the nodes, while preserving the structure of the weight network. This essentially decomposes W into square submatrices that may be reducible or irreducible. We continue the process until we fully decompose W into irreducible submatrices to obtain the following form:

$$W \sim \begin{pmatrix} W_{1,1} & W_{1,2} & \cdots & W_{1,k} \\ 0 & W_{2,2} & \cdots & W_{2,k} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & W_{k,k} \end{pmatrix}$$

Where every square submatrix $W_{i,j}$ is either irreducible or a 1x1 matrix of zero: $[0]_{1,1}$. The final step is to switch all the rows that only contain non-zero elements in their diagonal blocks to the bottom of the matrix, leaving W in the canonical form:

$$W \sim \left(\begin{array}{cccc|cccc} W_{1,1} & W_{1,2} & \cdots & W_{1,r} & W_{1,r+1} & W_{1,r+2} & \cdots & W_{1,k} \\ 0 & W_{2,2} & \cdots & W_{2,r} & W_{2,r+1} & W_{2,r+2} & \cdots & W_{2,k} \\ \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & W_{r,r} & W_{r,r+1} & W_{r,r+2} & \cdots & W_{r,k} \\ \hline 0 & 0 & \cdots & 0 & W_{r+1,r+1} & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 & 0 & W_{r+2,r+2} & \cdots & 0 \\ \vdots & \vdots & \cdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 & 0 & 0 & \cdots & W_{k,k} \end{array} \right) = \begin{pmatrix} T_{1,1} & T_{1,2} \\ 0 & T_{2,2} \end{pmatrix}$$

Each diagonal block $W_{i,i}$ in the canonical form corresponds to a communicating class, as every node represented by that block can reach every other node within that block, and the off-diagonal blocks (the upper off-diagonal blocks of $T_{1,1}$ and all the blocks in $T_{1,2}$) represent probabilities that weight moves from one communicating class to another. However, the canonical form makes it clear that some communicating classes, specifically those in $T_{1,1}$ are a temporary location. All movement between rows is downward until you reach the blocks in $T_{2,2}$, wherein weight enters one communicating class and never leaves it. For this reason, the communicating classes in $T_{1,1}$ are called the *transient classes*, and those in $T_{2,2}$ are called the *ergodic classes*. There are r transient classes and $m - (r + 1)$ ergodic classes.

Importantly, a row-stochastic matrix will have at least one ergodic class, which means that there will always be a 0 and $T_{2,2}$ block. This is guaranteed from the fact that every row of a row-stochastic matrix will have at least one positive entry. If you create a sequence of nodes with indices $i_1, i_2, \dots, i_{n+1}$, you will have at least one repeat, meaning there will be at least one subgraph that is fully connected (Seneta 2006).

The blocks corresponding to the ergodic classes will converge to matrices with repeated rows. This can be seen from the fact that the leading eigenvector p of a row-stochastic matrix will always be the vector of 1s, which follows from the definition of the eigensystem as satisfying $Wx = \lambda x$ and W being row-stochastic. If $\lambda = 1$ is the leading eigenvector, then the eigenvalue equation is $Wx = 1x$, and the 1 vector uniquely satisfies the equation:

$$W \begin{pmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ 1 \end{pmatrix} = \begin{pmatrix} \sum_{j=1}^n w_{1j} \\ \sum_{j=1}^n w_{2j} \\ \cdot \\ \cdot \\ \sum_{j=1}^n w_{nj} \end{pmatrix} = 1 \times \begin{pmatrix} 1 \\ \cdot \\ \cdot \\ 1 \\ 1 \end{pmatrix}$$

In other words, because the rows sum to 1, multiplying W by the 1-vector is the same as multiplying 1 to the 1-vector. From this we know that the leading eigenvector of W will always be the 1-vector. It also follows that W^∞ will have repeating rows. The equilibrium matrix will match the formula $\frac{pq^T}{q^T p}$, with the denominator $q^T p$ being a scalar. Multiplying the 1-vector $p = (1, 1, \dots, 1)$ and q^T will always produce a matrix where each row is q^T :

$$\begin{pmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ 1 \end{pmatrix} \times (q_1 \ q_2 \ \dots \ q_n) = \begin{pmatrix} q_1 & q_2 & \dots & q_n \\ q_1 & q_2 & \dots & q_n \\ q_1 & q_2 & \dots & q_n \\ q_1 & q_2 & \dots & q_n \end{pmatrix}$$

Given that all of the blocks in T_{22} correspond to the ergodic classes, each with its a corresponding irreducible matrix, T_{22} will be block-diagonal where each block has the form of $\frac{pq^T}{q^T p}$. We will refer to this block-diagonal matrix as E .

In contrast, the blocks corresponding to the transient classes (those in T_{11}) will tend to 0. The diagonal blocks of T_{11} will tend toward zero, because they are irreducible matrices with an eigenvalue of less than 1 (because their rows sum to less than 1). This leads to T_{11} converging to zero, because all of its eigenvalues are 0 (as the eigenvalues of triangular matrices are the diagonal entries). All that remains is to find $T_{1,2}$'s limit, which we call Z . Z can be discerned from the fact that the $\lim_{k \rightarrow \infty} W^k = G$ is the projector onto $N(I - W)$ along $R(I - W)$. This means that for any vector $v \in \mathbb{R}^n$, $Gv = n$, where $n \in N(I - W)$, meaning that the columns of G span $N(I - W)$. If G 's columns form a basis for the eigenspace, the nullspace of $I - W$ (which is equal to the nullspace of $W - I$), then it follows that $(I - W)G = 0$. Using this fact, some algebra will give us an expression for Z :

$$(I - W)G = 0 \Rightarrow \begin{pmatrix} I - T_{1,1} & -T_{1,2} \\ 0 & I - T_{2,2} \end{pmatrix} \begin{pmatrix} 0 & Z \\ 0 & E \end{pmatrix} = 0 \Rightarrow \begin{pmatrix} 0 & (I - T_{11})Z - T_{12}E \\ 0 & E - T_{2,2}E \end{pmatrix} = 0$$

Solving for Z only requires that we pay attention to the top right block here, $(I - T_{11})Z - T_{12}E$. This must resolve to 0, so we do slightly more algebra:

$$(I - T_{11})Z - T_{12}E = 0 \Rightarrow (I - T_{11})Z = T_{12}E \Rightarrow Z = (I - T_{11})^{-1}T_{12}E$$

This gives us our final expression for G :

$$\lim_{k \rightarrow \infty} W^k = \begin{pmatrix} 0 & (I - T_{11})^{-1}T_{12}E \\ 0 & E \end{pmatrix}$$

4.4 New Results

4.4.1 Perfect Cycles

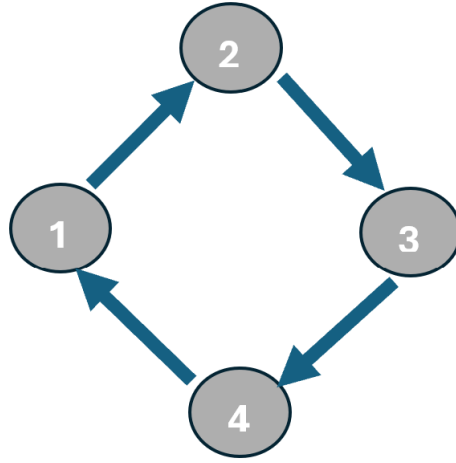
While all this is known from prior work, less is known about how specific network structures affect the equilibrium. This chapter will demonstrate how structural properties of the network of other-regard affects W^∞ . In some cases we will use the characteristic polynomials of the matrices alone to derive the equilibria; in other cases we will use the fact that W^∞ is the projector onto $N(I - W)$ along $R(I - W)$. The first example that will be discussed is the class of weight matrices that represent cycles (see Figure 4.3 for an example). In particular, we look at perfect cycles, an extreme situation in which the agents in the network only consider the utility of another agent, in a cycle. This situation is represented by a directed network where each person puts all their utility weight on the next person in the cycle. Consider this 4-person example:

$$C_{4 \times 4} = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{pmatrix}$$

This matrix is a special case of a circulant matrix, a matrix where every row is equal to the previous row, with the exception that every cell shifted once to the right:

$$C_{4 \times 4} = \begin{pmatrix} c_0 & c_1 & c_2 & c_3 \\ c_3 & c_0 & c_1 & c_2 \\ c_2 & c_3 & c_0 & c_1 \\ c_1 & c_2 & c_3 & c_0 \end{pmatrix}$$

Strang (2019) demonstrates that matrices of this form have the following eigenvalues, for the j^{th} eigenvalue, where $\omega = e^{\frac{2\pi i}{n}}$:



$$w_{12} = w_{23} = w_{34} = w_{41} = 1$$

Figure 4.3: Example of a 4-person perfect cycle

$$\lambda_j = \sum_{i=0}^{n-1} c_i \omega^{i \times j}$$

A cyclic graph's adjacency matrix will have rows where all the cells are 0 except for one cell which is 1. This is true of any cyclic graph, not just the 4×4 example shown above. A graph's adjacency matrix is square and will therefore have n eigenvalues, and the j^{th} eigenvalue will be ω^{j^2} because all the other terms will cancel out:

$$\lambda_j = \sum_{i=0}^{n-1} c_i \omega^{i \times j} = \sum_{i \neq j} c_i \omega^{i \times j} + c_j \omega^{j \times j} = (\sum_{i \neq j} 0 \times \omega^{i \times j}) + 1 \times \omega^{j \times j} = w^{(j^2)} = (e^{\frac{2\pi i}{n}})^{j^2} = e^{\frac{(j^2)2\pi i}{n}}$$

We can prove that λ_j always has an absolute value of 1 by exploiting Euler's formula to express it as $\lambda_j = e^{\frac{(j^2)2\pi i}{n}} = \cos(e^{\frac{(j^2)2\pi}{n}}) + i \times \sin(e^{\frac{(j^2)2\pi}{n}})$. This expression represents a point on the unit circle, which will have an absolute value of 1.

Every other-regard network that is a perfect cycle (i.e. every node places its full weight on the next node in the cycle) will have an adjacency matrix with eigenvalues that have an absolute value of 1. Because the network has an irreducible adjacency matrix *and* more than one of its eigenvalues

lies on the spectral circle (i.e. more than one eigenvalue has the highest absolute value), this proves that every other-regard network that is a perfect cycle will not have a steady state of utilities. In structural terms, this is saying that a stable set of utilities is not possible when each agent is perfectly altruistic to another agent, and so on in a cycle.

4.4.2 Partial Orders (With One Maximal Node)

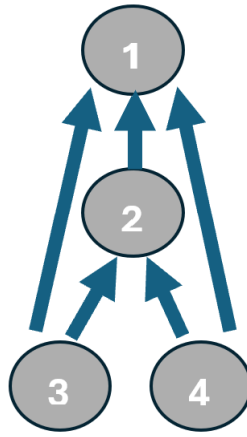


Figure 4.4: Example partial order with one apex

Consider a partial order, where an agent only distributes their weight over themselves and other agents that are higher in rank. The matrix in this case is triangular, and it is known that the eigenvalues of a triangular matrix are the diagonal elements of that matrix. In the primitive case, only one of the eigenvalues is 1, representing a situation in which there is exactly one agent at the top of the hierarchy (i.e. a partial order with exactly one greatest element, see Figure 4.4 for an example). This leads to an equilibrium W^∞ where all agents place all their weight on the maximally selfish agent.

There are two different ways to prove this result. First, it can be proved by examining q . While p will be the 1-vector, q will be a vector where the first entry is 1 and all other entries are 0. To see this, recall the fact that q is the leading eigenvector of W^T . Given that W is a triangular:

$$W_{\text{partialorder}} = \begin{pmatrix} w_{1,1} & 0 & \dots & 0 & 0 \\ w_{2,1} & w_{2,2} & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ w_{n-1,1} & w_{n-1,2} & \dots & w_{n-1,n-1} & 0 \\ w_{n,1} & w_{n,2} & \dots & w_{n,n-1} & w_{n,n} \end{pmatrix}$$

Where $W_{1,1} = 1$ and q will be the vector that satisfies the following eigensystem:

$$W^T q = 1q = q$$

$$W^T \begin{pmatrix} q_1 \\ q_2 \\ \vdots \\ q_n \end{pmatrix} = \begin{pmatrix} q_1 \\ q_2 \\ \vdots \\ q_n \end{pmatrix}$$

Solving this eigensystem for the entries of q requires solving the following system of linear equations

$$q_1 w_{1,1} + q_2 w_{2,1} + \dots + q_{n-1} w_{n-1,1} + q_n w_{n,1} = q_1$$

$$q_2 w_{2,2} + \dots + q_{n-1} w_{n-1,2} + q_n w_{n,2} = q_2$$

$$\vdots$$

$$q_{n-1} w_{n-1,n-1} + q_n w_{n,n-1} = q_{n-1}$$

$$q_n w_{n,n} = q_n$$

We can first solve for q_n by noting that, for $w_{n,n} \neq 1$, the only solution to this equation is $q_n = 0$. We can plug 0 into the next equation above and similarly show that $q_{n-1} = 0$. This

continues until we finally reach $q_1 w_{1,1} = q_1$, which resolves to $q_1 = q_1$ because $w_{1,1} = 1$.

Therefore, q is proportional to
$$\begin{pmatrix} 1 \\ 0 \\ \cdot \\ \cdot \\ 0 \end{pmatrix}.$$

$$W \begin{pmatrix} 1 \\ 0 \\ \cdot \\ \cdot \\ 0 \end{pmatrix} = \begin{pmatrix} \sum_{j=1}^n w_{1j} \\ \sum_{j=1}^n w_{2j} \\ \cdot \\ \cdot \\ \sum_{j=1}^n w_{nj} \end{pmatrix} = 1 \times \begin{pmatrix} 1 \\ 0 \\ \cdot \\ \cdot \\ 0 \end{pmatrix}$$

Now that we have $p = \begin{pmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{pmatrix}$ and $q = \begin{pmatrix} 1 \\ 0 \\ \vdots \\ 0 \end{pmatrix}$, we can see that $pq^T = \begin{pmatrix} 1 & 0 & \dots & 0 \\ 1 & 0 & \dots & 0 \\ 1 & 0 & \dots & 0 \\ 1 & 0 & \dots & 0 \end{pmatrix}$, and

$$q^T p = 1, \text{ so } W^\infty = \frac{pq^T}{q^T p} = pq^T$$

The other way to prove this result is by examining the canonical form. A partial order with one maximal node is a triangular matrix where one of the rows has 1 on the diagonal and 0 everywhere else.

$$W_{PO1} = \begin{pmatrix} 1 & 0 & 0 & \dots & 0 \\ w_{2,1} & w_{2,2} & 0 & \dots & 0 \\ \vdots & \vdots & \ddots & 0 & \vdots \\ w_{n-1,1} & w_{n-1,2} & \dots & w_{n-1,n-1} & 0 \\ w_{n,1} & w_{n,2} & \dots & w_{n,n-1} & w_{n,n} \end{pmatrix}$$

And the canonical form will look like this:

$$W_{PO1} \sim \left(\begin{array}{cccc|c} w_{n,n} & w_{n,n-1} & \cdots & w_{n,2} & w_{n,1} \\ 0 & w_{n-1,n-1} & \cdots & w_{n-1,2} & w_{n-1,1} \\ \vdots & 0 & \ddots & \vdots & \vdots \\ 0 & \cdots & 0 & w_{2,2} & w_{2,1} \\ \hline 0 & \cdots & 0 & 0 & 1 \end{array} \right)$$

$$\text{Where } T_{11} = \begin{pmatrix} w_{n,n} & w_{n,n-1} & \cdots & w_{n,2} \\ 0 & w_{n-1,n-1} & \cdots & w_{n-1,2} \\ \vdots & 0 & \ddots & \vdots \\ 0 & \cdots & 0 & w_{2,2} \end{pmatrix}, T_{12} = \begin{pmatrix} w_{n,1} \\ w_{n-1,1} \\ \vdots \\ w_{2,1} \end{pmatrix}, \text{ and } T_{22} = \begin{pmatrix} 1 \end{pmatrix}.$$

$E = 1$ represents the fact that the maximal node is its own ergodic class. We can obtain the rest of the W_{PO1}^∞ by finding $Z = (I - T_{11})^{-1}T_{12}E$. Because $E = \begin{pmatrix} 1 \end{pmatrix}$, we can drop it and simply prove that $Z = (I - T_{11})^{-1}T_{12}$ is the column of 1s. This is equivalent to proving that

$$(I - T_{11}) \begin{pmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{pmatrix} = T_{12}. \text{ Notice that:}$$

$$(I - T_{11}) = \begin{pmatrix} 1 - w_{n,n} & -w_{n,n-1} & \cdots & -w_{n,2} \\ 0 & 1 - w_{n-1,n-1} & \cdots & -w_{n-1,2} \\ \vdots & 0 & \ddots & \vdots \\ 0 & \cdots & 0 & 1 - w_{2,2} \end{pmatrix}$$

And when we multiply $(I - T_{11})$ to Z , we will multiply the entries of Z to the columns of $(I - T_{11})$, and then add those columns together:

$$(I-T_{11})Z = z_1 \begin{pmatrix} 1 - w_{n,n} \\ 0 \\ \vdots \\ 0 \end{pmatrix} + z_2 \begin{pmatrix} -w_{n,n-1} \\ 1 - w_{n-1,n-1} \\ \vdots \\ 0 \end{pmatrix} + \dots + z_n \begin{pmatrix} -w_{n,2} \\ -w_{n-1,2} \\ \vdots \\ 1 - w_{2,2} \end{pmatrix} = \begin{pmatrix} w_{n,1} \\ w_{n-1,1} \\ \vdots \\ w_{2,1} \end{pmatrix}$$

Where z_i is the i^{th} entry of Z . We are once again left to solve a system of equations, though in this case we can intuit the correct solution. If we ignore the z_i terms, we notice that the left hand side of each equation contains 1 subtracted from all of the weights of that row, with the exception of the weight on the right hand side of the equation. Because all of the rows sum to 1, we know that, for example $1 - w_{n,n} - w_{n,n-1} - \dots - w_{n,2} = w_{n,1}$, and similarly for every other row. Therefore, this equation requires that all the z_i terms must equal 1. This proves that Z is the column of 1s for every partial order with one apex, making the projection matrix representing the equilibrium

weights $\begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$; the equilibrium has every agent placing all their concern on the maximal node in the network.

4.4.3 Partial Orders (With More Than One Maximal Node)

The case of a partial order with more than one maximal node is somewhat more complicated, but the results are quite similar. The maximal nodes, those that receive concern but don't give any concern to anyone else, are once again the recipients of all of the concern of the non-maximal nodes. The difference is that, as the concern flows from the nodes lowest in the hierarchy to the nodes at the apex, it gets weighted by each node it passes on the journey to the apex.

Partial orders with more than one maximal node will have the following form:

$$W_{PO} = \begin{pmatrix} 1 & \cdots & 0 & 0 & \cdots & 0 \\ \vdots & \ddots & \vdots & \vdots & & \vdots \\ 0 & \cdots & 1 & 0 & \cdots & 0 \\ w_{r+1,1} & \cdots & w_{r+1,r} & w_{r+1,r+1} & \cdots & 0 \\ \vdots & & \vdots & \vdots & \ddots & \vdots \\ w_{n,1} & \cdots & w_{n,r} & w_{n,r+1} & \cdots & w_{n,n} \end{pmatrix}$$

And when permuted into the canonical form:

$$W_{PO} \sim \left(\begin{array}{ccc|ccc} w_{n,n} & \cdots & w_{n,r+1} & w_{n,r} & \cdots & w_{n,1} \\ \vdots & \ddots & \vdots & \vdots & & \vdots \\ 0 & \cdots & w_{r+1,r+1} & w_{r+1,r} & \cdots & w_{r+1,1} \\ \hline 0 & \cdots & 0 & 1 & \cdots & 0 \\ \vdots & & \vdots & \vdots & \ddots & \vdots \\ 0 & \cdots & 0 & 0 & \cdots & 1 \end{array} \right)$$

$$\text{Where } T_{11} = \begin{pmatrix} w_{n,n} & \cdots & w_{n,r+1} \\ \vdots & \ddots & \vdots \\ 0 & \cdots & w_{r+1,r+1} \end{pmatrix}, T_{12} = \begin{pmatrix} w_{n,r} & \cdots & w_{n,1} \\ \vdots & & \vdots \\ w_{r+1,r} & \cdots & w_{r+1,1} \end{pmatrix}, \text{ and } T_{22} = I_{r \times r},$$

the $r \times r$ identity matrix, where r is the number of nodes at the apex (i.e. the number of maximally selfish agents in the network). Similarly to the case with one maximal node, it is sufficient for us to prove that $T_{12} = (I - T_{11})Z$. Un-similarly to the case with one maximal node, we don't immediately have a good guess for the form of Z , so we will derive it with some tedious algebra, and then check that it satisfies $T_{12} = (I - T_{11})Z$.

We introduce some notation for Z and its entries that line up with T_{12} :

$$Z = \begin{pmatrix} z_{n,r} & \cdots & z_{n,1} \\ \vdots & & \vdots \\ z_{r+1,r} & \cdots & z_{r+1,1} \end{pmatrix}$$

We can then solve for Z , as a function of the entries of W . As an aid to our intuition, let us only consider the $(r+1)^{th}$ row of $(I - T_{11})Z$ and T_{12} :

$$(I - T_{11})Z_{r+1,\bullet} = \begin{pmatrix} (1 - w_{r+1,r+1})z_{r+1,r} & \cdots & (1 - w_{r+1,r+1})z_{r+1,1} \end{pmatrix} = \begin{pmatrix} w_{r+1,r} & \cdots & w_{r+1,1} \end{pmatrix}$$

Solving this equation for each of the z terms gives us the row:

$$Z_{r+1,\bullet} = \begin{pmatrix} \frac{w_{r+1,1}}{1-w_{r+1,r+1}} & \cdots & \frac{w_{r+1,r}}{1-w_{r+1,r+1}} \end{pmatrix}$$

Now let us solve Z for the $(r+2)^{th}$ row, the row immediately above the row we just solved for:

$$(I - T_{11})Z_{r+2,\bullet} = \begin{pmatrix} (1 - w_{r+2,r+2})z_{r+2,r} + -w_{r+2,r+1} \times z_{r+1,r} & \cdots & (1 - w_{r+2,r+2})z_{r+2,1} + -w_{r+2,r+1} \times z_{r+1,1} \end{pmatrix}$$

Which is equal to $\begin{pmatrix} w_{r+2,r} & \cdots & w_{r+2,1} \end{pmatrix}$. We once again do some algebra obtain:

$$Z_{r+2,\bullet} = \begin{pmatrix} \frac{1}{1-w_{r+2,r+2}}(w_{r+2,r} + w_{r+2,r+1} \times z_{r+1,r}) & \cdots & \frac{1}{1-w_{r+2,r+2}}(w_{r+2,1} + w_{r+2,r+1} \times z_{r+1,1}) \end{pmatrix}$$

Notice that the z terms in the $(r+2)^{th}$ row are a function of the z terms in the $(r+1)^{th}$ row, which we have already derived as a function of the w terms in the $(r+1)^{th}$ row. This process will continue, with higher rows including terms borrowed from the lower rows, until we have an expression for the entire Z matrix:

$$Z = \begin{pmatrix} \frac{1}{1-w_{n,n}}(w_{n,r} + \sum_{j=r+1}^{n-1} w_{n,j} \times z_{j,r}) & \cdots & \frac{1}{1-w_{n,n}}(w_{n,1} + \sum_{j=r+1}^{n-1} w_{n,j} \times z_{j,1}) \\ \vdots & & \vdots \\ \frac{1}{1-w_{r+2,r+2}}(w_{r+2,r} + \sum_{j=r+1}^{r+1} w_{r+2,j} \times z_{j,r}) & \cdots & \frac{1}{1-w_{r+2,r+2}}(w_{r+2,1} + \sum_{j=r+1}^{r+1} w_{r+2,j} \times z_{j,1}) \\ \frac{w_{r+1,r}}{1-w_{r+1,r+1}} & \cdots & \frac{w_{r+1,1}}{1-w_{r+1,r+1}} \end{pmatrix}$$

We've abused the sigma notation somewhat in the $(r+2)^{th}$ row, as the starting and ending index of summation is the same, to indicate that this summation only includes one term. Now that we have Z , all that remains is to demonstrate that $(I - T_{11})Z = T_{12}$. We will again proceed from the $r+1^{th}$ row, the simplest row to evaluate, to the n^{th} row:

$$(I - T_{11})Z_{r+1,\bullet} = \begin{pmatrix} 0 & \cdots & 0 & 1 - w_{r+1,r+1} \end{pmatrix} Z = \begin{pmatrix} w_{r+1,r} & \cdots & w_{r+1,1} \end{pmatrix}$$

Which is equal to the $(r+1)^{th}$ row of T_{12} . Checking the $(r+2)^{th}$ row, we find that $(I - T_{11})Z_{r+2,\bullet}$ is a row vector where the j^{th} entry is $w_{r+2,j} + (w_{r+2,r+1} \times z_{r+1,j}) - (w_{r+2,r+1} \times z_{r+1,j}) = w_{r+2,j}$, Which once again simplifies to:

$$(I - T_{11})Z_{r+2,\bullet} = \begin{pmatrix} w_{r+2,r} & \cdots & w_{r+2,1} \end{pmatrix}$$

We can now see that the i^{th} row of $(I - T_{11})Z$ can be expressed as $(I - T_{11})Z_{i,\bullet}$, a row vector where the k^{th} entry is $w_{i,k} + (\sum_{j=r+1}^{i-1} w_{i,j} \times z_{j,k}) - (\sum_{j=r+1}^{i-1} w_{i,j} \times z_{j,k}) = w_{i,k}$:

$$(I - T_{11})Z_{i,\bullet} = \begin{pmatrix} w_{i,r} & \cdots & w_{i,1} \end{pmatrix}$$

Which completes the proof:

$$(I - T_{11})Z = \begin{pmatrix} w_{n,r} & \cdots & w_{n,1} \\ \vdots & & \vdots \\ w_{r+1,r} & \cdots & w_{r+1,1} \end{pmatrix} = T_{12}$$

Let us take stock of the finding here. Once again, in equilibrium, the amount of concern placed on anyone below the apex (i.e. in columns $r + 1$ through n), is zero. Only the maximal nodes receive any concern. However, in the case of multiple maximal nodes, the subordinate nodes have more than one option to place all of their concern. They must allocate it among the maximal nodes. Therefore, the relative amount of the concern of subordinates that flow to the superordinates is also a function of the structure of the path from the bottom to the top of the hierarchy. To see this, let us again start from the $(r + 1)^{th}$ row of Z . This row represents the allocation of concern in the layer immediately below the maximal nodes, and each of the maximal nodes gets the proportion that the $(r + 1)^{th}$ node gives to them. The $(r + 2)^{th}$ row represents the amount of concern given to the maximal nodes directly, as well as the amount given to the $(r + 1)^{th}$ row that is then given to the maximal nodes. For every layer lower in the hierarchy we go, we find that Z contributions that move up the hierarchy are re-routed by those higher up, until all weight is placed on the maximal nodes, whose allocation of the total concern of the group depends on proportion of the pathways that lead to them.

4.4.4 Symmetric Matrices

Symmetric matrices have a close connection to mutual or egalitarian relations (Martin 2009: 26). As it turns out, symmetric matrices of other-regard produce egalitarian distributions of concern in both the irreducible and reducible case. Specifically, the entries of an $n \times n$ irreducible row-stochastic matrix W^∞ will all be $\frac{1}{n}$ if W is symmetric and irreducible.

Let W be a real and row-stochastic matrix that is symmetric and irreducible; and let p be the Perron vector of W , and q be the Perron vector of W^T . Because of symmetry ($W = W^T$), $p = q$. As discussed before because p and q correspond to the eigenvalue of 1, the vectors will be

proportional to the 1 vector, since vectors that are proportional to 1 are the only vectors that satisfy the eigensystem requirement that $Wx = \lambda x$ where $\lambda = 1$:

$$p = q = \begin{pmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ 1 \end{pmatrix}$$

Perron-Frobenius theorem guarantees that, for an irreducible and primitive matrix (primitiveness is guaranteed from row-normalization), the equilibrium is $W^\infty = \frac{pq^T}{q^T p}$. The denominator comes out to a scalar, and the numerator will be an $n \times n$ matrix. In this case, pq^T is an $n \times n$ matrix where all the entries are 1:

$$pq^T = \begin{pmatrix} 1 & \dots & 1 \\ \vdots & \ddots & \vdots \\ 1 & \dots & 1 \end{pmatrix}$$

and $q^T p$ resolves to n :

$$q^T p = (11\dots 1) \cdot \begin{pmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ 1 \end{pmatrix} = n$$

Leaving all the entries of $\frac{pq^T}{q^T p}$ as $\frac{1}{n}$. For *reducible* row-stochastic matrices, the entries in equilibrium *within each ergodic class with a symmetric matrix*, will all be $\frac{1}{n_i}$, where n_i is the number of nodes in the i^{th} ergodic class.

4.5 Applications of Closed Form Solutions

The equilibria of concern discussed above are brought to bear on how equilibrium social preferences would transform strategic games into situations where cooperation is the dominant strategy. Overall, the strategy has three steps:

1. Start with a payoff matrix and equilibrium weights
2. Transform the payoff matrix according to the equilibrium weights
3. Predict dominant strategy with the transformed matrix

What follows will be an analysis of the linear public goods game under a partially ordered other-regard network and the 2-person prisoner's dilemma under a symmetric other-regard network.

4.5.1 Application: Linear Public Goods Game with Partially Ordered

Other-Regard Network

In the linear public goods game, an individual i 's utility function is $u_i = \alpha(e_i - c_i) + \beta C$, where e_i is i 's endowment, c_i is i 's contribution to the public good, C is the sum of all agent contributions, and α and β are rates of return for individual consumption and collective contribution respectively (Zelmer 2003). Usually we study situations where α and β are defined such that the dominant strategy for agents is to withhold their endowment and contribute nothing to the public good.

Introducing social preferences can change this situation. With social preferences, an individual's utility function $u_i = \sum_j W_{i,j}(\alpha(e_j - c_j) + \beta C)$, a weighted sum of the utility of every agent that i is concerned with (which can include i herself). Supposing a partial order with one maximal element, k , then every agent's utility is $u_i = w_{i,k}(\alpha(e_k - c_k) + \beta C) + \sum_{j \neq k} w_{i,j}(\alpha(e_j - c_j) + \beta C)$. $w_{i,k} = 1$ and $w_{i,j} = 0$, so the utility function reduces to $u_i = \alpha(e_k - c_k) + \beta C$.

Under this structure, every agent's private consumption has been replaced with the private consumption of whoever stands at the top of the hierarchy, making the dominant strategy for them to give all of their endowment to the public good. The agent at the top of the hierarchy has what is

essentially the selfish utility of the standard linear public goods game, so their dominant strategy is to withhold their endowment and contribute nothing to the public good. The upshot of this is that hierarchical other-regard networks can catalyze contributions to the public good.

4.5.2 *Application: 2-person Prisoner's Dilemma with Symmetric Other-Regard Network*

The previous application showed us how a hierarchical pattern of concern can catalyze public goods contribution. While technically feasible, we might be looking for more egalitarian methods for producing cooperation. The following example looks at how a symmetric other-regard network can produce cooperation in the 2-person prisoner's dilemma.

Below is the template for the payoff matrix of a prisoner's dilemma, subject to the constraints that $T > R > P > S$ and $2R > T + S$

	Cooperate	Defect
Cooperate	(R,R)	(S,T)
Defect	(T,S)	(P,P)

In the prisoner's dilemma, the dominant strategy for both players is to defect. However, with the equilibrium weights of a symmetric other-regard network, each player's outcome in each cell of the matrix is the sum of both self and other's outcome in that cell divided by two (because there are two players). The diagonal cells remain the same, because $\frac{R+R}{2} = \frac{2R}{2} = R$, and likewise for P . This transforms the original payoff matrix to

	Cooperate	Defect
Cooperate	(R,R)	$((S+T)/2, (S+T)/2)$
Defect	$((T+S)/2, (T+S)/2)$	(P,P)

Now cooperation is the dominant strategy, because $R > (T + S)/2$ is equivalent to the constraint that $2R > T + S$.

4.6 Discussion

Let us briefly return to the original intention of Krackhardt's (1998) model. He proposed this model to explain how preferences endogenously changed through social influence, particularly in how groups influence each other to have similar preferences. He proposed that the weight matrix W could be defined in terms of some matrix X that expresses the level of interaction that occurs between agents: $W_{i,j} = \frac{x_{ij}}{\sum_{k=1}^N x_{kj}}$. In other words, the original model proposed that i is influenced by j to the extent that they interact with j than with more than with other agents in the network. This is a plausible assumption, but whether social preferences are actually governed by a social influence process like the one Krackhardt described is an empirical question. Even so, the fecundity of this approach is that any empirically justifiable set of weights can work. As long as the researcher thinks that they have described a structure of other-regard that adheres to the assumptions of this model, they may study whether equilibrium social preferences predict behavior in observed social dilemmas.

Even so, there are many limitations of the current model. First, some of the assumptions are overly strict, and future work will focus on what results can be obtained without them. For example, future work will consider how to obtain equilibria when weights can be negative, perhaps for $W_{i,j} \in (-1, 1)$. The assumption of row-stochasticity may also be replaced with column-stochasticity, although this would only be a plausible model of situations where there is a strict inter-dependence of weight-placing on the part of egos, as this implies that there is a cap on how

much weight any agent can receive. Another important future step is to consider a broader set of other-regard network structures. This chapter has deliberately focused on relatively simple structures so as to derive elegant closed-form solutions. Future work will consider a broader set of more realistic structures.

This chapter has focused on the comparative statics of different structures, but future work must consider how minor departures from the structures considered here (ex: a matrix that is *almost* symmetric but not quite) lead to different outcomes. In other words, the *asymptotics* of these network structures must be developed in order for this to be a complete theory. It is also important to know how many steps of transitive utility computation is necessary to reach outcomes that are qualitatively similar to the equilibria, as those that approach their equilibrium quickly will be easier to study empirically. Finally, future work must consider how to fit empirical data to this model. Canonical social influence models have procedures for fitting data on observed changes in opinion (see Friedkin and Johnsen 2011); similar methods may be available for the model proposed here.

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