Does Africa Need a Rotten Kin Theorem? Experimental Evidence from Village Economies

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Abstract

This paper measures the economic impacts of social pressures to share income with kin and neighbors in rural Kenyan villages. We conduct a lab experiment in which we randomly vary the observability of investment returns to test whether subjects reduce their income in order to keep it hidden. We find that women adopt an investment strategy that conceals the size of their initial endowment in the experiment, though that strategy reduces their expected earnings. This effect is largest among women with relatives attending the experiment. Parameter estimates suggest that women anticipate that observable income will be "taxed" at a rate above four percent; this effective tax rate nearly doubles when kin can observe income directly. At the village level, we find an association between willingness to forgo expected return to keep income hidden in the laboratory experiment and worse economic outcomes outside the laboratory.

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1 Introduction

Risk is a pervasive aspect of the lives of individuals in many developing economies, and informal risk-pooling arrangements which help households cope with shocks can have significant welfare impacts when credit and insurance markets are incomplete. A substantial body of evidence documents the existence of mutual insurance arrangements throughout the world (cf. Townsend 1994, Coate and Ravallion 1993, Fafchamps and Lund 2003). Much of the literature focuses on mutual insurance arrangements which are efficient given constraints, characterizing the conditions under which self-interested households will enter risk-pooling schemes voluntarily *ex ante* and the participation constraints which keep households from defecting *ex post*.[1] Yet, as Ligon (1998) demonstrates, models that allow agents to hide part of their income in order to avoid making transfers to those in need may better explain observed patterns of income and consumption in rural villages.[2] Moreover, the expectation of future transfers is only one of many reasons households offer assistance to those worse off: altruism, guilt, and social pressure to share income may also play a role (Geertz 1963, Scott 1976, Foster and Rosenzweig 2001, Alger and Weibull 2010). In fact, several recent studies suggest that individuals living in poor communities often feel obligated to make transfers to relatives and neighbors, and that successful families who do not make sufficient transfers to others can face harsh social sanctions (Platteau 2000, Barr and Stein 2008, Di Falco and Bulte 2011).[3] For example, Baland, Guirkinger, and Mali (2011) provide evidence of this type of behavior in Cameroon, where members of credit cooperatives take out loans to signal that they are liquidity constrained — even when they also hold substantial savings — in order to avoid sharing accumulated wealth with relatives. Collier and Garg (1999) argue that such pressures to share income with kin are most intense in Africa, and are common to many ethnic groups across the continent; they write that "African kin groups are distinctive both by their ubiquity and by the strength of their claims upon members." Yet, such social pressure to share is not confined to Sub-Saharan Africa, or even the developing world: Geertz (1963) describes a similar phenomenon in post-independence Indonesia, while Stack (1974) documents the existence of analogous kin obligations in poor, urban communities in the United States.

In this paper, we report the results of an experiment designed to measure social pressure to share income with relatives and neighbors. We use a controlled laboratory environment to explore behaviors which are difficult to document using survey data: the willingness to forgo profitable investment opportunities to keep income secret. Our experimental design yields simple theoretical predictions, and also provides the identification necessary for structural estimation of the underlying "kin tax" parameter in the presence of heterogeneous risk preferences.

[1] See Ligon, Thomas, and Worrall (2002), Albarran and Attanasio (2003), and Kinnan (2011) for examples. Foster and Rosenzweig (2001), which explores the impact of altruism on the set of self-enforcing insurance arrangements, is an important exception.

[2] A rich literature characterizes constrained optimal mutual insurance arrangements when agents can hide a portion of their income (cf. Cole and Kocherlakota 2001, Attanasio and Pavoni 2011). Our work complements this literature, introducing more heterogeneity and noise in individual behavior, but at the cost of a reduced ability to characterize the constrained optimal arrangement.

[3] See Hoff and Sen (2006), Comola and Fafchamps (2011), and Dupas and Robinson (2013) for other examples.

We conduct economic experiments in 26 rural communities in western Kenya. Within the experiment, subjects receive an endowment which they divide between a risk-free savings account and a risky but profitable investment. The size of the endowment varies across subjects, and the distribution of endowment sizes is common knowledge. While the amount saved is always private information, we randomly vary whether the amount invested in the risky security can be observed by other subjects, creating an incentive for those receiving the large endowment to invest no more than the small endowment, thereby keeping their endowment size hidden. We also offer a subset of subjects the option of paying to keep their investment returns secret, allowing us to directly measure the willingness-to-pay to hide income.

In light of evidence that women and men have different risk preferences (cf. Croson and Gneezy 2009) and that women in poor communities may have more trouble accumulating savings (cf. Dupas and Robinson 2013), we stratify our experiment by gender, and report results for men and women separately.[4] Consistent with a simple model of decisions in the experiment when risk preferences are heterogeneous and subjects face pressure to share income, we find that women receiving the large endowment are more likely to make investment choices that obscure the amount of money they have received when investment returns are observable. The effect we observe among women appears to be driven primarily by the behavior of women whose payoffs are most directly visible to their kin network: those with relatives attending the experiment. Interestingly, we find no similar tendency to hide income among men. Among women, impacts are unlikely to be driven by in-laws providing information to husbands: there is no direct impact of having one's husband present, and choice patterns are similar in the sub-sample of unmarried women. We also demonstrate that the gender difference we observe is unlikely to be driven by differences (across genders) in other observable characteristics. At the village level, women's tendency to hide income within the experiment is negatively associated with durable asset accumulation by households, skilled and formal sector employment, and the probability of using fertilizer on crops, suggesting that social pressure to share may hinder growth and development.

Among subjects given the opportunity to pay a randomly-assigned price to keep income hidden, 30 percent of those able to afford the cost of hiding income choose to do so. These subjects pay an average of 15 percent of their gross payout from the experiment. Interestingly, we estimate a similar willingness-to-pay to hide income among men.

After presenting our reduced form results, we estimate the magnitude of the "kin tax" parameter via maximum simulated likelihood in a mixed logit framework. This is important because the size of the treatment effect of observability depends on both the level of social pressure and the distribution of individual risk preferences; decisions in our (control) private information treatments suggest substantial heterogeneity in risk aversion across subjects.[5] After controlling for

[4] Dupas and Robinson (2013) find evidence that female daily wage earners in western Kenya are more savings constrained than men in similar occupations. In a similar vein, De Mel, McKenzie, and Woodruff (2008), De Mel, McKenzie, and Woodruff (2009), and Fafchamps, McKenzie, Quinn, and Woodruff (2014) find lower returns to capital for microenterprises operated by women than for those operated by men.

[5] See Hey and Orme (1994); Choi, Fisman, Gale, and Kariv (2007); Andersen, Harrison, Lau, and Rutström (2008); Choi, Kariv, Müller, and Silverman (2014), and Von Gaudecker, van Soest, and Wengström (2011) for

unobserved heterogeneity in risk preferences, we find a statistically significant tax for women, averaging four percent in general. For women whose kin attend the experimental session, consistent with the reduced form pattern, the tax appears to be twice as large. Simulations suggest that this level of social pressure may lead to a dramatic reduction in the likelihood of starting a business.

The main aim of this paper is to document the importance of social pressure in interhousehold transfer relationships within kin networks in poor communities. We make several contributions to the existing literature. First, we introduce a novel lab experiment designed to measure social pressure to share income in field settings.[6] The experiment is simple to understand, but provides subjects with a rich menu of investment options and multiple mechanisms for hiding income. Our design allows us to effectively rule out several alternative explanations: behavior is not consistent with models of attention aversion or a desire to avoid social sanctions against risk-taking, and the lack of a direct effect of having one's spouse present suggests that kin networks are not just passing information on to husbands. Second, treatment assignments within the experiment were randomized within villages, allowing us to explore the association between community outcomes and income hiding in the lab. Third, we link decisions in the experiment to a model of individual investment choices when risk preferences are heterogeneous, and estimate this model via maximum simulated likelihood. This allows us to recover an estimate of the kin tax parameter, and to simulate the magnitude of its impact on microentrepreneurship.

Our experimental approach is, however, not without drawbacks. One concern with all experimental work on distributional choices is that subjects might behave differently in non-laboratory settings when the money being shared or redistributed is someone's earned income. In fact, consistent with descriptive evidence suggesting that those living in rural villages in less developed countries often attribute success to luck and supernatural forces rather than individual effort (cf. Platteau 2000), previous experimental work suggests that this distinction between earned and unearned income is less salient rural Kenya than in a developed country (Jakiela 2014). A second issue is that our one-shot, communication-free experiment intentionally minimizes the potential for risk-pooling.[7] We view our work as a first step in the direction of characterizing and quantifying the extent of social pressure to share income; future work will be needed to explore the extent to which such pressure depends on the source of income.

The rest of this paper is organized as follows: Section 2 describes our experimental design and procedures; Section 3 presents a simple theoretical framework for interpreting our results; Section 4 presents our main reduced-form empirical results; Section 5 presents our structural framework and estimates; and Section 6 concludes.

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further experimental evidence on risk preference heterogeneity.

[6] Our design is most closely related to Barr and Genicot (2008) and Ligon and Schechter (2012), both of whom introduce original experiments capturing the desire to avoid social sanctions outside the lab.

[7] For recent examples of experimental work on risk-pooling with limited commitment, see Barr and Genicot (2008), Charness and Genicot (2009), Attanasio, Barr, Cardenas, Genicot, and Meghir (2012), and Barr, Dekker, and Fafchamps (2012).

2 Experimental Design and Procedures

2.1 Structure of the Experiment

The experiment was designed to introduce exogenous variation in the observability of investment returns. Within the experiment, each participant was given an initial endowment, either 80 or 180 Kenyan shillings.[8] Each subject divided her endowment between a zero-risk, zero-interest savings account and an investment that was risky but profitable in expectation. The subject received five times the amount that she chose to invest in the risky prospect with probability one half, and lost the amount invested otherwise. A coin was flipped to determine whether each risky investment was successful. Thus, the main decision subjects faced was how much of their endowment to invest in the risky security and how much to allocate to the secure, zero-profit alternative.[9]

Within the experiment, players were randomly assigned to one of six treatments. First, players were allocated either the smaller endowment of 80 shillings or the larger endowment of 180 shillings. Endowment sizes were always private information — experimenters did not identify those subjects who received the large endowment. However, the distribution of endowments was common knowledge, so all subjects were aware that half the participants received an extra 100 shillings.

Every player was also assigned to either the **private** treatment or one of two public information treatments, the **public** treatment or the **price** treatment. Participants assigned to the **private** treatment were able to keep their investment income secret: the decisions they made in the experiment were never disclosed to other participants. In contrast, those assigned to the **public** treatment were required to make an announcement revealing how much they had invested in the risky security and whether their investment was successful to all of the other participants at the end of the experiment.[10] The amounts that subjects invested in the zero-interest savings technology were never revealed, so those who received the larger amount could choose whether to invest 80 shillings or less so as to obscure their endowment size. Finally, those assigned to the **price** treatment were obliged to make the public announcement revealing their investment returns unless they preferred to pay a price, p, to avoid making the announcement. Prices ranged from 10 to 60 shillings, and were randomly assigned to subjects in the price treatment. Subjects were informed what price they faced *before* making their investment decisions, but decided whether to pay the price *after* investment returns were realized.[11]

[8] Experimental sessions were conducted between August 3 and October 1, 2009. We report dollar amounts using the exchange rate 75.9 shillings to the dollar, which is the average over that period. The two endowments were equivalent to 1.05 and 2.35 U.S. dollars, respectively. For comparison, the median monthly wage among subjects in full-time, unskilled employment is 2000 shillings (26.35 U.S. dollars).

[9] Variants of this portfolio choice design have been used for at least two decades in experimental economics, though without the variation in observability that is the focus of our study. Earlier examples include Loomes (1991), Alm, Jackson, and McKee (1992), Gneezy and Potters (1997), and Choi, Fisman, Gale, and Kariv (2007).

[10] Subjects were informed that they were allowed to delegate the task of making the public announcement to a member of the research team if they wished to avoid the public speaking aspect of the announcement process.

[11] Hence, subjects in the price treatment were not always able to afford to pay to avoid the public announcement:

Random assignment to treatment generated exogenous variation in the observability of investment returns and created costly opportunities to hide income. Assignment to the public information treatments meant that outcomes were verifiable, and might therefore facilitate risk-pooling and, consequently, risk-taking. On the other hand, if subjects face social pressure to share income with neighbors and kin, they might be willing to pay for obscurity when returns are visible.[12] In particular, the experiment creates two mechanisms through which subjects could incur a cost to hide income from others. First, those receiving the larger endowment could keep their endowment size secret by investing no more than 80 shillings. Second, subjects in the price treatment could pay the randomly-assigned price, p, to conceal their income entirely.

Random assignment to treatment was stratified by gender, allowing us to conduct our analysis separately for men and women. Such a disaggregated analysis is important for two reasons. First, as discussed in more detail in Section 3, behavior in our experiment depends on individual risk preferences. There is ample evidence that risk preferences are heterogeneous, but many studies find that, on average, women are more risk averse than men (see Croson and Gneezy (2009) for a detailed discussion of the literature). Second, as we discuss in detail below, women and men in our sample have quite different social realities: women are more likely to be living on their own because their spouse is working elsewhere, they are less likely to have other sources of cash income or a bank account, and those who are married typically live near their husband's blood relatives rather than their own.[13] Though studies to date have not directly measured the extent of social pressure to share income, gender differences in social pressure would be consistent with existing evidence on gender differences in savings constraints and returns to capital for microenterprises (Dupas and Robinson 2013, De Mel, McKenzie, and Woodruff 2009, Fafchamps, McKenzie, Quinn, and Woodruff 2014).

2.2 Experimental Procedures

Experiments were conducted in 26 rural, predominantly agricultural communities in western Kenya.[14] One day prior to each experimental session, the survey team conducted a door-to-door recruitment campaign, visiting as many compounds and households within each village as possible.[15] All adult residents of each village were invited to participate in the experimental session

those who invested and lost a large fraction of their endowment did not always have enough experimental income left to pay the randomly-assigned price, p. Subjects were never allowed to use money from outside the experiment to pay to avoid the public announcement.

[12] Our design is related to those of Barr and Genicot (2008), Attanasio, Barr, Cardenas, Genicot, and Meghir (2012), and Ligon and Schechter (2012), who also use experiments which capture the desire to avoid social sanctions outside the lab.

[13] See Brabin (1984) and Luke and Munshi (2006) for discussion of the patrilocal traditions of the most common tribes in Western Kenya.

[14] Communities were selected to be at least five kilometers apart from one another, to prevent overlap in subject populations, and to avoid areas where IPA–Kenya had ongoing projects.

[15] As is typical in rural Kenya, survey teams moved from compound to compound with the assistance of local guides, typically village elders. When the recruitment team was unable to contact and survey anyone from a particular household prior to the experiment, village elders were asked to invite the adult members of that household to attend the subsequent experimental session.

the following day. Approximately 80 percent of individuals contacted prior to the experimental sessions chose to participate.[16]

Experimental sessions were conducted in empty classrooms at local primary schools. Sessions included an average of 83 subjects; no session included fewer than 65 or more than 100 subjects. Each session lasted approximately three hours.

Within each session, participants were stratified by gender and education level. There were six experimental treatments, corresponding to the three information conditions (private, public, price) interacted with the two endowment sizes. Within each stratum, players were randomly assigned to each of the six treatments with equal probability.[17] Players assigned to the price treatments were subsequently assigned a random price from the set of multiples of ten between 10 and 60.[18]

Experimental sessions were structured as follows. After a brief introduction, enumerators read the instructions and answered participant questions, illustrating the decisions that a subject might face with a series of wall posters.[19] Subjects were then called outside one at a time to make their investment decisions.[20] Enumerators began by asking a series of questions designed to make sure that subjects understood the experiment. Subjects were then informed whether they had received the large or small endowment and whether they were assigned to the private, public, or price treatment. Those assigned to the price treatment were also told what price they would need to pay if they wished to avoid the public announcement. Subjects then made their investment decisions: each subject was handed a number of 10 shilling coins equivalent to her endowment; the participant divided these coins between a "savings" cup and a "business" cup.[21] After recording a subject's investment decision, the enumerator would give the subject a one shilling coin to flip.[22] The outcome of the coin toss determined whether the money placed in the business cup was multiplied by five or removed from the subject's final payout. Subjects assigned to the price treatment were then asked whether they wanted to pay the fee to avoid announcing their investment results. If they had enough money left to pay the fee, and they chose to do so, it was deducted from their payoff. After all decisions had been recorded, public announcements

[16] In the Online Appendix, we examine the correlates of choosing to attend to the experimental session. Individuals from larger households and those more embedded in interhousehold transfer networks were more likely to attend, while ethnic minorities were somewhat less likely to attend. We find no evidence of differential selection by gender. Subjects in more isolated communities — as measured by distance from a paved road — were more likely to participate, though this cannot bias our results since assignment to treatment occurs within villages.

[17] The first experimental session did not include the two price treatments, so players were assigned to each of the other four treatments with equal probability.

[18] Note that each session included subjects assigned to all three information conditions, so it was impossible to infer which individuals chose to pay to avoid the public announcement, since these subjects could not be distinguished from those randomly assigned to the private treatments.

[19] Detailed instructions are included in the Online Appendix.

[20] Since some participants had limited literacy skills, decisions were recorded by members of the research team. To ensure that earnings not announced publicly remained private information, each enumerator sat at a desk in an otherwise empty section of the schoolyard.

[21] The two cups made of plastic and were identical in size and color.

[22] To limit the possibility of influencing the outcome of the coin flip, each subject placed the coin into a sealed, opaque container which she shook vigorously before opening it to reveal the outcome of the coin toss.

were made. Each subject received her payout in private at the end of the session, and was allowed to leave immediately after receiving her money. Figure 1 summarizes the progression of activities within the experiment.

2.3 Experimental Subjects

Sessions were conducted in Kenya's Western Province, in three adjoining districts: Bunyala, Samia, and Butula. All three districts are predominantly smallholder farming communities, though Samia and Bunyala also have ports on Lake Victoria. Summary statistics on experimental subjects are presented in Table 1.

61 percent of subjects are female, reflecting the fact that women account for more than half of the rural population. Men often reside in urban and peri-urban areas — where more jobs are available — and make occasional visits to their wives and children in the village.[23] 77 percent of subjects are married, while 12 percent are widowed, separated, or divorced. 97 percent of male subjects who are married live in the same household as their spouse, compared with only 76 percent of married female subjects. This pattern reflects the migratory patterns described above and, to a lesser extent, polygyny (9 male subjects report living with with more than one current spouse). The median household size is 6; less than 2 percent of subjects live alone, and less than 5 percent of subjects live in households that include more than 12 people.

Respondents ranged in age from 18 to 88. 9 percent of subjects had no formal schooling, while 12 percent had finished secondary school. Among men in our sample, 8 years of schooling (completing primary school) is both the median and the mode; among women, the median and the mode is 7 years of schooling. 23 percent of respondents live in households with at least one employed household member; most (65 percent of) employed subjects do agricultural work or other unskilled labor. The median monthly wage among participants with full-time employment was 2,050 Kenyan shillings, or 1.35 USD per day (assuming 20 work days per month). 35 percent of subjects operate their own business enterprise, but only 12 percent of these businesses have any employees. 17 percent of participants have bank accounts,[24] and 53 percent are members of rotating savings and credit associations (ROSCAs).[25] Men are more likely to have bank accounts, but less likely to participate in ROSCAs.

Most experimental subjects in our sample live amongst their kin, and are embedded in inter-household transfer networks. Participants have a median of seven relatives living outside their households but in the same village. Because most of Kenya's tribes are patrilocal, married women

[23]As part of another project in other rural villages in Kenya's Western Province, we conducted a census of all the adults living in each of two communities. We found that females accounted for 58 percent of adults in each of these villages.

[24]Dupas and Robinson (2013) found that less than 3 percent of the daily wage earners sampled in Bumala, Kenya, had savings accounts. While Bumala is just a few kilometers from the region where the present study took place, their data were collected over two years before our household survey.

[25]Gugerty (2007) surveys ROSCA participants in Busia and Teso Districts in western Kenya; she argues that the social component of ROSCA participation helps individuals overcome savings constraints. Anderson and Baland (2002) show income-earning women living in Nairobi slums use ROSCAs to protect their savings from their husbands.

generally live near their in-laws rather than their own blood relations (Brabin 1984, Luke and Munshi 2006). This is borne out in our sample: 50 percent of male subjects live in the same village as their mother, compared with only 12 percent of female subjects. 90 percent of subjects reported making a transfer in the last three months, while 44 percent reported receiving a transfer from another household over the same period.[26] 40 percent of subjects reported making a transfer to relatives within the village in the last 3 months, and 9 percent of subjects reported receiving a transfer from relatives in the village over the same time period. In the three months prior to being surveyed, 42 percent of subjects' households had been asked for a gift or loan, and 90 percent of households had contributed money to a "harambee," a local fundraising drive.[27]

Table 1 reports tests of balance across our six experimental treatments (anticipating the nature of our analysis, we report balance checks separately by gender).[28] The randomization was unproblematic, generating typically small differences in observables across treatments. Of 64 tests (32 for each gender) reported, we observe only six significant differences in observables across treatments (two of which are only marginally significant). Though the number of distant family members living in one's village differs significantly across treatments in the sample of men, this variation is driven by outliers: the maximum number (within a treatment) of distant relatives reported to live in one's village ranges from 72 to 154. A quantile regression of the median number of distant family members on the set of treatment dummies does not find significant differences across experimental treatments (results not shown). Monthly wages conditional on employment are also not balanced (possibly because so few subjects report being employed). Among women attending the experiment, the indicator for having one's spouse present at the experiment is not balanced. However, as we demonstrate in the Online Appendix, this results from an unusually large number of women whose spouses were present in the public small endowment treatment; this variable is balanced across the three large endowment treatments that are the focus of our reduced form analysis. Among women, there is also a significant difference in the number of televisions owned across treatments, and a marginally significant difference in the number of cows, but no difference in the total value of durable household assets.

[26] There are several reasons for the asymmetry between the probability of making a transfer and the probability or receiving a transfer. First, households comprising only children and/or the ill or handicapped could not participate (because only those adults who could be physically present for the session and were able to hear the oral instructions could take part), but are likely to be net recipients of transfers. Another reason is that most households in any village will make a small transfer toward the funeral expenses of their neighbors; since funerals are relatively rare events, we would expect to see an asymmetry between the likelihood of giving and receiving in the short-term. Finally, transfer data are quite noisy, and households are more likely to report transfers made than transfers received (Comola and Fafchamps 2011).

[27] A *harambee* is a self-help effort in which community members contribute money or resources to assist a particular person in need. The concept existed within a number of different tribal groups in Kenya, but was made into a national rallying cry by Kenya's first president, Jomo Kenyatta (Ngau 1987).

[28] In the Online Appendix, we report additional balance checks, including both tests which pool the genders and tests which restrict attention to subjects receiving the large endowment treatment (which are the focus of our reduced form analysis). We also show that the randomization of the price of avoiding the public announcement was as balanced as one could expect.

3 Theoretical Framework

3.1 Individual Investment Decisions

Subjects in our experiment receive an endowment of $m \in \{m_{small}, m_{large}\}$ — either 8 or 18 Kenyan coins worth 10 shillings each; they then decide how many of these coins to allocate to the business cup, choosing one of a finite number of possible investment levels. We model their choices by assuming that the utility of investing $b_j \in \{0, 10, 20, \ldots, m\}$ takes an additive random utility form,

$$EU_{ij} = EV_{ij} + \varepsilon_{ij}, \tag{1}$$

where EV_{ij} is the expected utility of investing b_j given a constant relative risk aversion (CRRA) utility function parameterized by $\rho_i \geq 0$,

$$v_i(x) = \frac{x^{1-\rho_i}}{1-\rho_i}, \tag{2}$$

and ε_{ij} is an i.i.d. type 1 extreme value distributed preference shock.[29] Subjects in our experiment make a discrete choice from among a finite set of investment levels; the investment amount associated with the highest CRRA expected utility (given ρ_i) is the most likely to be chosen, but other outcomes occur with positive probability. The probability that subject i chooses to invest b_j takes the standard logit form:

$$P_{ij} = \frac{e^{EV_{ij}/\sigma_\varepsilon}}{\sum_{k=1,\ldots,J_t} e^{EV_{ik}/\sigma_\varepsilon}} \tag{3}$$

where σ_ε^2 is proportional to the variance of $\varepsilon_{ij} - \varepsilon_{ik}$.[30] Thus, the probability of choosing an investment amount b_j depends on the associated CRRA expected utility, EV_{ij}, on the CRRA expected utilities of the other possible investment options, and on the noise parameter, σ_ε^2, which measures the relative importance of the CRRA expected utilities vis-a-vis the stochastic preference shocks.[31]

Subjects assigned to the public and price treatments may face pressure to share their payoffs after the experiment. Following Ashraf (2009) and Goldberg (2010), we model this social pressure as a proportional tax on observable income: subject i is obliged to transfer a proportion, τ, of her observable income to members of her social network — for example, her spouse or her

[29] In our setting, EV_{ij} is what Train (2003) terms "representative utility." Loomes (2005) refers to the logit error terms as "Fechner errors." See Hey and Orme (1994) and Von Gaudecker, van Soest, and Wengström (2011) for examples of their use in modeling stochastic choices in individual decision-making experiments.

[30] When $V_{ij} = X'\beta$, β and σ_ε are not separately identified; σ_ε is identified in our framework because EV_{ij} is a non-linear function of parameters.

[31] A higher σ_ε^2 indicates noisier (less deterministic) choices; the probability of choosing the investment amount associated with the highest (CRRA) expected utility goes to 1 as σ_ε^2 approaches 0. For example, the probability that a subject with a CRRA coefficient of 0.5 chooses the investment amount with the highest CRRA expected utility ($b = 60$) in the private, small endowment treatment is 0.92 when $\sigma_\varepsilon = 0.001$, but drops to 0.14 when $\sigma_\varepsilon = 0.1$.

relatives.[32] Income is observable when an individual is known to have it with probability one, whether it is announced or not; income is unobservable whenever a person can plausibly deny having received it.[33] Thus, an individual assigned to one of the private treatments can plausibly claim to have invested and lost all or most of her endowment, limiting the potential for social pressure. In contrast, a subject assigned to the public small endowment treatment cannot hide any of her income: every subject is known to have received at least 80 shillings (the amount of the smaller endowment, m_{small}), and she is obliged to announce her investment level and whether her investment succeeded. In both the public large endowment treatment and the price treatments, subjects can make choices which conceal all or part of their payoffs — but at a cost. A subject assigned to the public large endowment treatment can choose to invest $b_j \leq m_{small}$, thereby making 100 shillings of income ($m_{large} - m_{small}$) unobservable (because she can plausibly claim to have received the small endowment). A subject assigned to one of the price treatments has the option of paying p shillings to avoid making the public announcement, making her entire payout from the experiment unobservable.

In what follows, we characterize the decisions of individual subjects conditional on ρ_i, the CRRA risk aversion parameter. Given ρ_i, the CRRA expected utility of investing b_j in experimental treatment t depends on: the size of one's endowment, $m \in \{m_{small}, m_{large}\}$; τ, the level of social pressure to share income (in the public and price treatments); and p, the randomly-assigned price of paying to avoid the public announcement (in the price treatments). We expect risk preferences to be heterogeneous (Binswanger 1980, Choi, Fisman, Gale, and Kariv 2007), and our goal is to characterize expected differences in behavior across (randomly-assigned) treatments. An advantage of our approach is that our discrete choice model characterizes the entire data-generating process; this allows us to complement analytical predictions (derived algebraically) with numerical predictions found by calculating choice probabilities across the parameter space. To derive predictions numerically, we calculate quantities of interest (e.g. choice probabilities) at each of 1,000,000 points spanning the space of reasonable parameter values — at each point in a $\rho \times \tau \times \sigma$ grid where $\rho \in [0.001, 3]$, $\tau \in [0.001, 0.5]$ and $\sigma \in [0.001, 0.1]$. After making analytical and numerical predictions at the individual level, we extend each prediction to a population of heterogeneous individuals. Specifically, we generate empirical predictions which combine our analytical results with numerical regularities that are true at every simulated parameter grid point we consider.

3.1.1 Public and Private Small Endowment Treatments

To frame our discussion, we begin by considering investment probabilities in the private and public small endowment treatments. The CRRA expected utility of investing b_j in the private

[32] Though Ashraf (2009) and Goldberg (2010) do not characterize the optimal contract, we note that a fixed tax rate τ, and piecewise linear variations on it, are the forms taken by optimal contracts under conditions described by Lacker and Weinberg (1989).

[33] Our theoretical assumptions in this regard are again consistent with those made by Ashraf (2009) and Goldberg (2010). See De Mel, McKenzie, and Woodruff (2009) for a closely related modeling approach.

small endowment treatment is given by:

$$EV_{ij}^{PRIVATE \times SMALL} = \frac{(m_{small} - b_j)^{1-\rho_i}}{2(1-\rho_i)} + \frac{(m_{small} + 4b_j)^{1-\rho_i}}{2(1-\rho_i)}. \tag{4}$$

In the public small endowment treatment, the CRRA expected utility of investing b_j is given by:

$$\begin{aligned} EV_{ij}^{PUBLIC \times SMALL} &= \frac{\left[(1-\tau)(m_{small} - b_j)\right]^{1-\rho_i}}{2(1-\rho_i)} + \frac{\left[(1-\tau)(m_{small} + 4b_j)\right]^{1-\rho_i}}{2(1-\rho_i)} \\ &= (1-\tau)^{1-\rho_i} EV_{ij}^{PRIVATE \times SMALL}. \end{aligned} \tag{5}$$

Thus, expected utilities in the public treatment are scaled by the (positive) factor $(1-\tau)^{1-\rho_i}$. The implication is that, given a fixed level of risk aversion ρ_i, the ordering of the CRRA expected utilities associated with the possible investment amounts (and hence the ordering of the probabilities of being chosen) is the same in the private and public small endowment treatments. Intuitively, because every subject receives at least m_{small}, subjects in the public small endowment treatment cannot adopt any strategy that will hide a portion of their income; the proportional social pressure tax on observable income, τ, impacts the absolute attractiveness of the investment levels, but not their relative attractiveness. In the specific case of log utility (which the CRRA utility function approaches as ρ_i approaches 1), the probability of choosing any amount b_j is the same in private and public small endowment treatments.[34] For other values of ρ_i, investment probabilities in the small endowment private and public treatments differ, but the difference in expected investment level is typically small — especially for small to moderate values of τ. Calculating the expected level of investment in the private and public small endowment treatments at each of our 1,000,000 grid points, we find that the median difference is -0.62 shillings.[35] For $\tau \leq 0.1$, the magnitude of the difference in investment levels is less than 2 shillings at all simulated grid points. Thus, if parameter estimates suggest a moderately-sized τ of 10 percent or less, our numerical results suggest a theoretical prediction that can be used to check overall model consistency: the average levels of investment in the private and public small endowment treatments should be approximately equal.

Empirical Prediction 1. *When $\tau \leq 0.1$, the expected investment levels in the private and public small endowment treatments are approximately equal.*

[34] In the log utility case, the $\ln(1-\tau)$ term cancels out of the expression for the probability of choosing b_j. For $\rho < 1$, $(1-\tau)^{1-\rho_i} < 1$, so (CRRA) expected utility differences are scaled down in the public treatments relative to the private treatments. Such a scaling has effects that are equivalent to an increase in the noise parameter, σ_ε: probability is shifted towards the tails (away from the central tendency) of the distribution. For $\rho > 1$, $(1-\tau)^{1-\rho_i} > 1$, so the effect is the opposite: probability is shifted away from the tails of the distribution.

[35] The average investment level in the private small endowment treatment is 30.5 shillings, versus 29.3 shillings in the public small endowment treatment. The largest observed difference in investment levels (-10.3 shillings) occurs for $\rho = 0.001$, $\tau = 0.5$, and $\sigma_\varepsilon = 0.029$ — i.e. for the minimally risk averse subject facing the maximum τ that we consider.

3.1.2 Public and Private Large Endowment Treatments

The CRRA expected utility of investing b_j in the private large endowment treatment is given by:

$$EV_{ij}^{PRIVATE \times LARGE} = \frac{(m_{large} - b_j)^{1-\rho_i}}{2(1-\rho_i)} + \frac{(m_{large} + 4b_j)^{1-\rho_i}}{2(1-\rho_i)}. \tag{6}$$

In the public large endowment treatment, subjects have the option of investing 80 shillings (m_{small}) or less, thereby making 100 shillings ($m_{large} - m_{small}$) unobservable to other participants. We indicate this potentially hidden quantity as:

$$H_{ij} = (m_{large} - m_{small}) \cdot \mathbb{1}\{b_j \leq m_{small}\} \tag{7}$$

where $\mathbb{1}\{\cdot\}$ is the indicator function. Thus, the CRRA expected utility of investing b_j is given by:

$$EV_{ij}^{PUBLIC \times LARGE} = \frac{\left[(1-\tau)(m_{large} - b_j) + \tau H_{ij}\right]^{1-\rho_i}}{2(1-\rho_i)} + \frac{\left[(1-\tau)(m_{large} + 4b_j) + \tau H_{ij}\right]^{1-\rho_i}}{2(1-\rho_i)}. \tag{8}$$

If the large endowment treatment did not create the possibility of hiding income, we would observe the same relationship between investment probabilities in the large endowment treatments that we see in the small endowment treatments: scaling CRRA utilities by $(1-\tau)^{1-\rho_i}$ would lead to a small shift in the probability distribution toward or away from the central tendency, but no change in the ordering of expected utilities or probabilities. However, the possibility of hiding income makes all possible investment levels below 90 shillings relatively more attractive — because $\tau H_{ij} = 100\tau$ is, in essence, added to the payoff in each state.

The empirical consequence of this shift in the relative attractiveness of investment levels above the size of the small endowment is an increase in the probability of investing no more than 80 shillings, thereby (implicitly) hiding 100 shillings, the difference between the large and the small endowments. In Proposition 1, we show analytically that the probability of investing 80 shillings or less is always higher in the public large endowment treatment than in the private large endowment treatment when $\tau > 0$.

Proposition 1. *For any $\tau > 0$ and any $\rho \geq 0$, the probability of investing 80 shillings or less is higher in the public large endowment treatment than in the private large endowment treatment.*

Proof: see Appendix.

In fact, for the vast majority of cases involving reasonable parameter values, the probability of investing every (discrete) amount at or below 80 shillings is weakly higher in the public large endowment treatment than in the analogous private treatment: this holds for 89.9 percent of the 1,000,000 $\rho \times \tau \times \sigma_\varepsilon$ grid points we consider.[36] In the entire parameter range we consider,

[36] To focus attention on the set of empirically relevant cases and avoid rounding issues that arise with extremely small probabilities, we treat probability differences less than 0.001 as equivalent to 0.

the probability of investing exactly 80 shillings is always higher in the public large endowment treatment than in the private large endowment treatment.[37] Combining this empirical regularity with Proposition 1 generates our second empirical prediction.

Empirical Prediction 2. *For $\tau \in (0, 0.5)$ and $\rho_i > 0$,*

(i) the probability investing no more than 80 shillings (the amount of the small endowment) is strictly higher, and

(ii) the probability of investing exactly 80 shillings is weakly higher

in the public large endowment treatment than in the private large endowment treatment.

This prediction applies not just to individuals, but to populations of individuals who are heterogeneous in terms of ρ_i and are randomly assigned to experimental treatments (so that, in expectation, the distribution of risk aversion parameters is the same in all treatments).

Interestingly, while the expected investment level is lower in the public large endowment treatment than in the private treatment at the majority of grid points, the opposite is true in some cases (at 5.4 percent of grid points). Specifically, for high values of ρ_i and relatively low values of σ_ε, the probability of investing more than 80 shillings is quite low in the private treatment; in such cases, the expected investment level may be higher in the public treatment than in the private treatment. We therefore focus our empirical analysis on probabilities rather than investment amounts.

3.1.3 Investment Decisions in Price Treatments

In the price treatments, subjects may choose to pay a randomly chosen price, $p > 0$, to avoid making the public announcement. Forward-looking subjects make their investment decisions in this setting conditional on their beliefs about whether or not they will pay p and avoid the public announcement in each of the possible outcome (payoff) states (heads and tails). They choose their investment level expecting to follow one of three strategies: never paying to avoid the public announcement, paying to avoid the public announcement only if their investment is successful, or always paying to avoid the public announcement.[38] We refer to these strategies as *never*, *heads*,

[37] This does not hold analytically across the entire range of feasible (if unreasonable) parameter values. Specifically, when τ is sufficiently close to 1 (e.g. above 0.95), we observe combinations of parameter values such that the probability of investing exactly 80 shillings is lower in the private large endowment treatment than in the public large endowment treatment.

[38] Abstracting from random utility shocks, subject i receiving gross payout $x_i > 0$ in the small endowment treatment prefers to pay p to avoid the public announcement whenever

$$\frac{(x_i - p)^{1-\rho_i}}{1-\rho_i} \geq \frac{(1-\tau)^{1-\rho_i} x^{1-\rho_i}}{1-\rho_i}, \tag{9}$$

or $\tau \geq p/x_i$. Similarly, a subject in the large endowment treatment prefers to pay p to avoid the public announcement whenever

$$\frac{(x_i - p)^{1-\rho_i}}{1-\rho_i} \geq \frac{[(1-\tau)x + \tau H_{ij}]^{1-\rho_i}}{1-\rho_i}, \tag{10}$$

and *always*, respectively.[39] We assume that subject i in a price treatment chooses investment amount b_j to maximize:

$$EU_{ij} = \max\left\{EV_{ij}^{never}, EV_{ij}^{heads}, EV_{ij}^{always}\right\} + \varepsilon_{ij}. \tag{13}$$

In other words, subjects choose an investment level expecting to follow an optimal strategy.[40]

Subjects assigned to the large endowment price treatment have two mechanisms for hiding income: paying p obscures their entire payout, while investing no more than 80 shillings keeps 100 shillings of their endowment hidden. This makes paying to avoid the public announcement relatively less attractive at investment levels at or below 80 shillings, particularly when one's investment is unsuccessful. In fact, at reasonable parameter values, it is only optimal to pay to avoid the public announcement in the unsuccessful investment state when τ is extremely high. When subjects do not anticipate paying to avoid the public announcement in both the high and low payoff states (heads and tails), the same forces are at work in the price large endowment treatments that drive investment decisions in the public large endowment treatments, albeit to a lesser extent. This leads to clear numerical patterns: at all 1,000,000 simulated grid points, the probabilities of investing both no more than 80 shillings and exactly 80 shillings are weakly higher in the price large endowment treatment as in the private large endowment treatment, leading to our third empirical prediction.

Empirical Prediction 3. *For $\tau \in (0, 0.5)$ and $\rho_i > 0$, both*

(i) the probability investing no more than 80 shillings (the amount of the small endowment), and

(ii) the probability of investing exactly 80 shillings

are weakly higher in the price large endowment treatment than in the private large endowment treatment.

Taken together Predictions 2 and 3 indicate that, if subjects face a non-negligible amount of social pressure to share their income with others, we should expect to observe higher proportions

or $\tau \geq p/(x_i - H_{ij})$. It is clear that, if equations 9 and 10 hold when $x_i = m_i - b_j$ (or $x_i = m_i - b_j + \tau H_{ij}$), they will also hold when $x_i = m_i + 4b_j$ (or $x_i = m_i + 4b_j + \tau H_{ij}$). Hence, the strategy of paying to avoid the public announcement when one's investment fails but not when it succeeds is never optimal.

[39] For each possible investment level, b_j, the CRRA expected utility of following the *never* strategy is the same as in the public treatments, as defined in Equations 5 and 8. The CRRA expected utilities of the *always* and *heads* strategies are:

$$EV_{ij}^{always} = \frac{(m_i - b_j - p)^{1-\rho_i}}{2(1-\rho_i)} + \frac{(m_i + 4b_j - p)^{1-\rho_i}}{2(1-\rho_i)} \tag{11}$$

$$EV_{ij}^{heads} = \begin{cases} \left\{[(1-\tau)(m_{small} - b_j)]^{1-\rho_i} + (m_{small} + 4b_j - p)^{1-\rho_i}\right\} / [2(1-\rho_i)] & \text{if } m_i = m_{small} \\ \left\{[(1-\tau)(m_{large} - b_j) + \tau H_{ij}]^{1-\rho_i} + (m_{large} + 4b_j - p)^{1-\rho_i}\right\} / [2(1-\rho_i)] & \text{if } m_i = m_{large} \end{cases} \tag{12}$$

[40] For some values of b_j and p, *always* may not be a viable strategy — for example, participant i cannot plan to pay p if she invests and loses her entire endowment. Whenever $m_i - b_j < p$, EV_{ij}^{always} is omitted from Equation 13.

of subjects investing no more than 80 shillings and exactly 80 shillings in the public and price large endowment treatments than in the private large endowment treatment. We test this prediction in Section 4.1.

3.2 Paying to Avoid the Public Announcement

After the investment return is realized, if subject i assigned to one of the price treatments has a gross payout greater than p, she decides whether to pay p to avoid the public announcement. As in the case of investment decisions, we model noise in the decision about whether to pay p in a random utility framework: given a realized gross payout of x_i, the utility of paying to avoid the announcement is:

$$\frac{1}{(1-\rho_i)}\left(x_i - p\right)^{1-\rho_i} + \zeta_{i1} \tag{14}$$

This includes ζ_{i1}, participant i's idiosyncratic utility from paying to avoid the announcement. The analogous expression for the utility of making the announcement is:

$$\frac{1}{(1-\rho_i)}\left[(1-\tau)x_i + \tau H_{ij}\right]^{1-\rho_i} + \zeta_{i0} \tag{15}$$

where ζ_{i0} is idiosyncratic utility associated with announcing her payout and facing pressure to share a portion of her observable income. We assume that ζ_{i1} and ζ_{i0} are draws from a type 1 extreme value distribution, and that they are independent of each other and of the ε_{ij} terms. The probability that subject i pays to avoid the public announcement is then given by:

$$P_i^{exit} = \frac{1}{1 + e^{\left(\left[(1-\tau)x_i + \tau H_{ij}\right]^{1-\rho_i} - (x_i - p)^{1-\rho_i}\right)/[(1-\rho_i)\gamma]}}, \tag{16}$$

where γ^2 is proportional to the variance of the difference between ζ_{i1} and ζ_{i0}. It is apparent that P_i^{exit} is decreasing in p, the randomly-assigned price. P_i^{exit} is equal to one half when subject i is indifferent between paying p to avoid the public announcement and not paying p — i.e. whenever

$$\frac{\left[(1-\tau)\,x_i + \tau H_{ij}\right]^{1-\rho_i}}{1-\rho_i} = \frac{(x_i - p)^{1-\rho_i}}{1-\rho_i}. \tag{17}$$

The probability of paying to avoid the public announcement is less than one half when the left-hand side of Equation 17 exceeds the right-hand side; when the right-hand side is larger, the probability of paying to avoid the public announcement is greater than one half. Rearranging the terms in Equation 17 generates our final empirical prediction, which links behavior in price treatments to the underlying value of τ.

Empirical Prediction 4. *Let z_i denote subject i's observable payout — her gross payout x_i minus H_{ij}, the 100 shillings hidden from view if a subject receives the large endowment and then* *chooses an investment level of no more than 80 shillings. For all i,*

$$P_i^{exit} \geq \frac{1}{2} \Leftrightarrow \tau \geq \frac{p}{z_i}.$$

Given this, the expected proportion of subjects choosing to pay to avoid the public announcement is greater than one half for values of p and z_i such that $\tau \geq p/z_i$ and less than one half otherwise.

In Section 4.2, we use this prediction to provide rough bounds on the range of τ values consistent with the observed average willingness-to-pay to avoid the public announcement.

3.3 Extensions to the Model

In this section, we explore the possibility that individual behavior in the public information treatments might be influenced by factors other than social pressure to share income. We consider two such alternative explanations. First, we explore the possibility that risky behaviors — including investing in the business cup — might be socially sanctioned. We then discuss the hypothesis that subjects might be willing to pay to avoid the public announcement because they are averse to attention or public scrutiny. We refer to this as "attention aversion."

3.3.1 Social Sanctions Against Risk-Taking

An alternative explanation of any observed differences in investment choices between the private and public information treatments is that subjects wish to avoid potential social sanctions against risk-taking — for example, if investing in the business cup were perceived as similar to gambling. We made it clear to participants that there was no way for them to realize an actual loss during the experiment, and used the "business cup" framing to push this point more subtly. However, we can also examine the data for patterns that would suggest that participants were concerned about hiding the riskiness of their investments. An obvious test of this hypothesis would be to see whether the proportion of subjects investing nothing in the business cup — completely abstaining from taking any risk — is higher when investments are observable. The theory discussed above suggests that, for many reasonable parameter values, the probability of investing every (discrete) amount at or below 80 shillings is weakly higher in the public large endowment treatment than in the private large endowment treatment; however, our simulations suggest that these differences are the most robust at investment levels very close to 80 shillings. Evidence of a major shift toward extremely low investment levels would be consistent with an aversion to revealing any risk-taking and not just a desire to hide the size of one's endowment.

3.3.2 Attention Aversion

A straightforward model of participants' desire not to draw attention to themselves — without regard to any effective taxation — is to incorporate an additive cost parameter, κ, into the utility function, subtracting it from the expected utility of any outcome that involves making a public announcement of one's investment decision. It is apparent that the inclusion of κ would not change the probability ordering of investment levels in the public treatments (since one is always obliged to make the public announcement). However, within the price treatment, $\kappa > 0$ would influence the willingness-to-pay to avoid making the public announcement. We return to this point in Section 5, when we explicitly estimate the κ parameter to test whether it drives decisions in the price treatments.

4 Results

In this section, we estimate the impacts of observability on behavior in the experiment. We report results relating to investment decisions in Section 4.1, and describe decisions regarding whether to pay to avoid the public announcement in Section 4.2. Summary statistics on outcomes in the experiment are presented in Table 2. On average, subjects chose to invest just over half their endowments in the business cup; the fraction of the endowment invested is similar in the large and small endowment treatments.[41] Subjects earned an average of 3.16 US dollars (240 Kenyan shillings) in the experiment, which is equivalent to eight percent of mean monthly wages among subjects reporting paid employment. Thus, stakes were large, but not life-altering. There is substantial variation in payoffs across across treatments: subjects in the public, small endowment treatment received the lowest average payoffs (1.83 US dollars); those in the private, large endowment treatment earned the most (4.68 US dollars).

4.1 Individual Investment Decisions

Our analysis of individual investment decisions focuses on testing the predictions of our theoretical model. Subjects allotted the larger (180 shilling) endowment could avoid revealing the amount they received by investing no more than 80 shillings (the amount of the small endowment) in the business cup; as a consequence, our model predicts that both the probability of investing no more than 80 shillings and the probability of investing exactly 80 shillings will be higher in the public and price large endowment treatments than in the private large endowment treatment.[42]

To test these hypotheses, we estimate probit regressions of the form

$$\Pr\left[Y_i = 1\right] = \Phi\left(\alpha + \beta PublicTreatments_i + X_i'\gamma\right) \tag{18}$$

where Y_i is a binary outcome of interest, an indicator for investing no more than 80 shillings ($Y_i = LTE80_i$) or for investing exactly 80 shillings ($Y_i = EX80_i$); $PublicTreatments_i$ is an

[41] We note that the fraction of the budget invested is very similar in all three small endowment treatments, as predicted by the model when τ is not unduly large. Histograms of investment decisions are included in the Online Appendix. All but 5 subjects invest a positive amount, suggesting that subjects are not concerned with social sanctions against (at least moderate) risk-taking within the experiment.

[42] Our theoretical model makes predictions about investment decisions in the large endowment treatments, and our analysis throughout Section 4.1 focuses on the sample of subjects randomly assigned to the large endowment treatments. To keep our writing as concise as possible, throughout the rest of Section 4.1 we omit the descriptive "large endowment" when referring to our experimental treatments.

indicator equal to 1 if subject i was assigned to either the public or price treatment; and X_i is a vector of individual characteristics. We also report analogous OLS linear probability model specifications, including specifications which control for village fixed effects. Results are reported in Table 3. Given our stratified design, we present results that are disaggregated by gender: columns 1 through 4 report results for women, while columns 5 through 8 report results for men.[43]

In all specifications, women are significantly more likely to invest no more than 80 shillings in the public and price treatments than in the private treatment. For example, probit coefficient estimates indicate that women are 9.7 to 10.3 percentage points more likely to invest 80 shillings or less when investment returns are observable (Table 3, Panel A, columns 1 and 2).[44] OLS results are similar (Table 3, Panel A, columns 3 and 4). These coefficient magnitudes mean that the probability that a woman invests no more than 80 shillings is approximately 25 percent higher in the public and price treatments than in the private treatment. Women are also significantly more likely to invest exactly 80 shillings in the public and price treatments, as our model predicts. Coefficient estimates suggest that the probability of investing exactly 80 shillings is 6.2 to 7.3 percentage points higher in the public and price treatments than in the private treatments (Table 3, Panel B, Columns 1 through 4).

Interestingly, we find that random assignment to the public and price treatments does not appear to have a significant impact on men's investment decisions: men are not significantly more likely to invest either 80 shillings or less or exactly 80 shillings in the public and price treatments than in the private treatments (Table 3, columns 5 through 8). In fact, coefficient estimates suggest a small, statistically insignificant decline in the probability that a male subject invests no more than 80 shillings (Table 3, Panel A, columns 5 through 8), and a small and statistically insignificant increase in the probability of investing exactly 80 shillings (Table 3, Panel B, columns 5 through 8). There are many possible interpretations. One possibility is that men are less subject to unwanted social pressure to share their income with members of their community, making the possibility of paying to hide income less attractive. However, this need not be the case. It is also possible that the opportunities to hide income afforded by the experiment may have been less valuable to men — if, for example, a larger fraction of their consumption occurs outside of the home in contexts where expenditures are observable. Alternatively, men may have failed to grasp the fact that investing no more than 80 shillings obscured the size of one's endowment.

[43] We report pooled specifications, some of which include an interaction between $PublicTreatments_i$ and the indicator for being female, in the Online Appendix. In pooled specifications which do not include gender interactions, random assignment to the public or price treatments is positively associated with the probability of investing both no more than 80 shillings and exactly 80 shillings, but the effect is only marginally statistically significant. When $LTE80_i$ (the indicator for investing no more than 80 shillings) is used as the dependent variable, the interaction between the female dummy and the $PublicTreatments_i$ indicator is marginally significant in both specifications we consider. When $EX80_i$ (the indicator for investing exactly 80 shillings) is used as the dependent variable, the interaction term is not statistically significant; it is only the sum of $PublicTreatments_i + Female \times PublicTreatments_i$ that is statistically significant.

[44] Coefficients and significant levels are similar if we restrict attention to either the private vs. price treatment comparison or the private vs. public treatment comparison.

We discuss these possibilities in greater detail below, and place this pattern in the context of the model in Section 5.2.

Given our stratified design, it is appropriate to report results for men and women separately; this is particularly true given the extensive literature suggesting that men and women have different risk preferences and, at least in rural villages in Kenya, different social realities. Nonetheless, a concern is that gender may be proxying for some other household or individual characteristic that actually explains the differential gender impacts that we observe. Random assignment within gender strata means that this concern is related to the interpretation of our data, not to identification — but this does not minimize its potential importance. In the Online Appendix, we provide additional analysis exploring this issue. We show, first, that there is no evidence of differential selection into the experiment by gender, and, second, that the observable characteristics that differ systematically between men and women do not explain treatment effect heterogeneity within each gender separately. This suggests that the effects we document are indeed gender-specific, and are not explained by other characteristics which differ across the sexes.

4.1.1 Treatment Effect Heterogeneity

If women are socially obligated to share their income, the extent of income hiding should be associated with factors predicting the level of social pressure an individual is likely to face after the experiment. We consider two sources of social pressure suggested by existing literature: relatives outside of one's household and, within the household, one's husband.[45] We first test whether the impact of the public information treatments on investment behavior (documented above) is concentrated among those women with close kin attending the experiment who would observe their payoffs. We test for such treatment effect heterogeneity by interacting the $PublicTreatments_i$ variable with indicators for whether or not a subject had any close kin attending the experiment, thereby disaggregating the impact of the public information treatments.[46] We estimate the OLS regression equation

$$\begin{aligned} Y_i = \alpha + \beta_1 KinPresent_i + \beta_2 PublicTreatments_i \times KinPresent_i \\ + \beta_3 PublicTreatments_i \times NoKinPresent_i + \nu_v + X_i'\zeta + \varepsilon_{it} \end{aligned} \tag{19}$$

where Y_i is one of our binary outcomes of interest — either the indicator for investing no more than 80 shillings ($LTE80_i$) or the indicator for investing exactly 80 shillings ($EX80_i$).[47] Our

[45] Hoff and Sen (2006) highlight the role played by kin networks in extracting surplus from successful relatives, while Baland, Guirkinger, and Mali (2011) provide evidence that individuals seek to hide income from family members. Robinson (2008) and Ashraf (2009) document limited commitment and observability effects *within* the household, while Anderson and Baland (2002) argue that Kenyan women use ROSCAs to hide savings from their husbands.

[46] We define close kin as a respondent's parents, in-laws, grandparents, siblings, grown children, and aunts and uncles. Note that we were unable to stratify treatment assignment by kin presence because the variable was constructed after experimental sessions took place using a name-matching algorithm that compared close relatives' names (recorded during pre-experiment surveys) with the roster of experimental subjects.

[47] We report OLS results; probit results are nearly identical in terms of both coefficient magnitudes and statistical significance, and are omitted to save space. Village fixed effects and controls for age and education level, household

specification includes an indicator for having kin present, thereby controlling for any overall differences in investment behavior between subjects with relatives attending the experiment and those without. Results are reported in (Table 4).

Women with close kin attending the experiment are more likely to invest both 80 shillings or less and exactly 80 shillings in the public and price treatments than in the private treatment. Women with relatives present are 41.8 percentage points more likely to invest 80 shillings or less (Table 4, Column 1, p-value = 0.0002) and 14.9 percentage points more likely to invest exactly 80 shillings (Table 4, Column 3, p-value 0.0972). In contrast, coefficient magnitudes are smaller — though still positive — and not statistically significant for women with no kin attending the experiment (p-values 0.148 and 0.114, respectively). Thus, our results suggest that relatives outside the household may be an important source of pressure to share income.

Women may also seek to hide income from their husbands. An alternative explanation of our result is that kin are relevant because they pass information about wives' incomes to their husbands. As discussed above, 76 percent of women in our sample are married, and the two main ethnic groups in the area — the Luhya and the Luo — are both patrilocal (Brabin 1984, Luke and Munshi 2006), so married women typically live near their in-laws rather than their blood relatives. To explore this possibility, we estimate Equation 19 replacing the kin variables with indicators for whether or not a subject's spouse attended the experiment (Table 4, Columns 2 and 4). If relatives were only important because they shared information with husbands, we would expect the direct effect of a husband's presence to be at least as large as the impact of having kin at the experiment. However, in both specifications we consider, we cannot reject the hypothesis that $PublicTreatments_i \times SpousePresent_i$ is equal to $PublicTreatments_i \times NoSpousePresent_i$, i.e. than women are no more inclined to conceal the size of their endowment when their husband is present.[48] Thus, our evidence suggests that women in the experiment seek to shield information about their income from their close relatives rather than their husband.[49]

size, marital status, and household durable asset holdings are included in all specifications.

[48]To further explore the possibility that kin may simply act as a channel through which husbands exert control over their wives, we examine investment decisions among the small sample of women receiving the large endowment who were not married and had close kin attending the session. These women are 51.4 percentage points more likely to invest 80 shillings or less in the public treatments. These differences are not statistically significant in this twelve subject sub-sample, but it nonetheless appears that women with kin present are concerned about observability even in cases where the kin cannot possibly pass information on to husbands.

[49]Women with relatives attending the experiment may, of course, differ from other female subjects in many ways; the heterogeneity that we observe could be driven by another variable that is correlated with kin presence. We explore this issue in greater detail in the Online Appendix. First, we attempt to identify the factors associated with having one's relatives attend the experiment by regressing $KinPresent_i$ on a range of household and individual characteristics. After controlling for village fixed effects, none of the standard demographic characteristics — age, education level, marital status, and household asset holdings — is strongly related to the likelihood of having relatives attending the experiment; one factor that is significantly associated with kin presence at the experiment is, unsurprisingly, the number of close relatives residing in the village. To test whether observability effects are driven by simply having many relatives in the village (whether or not they are present at the experiment), we estimate specifications which control for the presence of close and distant kin in the village, plus interactions between these variables and the $PublicTreatments_i$ variable. In all specifications, we find that having kin in the village who are physically present at the experiment is the critical factor predicting differences in investment behavior across treatments.

4.1.2 Income Hiding across Villages

Next, we explore the association between the level of income hiding, aggregated within a community, and village-level outcomes. If pressure to share income does, in fact, act like a tax on investment returns, we would expect to see a correlation between the level of social pressure within a community and a range of development indicators. We explore this by constructing two aggregate measures of income hiding motivated by the theoretical framework presented in Section 3: (*i*) the within-village difference in the proportion of women investing no more than 80 shillings in the public and price treatments and the proportion investing no more than 80 shillings in the private treatment, and (*ii*) an analogous measure of the difference in the proportion of women investing exactly 80 shillings across treatments. Larger positive differences suggest greater levels of income hiding. Across all 26 communities, the average difference in the proportion investing no more than 80 shillings is 11.4 percentage points, while the average difference in the proportion investing exactly 80 shillings is 7.2 percentage points.[50]

Having constructed our measures of women's propensity to hide income, we explore the associations between these measures and four outcomes: the mean of the log value of subjects' durable household assets, the fraction of subjects with any form of formal or skilled employment, subjects' average level of wages from paid work, and the proportion of subjects' that have used fertilizer on their plots in the past year. We report regression results in Table 5. Odd-numbered columns include only a session-level measure of income hiding as an independent variable, while even-numbered columns also include controls for for distance to the nearest paved road, the mean education level of subjects from that community, the mean number of close relatives in the village, and the mean number of community groups in which subjects participate (a measure of social capital). All estimated coefficients are negative, and the majority are statistically significant. Higher levels of income hiding within the experiment are associated with lower levels of household wealth, lower rates of skilled and formal employment, lower wages, and a reduction in the likelihood of using fertilizer.

These cross-community results do not merit a causal interpretation. Nonetheless, these findings are of interest for two reasons. First, results are consistent with the view that pressure to share income may act as a drag on savings and investment, and may therefore slow development. An alternative, though not mutually exclusive, explanation is that in the poorest areas, enforced sharing norms remain an essential tool for handling risk, and thus the pressure to share is the most acute. In either case, the evidence suggests that social pressure to share income is greatest in the worst-off areas, and should be viewed as an important social factor in models of poor, rural village economies. More generally, these results go some way toward addressing the concern that

[50]The former measure is negative in 7 of 26 villages, the latter in 9 of 26 villages. This pattern is consistent with the types of behavior predicted by our stochastic choice model, as we discuss further in Section 5.2. Both measures of income hiding are positively but weakly correlated with the percentage of subjects who report (in the pre-experiment survey) making a transfer to another household in the last three months, and more strongly correlated with the percentage of households who report making a transfer but who do not report receiving a transfer.

behavior in lab experiments may not be related to decisions and outcomes outside the lab (cf. Levitt and List 2007); in this case, there is a clear association between what happens within the experiment and economic outcomes outside the lab.

4.2 Paying to Avoid the Public Announcement

We now examine the willingness-to-pay to avoid the public announcement using data from the price treatments. Subjects assigned to the price treatments were offered the option of paying a randomly chosen price — 10, 20, 30, 40, 50, or 60 shillings — to avoid announcing their investment income to the other subjects.[51] Of 690 subjects assigned to the price treatments, 627 subjects could afford to pay p to avoid the public announcement, and 190 of them (30.3 percent of those able to pay) chose to do so. Subjects who chose to buy out paid an average price of 29.3 shillings — equivalent to an average of 15.3 percent of their gross earnings.

Table 6 reports OLS regressions of the probability of paying to avoid the public announcement on exogenous factors: the randomly assigned price and indicators for receiving the large endowment and having the coin land with heads facing up. As the model predicts, both men and women are less inclined to buy out at higher exit prices: the coefficient on the price variable is negative and significant in all specifications. Women with more observable income are more likely to pay to avoid the public announcement: the coefficient on *Heads* is consistently positive and significant, suggesting that subjects with successful investments are approximately 23 percentage points more likely to pay to avoid announcing their investment return. Men, in contrast, are only significantly more likely to pay to avoid the announcement when their investments are successful in the (price) large endowment treatment.

The third prediction of our model is that the probability of paying to avoid the public announcement will be greater than one half when τ is greater than the randomly-assigned price divided by a subject's gross observable income from the experiment (her gross payoff or, if a subject was assigned to the large endowment treatments and invested no more than 80 shillings, her gross payoff minus 100 shillings). In Figure 2, we plot the relationship between the proportion of subjects paying to avoid the public announcement and the price as a fraction of the gross observable payout. We plot locally-weighted (lowess) regressions (separately for women and men). For both women and men, we observe a negative relationship between the price as a proportion of the observable payout and the probability of paying to avoid the public announcement. In fact, the two regression plots are quite similar. Both cross the horizontal line indicating that the probability of paying to avoid the public announcement is 0.5 at a price to observable payout ratio of approximately 0.039, suggesting that — for both men and women — we might expect to find a τ of around 4 percent. Unfortunately, the number of data points in the range of the crossover point is relatively small, so this exercise does not provide a particularly precise estimate

[51] Though this randomization was not stratified, it was largely successful. Table 2 in Appendix III (online) reports the results of a balance check exercise in which subject characteristics were regressed on dummies for prices 20 through 60. The price variables are jointly significant at the five percent level in only four of the 68 F-tests.

of the level of social pressure to share income.

5 Estimating the Social Pressure Parameter

In this section, we estimate the magnitude of the social pressure parameter, τ, while controlling for unobserved heterogeneity in individual risk aversion. Random assignment guarantees that, in expectation, the distribution of individual risk parameters in each of the six treatments is representative of the population distribution. We can therefore estimate the parameters of the risk preference distribution using data from the private treatments, and simultaneously estimate τ while controlling for unobserved heterogeneity in risk aversion in a structural framework.

Subjects are heterogeneous in terms of their risk preferences (Choi, Fisman, Gale, and Kariv 2007). Assumptions about the functional form of that heterogeneity allow us to estimate the magnitude of τ. As discussed in Section 3, we assume that subject i's expected utility of investing b_j is given by:

$$EU_{ij} = EV_{ij} + \varepsilon_{ij} \tag{20}$$

where EV_{ij} denotes the CRRA expected utility of investing b_j and ε_{ij} is an i.i.d. type 1 extreme value distributed preference shock. We further assume that individual ρ_i parameters are normally distributed with mean μ_ρ and variance σ_ρ^2.[52] Given these assumptions, the probability that subject i chooses to invest b_j can be written in the form of a mixed logit model:

$$P_{ij} = \int \left(\frac{e^{EV_{ij}/\sigma_\varepsilon}}{\sum_{k=1,\ldots,J_t} e^{EV_{ik}/\sigma_\varepsilon}} \right) f(\rho)\, d\rho. \tag{21}$$

Let y_{ij} be an indicator function equal to one if subject i chooses to invest amount b_j. The log-likelihood function for treatment t can be written as:

$$LL_t = \sum_{i \in I_t} \sum_{j \in J_t} y_{ij} \ln \left[\int \left(\frac{e^{EV_{ij}/\sigma_\varepsilon}}{\sum_{k=1,\ldots,J_t} e^{EV_{ik}/\sigma_\varepsilon}} \right) f(\rho)\, d\rho \right]. \tag{22}$$

The log-likelihoods can then be summed across treatments. We simulate the log-likelihood by taking one thousand random draws from the distribution of ρ_i for each individual, and maximize the simulated log-likelihood numerically.[53]

When estimating a mixed logit model which allows for heterogeneity in risk preferences, it is necessary to choose a utility formulation which generates comparable utility magnitudes across the range of risk aversion levels (Goeree, Holt, and Palfrey 2003, Wilcox 2008, Von Gaudecker,

[52] Results are nearly identical if we instead assume a triangular distribution for ρ_i, as shown in the Online Appendix.

[53] Our implementation follows the procedures outlined in Train (2003). We implement this using the MATLAB command `fminunc` using the default Broyden-Fletcher-Goldfarb-Shanno (BFGS) updating procedure. Standard errors are calculated using the inverse Hessian.

van Soest, and Wengström 2011). We achieve this by re-writing the CRRA utility function as

$$v(x|\rho_i) = \frac{1}{900^{1-\rho_i} - 10^{1-\rho_i}} x^{1-\rho_i}, \tag{23}$$

where $900^{1-\rho_i} - 10^{1-\rho_i}$ represents the difference between the utility of the highest possible payout in the experiment and the utility of the lowest strictly positive payout.[54] Since VNM expected utility functions represent preference orderings over lotteries and are robust to positive, affine transformations, this utility function represents the same preferences as the more traditional CRRA formulation described in Section 3.[55]

Before proceeding to our estimates of the kin tax parameter, it is worth reviewing the sources of identification in our model. Because subjects choose from a rich menu of investment options, the distributions of investment decisions in the two private treatments allow us to identify μ_ρ, σ_ρ, and σ_ε. The kin tax parameter, τ, is identified by the differences in the distribution of investment decisions between the private large endowment treatment and the public and price large endowment treatments; the relationship between the willingness to pay to avoid the public announcement and observable income provides a second source of identification. Finally, the variance of the logit error term in the buyout decisions, γ^2, is identified by the excess willingness to pay to avoid the public announcement at very low gross payouts and high exit prices.

5.1 Parameter Estimates

Summing the log likelihoods across all treatments, we can estimate all the parameters of the model using the full dataset. We do so separately for men and women, paralleling our reduced form analysis (since the experimental treatment randomization was stratified on gender to permit such analysis). Parameter estimates are reported in Table 7. In Column 1, we use only the data from the private treatments to estimate the parameters of the risk preference distribution (μ_ρ and σ_ρ) and the logit noise parameter associated with the investment decision (σ_ε). In Column 2, we report estimates from a simplified likelihood function which only uses data from investment decisions (in all 6 treatments) to estimate the risk preference parameters and τ. In Column 3, we report parameter estimates based on all the decisions within the experiment.

We estimate a μ_ρ of 0.75 for women, and a slightly higher value, 0.77, for men (Table 7, Column 1). Estimated levels of risk aversion are higher than those typically reported for undergraduate subjects (cf. Holt and Laury 2002, Goeree, Holt, and Palfrey 2003), but are not out of line with existing estimates of risk aversion among non-student subjects (cf. Andersen, Harrison, Lau, and

[54]See Goeree, Holt, and Palfrey (2003) and Wilcox (2008) for similar approaches. Using the lowest possible payout, zero, is not feasible because $u(x) \to -\infty$ as $x \to 0$ for subjects with $\rho \geq 1$. Results are almost identical when $10^{1-\rho}$ is replaced with $1^{1-\rho}$ or $0.01^{1-\rho}$.

[55]Our scaling generates estimates of μ_ρ and σ_ρ that are nearly identical to those generated by the contextual utility model of Wilcox (2008) and the certainty equivalent procedure used in Von Gaudecker, van Soest, and Wengström (2011). We refer the interested reader to the Online Appendix, where we discuss our scaling procedure in more detail and report the results of a sensitivity analysis.

Rutström 2008, Cardenas and Carpenter 2008).[56] Somewhat surprisingly, we do not find evidence that women are more risk averse than men — this contrasts with the broad conclusion reported in Croson and Gneezy (2009). One possible explanation is that the village represents a somewhat selected sample: as discussed above, many Kenyan men migrate to urban areas in search of work; and women account for a disproportionately large fraction of the village population. Our results suggest that those men remaining behind may be a selected sample in terms of their risk preferences.

Next, we turn to our estimates of the level of social pressure to share income. For women, the estimated τ ranges from 0.0432 to 0.0450, and is significantly different from zero at the 99 percent confidence level. Among men, the point estimate is smaller, ranging from 0.0234 to 0.0267, and is only marginally significant. For both men and women, these estimated values of τ are broadly in line with the reduced form results suggested by Figure 2

As discussed in Section 3, one alternative explanation for the relatively high willingness to pay to avoid the public announcement is that subjects are attention averse, and wish to avoid being asked to stand up in front of their neighbors, irrespective of whether their income from the experiment will be revealed. We explore this by incorporating an additional parameter, κ, into the model, which is simply subtracted from all EV_{ij} expressions any time a public announcement is being made. Intuitively, κ is identified from excess willingness to pay to avoid the announcement in the price treatments, as compared to the implied willingness to pay identified from the increased tendency to invest exactly 80 shillings in the public treatments, and by the imperfect correlation between total income and observable income, since subjects seeking to avoid social pressure would only be willing to pay to hide observable income from neighbors and relatives. Recall that τ is identified by changes in behavior across public and private treatments, and by variation in willingness to pay in price treatments with respect to *observable* income. In contrast, κ is identified by excess willingness to pay in the price treatments, and its variation with respect to *total* income. As shown in Column 4, κ is precisely estimated and very close to zero in the sample of women, and we cannot reject the null that κ is zero for both women and men.

Our ability to explore potential heterogeneity in τ is limited by the relatively small samples in different demographic categories, particularly in the price treatment, where subjects faced different randomly-assigned prices and decisions depended on both prices and (not randomly-assigned) gross payouts. However, in light of our reduced form results, we take an initial step in this direction by allowing τ to depend on whether a subject's close relatives were present at the experiment. In Table 8, we report parameter estimates when we replace the single τ with two separate parameters, $\tau_{no\ kin\ present}$ and $\tau_{kin\ present}$. Among women, $\tau_{no\ kin\ present}$ is slightly

[56] Andersen, Harrison, Lau, and Rutström (2008) report mean CRRA parameters of 0.74 in a representative sample of the Danish population. Cardenas and Carpenter (2008) review experiments measuring risk preferences of in developing countries; a key conclusion is that different studies (using different designs in different populations) lead to divergent estimates of risk aversion. Harrison, Humphrey, and Verschoor (2010) estimate a mean CRRA parameter of 0.536 in a sample of subjects drawn from Ethiopia, India, and Uganda. Tanaka, Camerer, and Nguyen (2010) estimate the average CRRA parameter to be between 0.59 and 0.63 among their Vietnamese subjects. Schechter (2007), on the other hand, reports a CRRA coefficient above 2.

smaller than in the full sample, at 0.043, but remains statistically significant. The estimated value of $\tau_{kin\ present}$ is 0.080 — substantially higher, and also statistically significant. Among men, as in the full sample, $\tau_{no\ kin\ present}$ remans about 2.7 percent, while the estimated $\tau_{kin\ present}$ is slightly below zero and imprecisely estimated. Thus, consistent with our reduced form results, we find evidence that women with kin present at the experiment are more exposed to social pressure to share income.

5.2 Comparing Model Predictions to Reduced-form Patterns

The behaviors our subjects exhibit, as demonstrated in the reduced-form results we show, must be squared with the predictions of the model under the parameter values we estimate. We do this three ways. We begin by relating our parameter estimates to the reduced form patterns that we observe in the data. We first discuss the predicted changes in investing no more than (or exactly) the small endowment amount; and then discuss the variation in hiding used for the cross-village results. Finally, we compare actual and predicted behavior in the price treatments.

A question we seek to answer is whether the parameters we estimate in Section 5.1 can explain the reduced-form investment patterns we find in Section 4.1. In particular, we wish to check whether gender differences in estimated structural parameters explain gender differences in reduced-form behavior. Here we can easily calculate four predictions to compare to the results. Under the estimated parameters, the largest probability difference the model predicts is the probability difference for women investing no more than 80 shillings across public and private treatments: the model suggests 7.5 percent; the data show a value of 9.6 percent, which, at the 68th percentile in simulated data, is a typical result. The smallest probability difference the model predicts is the probability difference for men investing exactly 80 shillings across public and private treatments: 1.7 percent; the data show almost exactly the same value, rounding to 1.7 percent (47th percentile in simulated data, a remarkably typical result). The predicted intermediate values are not quite as perfectly matched: the model predicts a 2.8 percentage point probability change for women investing exactly 80; the data show 6.2 percent, which is at the 90th percentile in simulations, so still easily within a 95-percent confidence interval. The model also predicts a 4.4 precent increase in investing no more than 80 shillings for men in the public versus private treatment; the data show a 2.5 percent decrease. This still only falls at the 8th percentile in model simulations, though, so still well within a 95-percent confidence interval; this interval is wider for men than for women because of their relatively smaller sample, and the data are correspondingly noisier. In summary, however, the model and the data are aligned on this front.

An additional question is whether the variation in community-level "hiding" behavior, the difference across public and private treatments in the probability of investing no more than (or exactly) 80 shillings, is consistent with the model. In particular, just under a third of the communities have negative values of "hiding." This, it turns out, is readily reconciled with the model's stochastic individual decision-making. If a community has a tax rate (τ parameter) of zero, then the probability difference that we use as a measure of "hiding" is equally likely to be positive or negative, because in a small sample of individuals (empirically, 24 women in large endowment treatments per community on average), half the time, the public treatment has more cases of investment of no more than the small endowment, and the other half of the time, the private treatment does. As the value of τ increases, so does the extent of "hiding," and with it, the probability that our "hiding" measure for that community is positive. In a setting where the average τ women face is around 4.3 percent, the predicted fraction of communities with negative values of hiding is 31 percent; for the two measures we use, the empirical values are 26.9 percent and 34.6 percent, averaging 31 percent, just as the model predicts.

Finally, to examine behavior in the price treatments, in Figure 3, we compare the predictions of the model to the actual frequency with which subjects pay to avoid the public announcement. We disaggregate the data according to the implied tax rate facing subjects: the randomly-assigned exit price they faced divided by their gross payout. As the figure demonstrates, the stochastic component plays a large role in individual decisions within our experiment, particularly when the difference between the expected utility of paying p and the expected utility of sharing income with others is small — though the estimated τ parameter is less than 0.05, the model predicts the observed rates of paying to avoid the public announcement even when the price is more than five percent of the gross payout. For women, the estimated parameters fit the data well, though the model over-predicts the likelihood of paying p at implied tax rates between 30 and 50 percent.

5.3 Alternative Laboratory Experiments

The reduced form results depend on the specific parameters of the investment scenario, while the structural parameter estimates shown in Tables 7 and 8 do not. To illustrate this, we briefly show how the reduced form results would have differed with the same population, but using slightly different experimental parameters.

To simulate the experiment for women, we begin by using the estimated parameters in Column 3 of Table 7: $\mu_\rho = 0.7488$, $\sigma_\rho = 0.1992$, $\sigma_\varepsilon = 0.0125$, $\tau = 0.045$, and $\gamma = 0.0588$. With these values, we can simulate behavior under a variety of settings. For a simple demonstration, we consider the same laboratory experiment but with different investment returns. Taking this a step further, we also simulate this range of experiments udner counterfactual scenarios in which populations were more or less risk averse.

In the actual lab setting, as described in Section 2, the investment amount was multiplied by five when successful, and zero when unsuccessful. We simulate the experiment for a range of values of the successful investment return on the interval [2,12], and show the predictions for one of the reduced form regressions — Table 3, Panel C, Columns 3 and 4. For subjects receiving the large endowment treatment, we compare behavior in the private treatment to choices in the two public information treatments, and measure the change in the probability of investing no more than the small endowment (80 shillings).

For the value 5.0, highlighted in Figure 4, the predicted change in the fraction of participants investing 80 shillings or less is 8 percentage points. This is close to the point estimates of 9.6 and 10.5 percentage points shown in Columns 3 and 4 of Table 3, Panel C. Figure 4 shows, however, that we might have seen even larger effects if successful investments had been multiplied by four rather than five, while we would have seen smaller effects if successful investments had been multiplied by three or ten, for example. The intuition behind the figure is straightforward: the largest reduced form effect is found when much of the population invests just over 80 shillings in the private treatment. Effects diminish as investment returns go up because the investment becomes so profitable that it is no longer worth sacrificing one's expected return to hide the large endowment. On the other side, effects diminish as investment returns decline because few participants invest over 80 shillings when the risky investment has a low expected return.

For the same intuitive reason, populations with different risk aversions would change the picture: while the bold curve in Figure 4 shows simulations for the estimated parameter values ($\hat{\mu_\rho} \approx 0.75$), the figure also includes two other curves for populations with $\hat{\mu_\rho}$ one standard deviation higher or lower. For the more risk averse population, the largest change in investment behavior around 80 shillings would have been seen for an investment multiplier of about 5.5; for the less risk averse population, a lower investment multiplier of about 3.0 would have induced investments close to the small endowment amount.

Similar figures can be constructed for other reduced form results in the paper, by varying other features of the laboratory experiment, or by simulating different populations. There are two key insights from this exercise. The first is that, without knowing the precise risk aversion characteristics of the population in advance, our choice of investment multiplier was not a bad one: it would have elicited responses no smaller than five percentage points even with substantially different study populations. The second insight here is that while the reduced form results would have varied across a range of closely related laboratory scenarios, the underlying structural parameters remain the same. It is these parameters that allow us to model behavior both in the lab, and beyond it.

5.4 Impacts of Social Pressure on Entrepreneurship

Our results thus far indicate that women in the experiment behave as if they expect to be pressed to share four percent of their cash income with others, and substantially more if their close kin can observe their income directly. A 4–8 percent "kin tax" may have large disincentive effects if, for example, relatives observe wages or micro-enterprise revenues, but are not able to easily separate profits from total income by accounting for labor time and indirect costs, both of which may be unobserved.[57] We explore this possibility by simulating a simple model of individual entrepreneurship adapted from the theoretical framework in Banerjee, Duflo, Glennerster, and Kinnan (2010). In their model, individuals receive income y_i in each of two periods. y_i can be seen as an individual's income from subsistence agriculture. In the first period, each person decides

[57] This would be consistent with evidence that many micro-entrepreneurs are unable to calculate their own profits, and do not correctly deduct time and indirect costs (cf. Karlan, Knight, and Udry 2012).

whether to invest in a microenterprise which yields return

$$A\left(K_i - \underline{K}\right) \tag{24}$$

where K_i is the amount that i invests in her microenterprise. To keep the model as simple as possible, we assume that individuals can neither save nor borrow. Thus, i chooses K_i to maximize

$$\frac{1}{\eta_i}\left(y_i - K_i\right)^{1-\rho_i} + \delta\frac{1}{\eta_i}\left(y_i + (1-\tau)A\left(K_i - \underline{K}\right)\right)^{1-\rho_i}. \tag{25}$$

We assume that individuals are pressed to share a proportion of their business income, but can avoid sharing their subsistence income — for example, because it may never be converted into cash.

We simulate a village economy comprising equal numbers of poor and non-poor individuals. We set $y_i = 800$ shillings for poor individuals, and $y_i = 1500$ shillings for the non-poor. These are roughly equivalent to the 30^{th} and 70^{th} percentiles of the rural consumption distribution in Uganda, as reported in Uganda Bureau of Statistics (2006).[58] We discretize the decision problem by assuming that individuals can invest any multiple of 100 shillings in a microenterprise. We do not allow individual consumption to drop to zero in any period, and we set $\underline{K}$ equal to 100 shillings, so that the fixed costs of starting an enterprise are quite low. We assume that individuals have heterogeneous risk preferences, and that individual CRRA parameters are normally distributed according to the mean and variance reported in Column 2 of Table 7.

We explore values of A ranging from 1.5 to 2.5. For each A value, we take $10,000$ draws from the distribution of CRRA parameters and calculate the fraction of women who invest a positive amount in a microenterprise and the average amount invested. We report results for three values of τ: when τ equals zero (i.e. in the absence of social pressure to share income), when τ is equal to 4.5 percent (as in our pooled data), and when τ is equal to 8 percent (our estimated value of τ when relatives are able to observe income streams directly). Results from the simulations are presented in Figure 5.

In the absence of kin pressure, only 1 percent of women become entrepreneurs when A is equal to 1.5, while 98 percent of women become entrepreneurs when A is equal to 2.5. Averaging across all values of A between 1.5 and 2.5, our simulations suggest that 59.9 percent of women would become entrepreneurs in the absence of kin pressure; but that number drops to 44.2 percent when τ is equal to 8 percent. Similarly, our simulations suggest that women would invest an average of 341 shillings in their enterprises in the absence of kin pressure, but this drops to 247 shillings if τ is equal to 8 percent. Thus, an 8 percent kin tax leads to more than a 27 percent decline in overall investment.

Thus, the investment impacts of relatively small kin taxes can be quite large. However, as the figures suggest, the simulated impact of social pressure depends on the value of A, the return

[58] We were unable to find analogous statistics for rural Kenya. Beegle, De Weerdt, and Dercon (2011) report similar figures for rural Tanzania.

on business investment. At the highest value of A we consider, 2.5, moving from a τ of zero to a τ of 8 percent reduces the fraction of women starting businesses from 0.98 to 0.97, and reduces average business investment by only 7 percent (from 598 shillings to 555 shillings). Intuitively, when entrepreneurship is profitable enough, social pressure has little effect since the return to starting a business is large even after sharing a portion of one's revenue with kin. On the other hand, at the value of A which maximizes the impact of social pressure to share, 1.94, even the relatively lower τ of 4.5 percent reduces the percent of women starting businesses from 64 to 40, and reduces average business investment by more than a third (from 349 to 232 shillings). At this level of A, a τ of 8 percent would have even more dramatic impacts, reducing the share of women starting businesses to only 26 percent, and reducing the average investment level by 56.7 percent. Thus, a relatively moderate level of social pressure to share can have large disincentive effects and, potentially, consequences for growth when profitable opportunities (jobs, new businesses) are relatively observable. However, the overall impacts will depend on the range of investments available to individuals, and their relative levels of observability.

6 Conclusions

We report the results of a economic experiment designed to measure social pressure to share income in Kenyan villages. Our approach is stratified to ensure balance, randomized within villages, and is conducted on a large sample. The design permits both reduced-form estimates to find results in line with theoretical predictions, and structural estimates to identify parameters of interest in the presence of heterogeneity.

Women who know that the outcome of their investments will be made public distort their choices to hide a portion of their income. Results are strongest for those who have relatives present at the experiment. When we offer some participants the opportunity to pay a fee to avoid making an announcement, they do so at substantial cost: 30 percent of those able to pay to avoid the public announcement choose to do so; these subjects sacrifice 15 percent of their gross payout, on average. Structural estimates of the average "kin tax" are significantly different from zero for women, estimated at roughly 4.3 percent for those whose relatives did not attend the experiment, but at 8.0 percent for those with relatives present. We also estimate a small and only modestly significant kin tax for men. Our model of stochastic choices in the experiment fits the data well, explaining both investment and exit decisions. We see no evidence that this behavior can be explained by household bargaining with a spouse, aversion to public announcements, or aversion to risk-taking in general.

We hypothesize that the behavior observed in this experiment is a sign that village sharing norms distort investment incentives towards less visible, but potentially less profitable, investments, and may consequently slow economic growth. The negative correlations we observe between the extent of income hiding at the village level and the level of prosperity in the village, measured several different ways, are in agreement with this interpretation. However, such results should be interpreted with caution, since the direction of causality is unclear. Moreover, the efficiency impacts of social pressure to share income will clearly depend on the range of income-hiding technologies available, and correlation between observability and profitability. There is still much to be learned about the range of observable and unobservable investment opportunities available to poor households, the set of technologies for hiding or protecting income from pressure to share, and the mechanics of that pressure. Nonetheless, simulating a simple model of entrepreneurship using our estimated structural parameters suggests that the levels of pressure to share documented in this paper may lead to large reductions in the probability of starting a business and the overall level of entrepreneurial investment. Whether the levels of social pressure we observe are large or small will depend on how social pressure is exerted outside of the lab: for example, whether individuals are pressed to share all cash income (such as business revenues) or only their profits after compensating themselves for indirect costs or labor time.[59]

Studies of mutual insurance typically assume that transfer arrangements are on the efficient frontier, though the analogous assumption has been called into question in intrahousehold bargaining contexts. Our work suggests that relationships with close kin outside the household may be similar to within-household interactions, and that social sanctions which encourage cooperation and sharing may also have important disincentive effects.

[59] One such possibility is that individuals are not pressured to share earned income. However, Jakiela (2014) reports experimental evidence that respect for "earned property rights" is less prevalent in rural villages than in university lab settings.

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Table 1: Summary Statistics on Experimental Subjects

Variable	Mean	S.D.	Median	Min	Max	N	— Balance — Women	Men
Female	0.61	0.49	1	0	1	2145	·	·
Years of schooling	6.74	3.36	7	0	16	2145	0.20	0.98
Age	36.82	14.28	34	18	88	2127	0.33	0.12
Currently married	0.77	0.42	1	0	1	2145	0.74	0.17
Spouse attended the experiment	0.08	0.27	0	0	1	2145	0.00^{***}	0.28
Ever married	0.88	0.32	1	0	1	2145	0.82	0.18
HH size	6.18	2.82	6	1	26	2145	0.18	0.40
Close relatives in village (outside of HH)	2.36	2.57	2	0	19	2145	0.19	0.05^{*}
Any close relatives attended the experiment	0.19	0.39	0	0	1	2145	0.64	0.73
Distant relatives in village	10.41	16.12	5	0	199	2145	0.05^{**}	0.01^{***}
No. chicken owned by HH	6.42	7.19	4	0	40	2145	0.66	0.78
No. cattle owned by HH	1.20	2.08	0	0	36	2144	0.08^{*}	0.41
No. bicycles owned by HH	0.83	0.76	1	0	6	2145	0.19	0.85
No. phones owned by HH	0.73	0.82	1	0	6	2145	0.82	0.92
No. televisions owned by HH	0.14	0.39	0	0	3	2145	0.03^{**}	0.92
Value of durable HH assets (in US dollars)	469.31	655.19	357.05	13.18	22695.65	2145	0.03^{**}	0.90
HH farms	0.99	0.12	1	0	1	2145	0.76	0.13
HH uses fertilizer on crops	0.46	0.50	0	0	1	2114	0.21	0.98
Has regular employment	0.08	0.28	0	0	1	2145	0.25	0.74
Monthly wages if employed (in US dollars)	39.28	61.59	19.76	1.32	434.78	178	0.19	0.02^{**}
Any HH member employed	0.23	0.42	0	0	1	2145	0.72	0.73
Self-employed	0.35	0.48	0	0	1	2145	0.27	0.81
Has bank account	0.17	0.37	0	0	1	2142	0.07^{*}	0.21
Member of ROSCA	0.53	0.50	1	0	1	2142	0.25	0.21
HH gave transfer in last 3 months	0.90	0.31	1	0	1	2145	0.45	0.91
Transfers to HHs in village (in US dollars)	6.79	21.96	1.98	0.00	480.90	2145	0.64	0.78
HH received transfer in last 3 months	0.41	0.49	0	0	1	2145	0.13	0.12
Transfers from HHs in village (in US dollars)	2.58	17.62	0.00	0.00	527.80	2145	0.39	0.57
Community groups	2.76	1.87	3	0	10	2145	0.30	0.11
Belongs to Luhya ethnic group	0.80	0.40	1	0	1	2145	0.33	0.99
Local minority ethnic group	0.20	0.40	0	0	1	2145	0.30	0.99
Christian	0.98	0.14	1	0	1	2145	0.28	0.57
Number of correct math responses	2.13	1.01	2	0	3	1998	0.41	0.94

Balance columns report p-values from F test of the joint significance of treatment dummies in a regression in which the variable listed in the first column is used as the dependent variable. Regressions are estimated separately by gender. *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level.

Table 2: Summary Statistics on Outcomes in Experiment, by Treatment

Information Condition: *Budget Size:*	PRIVATE SMALL	PUBLIC SMALL	PRICE SMALL	PRIVATE LARGE	PUBLIC LARGE	PRICE LARGE	ALL ALL
Amount invested in business cup	41.44	42.59	42.00	93.35	91.98	90.26	66.68
	(0.82)	(0.86)	(0.81)	(1.90)	(1.88)	(1.84)	(0.80)
Fraction of budget invested in business cup	0.52	0.53	0.53	0.52	0.51	0.50	0.52
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Total payout (in Kenyan shillings)	153.73	139.16	141.07	355.01	321.54	339.27	240.61
	(6.02)	(6.11)	(5.99)	(13.57)	(13.46)	(13.51)	(4.73)
Total payout (in US dollars)	2.03	1.83	1.86	4.68	4.24	4.47	3.17
	(0.08)	(0.08)	(0.08)	(0.18)	(0.18)	(0.18)	(0.06)
Invested exactly m_{small} (80 Kenyan shillings)?	0.03	0.04	0.02	0.20	0.23	0.27	0.13
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)
Invested m_{small} (80 Kenyan shillings) or less?	1.00	1.00	1.00	0.42	0.46	0.48	0.73
	(0.00)	(0.00)	(0.00)	(0.03)	(0.03)	(0.03)	(0.01)
Price of avoiding public announcement (in Kenyan shillings)	.	.	34.84	.	.	35.07	34.96
			(0.91)			(0.91)	(0.64)
Paid to avoid public announcement?	.	.	0.21	.	.	0.34	0.28
			(0.02)			(0.03)	(0.02)
Paid to avoid announcement (conditional on successful investment)?	.	.	0.29	.	.	0.45	0.37
			(0.03)			(0.04)	(0.03)
Paid to avoid announcement (conditional on failed investment)?	.	.	0.12	.	.	0.21	0.17
			(0.03)			(0.03)	(0.02)
Amount paid to avoid public announcement (in Kenyan shillings)	.	.	25.21	.	.	31.68	29.26
			(1.74)			(1.50)	(1.16)
N	369	370	345	358	358	345	2145

Standard errors in parentheses.

Table 3: Regressions of Investment Outcomes for Subjects in Large Endowment Treatments

Sample:	— Women Only —				— Men Only —			
Specification:	Probit	Probit	OLS	OLS	Probit	Probit	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Dependent Variable = Indicator for Investing 80 Shillings or Less								
Public or price treatment	0.097**	0.103**	0.096**	0.105**	-0.025	-0.015	-0.025	-0.022
	(0.041)	(0.041)	(0.041)	(0.042)	(0.052)	(0.052)	(0.052)	(0.051)
Panel B: Dependent Variable = Indicator for Investing Exactly 80 Shillings								
Public or price treatment	0.064*	0.073**	0.062*	0.070**	0.018	0.022	0.018	0.015
	(0.035)	(0.035)	(0.033)	(0.035)	(0.045)	(0.045)	(0.044)	(0.045)
Village FEs	No	No	No	Yes	No	No	No	Yes
Additional Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	644	644	644	644	417	417	417	417

Robust standard errors in parentheses. *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level. Sample restricted to subjects receiving larger endowment. Assignment to treatment was random within villages; similar results are obtained when standard errors are clustered at the village level.

Table 4: Impact Heterogeneity: Investment Outcomes and the Presence of Close Relatives

Dependent Variable:	Invested 80 Shillings or Less		Invested Exactly 80 Shillings	
	(1)	(2)	(3)	(4)
Close kin attended game	-0.223**	.	-0.076	.
	(0.089)		(0.068)	
Close kin at game × public	0.418***	.	0.15*	.
	(0.111)		(0.09)	
No close kin at game × public	0.065	.	0.059	.
	(0.045)		(0.037)	
Spouse at game	.	-0.029	.	0.022
		(0.118)		(0.098)
Spouse at game × public	.	0.139	.	-0.007
		(0.141)		(0.114)
No spouse at game × public	.	0.102**	.	0.077**
		(0.044)		(0.036)
Village FEs	Yes	Yes	Yes	Yes
Observations	644	644	644	644
R^2	0.095	0.085	0.079	0.079

Robust standard errors in parentheses. *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level. OLS specifications reported; probit results are nearly identical. Indicators for age and education categories, marital status, HH size, the log value of HH assets, and a constant are included as controls in all specifications. Sample restricted to women receiving larger endowment.

Table 5: OLS Regressions of Village-Level Outcomes on Income Hiding by Women in Experiment

Dependent Variable:	LN HH ASSETS		HAS REGULAR JOB		WAGES FROM WORK		FERTILIZER USE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income hiding (investing no more than 80 shillings)	-0.009	-0.043	-0.048**	-0.05**	-2.276	-2.758*	-0.179	-0.027
	(0.114)	(0.116)	(0.022)	(0.023)	(1.858)	(1.669)	(0.229)	(0.213)
Distance to paved road	.	-0.001	.	0.0007	.	0.051	.	0.006
		(0.006)		(0.001)		(0.08)		(0.01)
Mean(education)	.	-0.005	.	0.006	.	1.111*	.	0.092
		(0.042)		(0.008)		(0.601)		(0.077)
Mean(close kin in village)	.	0.092	.	0.013	.	1.289	.	-0.291***
		(0.057)		(0.011)		(0.826)		(0.105)
Mean(community groups)	.	0.077	.	0.013	.	0.678	.	0.201*
		(0.06)		(0.012)		(0.859)		(0.11)
Observations	26	26	26	26	26	26	26	26
R^2	0.0003	0.222	0.167	0.339	0.059	0.423	0.025	0.36
Income hiding (investing exactly 80)	-0.254*	-0.312**	-0.09***	-0.096***	-5.197**	-6.024***	-0.7***	-0.504**
	(0.134)	(0.129)	(0.024)	(0.024)	(2.162)	(1.799)	(0.254)	(0.244)
Distance to paved road	.	-0.003	.	0.0006	.	0.043	.	0.003
		(0.005)		(0.0009)		(0.067)		(0.009)
Mean(education)	.	-0.01	.	0.005	.	1.041**	.	0.085
		(0.037)		(0.007)		(0.514)		(0.07)
Mean(close kin in village)	.	0.114**	.	0.016*	.	1.560**	.	-0.253***
		(0.051)		(0.009)		(0.711)		(0.097)
Mean(community groups)	.	0.056	.	0.008	.	0.378	.	0.164
		(0.053)		(0.01)		(0.741)		(0.101)
Observations	26	26	26	26	26	26	26	26
R^2	0.13	0.394	0.368	0.546	0.194	0.58	0.24	0.472

Standard errors in parentheses. *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level. LN HH ASSETS is the average of the log value of durable assets owned by households. HAS REGULAR JOB is the fraction of participants with formal, skilled, and/or professional employment. WAGES FROM WORK is the average of wages received from paid work over the last month in US dollars; wages are set to zero for subjects with no paid employment. FERTILIZER USE denotes the fraction of households engaged in agricultural that used fertilizer over the previous twelve month period.

Table 6: OLS Regressions of Paying to Avoid Announcing

Sample:	Women in price treatments				Men in price treatments			
	All subjects		Able to pay		All subjects		Able to pay	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price of exit	-0.006***	-0.006***	-0.005***	-0.007***	-0.005***	-0.009***	-0.004**	-0.01***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Large budget	0.155***	0.16	0.136***	0.154	0.119**	-0.241*	0.093*	-0.28**
	(0.043)	(0.111)	(0.046)	(0.113)	(0.052)	(0.133)	(0.056)	(0.137)
Price × large budget	.	-0.0003	.	0.0001	.	0.007**	.	0.008**
		(0.002)		(0.003)		(0.003)		(0.003)
Coin flip lands heads	.	0.225***	.	0.23***	.	0.07	.	0.053
		(0.053)		(0.062)		(0.064)		(0.084)
Heads × large budget	.	-0.012	.	-0.023	.	0.236**	.	0.251**
		(0.082)		(0.089)		(0.098)		(0.113)
Constant	0.42***	0.317***	0.424***	0.327***	0.368***	0.464***	0.376***	0.503***
	(0.056)	(0.071)	(0.057)	(0.073)	(0.072)	(0.098)	(0.075)	(0.104)
Observations	416	416	380	380	274	273	247	247
R^2	0.08	0.138	0.055	0.107	0.053	0.139	0.031	0.112

Robust standard errors clustered at village level. *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level. Sample restricted to subjects assigned to the price treatments.

Table 7: Parameter Estimates

	(1)	(2)	(3)	(4)
Panel A: Women in All Treatments				
μ_ρ	0.7562	0.7498	0.7488	0.7504
	(0.0163)	(0.0108)	(0.0107)	(0.0114)
σ_ρ	0.1994	0.2000	0.1992	0.2006
	(0.0170)	(0.0116)	(0.0115)	(0.0118)
σ_ϵ	0.0107	0.0125	0.0125	0.0124
	(0.0017)	(0.0011)	(0.0011)	(0.0011)
τ		0.0432	0.0450	0.0419
		(0.0124)	(0.0113)	(0.0097)
γ			0.0588	0.0577
			(0.0088)	(0.0114)
κ				0.0022
				(0.0118)
Panel B: Men in All Treatments				
μ_ρ	0.7747	0.7555	0.7557	0.7557
	(0.0233)	(0.0131)	(0.0132)	(0.0134)
σ_ρ	0.2657	0.2385	0.2391	0.2395
	(0.0225)	(0.0125)	(0.0125)	(0.0125)
σ_ϵ	0.0107	0.0101	0.0102	0.0102
	(0.0022)	(0.0012)	(0.0012)	(0.0012)
τ		0.0267	0.0234	0.0242
		(0.0139)	(0.0134)	(0.0146)
γ			0.0623	0.0917
			(0.0122)	(0.0334)
κ				-0.0325
				(0.0292)

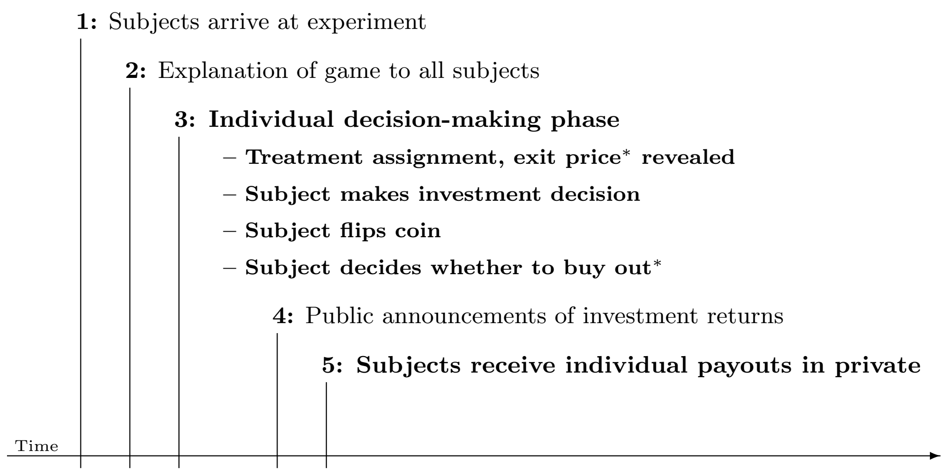
Standard errors (calculated using the inverse Hessian) in parentheses.

Table 8: Parameter Estimates Allowing for Heterogeneity in τ

Sample:	Women	Men
	(1)	(2)
μ_ρ	0.750^{***}	0.760^{***}
	(0.011)	(0.013)
σ_ρ	0.199^{***}	0.241^{***}
	(0.011)	(0.012)
$\sigma_{epsilon}$	0.013^{***}	0.010^{***}
	(0.001)	(0.001)
$\tau_{kin\ present}$	0.043^{***}	0.027^{*}
	(0.012)	(0.015)
γ	0.058^{***}	0.062^{***}
	(0.009)	(0.012)
$\tau_{no\ kin\ present}$	0.080^{**}	-0.011
	(0.032)	(0.022)

Standard errors (calculated using the inverse Hessian) in parentheses.

Figure 1: Structure of Experiment



Activities in plain text took place in primary school classrooms, with all subjects seated together. Activities in bold text took place in one-on-one interactions between individual subjects and enumerators; during these interactions, subjects and members of the research team were seated at desks in private locations in the schoolyard.

Figure 2: Paying to Avoid the Public Announcement

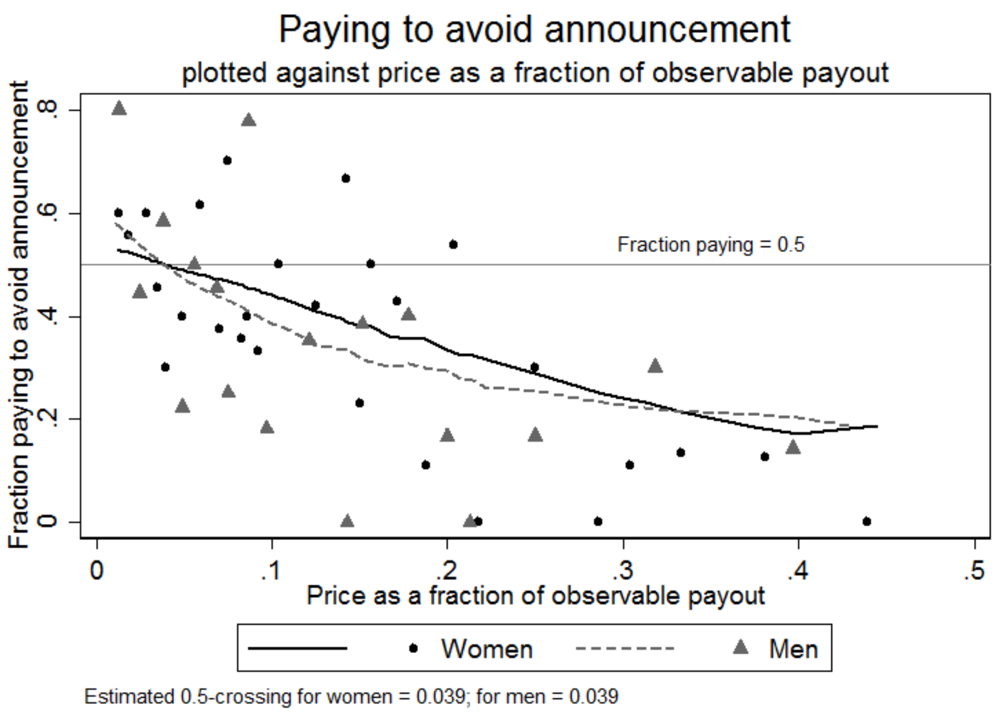
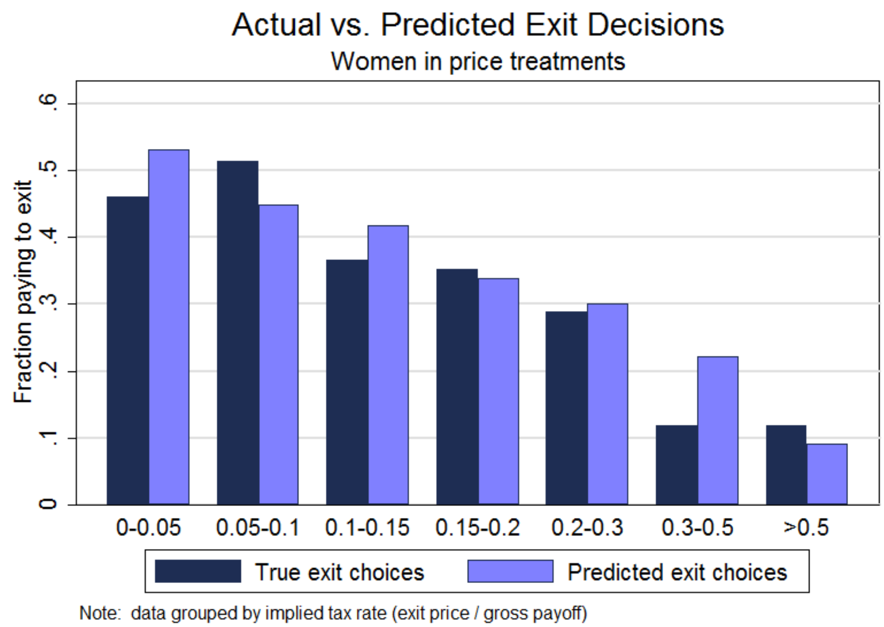


Figure 3: Actual vs. Predicted Exit Decisions



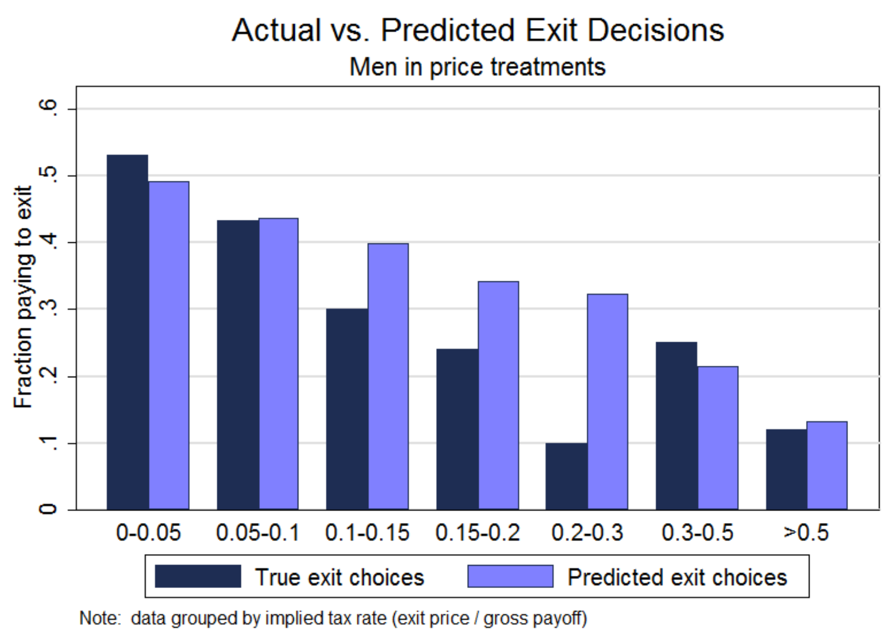
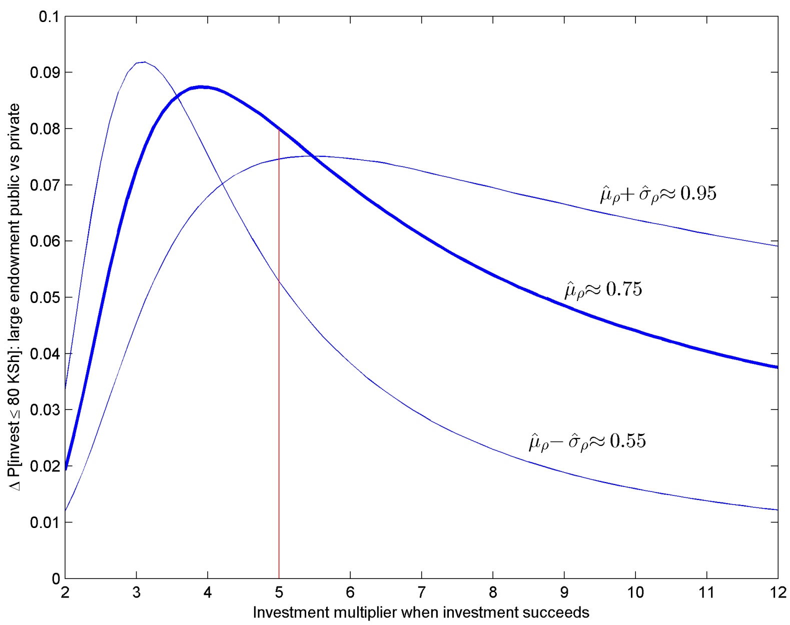
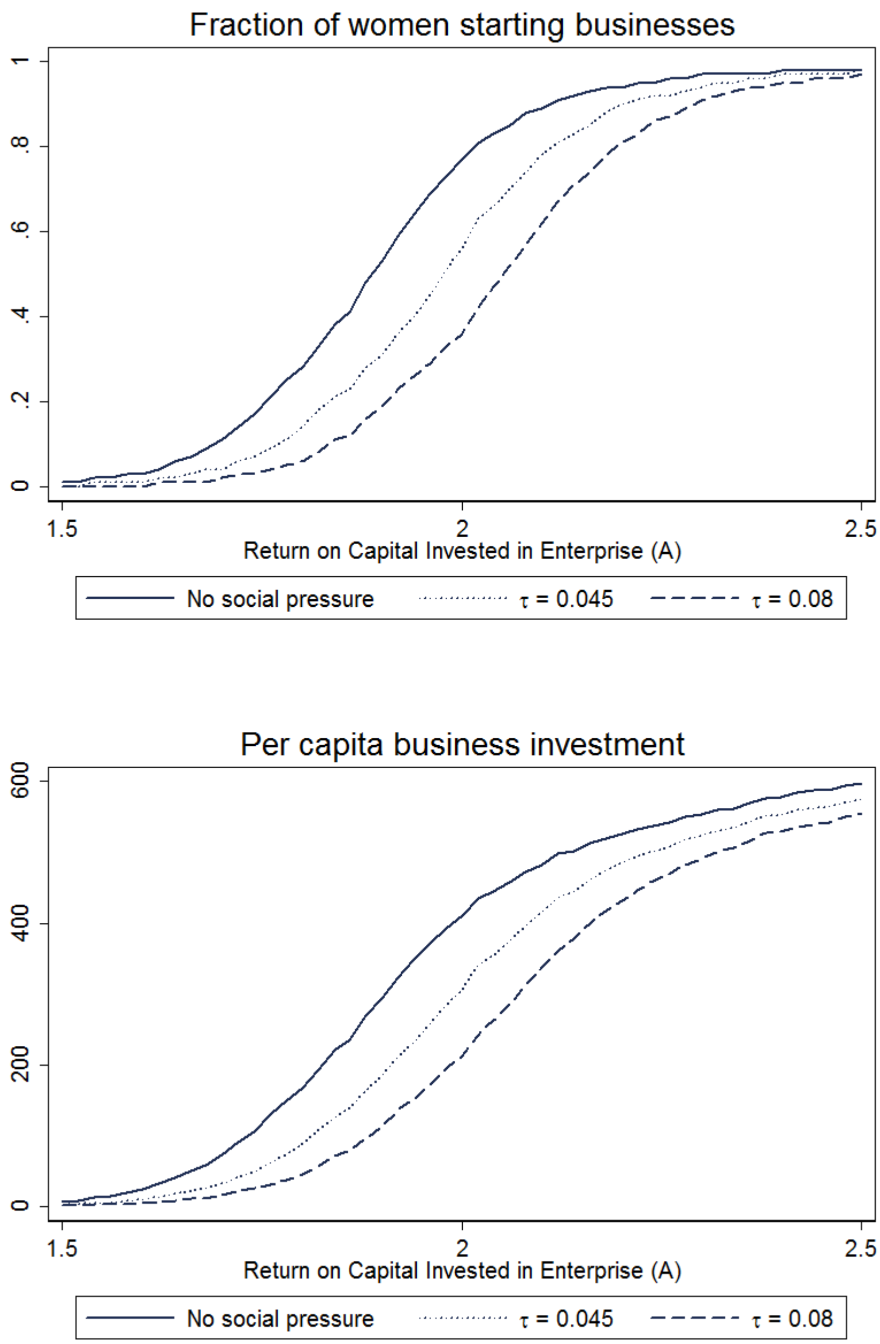


Figure 4: Simulated Alternative Laboratory Experiments



Results from 10 million simulations of players' behavior in alternative laboratory experiments in which a successful investment sees its value multiplied by a value between 2.0 and 12.0. The value 5.0, used in the actual experiment we perform, is highlighted. Parameters used in these simulations are taken from Column 2 of Table 7 for women.

Figure 5: Simulated Entrepreneurship Decisions



A Appendix

To simplify notation, we omit i subscripts when there is no possibility of ambiguity.

A.1 Proof of Proposition 1

Outline of the Proof. We wish to show that the probability of investing 80 shillings or less is higher in the public, large endowment treatment than in the private, large endowment treatment. The probability of investing 80 shillings or less (i.e. of the the event $b \leq 80$ occurring) in either the private or the public large endowment treatment is:

$$\Pr(b \leq 80) = \frac{\sum_{b=0}^{b=80} e^{[EV^t(b)]/\sigma_\varepsilon}}{\sum_{b=0}^{b=80} e^{[EV^t(b)]/\sigma_\varepsilon} + \sum_{b=90}^{b=180} e^{[EV^t(b)]/\sigma_\varepsilon}} \tag{26}$$

where $EV^t(b)$ indicates the CRRA expected utility of investing $b \geq 0$ in treatment t. Using the specific values of m_l and m_s for the experiment, we have:

$$EV^{PRIVATE \times LARGE}(b) = \frac{1}{2(1-\rho)} \left[(180+4b)^{1-\rho} + (180-b)^{1-\rho} \right]$$

In the public, large endowment treatment, the CRRA expected utility is:

$$EV^{PUBLIC \times LARGE}(b) = \\ \frac{1}{2(1-\rho)} \left(\left[(1-\tau)(180+4b) + \tau 100 \mathbb{1}\{b \leq 80\} \right]^{1-\rho} + \left[(1-\tau)(180-b) + \tau 100 \mathbb{1}\{b \leq 80\} \right]^{1-\rho} \right)$$

Note that for all b, $EV^{PRIVATE \times LARGE}(b) = EV^{PUBLIC \times LARGE}(b)$ in the special case where $\tau = 0$. Thus, to prove the proposition, we can use the investment probability formulas from the public, large endowment treatment to show that, as τ moves from zero to a positive number, the probability of choosing to invest an amount of at most 80 increases. This also allows us to simplify our notation by using EV as a shorthand for $EV^{PUBLIC \times LARGE}$ throughout the remainder of the proof, since we consider only expressions for the CRRA expected utilities in the public, large endowment treatment.

To easily distinguish values of b that are less than or equal to 80 from higher values, we partition the set of investment levels $B = \{0, 10, \ldots, 180\}$ as follows: $B = A \cup Z$ where $A = \{0, 10, \ldots, 80\}$ and $Z = \{90, 100, \ldots, 180\}$. This allows us to rewrite the probability of investing 80 shillings or less as

$$\Pr(b \leq 80) = \frac{\sum_{a \in A} e^{[EV(a)]/\sigma_\varepsilon}}{\sum_{a \in A} e^{[EV(a)]/\sigma_\varepsilon} + \sum_{z \in Z} e^{[EV(z)]/\sigma_\varepsilon}}. \tag{27}$$

Given the logit functional form of the probability, any one of the $[EV(a)]/\sigma_\varepsilon$ values can be subtracted from all of the exponents in the expression without changing the value of the expression — this is equivalent to multiplying the entire expression by $\left(1/e^{[EV(a)]/\sigma_\varepsilon}\right) / \left(1/e^{[EV(a)]/\sigma_\varepsilon}\right)$. Thus, for any fixed $\tilde{a} \in A$, we can write

$$\Pr(b \leq 80) = \frac{\sum_{a \in A} e^{[EV(a)-EV(\tilde{a})]/\sigma_\varepsilon}}{\sum_{a \in A} e^{[EV(a)-EV(\tilde{a})]/\sigma_\varepsilon} + \sum_{z \in Z} e^{[EV(z)-EV(\tilde{a})]/\sigma_\varepsilon}}. \tag{28}$$

The proof will build upon two lemmas. In the first, we show that for any $a \in A$ and $z \in Z$,

$$[EV(z)] - [EV(\tilde{a})]$$

is decreasing in τ. Thus, as τ moves from zero (in the private treatment) to a positive number (in the public treatment), every rescaled $e^{[EV(z)-EV(\tilde{a})]/\sigma_\varepsilon}$ term decreases. In the second lemma, we demonstrate that $\tilde{a}$ can be chosen so that, as τ moves from zero to a positive number, every $e^{[EV(a)-EV(\tilde{a})]/\sigma_\varepsilon}$ term (weakly) increases. Taken together, these lemmas imply that

$$\sum_{a=0}^{a=80} e^{[EV(a)-EV(\tilde{a})]/\sigma_\varepsilon}$$

is higher and that

$$\sum_{z=0}^{z=80} e^{[EV(z)-EV(\tilde{a})]/\sigma_\varepsilon}$$

is lower in the public, large endowment treatment than in the private, large endowment treatment; hence, the probability of investing 80 shillings or less given by Equation 28 is higher in the public treatments. We now proceed to state and prove the two lemmas before formally proving the proposition.

Lemma 1. *For any $a \in \{0, 10, \ldots, 80\}$ and $z \in \{90, 100, \ldots, 180\}$, the expression*

$$\begin{aligned} EV(z) - EV(a) = &\frac{1}{2(1-\rho)}\left([(1-\tau)(180+4z)]^{1-\rho} + [(1-\tau)(180-z)]^{1-\rho}\right) \\ &- \frac{1}{2(1-\rho)}\left([(1-\tau)(180+4a)+100\tau]^{1-\rho} + [(1-\tau)(180-a)+100\tau]^{1-\rho}\right) \end{aligned}$$

is decreasing in τ.

Proof of Lemma 1. The proof of the lemma proceeds by taking the derivative of the expression and successively showing higher upper bounds until one of them is clearly less than zero. We begin by rewriting the expression of interest as:

$$\begin{aligned} EV(z) - EV(a) = \frac{1}{2(1-\rho)}\Big(&(1-\tau)^{1-\rho}\left[(180+4z)^{1-\rho} + (180-z)^{1-\rho}\right] \\ &- [100+(1-\tau)(80+4a)]^{1-\rho} + [100+(1-\tau)(80-a)]^{1-\rho}\Big) \end{aligned}$$

Taking the derivative with respect to τ allows us to define:

$$\begin{aligned} \frac{\partial}{\partial\tau}\left[EV(z) - EV(a)\right] = &-\frac{(1-\tau)^{-\rho}}{2}\left[(180+4z)^{1-\rho} + (180-z)^{1-\rho}\right] \\ &+ \frac{1}{2}\underbrace{\left[(80+4a)[100+(1-\tau)(80+4a)]^{-\rho}\right]}_{=p} + \frac{1}{2}\underbrace{\left[(80-a)[100+(1-\tau)(80-a)]^{-\rho}\right]}_{=q} \end{aligned} \tag{29}$$

We will now proceed by characterizing expressions B, C, and D and a positive constant k such that $k\frac{\partial}{\partial\tau}[EV(z) - EV(a)] \leq B$, $B < C$, $C \leq D$, and $D < 0$.

In order to establish a larger B (such that $k\frac{\partial}{\partial\tau}[EV(z) - EV(a)] \leq B$), we note that the terms labeled p and q in Equation 29 both have the form $X \cdot Y^{-\rho}$. These are weakly decreasing in Y for $X \geq 0$ (since $\rho \geq 0$), so if we substitute $W < Y$, the new terms will be larger than the originals: $X \cdot Y^{-\rho} < X \cdot W^{-\rho}$. We therefore substitute $(1-\tau)100$ for 100. For the p term, we have:

$$\begin{aligned} (80+4a)(100+(1-\tau)[80+4a])^{-\rho} &\leq (80+4a)\left[(1-\tau)100+(1-\tau)(80+4a)\right]^{-\rho} \\ &= (80+4a)(1-\tau)^{-\rho}[180+4a]^{-\rho} \end{aligned}$$

For the q term, we have:

$$\begin{aligned} (80-a)\left[100+(1-\tau)(80-a)\right]^{-\rho} &\leq (80-a)\left[(1-\tau)100+(1-\tau)(80-a)\right]^{-\rho} \\ &= (80-a)(1-\tau)^{-\rho}(180-a)^{-\rho} \end{aligned}$$

Combining these back into equation 29 and multiplying through by $(1-\tau)^\rho$ gives us:

$$k\frac{\partial}{\partial\tau}[EV(z)-EV(a)] \leq B = -\left[(180+4z)^{1-\rho}+(180-z)^{1-\rho}\right]+(80+4a)(180+4a)^{-\rho}+(80-a)(180-a)^{-\rho} \tag{30}$$

where $k = (1-\tau)^\rho/2$.

We now establish an even higher bound, C. In each of the right two terms, 80 can be rewritten as the sum of 180 and -100, breaking the two terms into four:

$$\begin{aligned} B = & -\left[(180+4z)^{1-\rho}+(180-z)^{1-\rho}\right] \\ & + \underbrace{(180+4a)(180+4a)^{-\rho}-100(180+4a)^{-\rho}}_{=(80+4a)(180+4a)^{-\rho}} + \underbrace{(180-a)(180-a)^{-\rho}-100(180-a)^{-\rho}}_{=(80-a)(180-a)^{-\rho}} \\ = & -\left[(180+4z)^{1-\rho}+(180-z)^{1-\rho}\right]+\left[(180+4a)^{1-\rho}+(180-a)^{1-\rho}\right]-100\left[\frac{1}{(180+4a)^\rho}+\frac{1}{(180-a)^\rho}\right] \end{aligned} \tag{31}$$

The rightmost term may then be re-written as:

$$-100\left[\frac{1}{(180+4a)^\rho}+\frac{1}{(180-a)^\rho}\right] = -100\left[\frac{1}{(180+4a)(180+4a)^{\rho-1}}+\frac{1}{(180-a)(180-a)^{\rho-1}}\right] \tag{32}$$

This term is negative, so an upper bound for the term will be its smallest possible magnitude. Inspecting the two denominators, we see the terms $(180+4a)^{\rho-1}$ and $(180-a)^{\rho-1}$. We can increase one of the denominators by replacing the smaller of these with the larger. Which is larger depends on ρ. If $\rho < 1$, then $\rho - 1$ is negative, so the function $x^{\rho-1}$ is decreasing in x, and $(180-a)^{\rho-1}$ is larger; alternatively, for $\rho > 1$, $\rho - 1$ is positive, so $x^{\rho-1}$ is increasing in x, and $(180+4a)^{\rho-1}$ is larger.[60] The proof works either way. We first illustrate with the $\rho < 1$ case: $(180-a)^{\rho-1}$ is larger than $(180+4a)^{\rho-1}$, so, to find an upper bound (on a negative expression), we increase one of the denominators, substituting $(180-a)^{\rho-1}$ for $(180+4a)^{\rho-1}$:

$$\begin{aligned} -100\left[\frac{1}{(180+4a)^\rho}+\frac{1}{(180-a)^\rho}\right] &= -100\left[\frac{1}{(180+4a)(180+4a)^{\rho-1}}+\frac{1}{(180-a)(180-a)^{\rho-1}}\right] \\ &< -100\left[\frac{1}{(180+4a)(180-a)^{\rho-1}}+\frac{1}{(180-a)(180-a)^{\rho-1}}\right] \end{aligned}$$

Which may be rewritten:

$$-100\left[\frac{1}{(180+4a)^\rho}+\frac{1}{(180-a)^\rho}\right] < -(180-a)^{1-\rho}\cdot 100\cdot\left[\frac{1}{(180+4a)}+\frac{1}{(180-a)}\right] \tag{33}$$

Substituting into 31, we now have:

$$\begin{aligned} B &< C \\ &= -\left[(180+4z)^{1-\rho}+(180-z)^{1-\rho}\right]+\left[(180+4a)^{1-\rho}+(180-a)^{1-\rho}\right] \\ &\quad -(180-a)^{1-\rho}\cdot(100)\cdot\left[\frac{1}{(180+4a)}+\frac{1}{(180-a)}\right] \end{aligned} \tag{34}$$

The term on the last line is still negative, and thus it is bounded above by its smallest magnitude. The sum of the two fractions on the right is decreasing at $a = 0$, but increases to ∞ as $a \to 180$. We can minimize the sum by finding the interior solution: taking the first order condition and solving the resulting quadratic equation, we find that the minimum occurs at $a = 30$. Substituting into part of inequality 33

[60] The special case of $\rho = 1$ will be treated separately below.

gives us:

$$
\begin{aligned}
(100) \cdot \left(\frac{1}{180+4a} + \frac{1}{180-a} \right) &< \frac{100}{180+4\cdot 30} + \frac{100}{180-30} \\
&= \frac{10}{18+12} + \frac{10}{18-3} \\
&= \frac{10}{30} + \frac{10}{15} \\
&= \frac{1}{3} + \frac{2}{3} \\
&= 1
\end{aligned}
\tag{35}
$$

Substituting this back into inequality 34, we have:

$$
\begin{aligned}
C \leq D &= -\left[(180+4z)^{1-\rho} + (180-z)^{1-\rho}\right] + \left[(180+4a)^{1-\rho} + (180-a)^{1-\rho}\right] - (180-a)^{1-\rho} \cdot 1 \\
&= -\left[(180+4z)^{1-\rho} + (180-z)^{1-\rho}\right] + (180+4a)^{1-\rho}
\end{aligned}
\tag{36}
$$

However, we know that $a < z$, so:

$$180 - z < 180 + 4a < 180 + 4z \tag{37}$$

and thus, because $x^{1-\rho}$ is continuous and monotonic, the larger of the two negative terms on the left must be greater in magnitude than the positive term on the right. Thus, $D < 0$ when $\rho < 1$.

The case where $\rho > 1$ follows a nearly identical proof. After equation 32, we instead substitute $(180+4a)^{\rho-1}$ for $(180-a)^{\rho-1}$, allowing us to write:

$$-100 \left[\frac{1}{(180+4a)^{\rho}} + \frac{1}{(180-a)^{\rho}} \right] < -(180+4a)^{1-\rho} \cdot 100 \cdot \left[\frac{1}{(180+4a)} + \frac{1}{(180-a)} \right] \tag{38}$$

This yields a different version of equation 36:

$$C < D = -\left[(180+4z)^{1-\rho} + (180-z)^{1-\rho}\right] + (180-a)^{1-\rho} \tag{39}$$

However, again, we know that $a < z$, so:

$$180 - z < 180 - a < 180 + 4z \tag{40}$$

and thus we can once again be certain that the larger of the two negative terms in equation 39 is greater in magnitude than the positive term. Thus, it is also the case that $D < 0$ when $\rho > 1$.

Thus, for both the $\rho > 1$ or $\rho < 1$ cases, we have found a positive constant k such that $k\frac{\partial}{\partial \tau}\left[EV(z) - EV(a)\right] \leq B$, $B < C$, $C \leq D$, and $D < 0$.

It only remains to consider the $\rho = 1$ case. When $\rho = 1$, $EV(z) - EV(a)$ can be written as:

$$\frac{1}{2}\left(2\ln(1-\tau) + \ln(180+4z) + \ln(180-z) - \ln\left[100 + (1-\tau)(80+4a)\right] - \ln\left[100 + (1-\tau)(80-a)\right] \right) \tag{41}$$

Taking the derivative with respect to τ yields:

$$\frac{1}{2}\left[-\frac{2}{1-\tau} + \frac{80+4a}{100+(1-\tau)(80+4a)} + \frac{80-a}{100+(1-\tau)(80-a)} \right] \tag{42}$$

This may be bounded above — with weak inequality for $\tau = 0$, and with strict inequality for positive τ — by decreasing the denominators of the positive terms, thereby increasing the total. To do this, we substitute in $\tau 100$ for 100, yielding:

$$\frac{\partial}{\partial \tau}\left[EV(z) - EV(a)\right] \leq \frac{1}{2}\left[-\frac{2}{1-\tau} + \frac{80+4a}{(1-\tau)100 + (1-\tau)(80+4a)} + \frac{80-a}{(1-\tau)100 + (1-\tau)(80-a)}\right] \tag{43}$$

Then pulling out the common factor:

$$\frac{\partial}{\partial \tau}\left[EV(z) - EV(a)\right] \leq \frac{1}{2(1-\tau)}\left(-2 + \frac{80+4a}{180+4a} + \frac{80-a}{180-a}\right) \tag{44}$$

Each of the two fractions in the bracketed expression is clearly less than 1, so their sum is clearly less than 2. Thus, with strict inequality:

$$\frac{\partial}{\partial \tau}\left[EV(z) - EV(a)\right] < 0$$

when $\rho = 1$. Thus, we have now demonstrated that the lemma holds in the $\rho < 1$, $\rho = 1$, and $\rho > 1$ cases. □

Lemma 2. *For any $\bar{\tau} > 0$, there exists $\bar{a}(\bar{\tau}) \in A = \{0, 10, ..., 80\}$ such that*

$$\left[EV(a) - EV(\bar{a}(\bar{\tau}))\,\middle|\, \tau > 0\right] \geq \left[EV(a) - EV(\bar{a}(\bar{\tau}))\,\middle|\, \tau = 0\right] \tag{45}$$

for all $a \in \{0, 10, ..., 80\}$.

Proof of Lemma 2. We begin by rewriting the expression of interest as:

$$[EV(a)|\tau > 0] - [EV(a)|\tau = 0] \geq [EV(\bar{a}(\bar{\tau}))|\tau > 0] - [EV(\bar{a}(\bar{\tau}))|\tau = 0] \tag{46}$$

Define:

$$\bar{a}(\bar{\tau}) = \underset{a \in \{0,10,\ldots,80\}}{\arg\min} \left([EV(\bar{a}(\bar{\tau}))|\tau > 0] - [EV(\bar{a}(\bar{\tau}))|\tau = 0]\right) \tag{47}$$

By construction, inequality 46 must be satisfied by this $\bar{a}(\bar{\tau})$, proving Lemma 2. □

Proof of Proposition 1. We wish to show that

$$\Pr(b \leq 80) = \frac{\sum_{a \in A} e^{[EV(a) - EV(\tilde{a})]/\sigma_\varepsilon}}{\sum_{a \in A} e^{[EV(a) - EV(\tilde{a})]/\sigma_\varepsilon} + \sum_{z \in Z} e^{[EV(z) - EV(\tilde{a})]/\sigma_\varepsilon}}. \tag{48}$$

increases as we move from the private, large endowment treatment ($\tau = 0$) to the public, large endowment treatment ($\tau \in (0, 1)$). Because σ_ε is a positive constant and e^x is increasing in x, Lemma 1 implies that every

$$e^{[EV(z) - EV(\tilde{a})]/\sigma_\varepsilon}$$

term is lower when $\tau = 0$ than when $\tau > 0$. Similarly, Lemma 2 implies that every

$$e^{[EV(a) - EV(\tilde{a})]/\sigma_\varepsilon}$$

is weakly higher when $\tau = 0$ than when $\tau > 0$. Thus, because

$$\frac{X}{X+Y}$$

is increasing in X and decreasing in Y, the probability if investing no more than 80 shillings must be weakly higher in the public, large endowment treatment than in the private, large endowment treatment. □