The Origins of Risk Sharing: An Experimental Approach

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Abstract

Controversy exists about the act of giving as altruistic instead of self-interested behavior. Each side of this argument interprets similar results from similar experiments in different ways. One side argues the results show that the appearance of altruistic behavior can be explained by self-interested motives. The other side argues these results are evidence of something called "group selection," where a group member takes an action that is harmful to itself but beneficial to the group. We consider this question using a novel approach. We create a rich experimental environment in which subjects have the ability to cooperate to improve the group's outcome by sharing their wealth in non-compulsory, non-enforceable risk-sharing arrangements. We find that average subject behavior appears to be motivated by self-interest more than group survival.

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Contents

1 Introduction

Over the course of human history, various risk-sharing arrangements have formed. From emergent arrangements between east African herders to the designed arrangements of modern insurance firms, humans have spawned institutions designed to insulate ourselves from uncertain futures. Most of the time, these risk-sharing arrangements require one party to give up some amount of income or wealth today to ensure some beneficial outcome in the future. As the title suggests, our focus in this study is on the simpler, emergent risk-sharing arrangements. We are interested in the factors governing the amounts of income and wealth given up today for security in the future.

Our experimental methods are novel. We create a rich, ecologically valid environment inspired from a real-world risk sharing arrangement known as *osotua*. *Osotua* is an emergent risk-sharing arrangement between Maasai herdsmen, and is similar in function to arrangements between ranchers in the American west. By modeling an experiment on a real-world emergent risk-sharing institution, we can overcome many of the criticisms aimed at experimental economics, the main one being external validity. Our results do not reject the hypothesis that subjects "give" out of a sense of self preservation.

2 Related Work and Literature

This is not the first attempt to analyze emergent risk-sharing arrangements from an economic viewpoint. Geertz (1978) considers the application of economic theory to the bazaar to predict the formation of social networks via clientization. Posner (1980) considers an informal model of a primitive economy, arguing that primitive economies lacked elements such as interest and contract-enforcement. As an example, he points out that "loans" among African herdsman in the form of transferring cattle from one herdsman to another is not so much a means of capital investment as it is risk-sharing. By widely dispersing cattle, herdsman limit their exposure to local shocks such as drought or disease.

Kimball (1988) considers Posner's idea of risk-sharing from a game-theoretical perspective by modeling the English Open Field System, which was postulated by McCloskey (1976) to have been a form of self-insurance through planting crops in geographically distinct areas. Kimball (1988) theoretically compares this system with a risk-sharing cooperative where farmers contribute a portion of their harvest or face expulsion. His model shows that risk-sharing cooperatives are an equilibrium strategy under reasonable parameterizations of relative risk aversion, thus supporting the notion of risk-sharing as a best response to uncertainty.

Coate and Ravallion (1993) take Kimball (1988) one step further and compare compulsory full income pooling vs. non-committal risk-sharing over an infinite time horizon. Full income pooling is considered the first-best arrangement, as it leaves both players with the highest utility. However, informal insurance arrangements exist that are also equilibria. Their model predicts that these non-committal insurance arrangements break down if the future is heavily discounted, if one or more players have low levels of risk-aversion, or if incomes are generally low or highly disparate (which is when players need the benefits of insurance most). In light of this, we hypothesize capital transfers will be decreasing in volatility.

Genicot (2006) also considers a model of risk-sharing among players, but unlike Coate and Ravallion (1993) the players are of unequal types. Specifically, Genicot (2006) considers players with unequal incomes. Contrary to the results of Coate and Ravallion (1993), this model predicts income disparity contributing to sustaining risk-sharing relationships rather than breaking them down.

While the theoretical literature on risk-sharing has often considered infinitely repeated games, most of the experimental literature analyzing risk-sharing arrangements uses one-shot games. Attanasio et al. (2009) considers how social networks play a role in the formation of risk-sharing groups by studying how Colombian families play a 2-round "gamble choice game." Barr and Genicot (2008) use the gamble choice game to study risk-sharing behavior in Zimbabwean villagers.

Charness and Genicot (2008), however, do successfully simulate an infinite time-horizon environment in an experimental setting. The setup is as follows: each period, one player is randomly chosen to receive an amount h. That player may choose to give any portion of h to the other player. The pair continues play for a random number of periods, and the actual cash payoff is based on a randomly chosen period. The results show that transfers are greater the more likely they are to continue interacting with each other, and initial transfer amount is correlated with subsequent transfer amounts.

Our main inspiration, however, comes from Cronk (2007), who studied cultural framing effects by having Maasai herdsmen play a trust gamed framed as an *osotua* game. *Osotua* is relationship of gift-giving characterized by "obligation, need, respect, and restraint." One of the goals is to ensure relationship participants assist each other in times of need without an obligation to repay. This form of risk-sharing is insurance on the honor system.

Cronk (2007) found significant *osotua* framing effects in the form of **lower** initial transfers and **lower** reciprocal transfers, suggesting that the "restraint" trait of the *osotua* relationship influenced the behavior of the participants. Aktipis et al. (2011) takes Cronk (2007) one step further and studies the *osotua* rule using agent-based models testing whether or not an *osotua* rule could reduce variability in herd populations via *osotua*'s risk-sharing mechanism. Their results were positive.

Our experimental framework takes the agent-based model of Aktipis et al. (2011) to the next step: human subjects. We create a dynamic, ecologicaly valid environment in which subjects manage virtual "herds" and have the ability to participate in an *osotua*-like relationship, *i.e.* one in which wealth transfers are voluntary and repayments are unenforceable. Our experimental framework is data-rich, allowing us to control for a plethora of factors to ensure external validity of our results.

In our experiment, we consider a richer experimental environment than Charness and Genicot (2008) by giving players control over their income streams. This results in a scenario where not only might risk-sharing schemes become endogenized, but income streams as well.

This way, player incomes are not just products of exogenous random shocks but of their own management techniques.

Furthermore, Burnham and Johnson (2005) point out that there is no controversy about the existence of what appears to be altruistic behavior. Instead, they concern themselves with understanding the causes. They evaluate a slew of contending papers whose main controversy is rooted in group-selection (a pure form of altruism or punishment) vs. individual-selection (self-interest disguised as altruism or punishment)

Our experimental framework provides a new approach to evaluating the causes of apparently altruistic behavior, including the potential for cultural framing effects.

3 The Experiment

A subject plays 1 practice round of the treatment, then 4 payoff rounds of treatments. The practice round is 7 periods long, and the payoff rounds are 20 periods long. In every case, the players know how many rounds the treatments are. At the beginning of each round, all players are endowed with the same amount of resource. This resource grows and shrinks across the periods based on both the level of the resource and, in the payoff rounds, a random shock.

Our intention for the practice round is to get the subjects familiar with the interface and the resource growth rule. In the practice round, this rule described by the following difference equation[1]:

$$\mathit{\Delta} K_0 = \underbrace{-rK_h\left(1-\frac{K_h}{K_{\text{low}}}\right)\left(1-\frac{K_h}{K_{\text{hi}}}\right)}_{\text{Growth Rule}} - H \tag{3.1}$$

where K_0 is the amount of resource at the beginning of the period, H is the amount harvested from K_0, $K_h = K_0 - H$ (*i.e.* the amount of resource after harvesting some amount), r is a

[1]This is a discrete time version of the model described in Tung (2007)

rate parameter, and K_{low} and K_{hi} are the upper and lower critical values of the growth rule. A quick analysis shows that if K_h falls below K_{low} or above K_{hi}, then the change in K_0 is negative. If K_h falls between K_{low} and K_{hi}, then the change in K_0 is positive.

Once subjects have completed the practice round, they are informed that the next round will be for money. They are randomly paired with another player and endowed with the ability to request resource from their partner, as well as to respond to requests from their partner. Furthermore, their growth rule is now subject to random shocks. In these rounds, their growth rule becomes

$$\Delta K_0 = \underbrace{-rK_{\text{hg}}\left(1-\frac{K_{\text{hg}}}{K_{\text{low}}}\right)\left(1-\frac{K_{\text{hg}}}{K_{\text{hi}}}\right)}_{\text{Growth Rule}} - (H+G) + R + \nu \tag{3.2}$$

where we have augmented 3.1 with an amount G that the subject gives to their partner, an amount R that the subject receives from their partner, and an amount ν that is a mean 0 random shock. Here, $K_{\text{hg}} = K_0 - (H+G)$ (*i.e.* the amount of resource left after harvesting and giving to partner).

3.a Varying Risk

If a subject's resource level falls to 0 for three consecutive rounds, the subject is considered "starved," and as in real life can no longer respond or make requests to or from their partner. We thus define risk as the probability of starvation given some strategy. The higher the probability, the more risky the environment.

To allow us to observe if and how subjects' decisions change when faced with different levels of risk, we had them play at two different levels of risk. We induced this risk by using two different parameterizations of the growth rule: a low-risk parameterization where $K_{\text{low}} = 2$ and $r = .05$ and a high-risk parameterization where $K_{\text{hi}} = 8$ and $r = .25$. The differences in these growth rules can be seen by the growth rule phase plane described in figure 1.

Figure 1 here

To control for the order in which the subjects experienced these risk variations, half the subjects experienced the practice rounds and the first two paying rounds using the low-risk parameterizations and the last two paying rounds using the hi-risk parameterizations, while the other half experienced the practice rounds and the first two paying rounds using the hi-risk parameterizations and the last two paying rounds using the low-risk parameterizations.

3.b Payoffs and an Optimal Strategy

A subject's payoff is a function of how much they harvested across all 4 payoff rounds plus the level of resource remaining at the end of the round. Because we are primarily interested in how subjects risk-share, we told them the optimal strategy to adopt for a non-collaborative game. The optimal strategy is to always keep the resource level as close to the maximal growth rate level as possible. From figure 1, that level is around 17 in the low-risk case and around 18 in the hi-risk case.

If there were no paring, a subject's optimal strategy is to maintain the level of resource as close to the level that maximizes the growth rule, denoted K^*, by adopting the following strategy:

$$H^* = \max\{0, K_0 - K^*\}. \tag{3.3}$$

That is, for an individual subject with no partner, the optimal strategy is to harvest anything in excess of K^*, and to not harvest anything below K^*.

When matched with each other and endowed with the ability to transfer resources between each other, subjects can improve their outcomes, both expected payoff and probability of starvation, by adopting the following strategy:

- If both subjects' have $K_0 > K^*$, a.k.a. surplus, follow the rule described in 3.3.
- If both subjects' have $K_0 < K^*$, a.k.a. deficit, follow the rule described in 3.3.

- If one subject has $K_0 > K^*$ and the other subject has $K_0 < K^*$, the deficit subject requests a proportion p of surplus subject's surplus, and surplus subject fulfills the request.

Simulations suggest that for any $p \in]0, 1[$, both subjects end up with larger expected payoffs and lower probabilities of failure under either risk parameterization. See table 1 for details.

3.c Frames, Quizzes, Surveys, and Demographics

In an attempt to replicate the results of the framing effect of Cronk (2007), we had some subjects read a passage about the Maasai's *osotua* rule (the Maasai frame), some subjects read a passage about ranchers in the American West (the Rancher frame), and some subjects read nothing. To allow us to control for the potential influence and correct understanding of these passages, we also had subjects take a short quiz on the frames after all rounds were completed.

In addition to the data generated by the subjects in the experiment, we also asked the subjects a series of questions related to financial security and demographics. While this data is self-reported, it does allow us to control for subject-specific factors like the subject's real-world wealth background, current state, and perceived prospects to further support the external validity of our experimental data by controlling for real-life factors.

See the appendix for details about the instructions, frames, quizzes, and texts the subjects read and experienced.

4 Analyzis and Results

Most of the data is period-specific. That is, the data is unique in a particular treatment for a particular subject during a particular round for a particular period. Variables describing the resource level and choices are all period-specific. We denote data of this nature with 4 subscripts, *e.g.* w_{tsrp}, where the t denotes treatment, s denotes subject, r denotes round, and p denotes period. Some data is round-specific. These variables are denoted x_{tsr}. The demographic and quiz data are all subject-specific, thus the subscripts would be denoted y_{ts}. Treatment-specific data is denoted z_t.

Most of the response variables we are interested are all period-specific with some interactions with treatment indicators and second-order transformations. Thus, when specifying a model, we will use the form

$$y_{tsrp} = A_t\alpha_t + B_{ts}\beta_{ts} + C_{tsr}\gamma_{tsr} + D_{tsrp}\delta_{tsrp} + \nu_{tsrp} \tag{4.1}$$

where A_t are the treatment-specific data, B_{ts} are the subject-specific data, C_{tsr} are the round-specific data, D_{tsrp} are the period-specfic data (including interaction and second-order terms), and ν_{tsrp} is the idiosyncratic error.

We will assume the following correlation structure on ν_{tsrp}:

$$\text{Cov}(\nu_{tsrp}, \nu_{t's'r'p'}) = 0 \tag{4.2}$$

$$\text{Cov}(\nu_{tsrp}, \nu_{ts'r'p'}) = 0 \tag{4.3}$$

$$\text{Cov}(\nu_{tsrp}, \nu_{tsr'p'}) \neq 0 \tag{4.4}$$

Assumption (4.2) reflects exogenously imposed treatment variations. We justify assumption (4.3) by the fact that we have measured and observed every interaction across subjects and control for them. Anything left in the error term will not be correlated across subjects. Assumption (4.4) reflects the notion that, for the same treatment and the same subject, we expect correlation.

To account for this, we estimate our model using clustered standard errors at the subject level. With 198 subjects, we have 198 clusters of observations. We consider only those observations where a subject received a request, and only if the request was received in periods 3-19 (this is to avoid including data from the earliest and last periods which tend to be outliers). Of the 15,840 observations of 198 subjects playing 4 rounds of 20 periods each, there were 3,856 observations in which a partner made a request between during periods 3-19. Table 2 lists all the variables used in the regression, and table 7 lists the results of the full regression.

To more accurately account for the effects of the various treatments, we interact the treatment variables on several variables used in the following hypothesis tests. We also interact period indicators on measurements of transfer activity as a means of testing the hypothesis of altruistic reciprocity as a factor in giving.

4.a Hypothesis Testing

We are interested in testing several hypotheses about the factors behind giving. Specifically, we are interested in seeing if giving is motivated by altruistic behavior such as inequity aversion or reciprocity. We are also interested in the notion of withholding giving as a means of punishing a partner's perceived "greediness," or over-harvesting, and if subjects are able to tell the difference between bad decisions and bad luck.

We can measure how unequal a subject pair's wealth is the difference between starting resource levels, `k0Diff`, and we can measure how unequal a pair's income is as the cumulative difference between their harvest amounts in the previous period as `cumHarvestDiffLag1`. If inequity aversion is a factor, then the joint marginal effects of these two variables on `gaveAmt` should be positive.

If reciprocity is a factor, we should expect `cumNetTransferLag`, which is the cumulative difference between `gotAmt` and `gaveAmt`, to be positively correlated with `gaveAmt`. However, this behavior could also be explained by the self-interested motive of insurance: you give when having been given to as a means of either (i) keeping your partner alive and able to help you out in the future, or (ii) keeping your partner happy and willing to help you out in the future. That is, the primary concern is ensuring the partner is willing and/or able to give to the subject in the future.

One way to separate the altruistic reciprocity motive from the self-interested insurance motive is to consider the effects of `cumNetTransferLag` on `gaveAmt` in later periods when the opportunities for future harvesting are fewer, hence the opportunity cost of starvation is smaller. A positive marginal effect of `cumNetTransferLag` on `gaveAmt` earlier in the round and a non-positive marginal effect later in the round would support the notion that insurance, not reciprocity, is a factor motivating giving behavior.

To test whether subjects use giving as a means of either punishment or support for perceived partner bad behavior or bad luck, we can test to see how the partner's luck affects the giving decision and compare that with the effect of the partner's past decisions. While the subjects do not directly observe shocks, if the marginal effects of both `otherShockLag1` and `otherHarvestDeviationLag` are negative, this suggests that subjects are not only able to perceive when a subject has had bad luck, (giving more as partner shocks become more negative), but punishes those who over-harvest (giving less as partner deviation becomes larger).

4.b Results

Table 4 provides evidence that subjects are jointly considering the relative wealth and income levels when giving, though not in the direction inequity aversion would predict. The negative marginal effect of `cumHarvestDiffLag1` indicates that subjects with larger income gaps tend to give less. However, this could also be explained by the fact that subjects who tend to give less to the other player will have more to harvest for themselves. In no case, though, does this data support the existence of inequity aversion.

Table 4 here

Figures 2, 3, and 4 depict the marginal effects of `cumNetTransfersLag` on `gaveAmt`. Since the reciprocity motivation is applicable only to those who are net receivers, we consider only positive values of `cumNetTransferLag`. Table 5 lists the results of Wald tests with the null hypothesis that the marginal effects are the same both before and after period 16 and 17 at each level of `cumNetTransfersLag` (marginal effects are statistically insignificantly different before and after period 15).

Figures 2, 3, 4 here

Table 5 here

Figures 2, 3, and 4 show that, as the end of the round draws near, the marginal effects of `cumNetTransferLag` are dropping, especially as the subject's degree of net receiving increases. While the marginal effects are not statistically significantly different at 5% in figures 2 and 3, in figure 4 the marginal effects are significantly different at 5% for those subjects whose `cumNetTransferLag` values are 5 or more, and nearly statistically significant at 1% when the value is 8. Table 5 reports the results from the Wald tests. The data shows that subjects who have received more than they've given recognize the diminishing value of reciprocating by giving to their partners as the round comes to a close. This behavior is not consistent with altruistic reciprocity, rather it is consistent with a more self-interested form of reciprocity where the subject sees their partner as an insurance policy whose value is diminishing as the round comes to a close.

Table 6 shows the marginal effects of partner luck and partner overharvesting on `gaveAmt`. Even though subjects were unable to observe `otherShockLag1`, its marginal effect is significantly negative. This is consistent with the notion that subjects were not only able to identify when a partner had suffered bad luck, but responded by giving more as their partner's bad luck worsened. It is also interesting to note that, while the marginal effects of the running average of harvest deviations are statistically insignificant, the sign is negative. Coupled with the significantly positive marginal effect of `otherHarvestDeviationLag1`, this is consistent with the notion that while subjects may have been forgiving of one-time overharvesting by their partner, subjects were not so helpful to partners who were historically on average overharvesters.

Table 6 here

5 Conclusion

From these results, we can make the following inferences about subject behavior: subjects view the act of reciprocity not as altruism but a form of insurance; subjects exhibit no measureable levels of inequity aversion; though unobservable, subjects appear to respond favorably to partners who have experienced bad luck; and subjects are willing to give to one-time over-harvesters, but do not respond to habitual over-harvesters.

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A Tables

Table 1: A comparison of cooperative vs. noncooperative strategies.

Risk-level	Cooperative?	Avg Payoff	Starve Rate	Pair Starve Rate
low	no	61	8%	.6%
	yes	64	2%	.02%
high	no	50	15%	2%
	yes	52	6%	1%

Table 2: Variables used to explain gaveAmt. Second-order terms for all period variables were also included.

A_t	B_{ts}	C_{tsr}	D_{tsrp} Subject	D_{tsrp} Partner	D_{tsrp} Diff	D_{tsrp} Transfers
hiLo	age	round2	k0	otherEmptyPeriods	k0Diff	cumNetTransferLag
Maasai	comparativewealthAgree	round3	harvest	otherCumHarvestLag1	k0DiffLag1	cumGrossTransferLag
Rancher	comparativewealthDisagree	round4	askedFromAmt	otherHarvestDeviationLag1	harvestDiffLag1	afterP16
MaasaiL	currentbillsAgree		harvestLag1	otherGrowthLag1	cumHarvestDiffLag1	afterP17
RancherL	currentbillsDisagree		harvestDeviationLag1	otherShockLag1	k0DiffRunAvgLag	afterP18
	currentmoneyAgree		growthLag1	otherHarvestDeviationRunAvgLag	harvestDiffRunAvgLag	
	currentmoneyDisagree		shockLag1	otherGrowthRunAvgLag	cumHarvestDiffRunAvgLag	
	familymoneyAgree		harvestDeviationRunAvgLag	otherShockRunAvgLag		
	familymoneyDisagree		growthRunAvgLag			
	futuremoneyAgree		shockRunAvgLag			
	futuremoneyDisagree					
	neighborhoodwealthAgree					
	neighborhoodwealthDisagree					
	Female					
	Frosh					
	Soph					
	Junior					
	Senior					

Table 3: Interactions terms included in regression.

Variable	Interacts with
A_t	askedFromAmt, askedFromAmt, k0, k0Diff, cumHarvestDiffLag1, otherShockLag1, otherHarvestDeviationLag1
afterP1x	cumNetTransferLag, cumGrossTransferLag

Table 4: The marginal effects of inequity measurements on gaveAmt

	Avg. ME	Std. Err.
k0Diff	0.0209	0.0161
cumHarvestDiffLag1	-0.0134	0.0046

Wald test for jointly zero: $\chi^2(2) = 10.42$, p-val = 0.0055

Table 5: Wald test results of the differences between marginal effects of cumNetTransferLag across afterP16 and afterP17 (all differences are insignificant across afterP15).

cumNetTransferLag	afterP16	afterP17
4	$\chi^2(1) = 1.32$, p-val = 0.2511	$\chi^2(1) = 3.64$, p-val = 0.0565
5	$\chi^2(1) = 1.90$, p-val = 0.1685	$\chi^2(1) = 4.66$, p-val = 0.0309
6	$\chi^2(1) = 2.38$, p-val = 0.1227	$\chi^2(1) = 5.46$, p-val = 0.0195
7	$\chi^2(1) = 2.78$, p-val = 0.0954	$\chi^2(1) = 6.08$, p-val = 0.0137
8	$\chi^2(1) = 3.11$, p-val = 0.0780	$\chi^2(1) = 6.56$, p-val = 0.0105

Table 6: The marginal effects of punishment vs. luck measurements on gaveAmt.

	Avg. ME	Std. Err.
otherShockLag1	-.0411	.0146
otherHarvestDeviationLag1	.0298	.0114
otherHarvestDeviationRunAvgLag	-.0012	.0300

Wald test for jointly zero: $\chi^2(3) = 14.09$, p-val = 0.0028

Table 7: Results of main regression.

	(1)
	gaveAmt
hiLo	-0.0167
	(-0.12)
Maasai	-0.430
	(-1.95)
Rancher	-0.144
	(-0.76)
MaasaiL	-0.154
	(-0.69)
RancherL	-0.0488
	(-0.23)
age	0.0119
	(0.69)
comparativewealthAgree	-0.0247
	(-0.34)
comparativewealthDisagree	0.0120
	(0.16)
currentbillsAgree	-0.00778
	(-0.11)
currentbillsDisagree	-0.0797
	(-0.95)
currentmoneyAgree	-0.0241
	(-0.32)
currentmoneyDisagree	0.118
	(1.46)
familymoneyAgree	0.0700
	(0.74)
familymoneyDisagree	0.235
	(1.86)
futuremoneyAgree	0.0308
	(0.41)
futuremoneyDisagree	-0.0646
	(-0.96)
neighborhoodwealthAgree	-0.129
	(-1.54)
neighborhoodwealthDisagree	-0.0834
	(-0.95)
Female	0.115
	(1.89)
Frosh	-0.143
	(-0.97)
Soph	-0.138
	(-0.96)
Junior	-0.148
	(-1.14)

Senior	-0.219
	(-1.74)
round2	0.0163
	(0.33)
round3	-0.161**
	(-2.84)
round4	-0.125*
	(-2.00)
k0	0.0365
	(1.73)
harvest	0.00876
	(0.50)
askedFromAmt	-0.0169
	(-0.55)
harvestLag1	0.0207
	(0.66)
harvestDeviationLag1	-0.00741
	(-0.52)
growthLag1	-0.00149
	(-0.02)
shockLag1	0.0265
	(1.92)
harvestDeviationRunAvgLag	0.0115
	(0.42)
growthRunAvgLag	-0.123
	(-1.07)
shockRunAvgLag	0.0454
	(1.46)
c.k0#c.k0	-0.000572
	(-0.88)
c.harvest#c.harvest	-0.00411**
	(-2.62)
c.askedFromAmt#c.askedFromAmt	0.00142
	(1.14)
c.harvestLag1#c.harvestLag1	-0.000698
	(-0.22)
c.harvestDeviationLag1#c.harvestDeviationLag1	-0.000908
	(-0.41)
c.growthLag1#c.growthLag1	0.0140
	(1.05)
c.shockLag1#c.shockLag1	0.00259**
	(3.07)
c.harvestDeviationRunAvgLag#c.harvestDeviationRunAvgLag	-0.00597
	(-1.20)
c.growthRunAvgLag#c.growthRunAvgLag	-0.0183
	(-0.51)
c.shockRunAvgLag#c.shockRunAvgLag	0.0264***

	(3.89)
otherEmptyPeriods	-0.0523 (-1.32)
otherCumHarvestLag1	-0.00989 (-1.61)
otherHarvestDeviationLag1	0.0468 (1.86)
otherGrowthLag1	-0.0855 (-1.47)
otherShockLag1	-0.0313 (-1.80)
otherHarvestDeviationRunAvgLag	-0.00862 (-0.19)
otherGrowthRunAvgLag	0.106 (0.63)
otherShockRunAvgLag	0.00888 (0.32)
c.otherHarvestLag1#c.otherHarvestLag1	0.00375 (1.41)
c.otherCumHarvestLag1#c.otherCumHarvestLag1	-0.00000226 (-0.02)
c.otherHarvestDeviationLag1#c.otherHarvestDeviationLag1	-0.00273 (-0.68)
c.otherGrowthLag1#c.otherGrowthLag1	-0.0236 (-1.66)
c.otherShockLag1#c.otherShockLag1	-0.000431 (-0.23)
c.otherHarvestDeviationRunAvgLag#c.otherHarvestDeviationRunAvgLag	0.0148 (1.40)
c.otherGrowthRunAvgLag#c.otherGrowthRunAvgLag	0.0983 (1.65)
c.otherShockRunAvgLag#c.otherShockRunAvgLag	0.00250 (0.38)
k0Diff	0.0105 (0.70)
k0DiffLag1	-0.00314 (-0.23)
harvestDiffLag1	-0.00400 (-0.18)
cumHarvestDiffLag1	-0.0201*** (-3.40)
k0DiffRunAvgLag	0.00375 (0.25)
harvestDiffRunAvgLag	-0.00187 (-0.05)
cumHarvestDiffRunAvgLag	0.0163* (2.50)

c.k0Diff#c.k0Diff	0.000735* (2.04)
c.k0DiffLag1#c.k0DiffLag1	-0.0000475 (-0.24)
c.harvestDiffLag1#c.harvestDiffLag1	-0.00319 (-1.74)
c.cumHarvestDiffLag1#c.cumHarvestDiffLag1	-0.000165 (-0.81)
c.k0DiffRunAvgLag#c.k0DiffRunAvgLag	-0.00125*** (-3.56)
c.harvestDiffRunAvgLag#c.harvestDiffRunAvgLag	-0.000826 (-0.20)
c.cumHarvestDiffRunAvgLag#c.cumHarvestDiffRunAvgLag	0.000445 (1.26)
cumNetTransferLag	-0.0135 (-1.45)
cumGrossTransferLag	0.0505*** (4.39)
c.cumNetTransferLag#c.cumNetTransferLag	0.00258* (2.30)
c.cumGrossTransferLag#c.cumGrossTransferLag	-0.00151** (-2.97)
afterP15	-0.0995 (-1.02)
afterP16	-0.0939 (-0.94)
afterP17	0.220** (2.63)
0b.hiLo#co.askedFromAmt	0 (.)
1.hiLo#c.askedFromAmt	-0.0182 (-0.62)
0b.hiLo#co.k0	0 (.)
1.hiLo#c.k0	0.00753 (0.47)
0b.hiLo#co.k0Diff	0 (.)
1.hiLo#c.k0Diff	0.00192 (0.27)
0b.hiLo#co.cumHarvestDiffLag1	0 (.)
1.hiLo#c.cumHarvestDiffLag1	0.00896** (3.19)
0b.hiLo#co.askedFromAmt#co.askedFromAmt	0 (.)
1.hiLo#c.askedFromAmt#c.askedFromAmt	0.000988

	(0.76)
0b.hiLo#co.k0#co.k0	0 (.)
1.hiLo#c.k0#c.k0	-0.000726 (-1.25)
0b.hiLo#co.k0Diff#co.k0Diff	0 (.)
1.hiLo#c.k0Diff#c.k0Diff	0.0000506 (0.15)
0b.hiLo#co.cumHarvestDiffLag1#co.cumHarvestDiffLag1	0 (.)
1.hiLo#c.cumHarvestDiffLag1#c.cumHarvestDiffLag1	0.000157 (1.29)
0b.hiLo#co.otherShockLag1	0 (.)
1.hiLo#c.otherShockLag1	0.00738 (0.80)
0b.hiLo#co.otherHarvestDeviationLag1	0 (.)
1.hiLo#c.otherHarvestDeviationLag1	-0.0192 (-0.94)
0b.hiLo#co.otherHarvestDeviationRunAvgLag	0 (.)
1.hiLo#c.otherHarvestDeviationRunAvgLag	0.00129 (0.04)
0b.hiLo#co.otherShockLag1#co.otherShockLag1	0 (.)
1.hiLo#c.otherShockLag1#c.otherShockLag1	-0.000202 (-0.13)
0b.hiLo#co.otherHarvestDeviationLag1#co.otherHarvestDeviationLag1	0 (.)
1.hiLo#c.otherHarvestDeviationLag1#c.otherHarvestDeviationLag1	0.00461 (1.59)
0b.hiLo#co.otherHarvestDeviationRunAvgLag#co.otherHarvestDeviationRunAvgLag	0 (.)
1.hiLo#c.otherHarvestDeviationRunAvgLag#c.otherHarvestDeviationRunAvgLag	-0.00615 (-0.71)
0b.Maasai#co.askedFromAmt	0 (.)
1.Maasai#c.askedFromAmt	0.172** (2.88)
0b.Maasai#co.k0	0 (.)
1.Maasai#c.k0	0.00798 (0.33)
0b.Maasai#co.k0Diff	0 (.)

1.Maasai#c.k0Diff	0.00555 (0.54)
0b.Maasai#co.cumHarvestDiffLag1	0 (.)
1.Maasai#c.cumHarvestDiffLag1	0.000440 (0.10)
0b.Maasai#co.askedFromAmt#co.askedFromAmt	0 (.)
1.Maasai#c.askedFromAmt#c.askedFromAmt	-0.00962* (-2.52)
0b.Maasai#co.k0#co.k0	0 (.)
1.Maasai#c.k0#c.k0	0.000611 (0.75)
0b.Maasai#co.k0Diff#co.k0Diff	0 (.)
1.Maasai#c.k0Diff#c.k0Diff	-0.000911 (-1.90)
0b.Maasai#co.cumHarvestDiffLag1#co.cumHarvestDiffLag1	0 (.)
1.Maasai#c.cumHarvestDiffLag1#c.cumHarvestDiffLag1	0.000195 (1.00)
0b.Maasai#co.otherShockLag1	0 (.)
1.Maasai#c.otherShockLag1	-0.00791 (-0.48)
0b.Maasai#co.otherHarvestDeviationLag1	0 (.)
1.Maasai#c.otherHarvestDeviationLag1	-0.0518 (-1.81)
0b.Maasai#co.otherHarvestDeviationRunAvgLag	0 (.)
1.Maasai#c.otherHarvestDeviationRunAvgLag	0.0485 (1.27)
0b.Maasai#co.otherShockLag1#co.otherShockLag1	0 (.)
1.Maasai#c.otherShockLag1#c.otherShockLag1	0.00361 (1.67)
0b.Maasai#co.otherHarvestDeviationLag1#co.otherHarvestDeviationLag1	0 (.)
1.Maasai#c.otherHarvestDeviationLag1#c.otherHarvestDeviationLag1	0.00386 (0.94)
0b.Maasai#co.otherHarvestDeviationRunAvgLag#co.otherHarvestDeviationRunAvgLag	0 (.)
1.Maasai#c.otherHarvestDeviationRunAvgLag#c.otherHarvestDeviationRunAvgLag	-0.0129 (-1.45)
0b.Rancher#co.askedFromAmt	0

	(.)
1.Rancher#c.askedFromAmt	0.108* (2.55)
0b.Rancher#co.k0	0 (.)
1.Rancher#c.k0	0.00558 (0.25)
0b.Rancher#co.k0Diff	0 (.)
1.Rancher#c.k0Diff	0.00276 (0.24)
0b.Rancher#co.cumHarvestDiffLag1	0 (.)
1.Rancher#c.cumHarvestDiffLag1	0.00133 (0.30)
0b.Rancher#co.askedFromAmt#co.askedFromAmt	0 (.)
1.Rancher#c.askedFromAmt#c.askedFromAmt	-0.00560*** (-3.35)
0b.Rancher#co.k0#co.k0	0 (.)
1.Rancher#c.k0#c.k0	0.000136 (0.16)
0b.Rancher#co.k0Diff#co.k0Diff	0 (.)
1.Rancher#c.k0Diff#c.k0Diff	0.000612 (1.11)
0b.Rancher#co.cumHarvestDiffLag1#co.cumHarvestDiffLag1	0 (.)
1.Rancher#c.cumHarvestDiffLag1#c.cumHarvestDiffLag1	-0.000158 (-0.95)
0b.Rancher#co.otherShockLag1	0 (.)
1.Rancher#c.otherShockLag1	-0.00261 (-0.19)
0b.Rancher#co.otherHarvestDeviationLag1	0 (.)
1.Rancher#c.otherHarvestDeviationLag1	-0.00195 (-0.09)
0b.Rancher#co.otherHarvestDeviationRunAvgLag	0 (.)
1.Rancher#c.otherHarvestDeviationRunAvgLag	0.0335 (0.70)
0b.Rancher#co.otherShockLag1#co.otherShockLag1	0 (.)
1.Rancher#c.otherShockLag1#c.otherShockLag1	0.00390 (1.71)

0b.Rancher#co.otherHarvestDeviationLag1#co.otherHarvestDeviationLag1	0 (.)
1.Rancher#c.otherHarvestDeviationLag1#c.otherHarvestDeviationLag1	-0.00132 (-0.39)
0b.Rancher#co.otherHarvestDeviationRunAvgLag#co.otherHarvestDeviationRunAvgLag	0 (.)
1.Rancher#c.otherHarvestDeviationRunAvgLag#c.otherHarvestDeviationRunAvgLag	0.000502 (0.05)
0b.MaasaiL#co.askedFromAmt	0 (.)
1.MaasaiL#c.askedFromAmt	0.0628 (1.38)
0b.MaasaiL#co.k0	0 (.)
1.MaasaiL#c.k0	0.0362 (1.32)
0b.MaasaiL#co.k0Diff	0 (.)
1.MaasaiL#c.k0Diff	0.00705 (0.72)
0b.MaasaiL#co.cumHarvestDiffLag1	0 (.)
1.MaasaiL#c.cumHarvestDiffLag1	0.00518 (1.18)
0b.MaasaiL#co.askedFromAmt#co.askedFromAmt	0 (.)
1.MaasaiL#c.askedFromAmt#c.askedFromAmt	-0.00266 (-1.29)
0b.MaasaiL#co.k0#co.k0	0 (.)
1.MaasaiL#c.k0#c.k0	-0.000997 (-0.96)
0b.MaasaiL#co.k0Diff#co.k0Diff	0 (.)
1.MaasaiL#c.k0Diff#c.k0Diff	0.000357 (0.74)
0b.MaasaiL#co.cumHarvestDiffLag1#co.cumHarvestDiffLag1	0 (.)
1.MaasaiL#c.cumHarvestDiffLag1#c.cumHarvestDiffLag1	-0.00000971 (-0.05)
0b.MaasaiL#co.otherShockLag1	0 (.)
1.MaasaiL#c.otherShockLag1	-0.0146 (-0.87)
0b.MaasaiL#co.otherHarvestDeviationLag1	0 (.)
1.MaasaiL#c.otherHarvestDeviationLag1	0.00502

	(0.17)
0b.MaasaiL#co.otherHarvestDeviationRunAvgLag	0
	(.)
1.MaasaiL#c.otherHarvestDeviationRunAvgLag	0.0217
	(0.47)
0b.MaasaiL#co.otherShockLag1#co.otherShockLag1	0
	(.)
1.MaasaiL#c.otherShockLag1#c.otherShockLag1	0.00300
	(1.29)
0b.MaasaiL#co.otherHarvestDeviationLag1#co.otherHarvestDeviationLag1	0
	(.)
1.MaasaiL#c.otherHarvestDeviationLag1#c.otherHarvestDeviationLag1	-0.00297
	(-0.67)
0b.MaasaiL#co.otherHarvestDeviationRunAvgLag#co.otherHarvestDeviationRunAvgLag	0
	(.)
1.MaasaiL#c.otherHarvestDeviationRunAvgLag#c.otherHarvestDeviationRunAvgLag	-0.00460
	(-0.38)
0b.RancherL#co.askedFromAmt	0
	(.)
1.RancherL#c.askedFromAmt	0.0182
	(0.52)
0b.RancherL#co.k0	0
	(.)
1.RancherL#c.k0	-0.00713
	(-0.33)
0b.RancherL#co.k0Diff	0
	(.)
1.RancherL#c.k0Diff	-0.00549
	(-0.62)
0b.RancherL#co.cumHarvestDiffLag1	0
	(.)
1.RancherL#c.cumHarvestDiffLag1	0.00210
	(0.40)
0b.RancherL#co.askedFromAmt#co.askedFromAmt	0
	(.)
1.RancherL#c.askedFromAmt#c.askedFromAmt	-0.00235
	(-1.41)
0b.RancherL#co.k0#co.k0	0
	(.)
1.RancherL#c.k0#c.k0	0.000719
	(1.08)
0b.RancherL#co.k0Diff#co.k0Diff	0
	(.)
1.RancherL#c.k0Diff#c.k0Diff	-0.000296
	(-0.72)
0b.RancherL#co.cumHarvestDiffLag1#co.cumHarvestDiffLag1	0
	(.)

1.RancherL#c.cumHarvestDiffLag1#c.cumHarvestDiffLag1	0.000181
	(0.70)
0b.RancherL#co.otherShockLag1	0
	(.)
1.RancherL#c.otherShockLag1	-0.0125
	(-0.82)
0b.RancherL#co.otherHarvestDeviationLag1	0
	(.)
1.RancherL#c.otherHarvestDeviationLag1	0.0242
	(0.80)
0b.RancherL#co.otherHarvestDeviationRunAvgLag	0
	(.)
1.RancherL#c.otherHarvestDeviationRunAvgLag	-0.0658
	(-1.54)
0b.RancherL#co.otherShockLag1#co.otherShockLag1	0
	(.)
1.RancherL#c.otherShockLag1#c.otherShockLag1	0.00236
	(0.94)
0b.RancherL#co.otherHarvestDeviationLag1#co.otherHarvestDeviationLag1	0
	(.)
1.RancherL#c.otherHarvestDeviationLag1#c.otherHarvestDeviationLag1	-0.00861*
	(-2.06)
0b.RancherL#co.otherHarvestDeviationRunAvgLag#co.otherHarvestDeviationRunAvgLag	0
	(.)
1.RancherL#c.otherHarvestDeviationRunAvgLag#c.otherHarvestDeviationRunAvgLag	0.00109
	(0.16)
0b.afterP15#co.cumNetTransferLag	0
	(.)
1.afterP15#c.cumNetTransferLag	-0.000846
	(-0.08)
0b.afterP15#co.cumGrossTransferLag	0
	(.)
1.afterP15#c.cumGrossTransferLag	0.0281
	(1.27)
0b.afterP15#co.cumNetTransferLag#co.cumNetTransferLag	0
	(.)
1.afterP15#c.cumNetTransferLag#c.cumNetTransferLag	0.0000149
	(0.01)
0b.afterP15#co.cumGrossTransferLag#co.cumGrossTransferLag	0
	(.)
1.afterP15#c.cumGrossTransferLag#c.cumGrossTransferLag	-0.00102
	(-1.08)
0b.afterP16#co.cumNetTransferLag	0
	(.)
1.afterP16#c.cumNetTransferLag	0.0118
	(0.83)
0b.afterP16#co.cumGrossTransferLag	0

	(.)
1.afterP16#c.cumGrossTransferLag	-0.0123
	(-0.55)
0b.afterP16#co.cumNetTransferLag#co.cumNetTransferLag	0
	(.)
1.afterP16#c.cumNetTransferLag#c.cumNetTransferLag	-0.00116
	(-0.63)
0b.afterP16#co.cumGrossTransferLag#co.cumGrossTransferLag	0
	(.)
1.afterP16#c.cumGrossTransferLag#c.cumGrossTransferLag	0.000984
	(1.18)
0b.afterP17#co.cumNetTransferLag	0
	(.)
1.afterP17#c.cumNetTransferLag	-0.00705
	(-0.66)
0b.afterP17#co.cumGrossTransferLag	0
	(.)
1.afterP17#c.cumGrossTransferLag	-0.0430*
	(-2.24)
0b.afterP17#co.cumNetTransferLag#co.cumNetTransferLag	0
	(.)
1.afterP17#c.cumNetTransferLag#c.cumNetTransferLag	-0.00184*
	(-2.01)
0b.afterP17#co.cumGrossTransferLag#co.cumGrossTransferLag	0
	(.)
1.afterP17#c.cumGrossTransferLag#c.cumGrossTransferLag	0.00163*
	(2.39)
_cons	-0.103
	(-0.22)
N	3856
R^2	0.364
adj. R^2	0.336

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B Figures

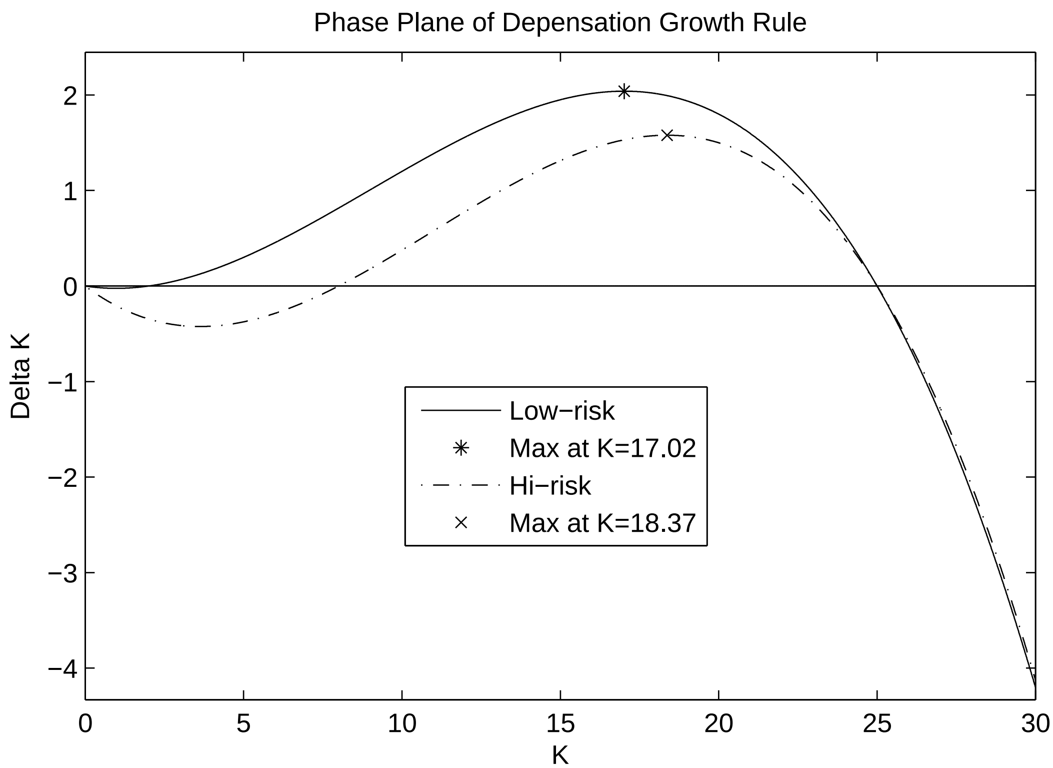

Figure 1: Depensation growth rule phase-plane for low and hi risk parameterizations.

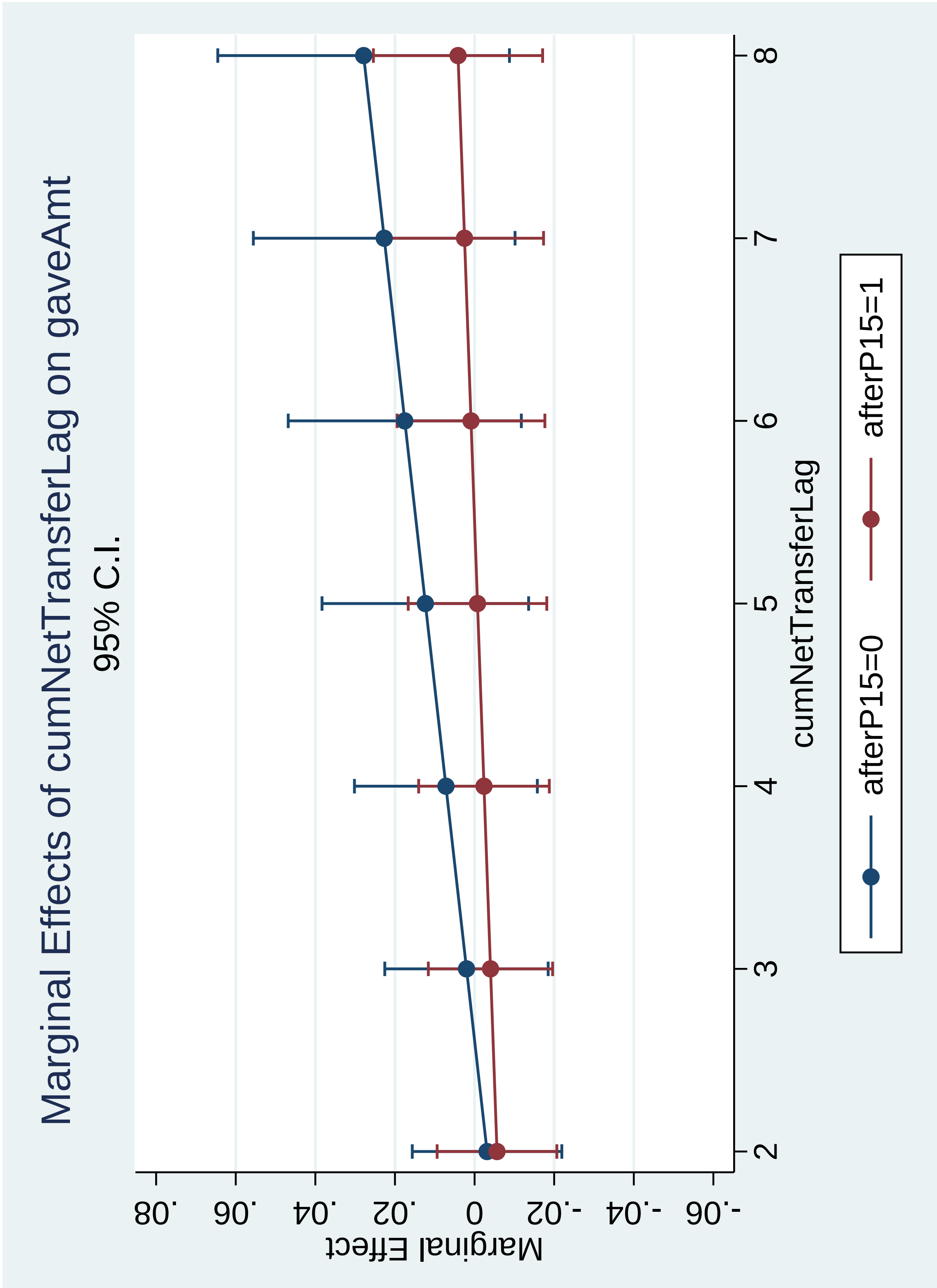

Figure 2: Marginal effects of net cumulative transfers on giving.

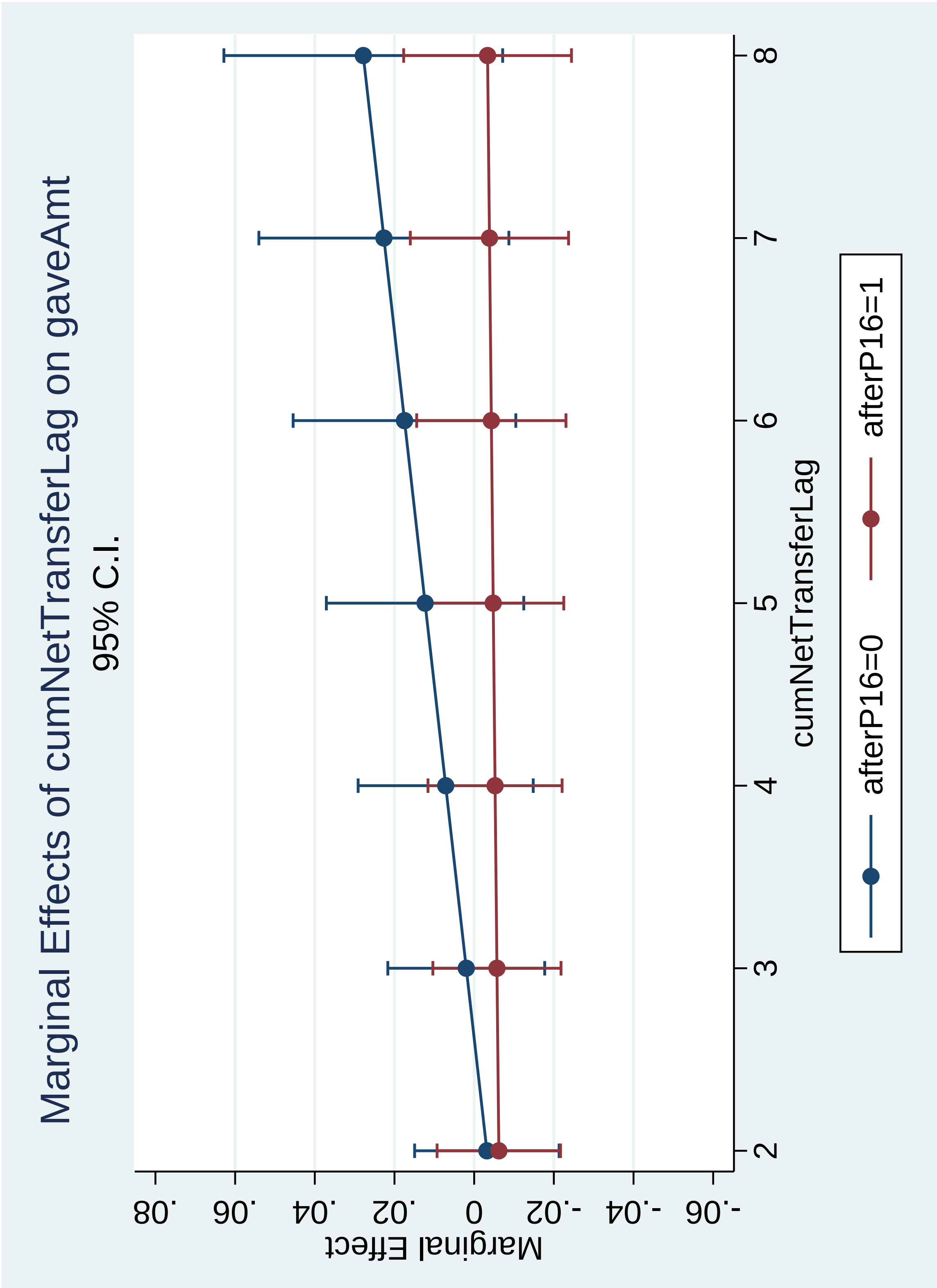

Figure 3: Marginal effects of net cumulative transfers on giving.

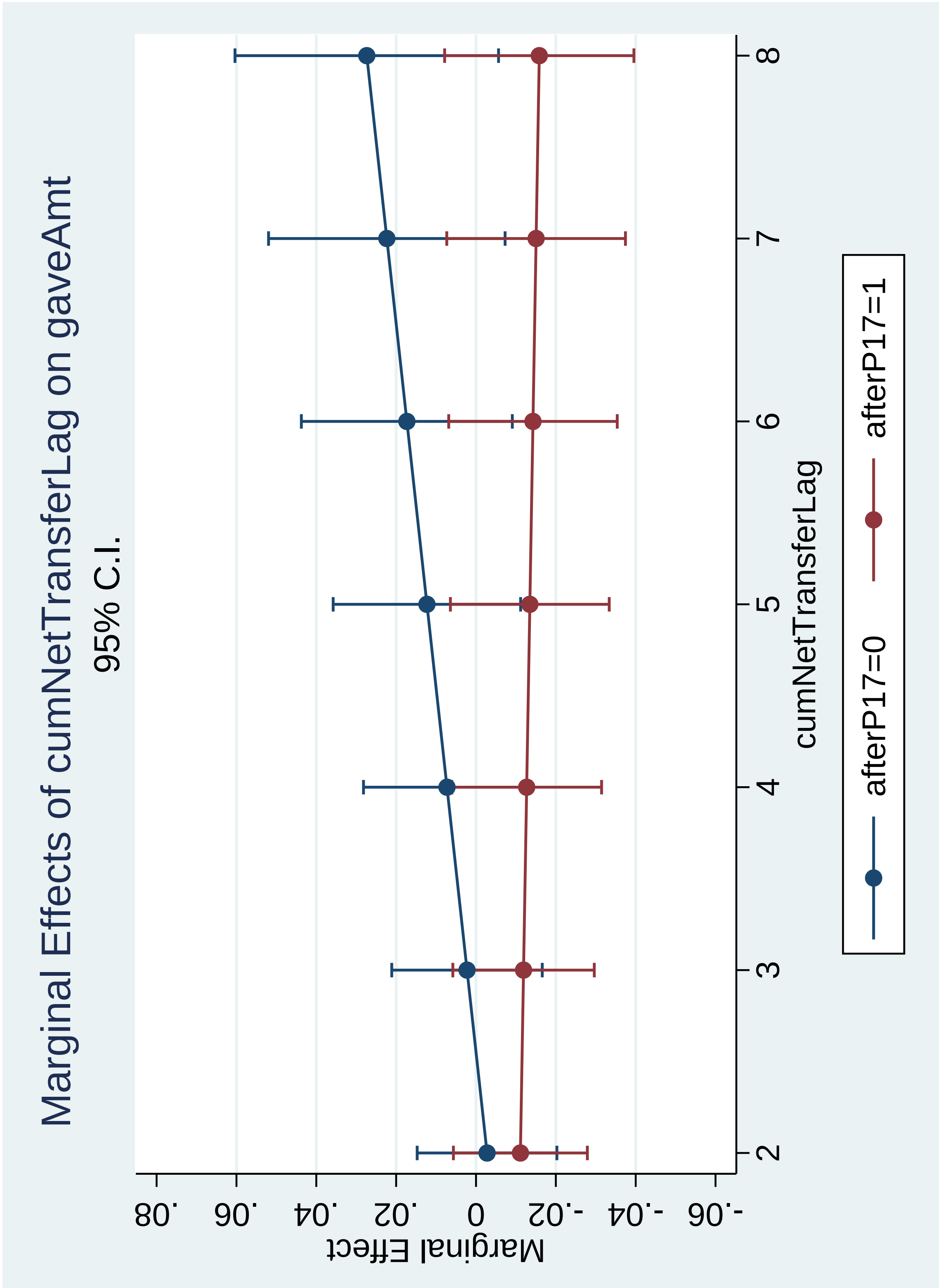

Figure 4: Marginal effects of net cumulative transfers on giving.

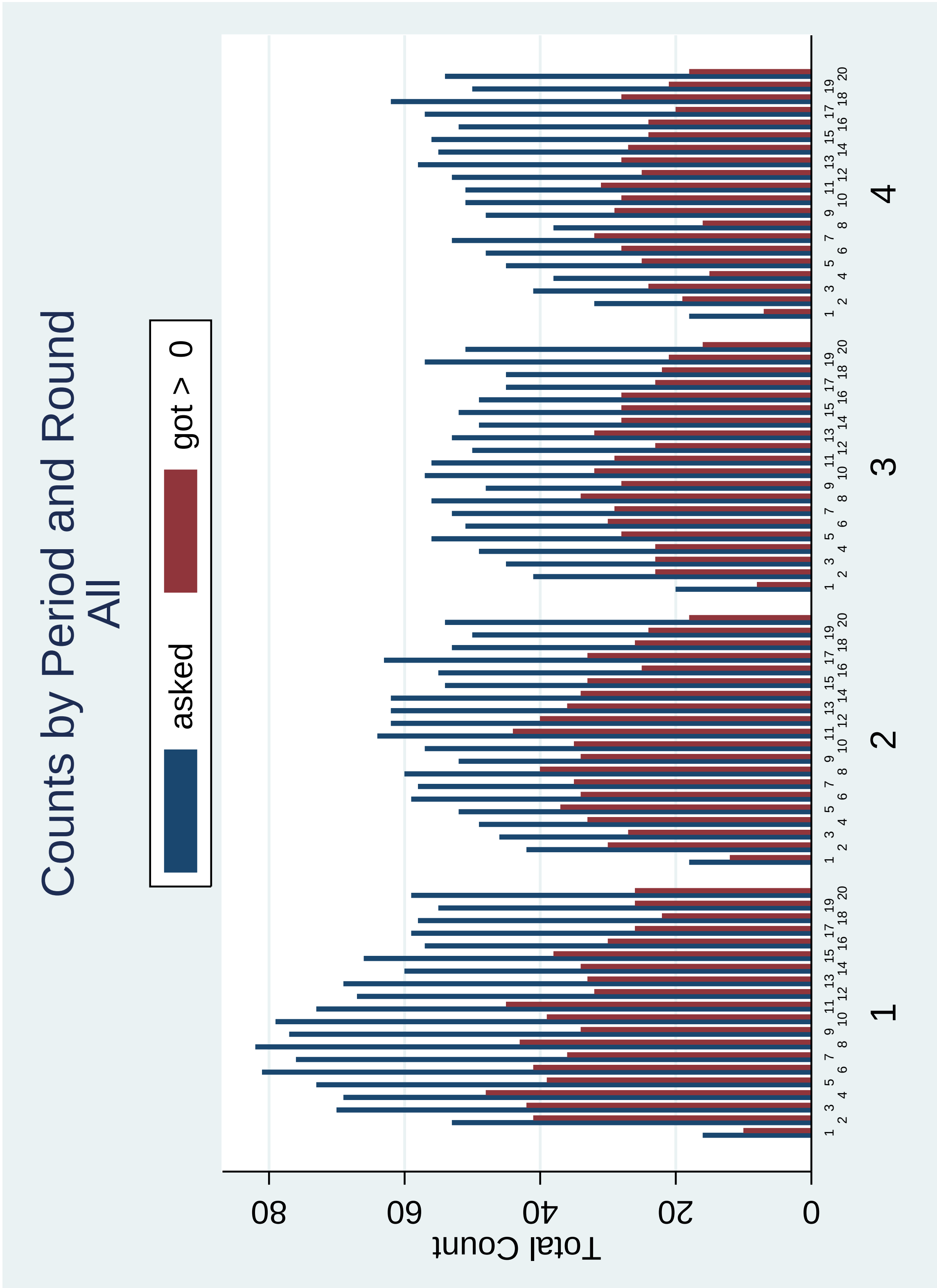

Figure 5: Total requests and total responses to requests by period and round.

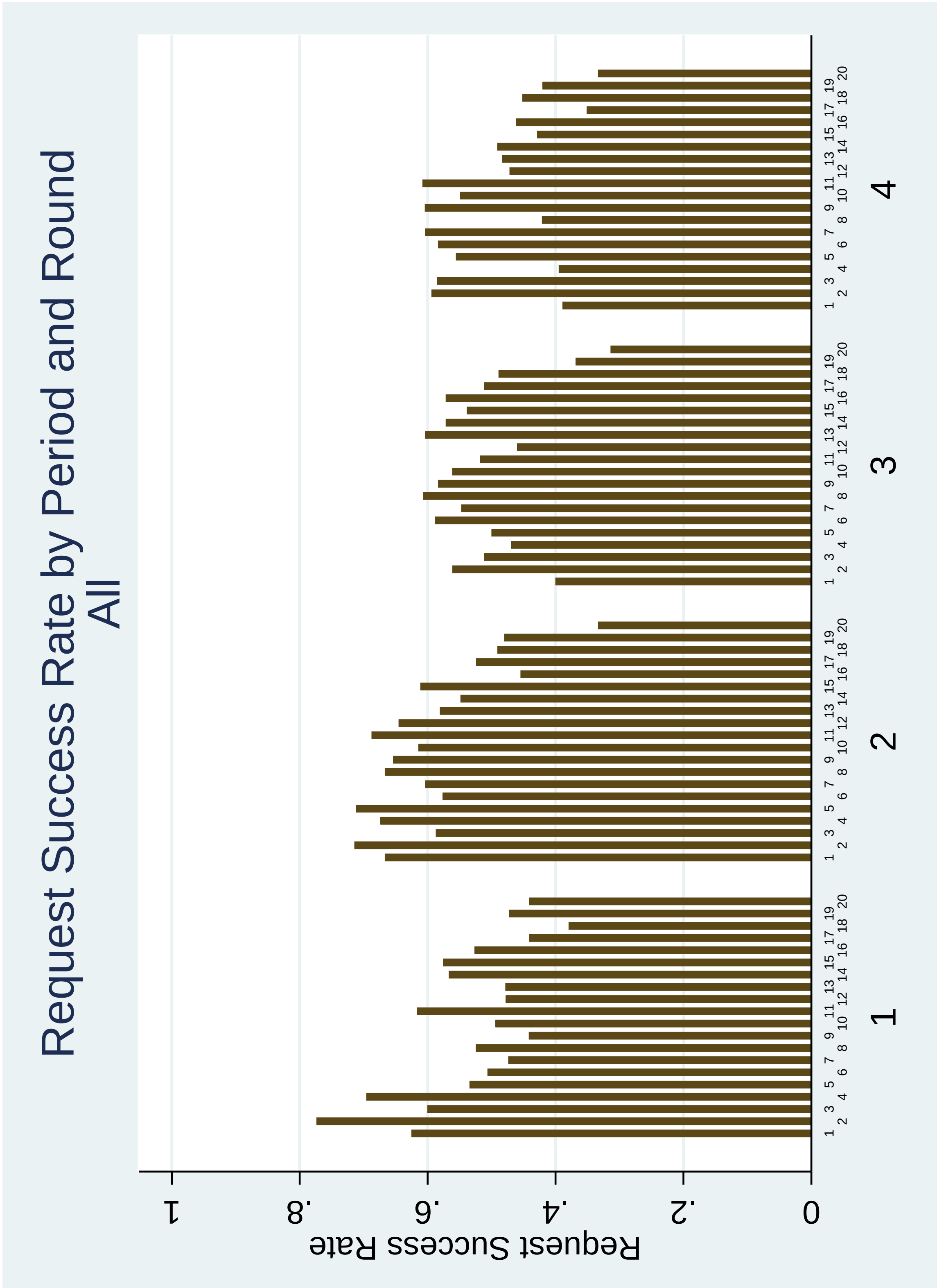

Figure 6: Proportion of responses to requests by period and round.

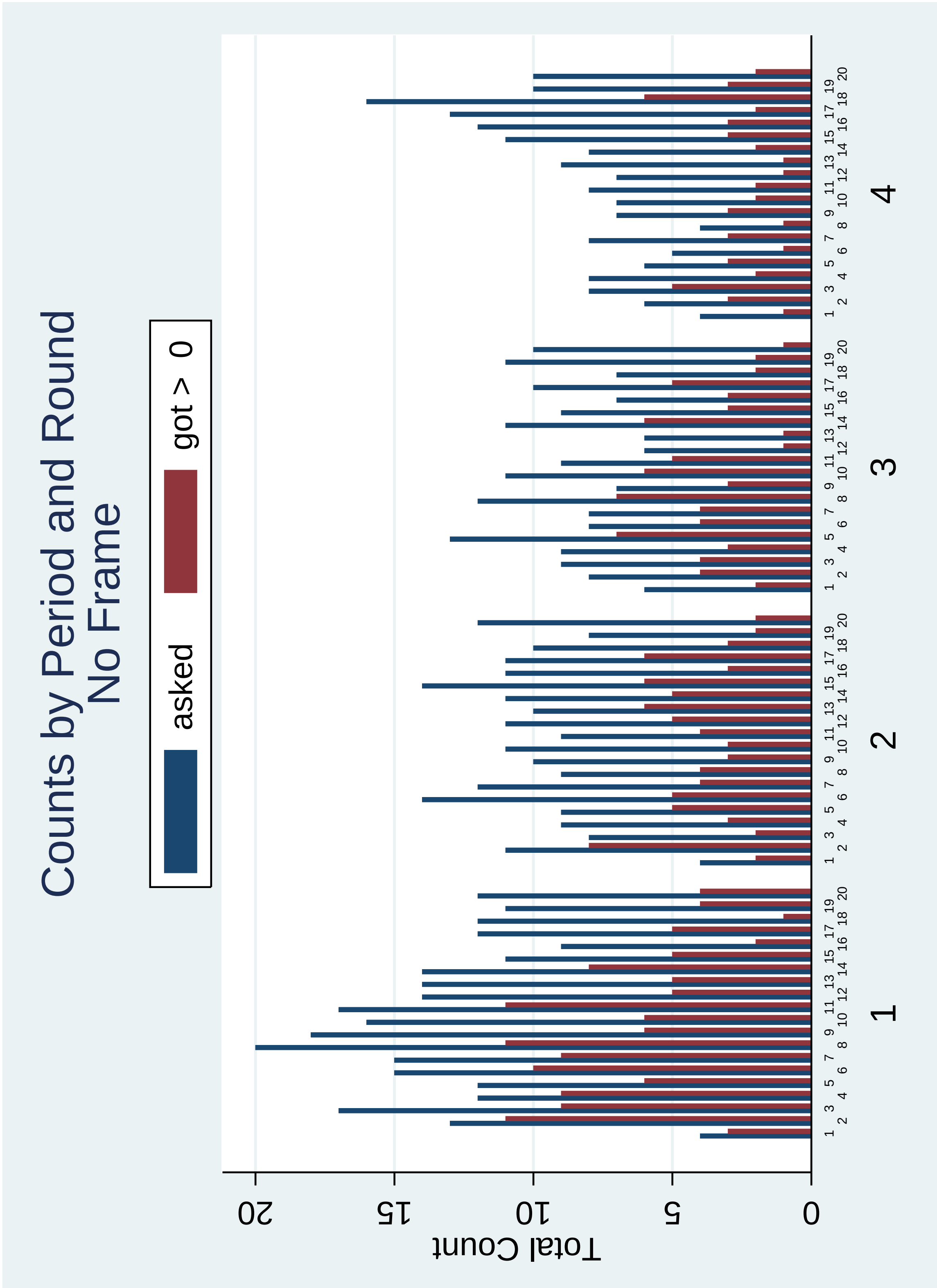

Figure 7: Total requests and total responses to requests by period and round, no frame.

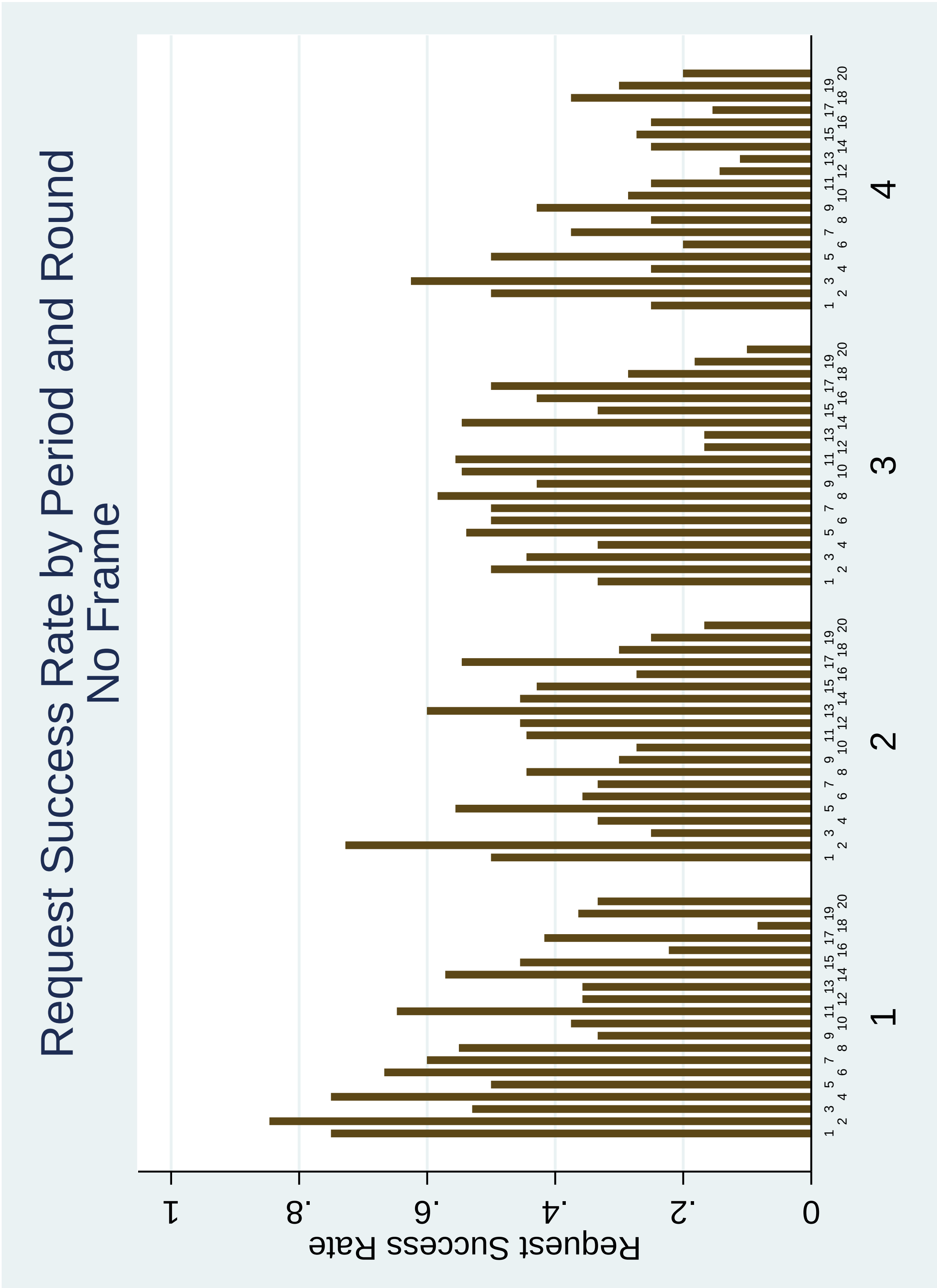

Figure 8: Proportion of responses to requests by period and round, no frame.

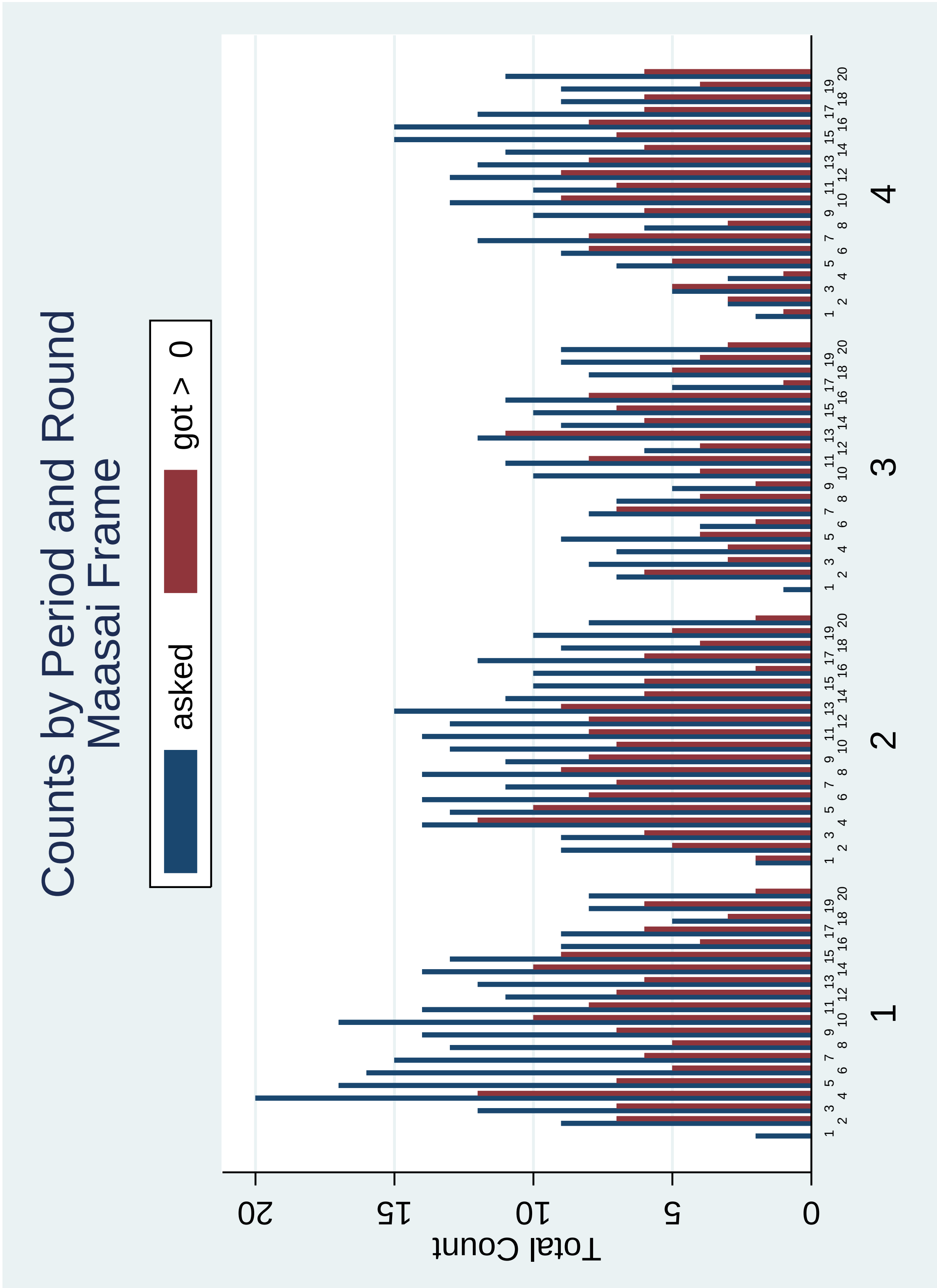

Figure 9: Total requests and total responses to requests by period and round, Maasai frame.

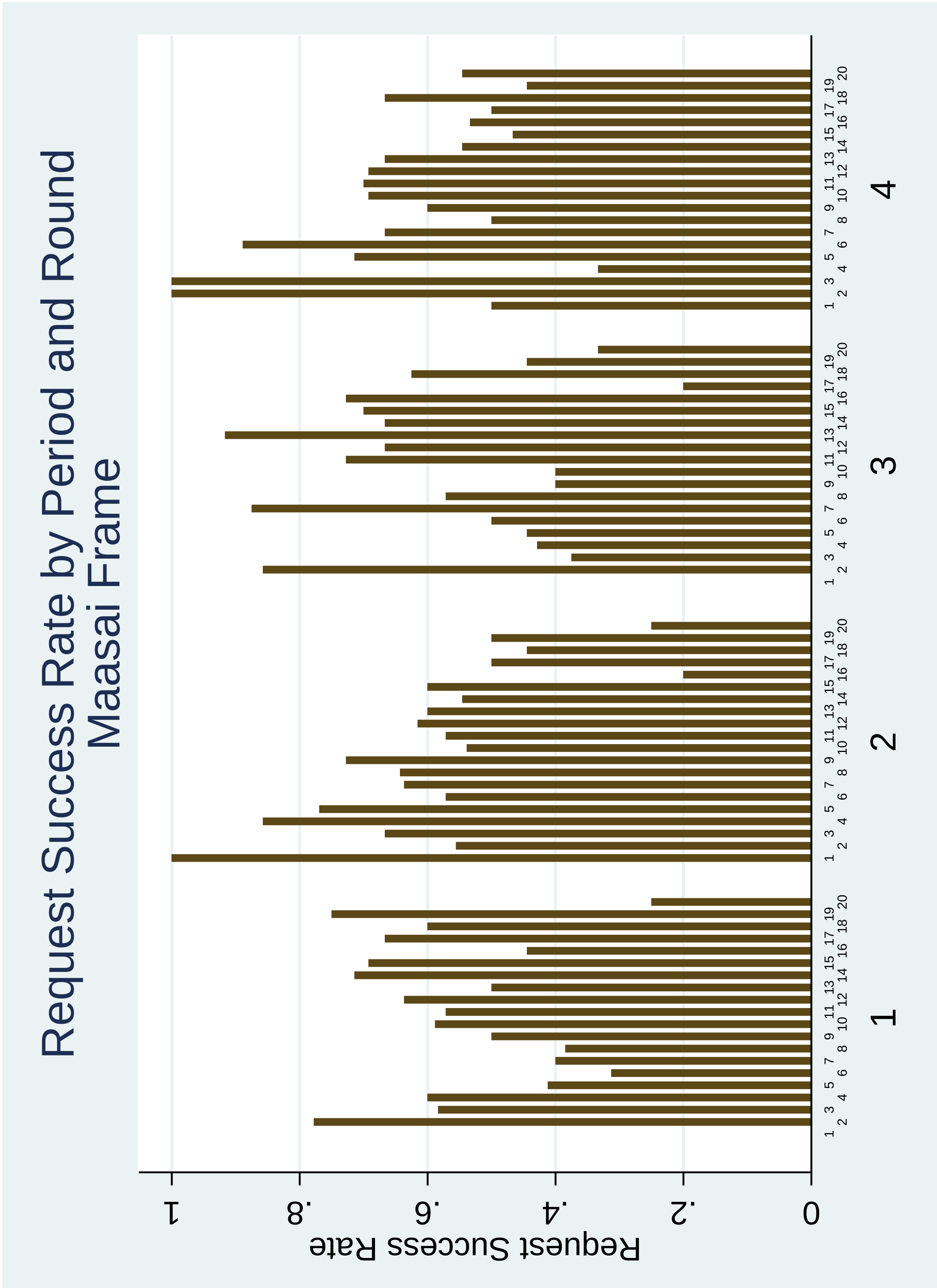

Figure 10: Proportion of responses to requests by period and round, Maasai frame.

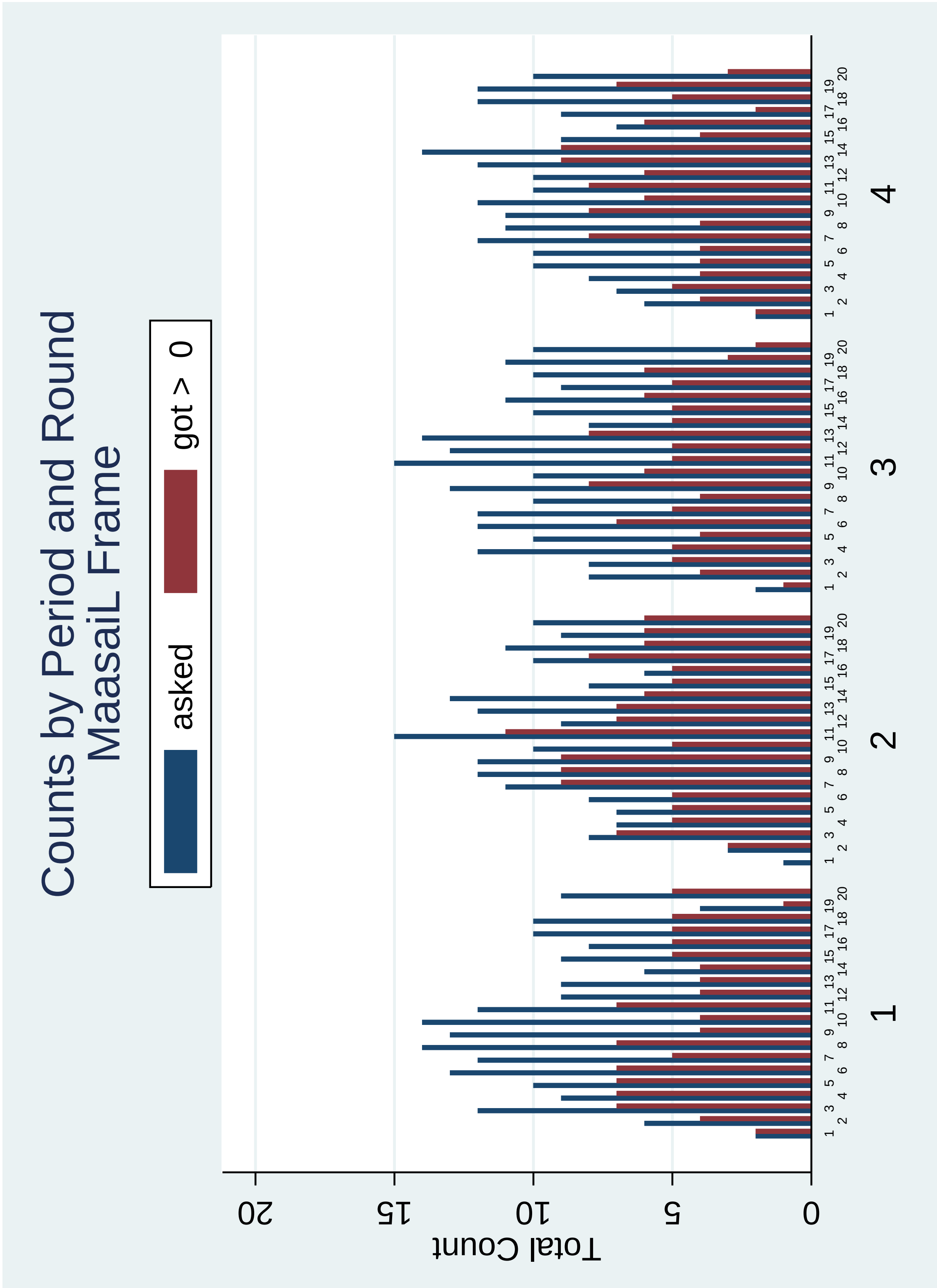

Figure 11: Total requests and total responses to requests by period and round, Maasai frame, labeled.

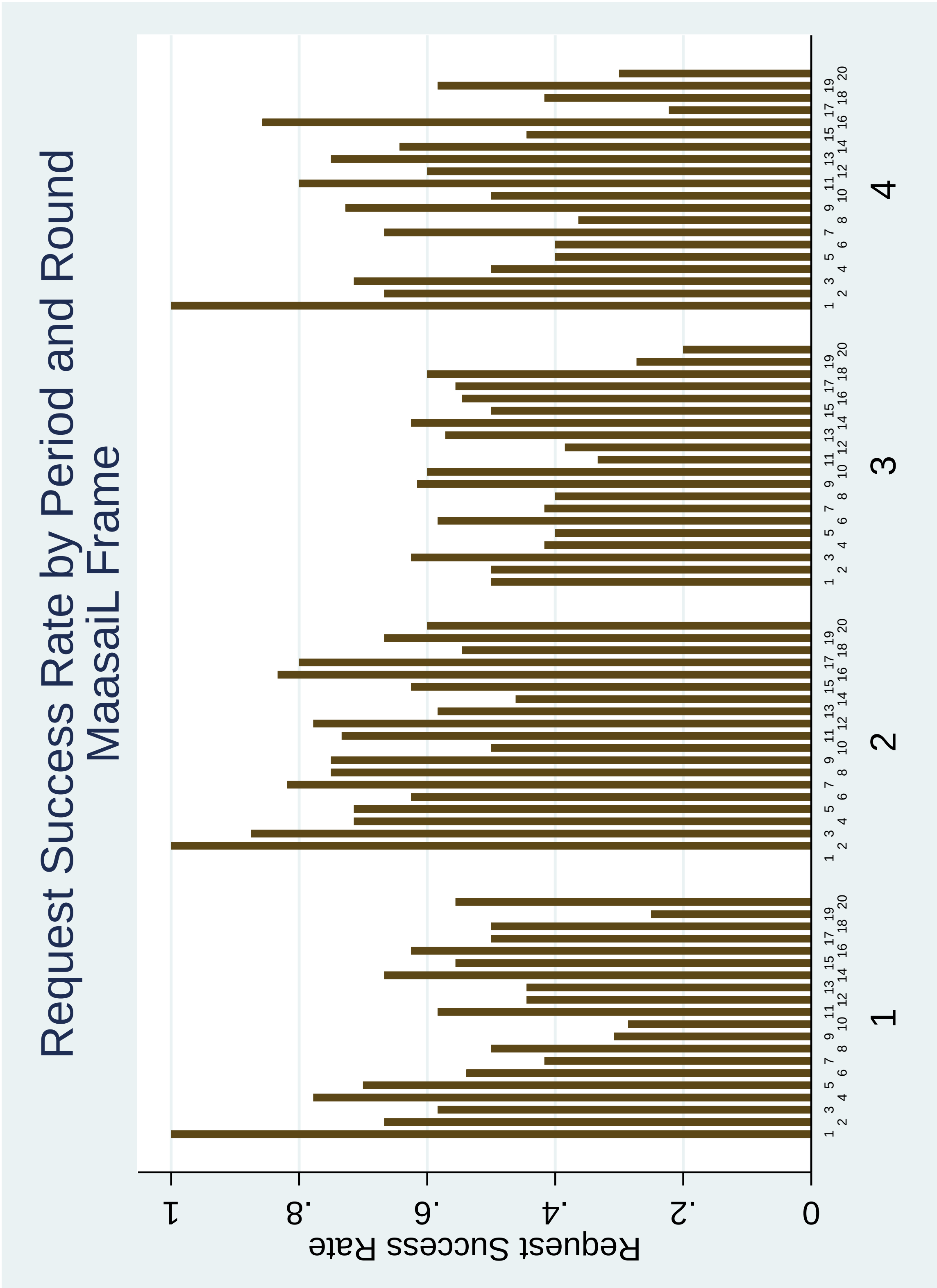

Figure 12: Proportion of responses to requests by period and round, Maasai frame, labeled.

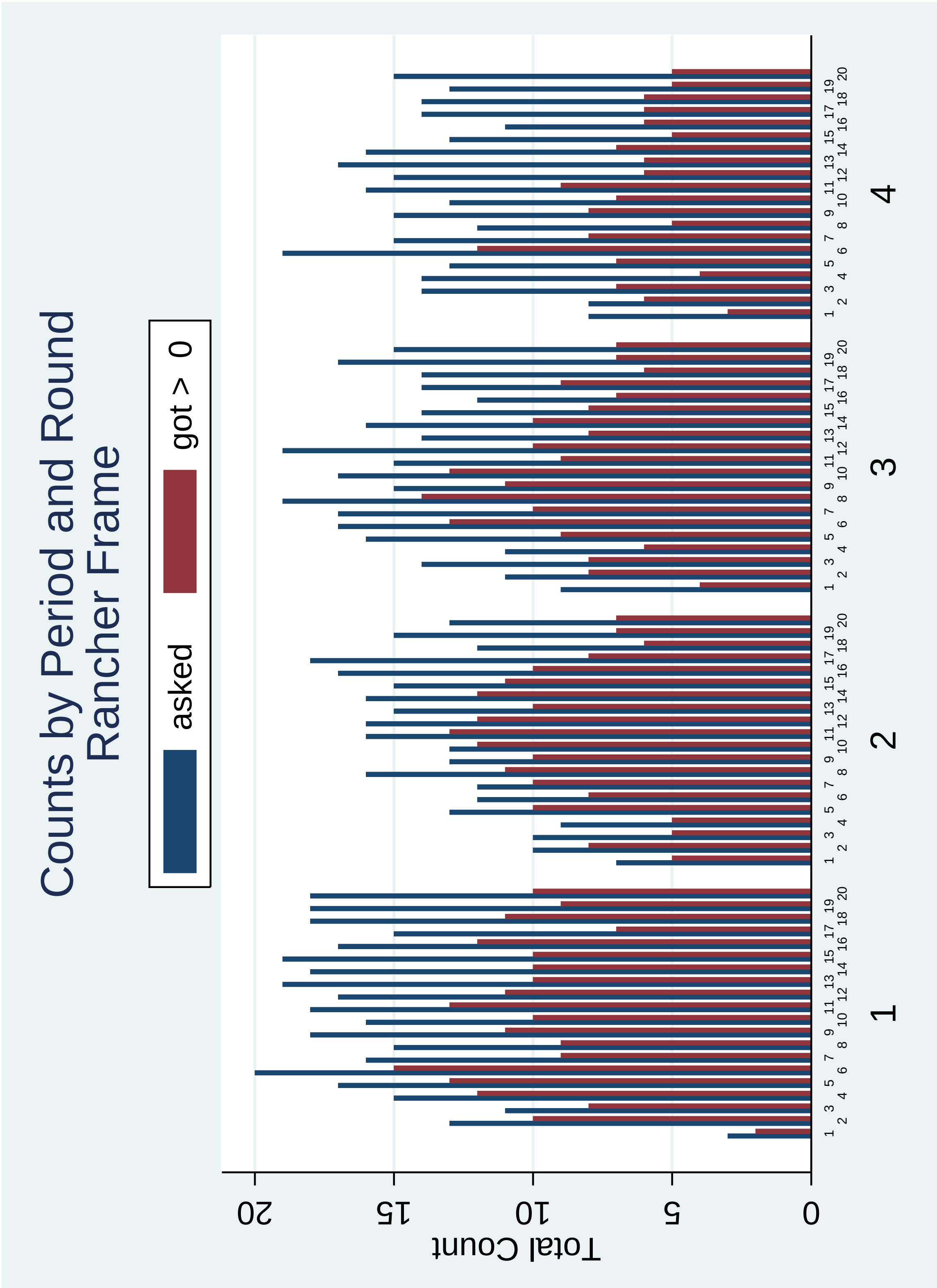

Figure 13: Total requests and total responses to requests by period and round, Rancher frame.

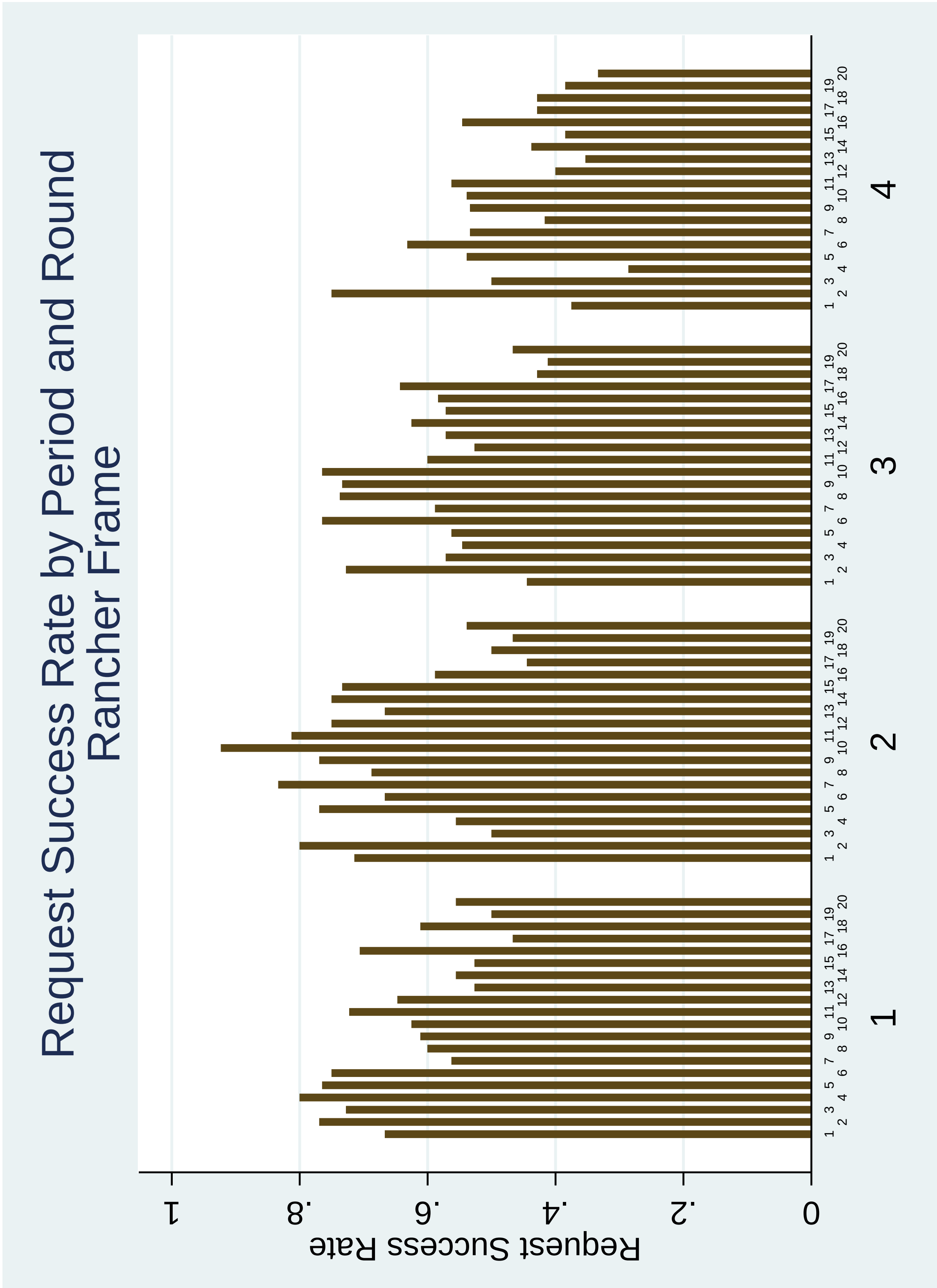

Figure 14: Proportion of responses to requests by period and round, Rancher frame.

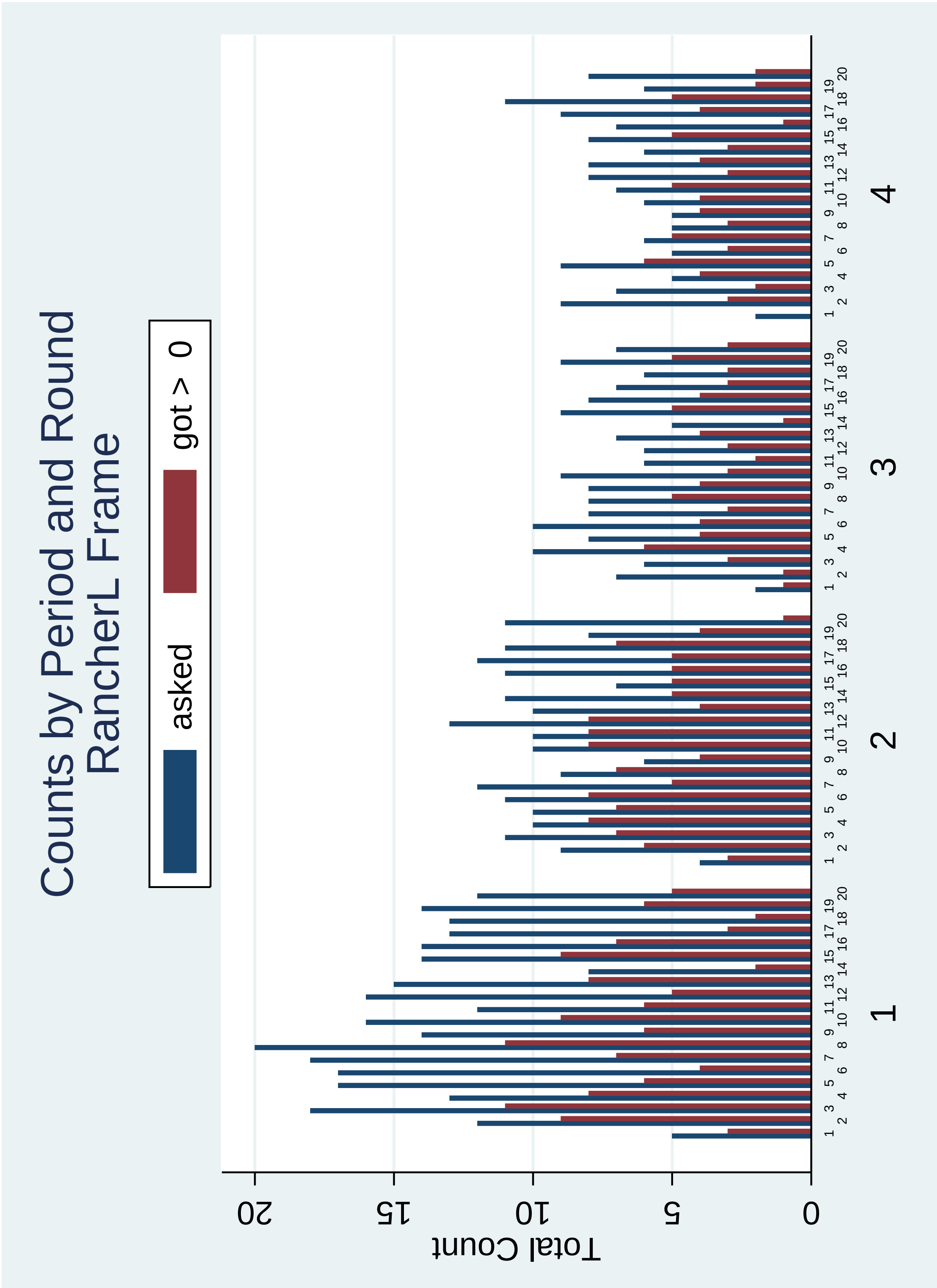

Figure 15: Total requests and total responses to requests by period and round, Rancher frame, labeled.

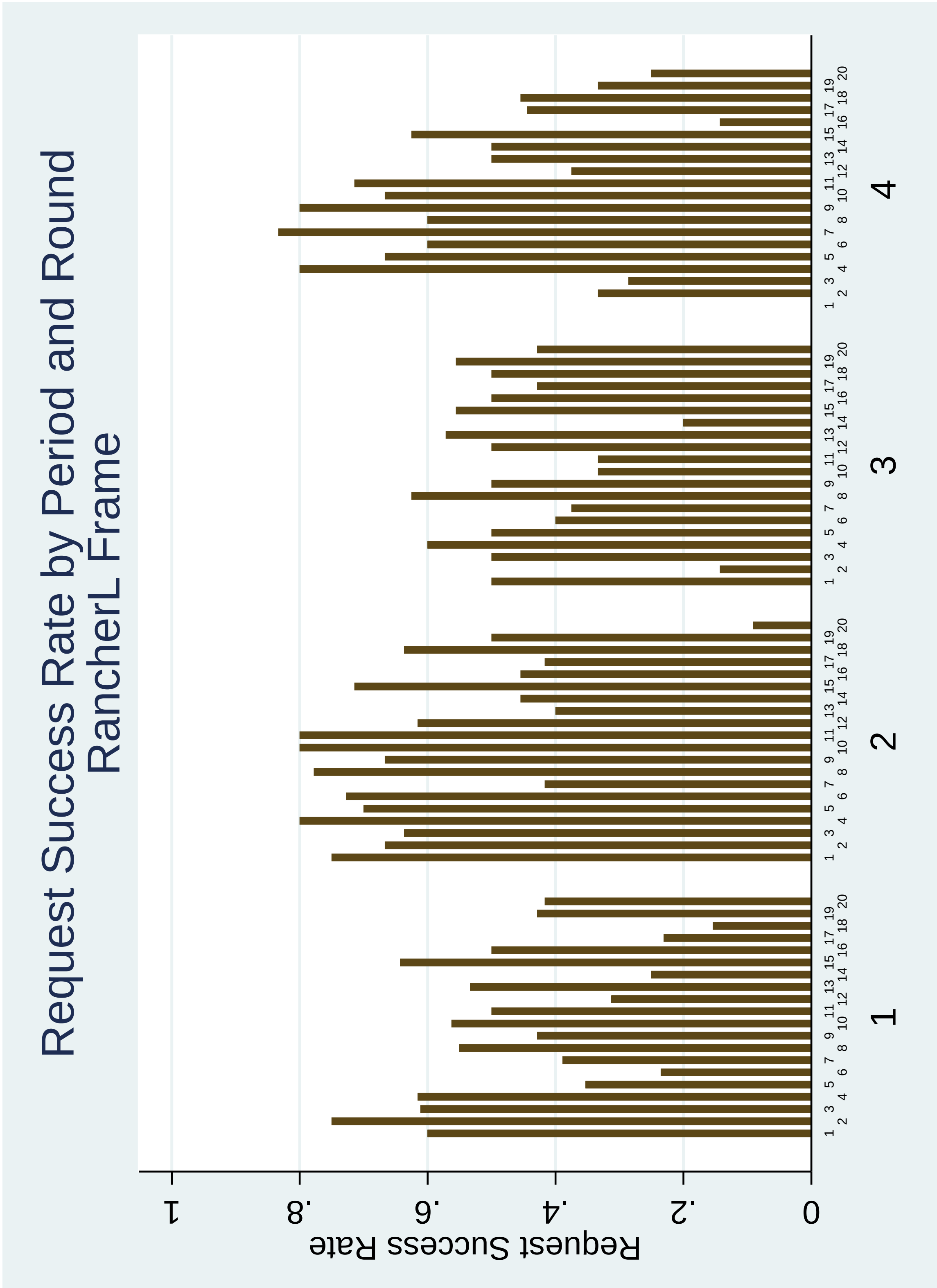

Figure 16: Proportion of responses to requests by period and round, Rancher frame, labeled.

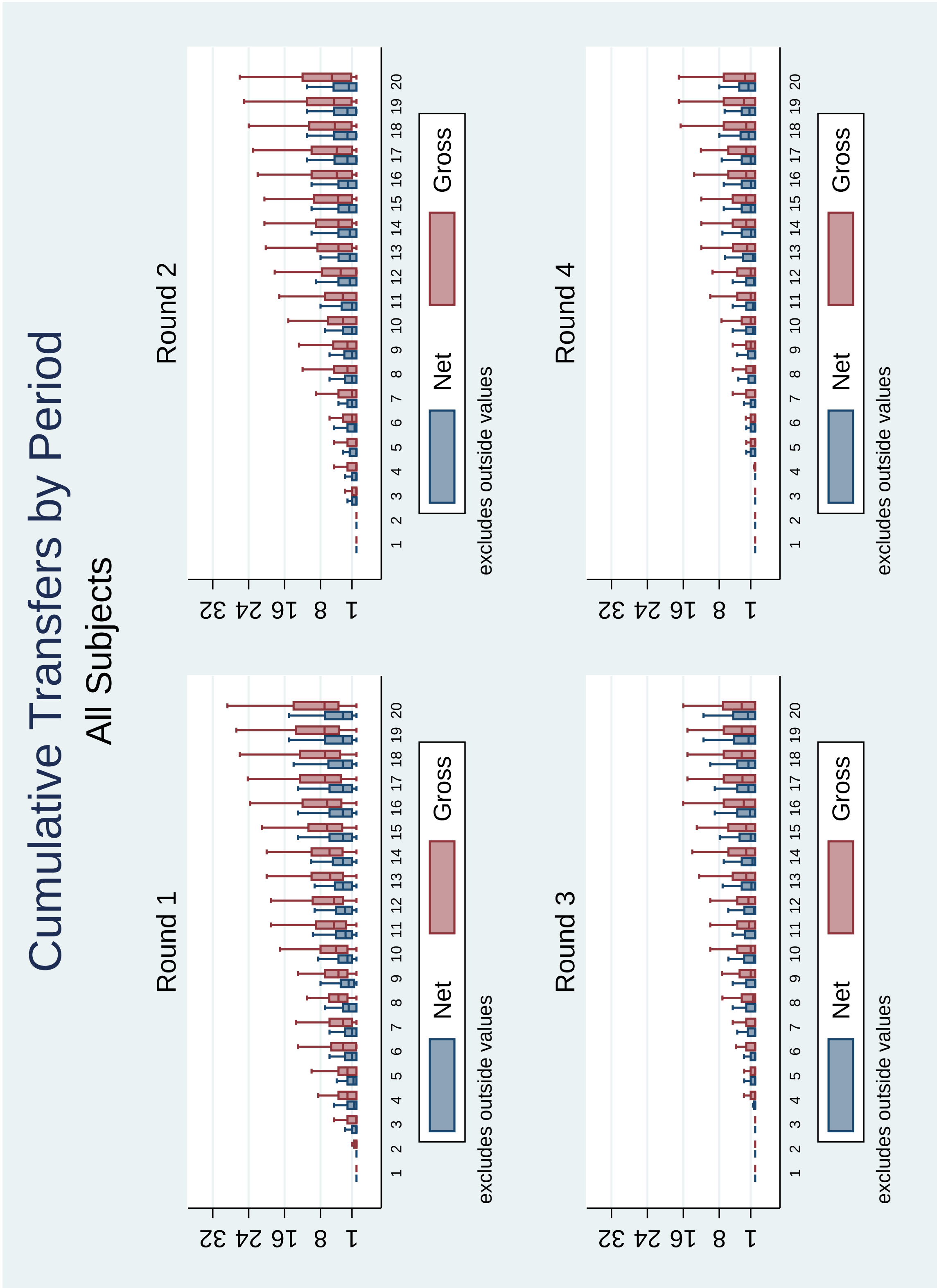

Figure 17: Cumulative transfers per period.

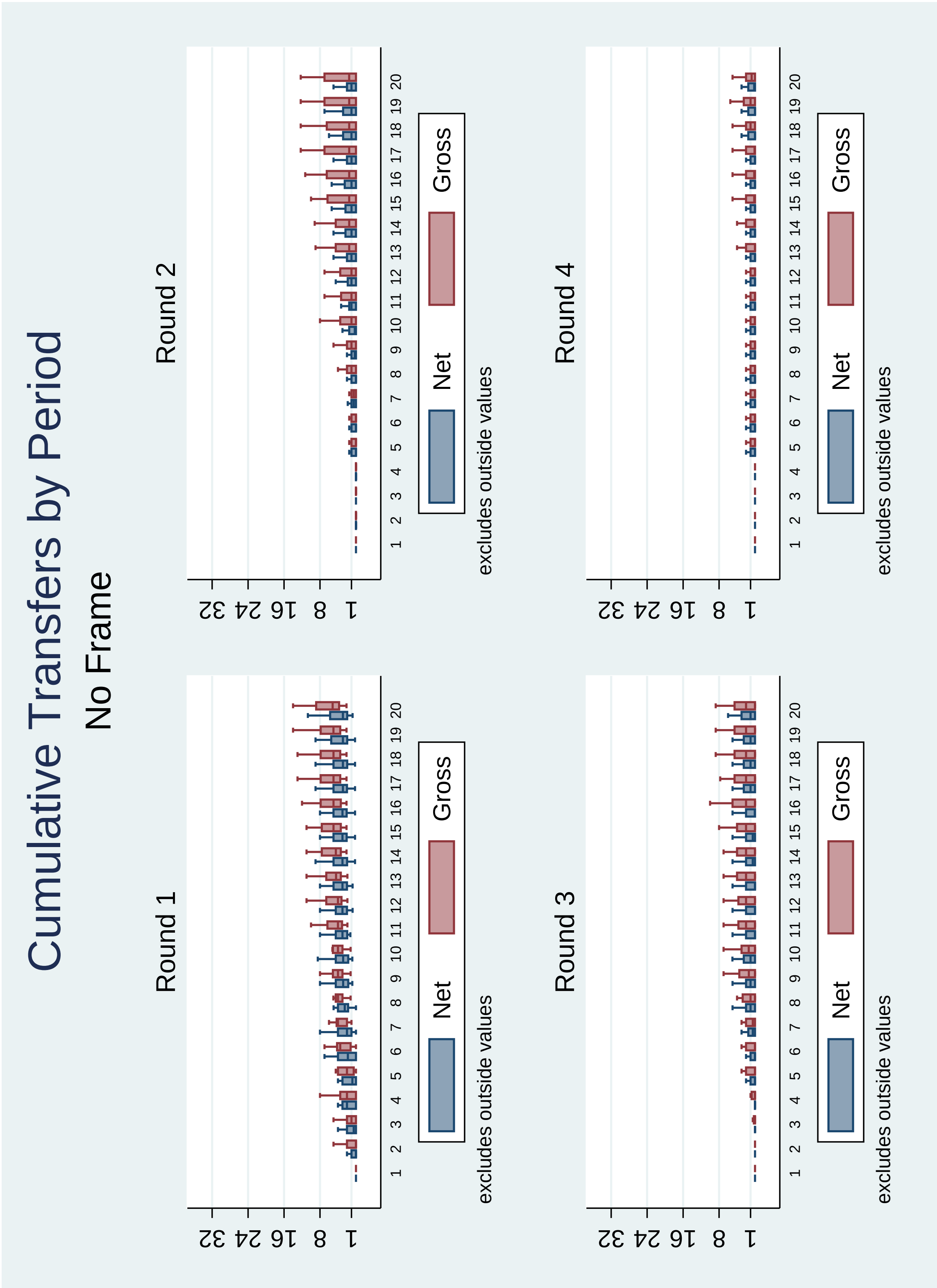

Figure 18: Cumulative transfers per perdiod, no frame.

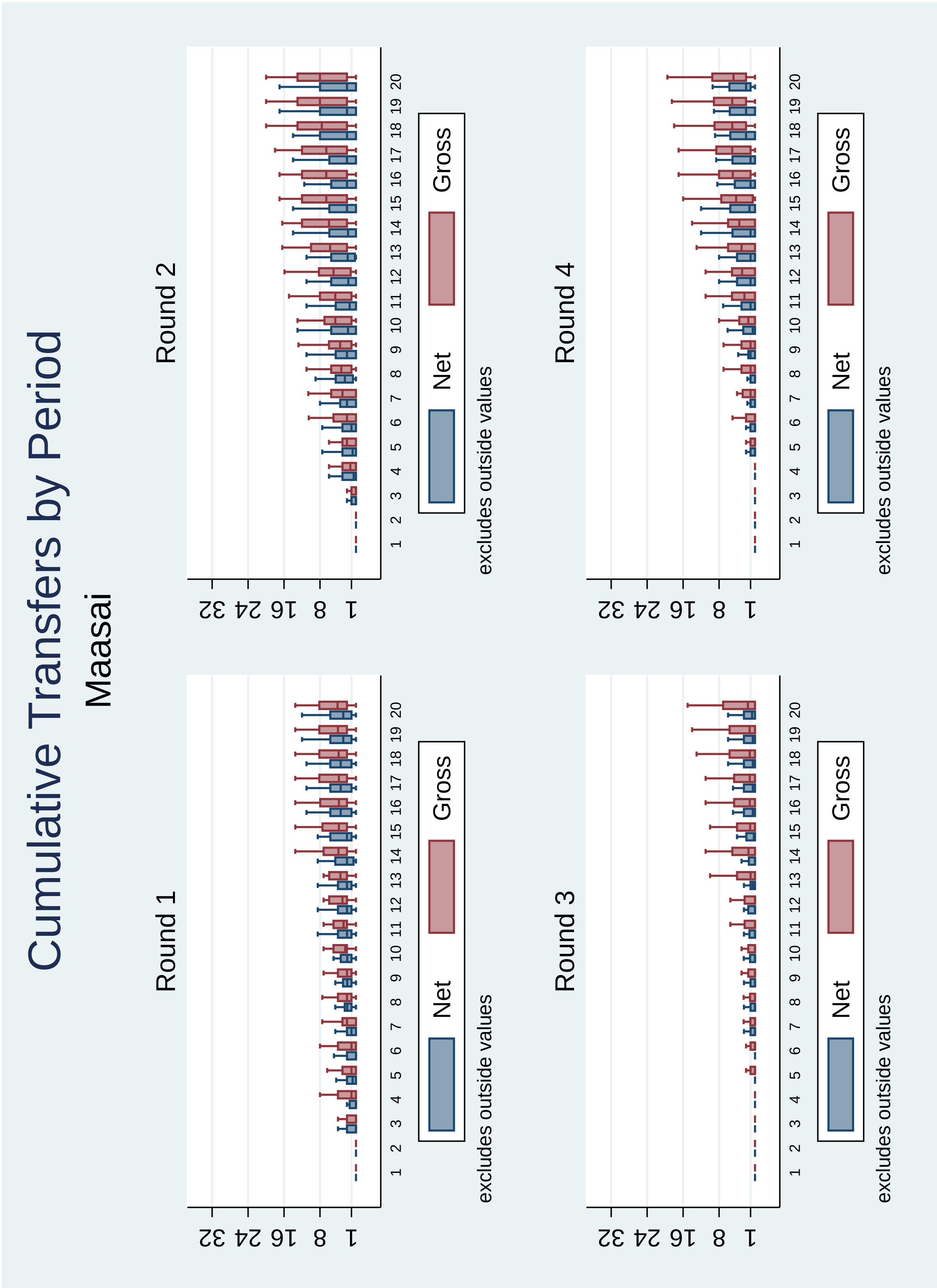

Figure 19: Cumulative transfers per perdiod, Maasai frame.

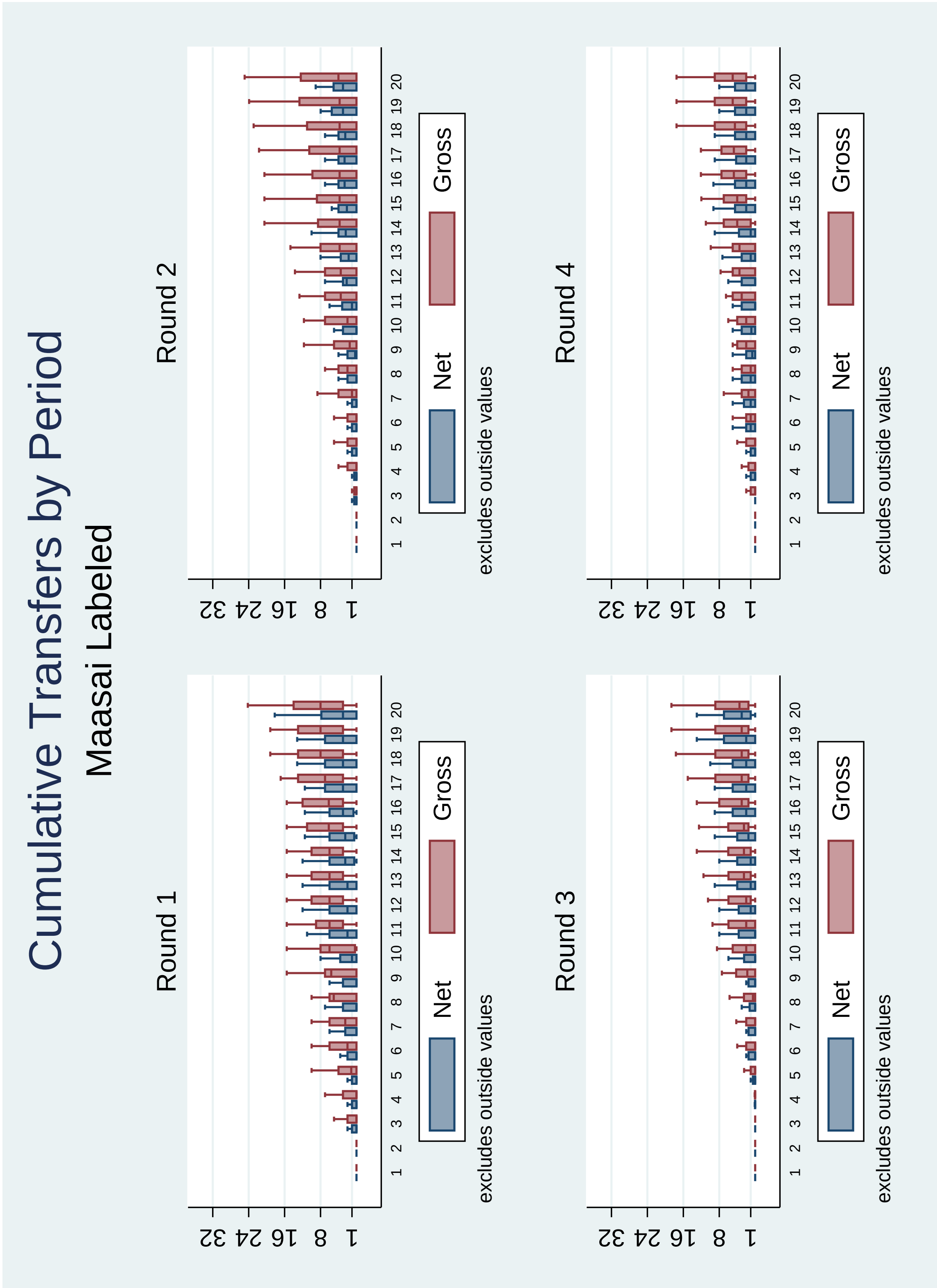

Figure 20: Cumulative transfers per perdiod, Maasai frame, labeled.

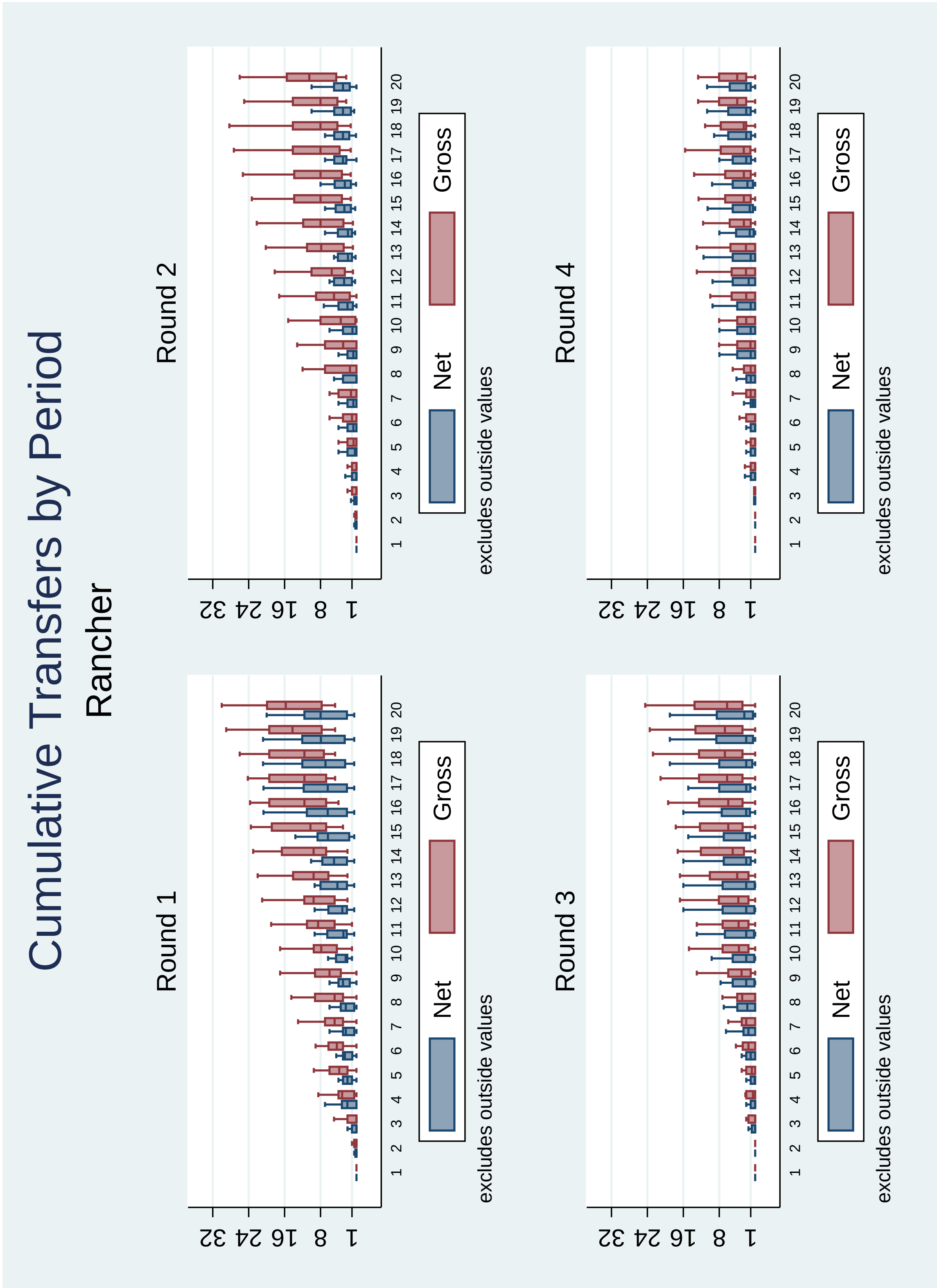

Figure 21: Cumulative transfers per perdiod, Rancher frame.

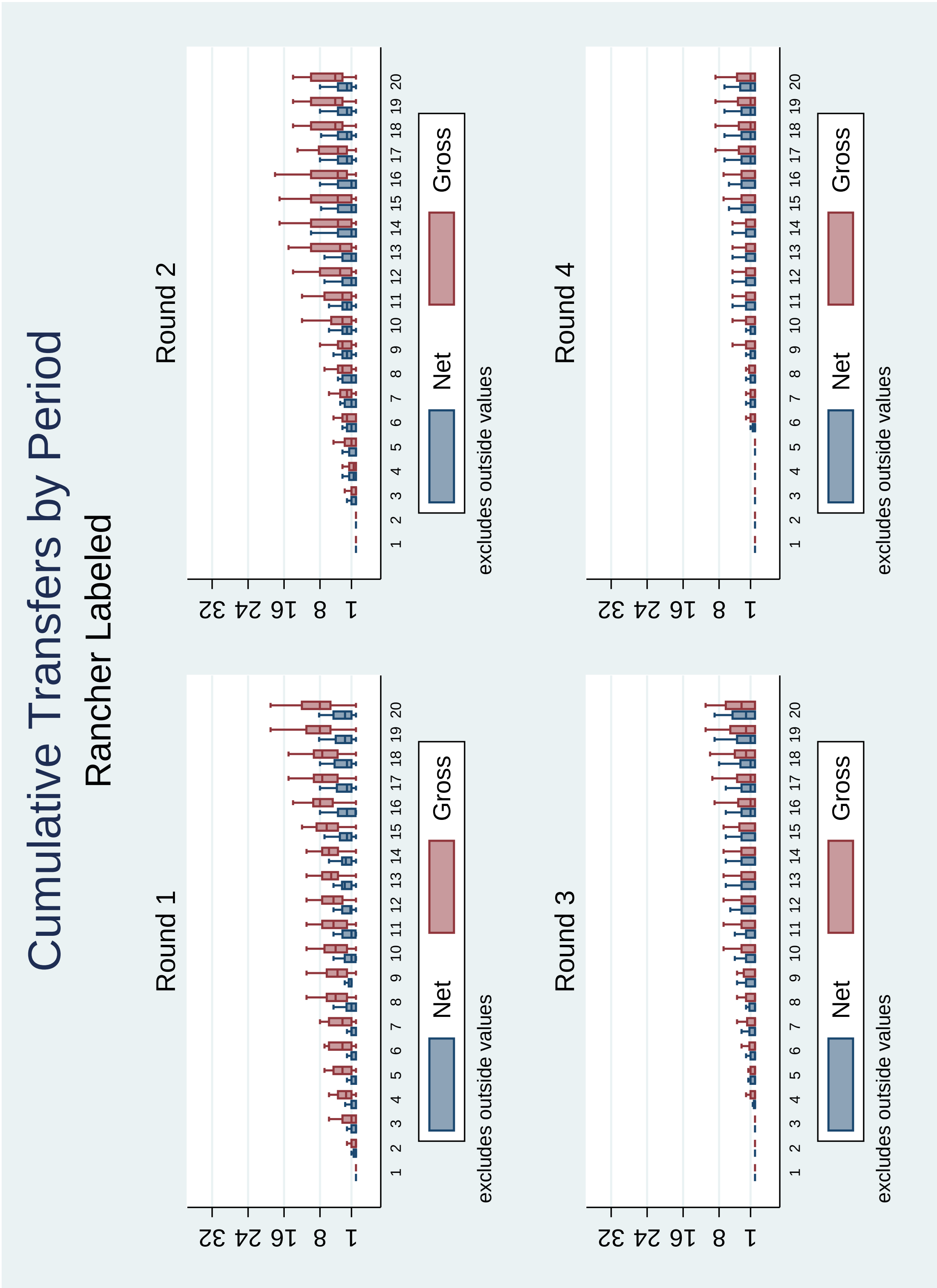

Figure 22: Cumulative transfers per perdiod, Rancher frame, labeled.

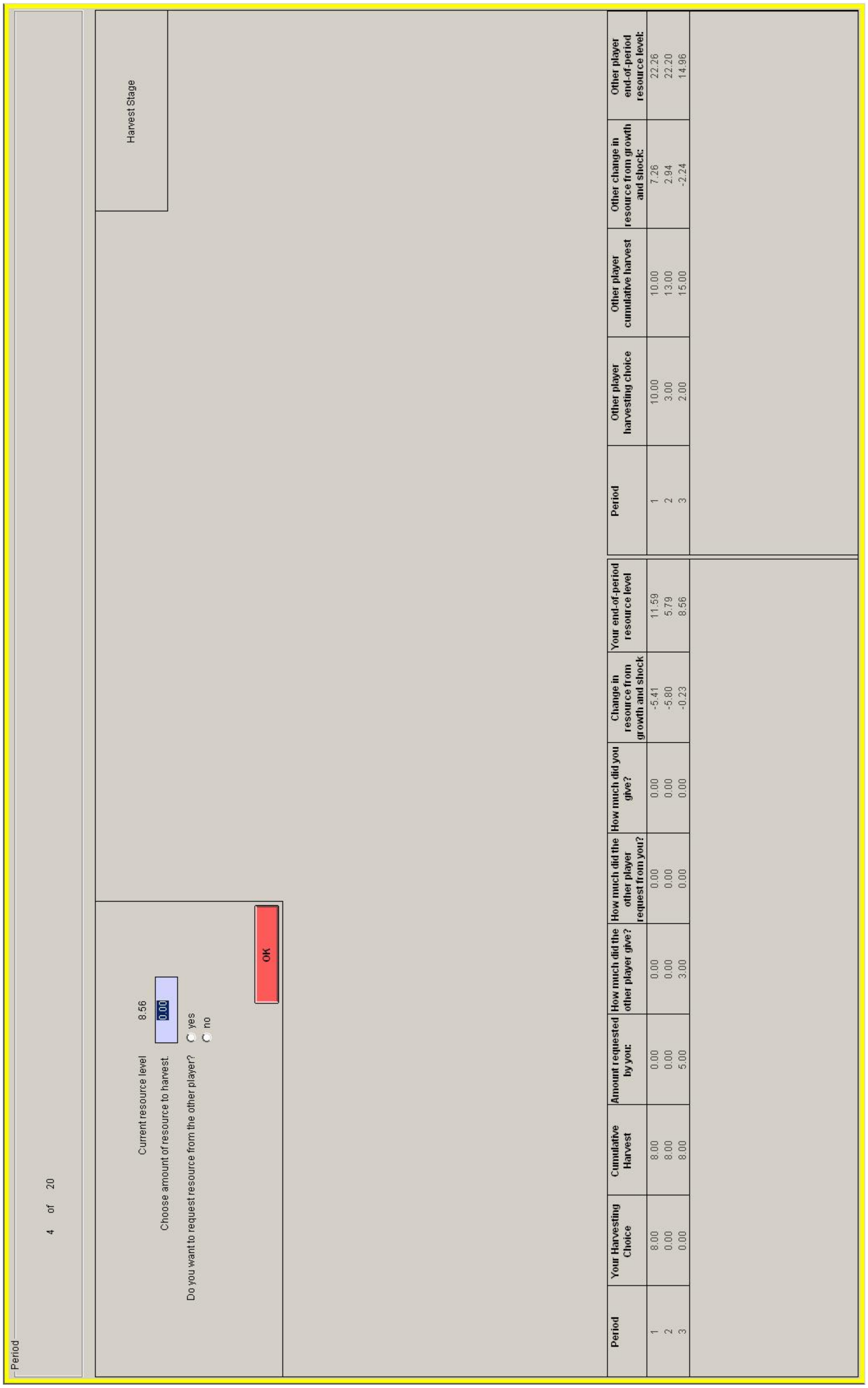

Figure 23: Example of the beginning of the harvest stage.

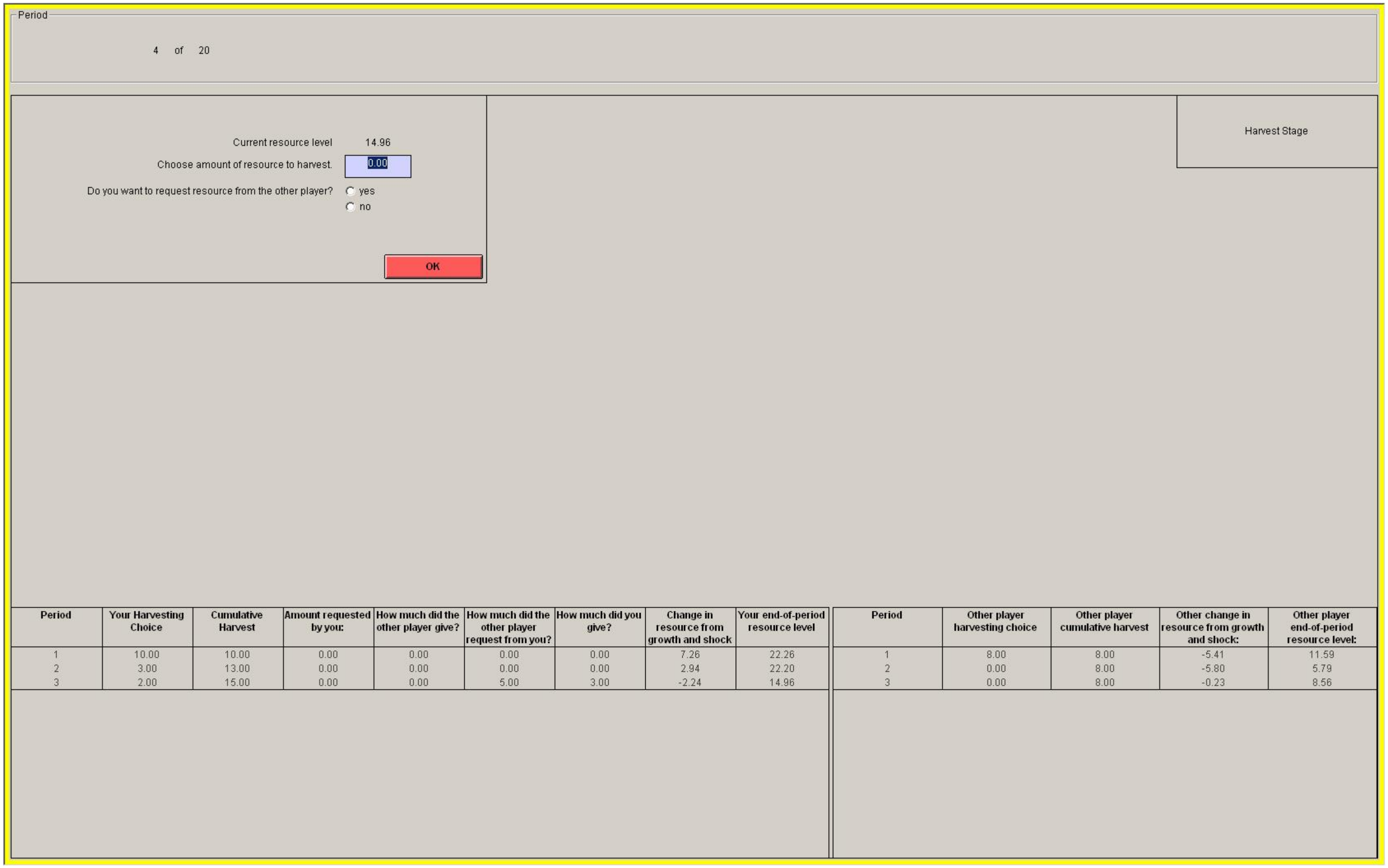

Figure 24: Example of the beginning of the harvest stage.

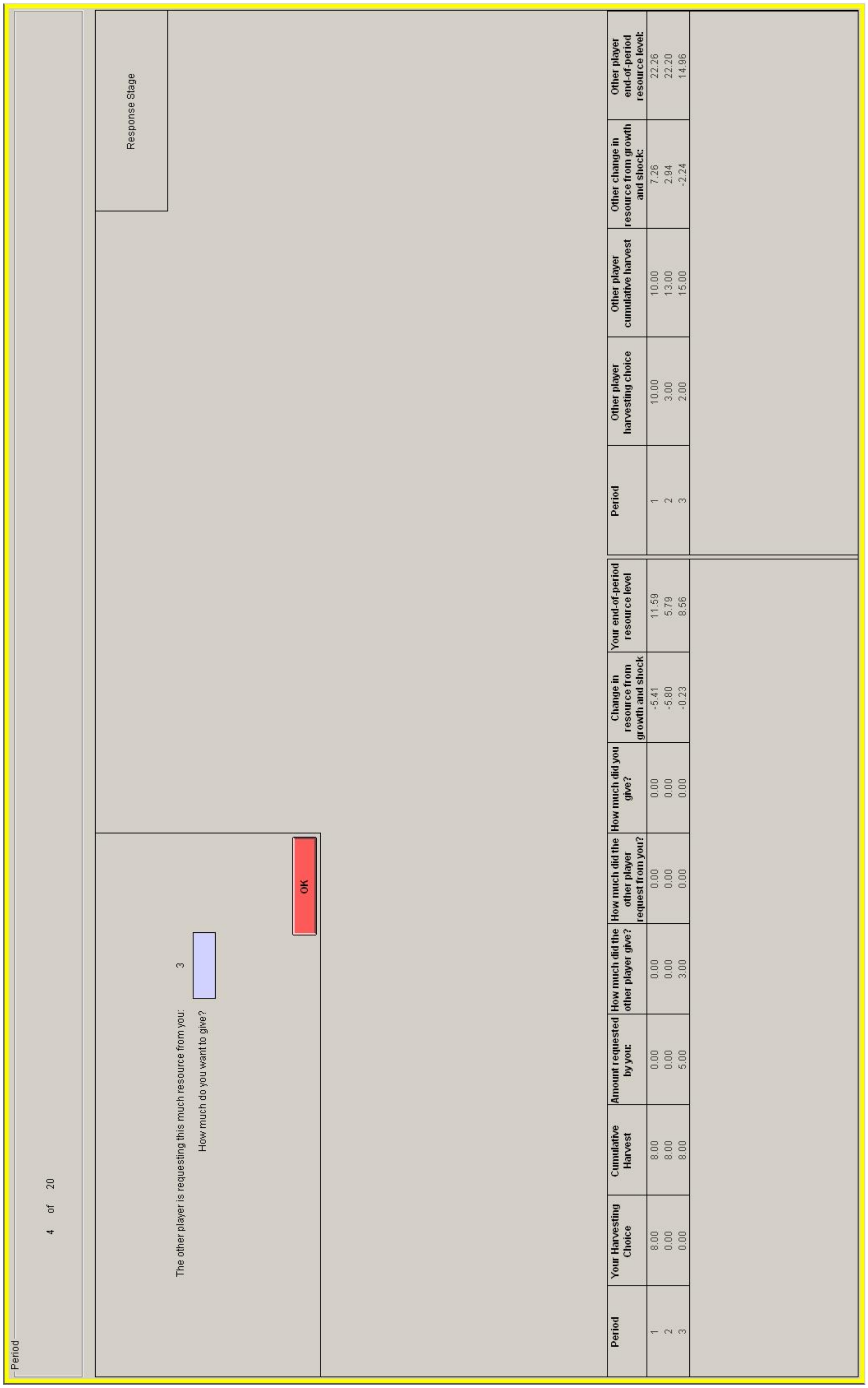

Figure 25: Example of the beginning of the harvest stage.

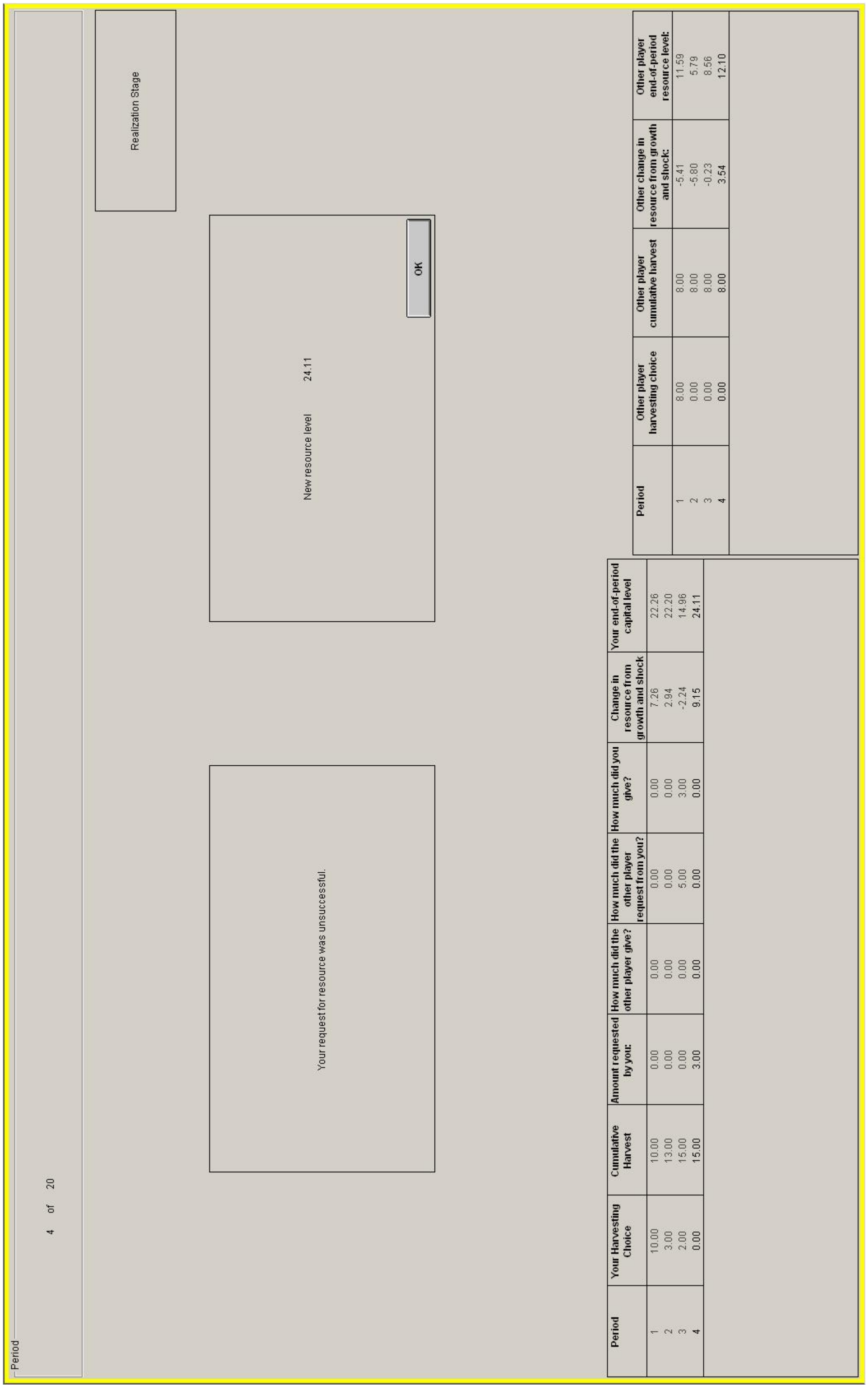

Figure 26: Example of the beginning of the harvest stage.

C Instructions, Tips, Quizzes, and Questionnaires

C.1 Rancher Frame Text

Ranching and Risk in the American West

This short essay will familiarize you with the basic features of ranching in the American West. After reading it, you will play a game. After the game, you will take a short quiz to assess your retention.

American ranchers live in the arid and semi-arid regions of the western United States, including parts of Texas, Arizona, New Mexico, California, Nevada, Utah, Colorado, Wyoming, and Montana. They live mainly in regions dominated by grasslands. American ranchers make use of this landscape by basing their economy on livestock that can graze these grasslands.

By definition, ranchers around the world make a living by raising livestock. Cattle are the most common type of livestock raised on ranches, but many other species, including sheep, goats, camels, llamas, alpacas, and even reindeer, are also raised. American ranchers raise mostly cattle and sheep. Some ranchers make a living directly from the milk and meat of the animals they raise, while others sell their animals on the market. Some ranchers work on a very small scale, keeping just enough livestock to sustain a single family, while others own thousands of animals. But despite this diversity, the fact that they all raise livestock leads ranchers around the world to share a surprising number of common characteristics.

One thing that is true of almost all ranchers is that they live in marginal environments with climates unsuitable for raising crops. The most common places to find them are in arid and semi-arid regions such as the American West. Wherever land is not suitable for raising crops but still provides something for livestock to eat, you are likely to find ranching. Because the land they live on is not very productive, American ranchers usually live at low population densities, spread thinly across the landscape.

Often, ranchers are far from the protection of police forces or other representatives of government authority. For that reason, they are often willing and able to defend their livestock and other property on their own, without help from outsiders. This leads to a degree of independence and freedom that many ranchers enjoy, despite the risks that accompany it. The dry regions in which most American ranchers live tend to be prone to droughts. Unpredictable and sometimes severe losses of livestock from droughts, diseases, and theft can make ranching a risky way to make a living. As a result, a person who is wealthy one year might be poor the next. American ranchers have found a variety of ways to insulate themselves from the risks associated with these severe losses.

One way of reducing these risks is to participate in a system of resource transfer, typically of goods or livestock. This system is based on honor, respect and restraint. Individuals ask for help only if they are in genuine need (limiting their request to what is actually needed), and those who are asked for help are bound by honor to give if they can. There is no expectation that gifts will necessarily balance out over time. If one partner is unlucky and thus in need more often than the other one, then transfers may be mostly in one direction. As a result, gifts in this system do not create debt and are not seen as payments. These relationships are seen as great responsibilities, and the partners treat each other with great respect. Asking for something that you do not really need or refusing to give when you can afford to do so are both seen as violations of the rules of the system. Computer models suggest that this system helps each individual rancher maintain a viable herd longer despite the problems of drought, disease, and theft because of the way that it insulates individuals from the variability of the environment.

Ranchers in the American West reduce their exposure to risk by pooling it with fellow ranchers. Risk-pooling serves basic and central values of ranchers as it is based on honor and respect. It also promotes their autonomy by improving the robustness of their capacity to respond to the uncertainty in the environment without intervention from centralized government.

One good example of this risk-pooling system comes from a study of ranchers and their buckaroos, also known as cowboys, in northern Nevada. During the summer, ranchers there grow hay to feed their livestock during the regions severe winters. Local variation in drought and disease can lead to high variability in the amount of hay a given rancher can grow in a given summer. During any given year, one rancher may find himself with a surplus of hay while another may be short. In the risk-pooling system, a rancher in this predicament can ask the more fortunate rancher for assistance. The more fortunate rancher would then fulfill the request, as long as the existing surplus of hay was great enough to give without putting his herd in jeopardy. The rancher giving this hay would not expect repayment since risk-pooling is not a system of debt.

C.2 Maasai Frame Text

Herding and Risk among the Maasai

This short essay will familiarize you with the basic features of herding among the Maasai. After reading it, you will play a game. After the game, you will take a short quiz to assess your retention.

The Maasai live in the East African countries of Kenya and Tanzania. They live mainly in and around the Great Rift Valley, which runs north and south through eastern Africa. The Great Rift Valley is a region dominated by vast grasslands. The Maasai make use of this landscape by basing their economy on livestock who can graze these grasslands.

By definition, herders around the world make a living by raising livestock. Cattle are the most common type of livestock raised in herds, but many other species, including sheep, goats, camels, llamas, alpacas, and even reindeer, are also raised. Maasai herds typically consist mainly of cattle, goats, and sheep. Some herders make a living directly from the milk and meat of the animals they raise, while others sell their animals on the market. Some herders work on a very small scale, keeping just enough livestock to sustain a single family, while others own thousands of animals. But despite this diversity, the fact that they all raise livestock leads herders around the world to share a surprising number of common characteristics.

One thing that is true of almost all herders is that they live in marginal environments with climates unsuitable for raising crops. The most common places to find them are in arid and semi-arid regions such as the Great Rift Valley. Wherever land is not suitable for raising crops but still provides something for livestock to eat, you are likely to find herding. Because the land they live on is not very productive, Maasai herders usually live at low population densities, spread thinly across the landscape.

Often, herders are far from the protection of police forces or other representatives of government authority. For that reason, they are often willing and able to defend their livestock and other property on their own, without help from outsiders. This leads to a degree of independence and freedom that many herders enjoy, despite the risks that accompany it. The dry regions in which most Maasai herders live tend to be prone to droughts. Unpredictable and sometimes severe losses of livestock from droughts, diseases, and theft can make herding a risky way to make a living. As a result, a person who is wealthy one year might be poor the next. Maasai herders have found a variety of ways to insulate themselves from the risks associated with these severe losses.

One way of reducing these risks is to participate in a system of resource transfer, typically of goods or livestock. This system is based on honor, respect and restraint. Individuals ask for help only if they are in genuine need (limiting their request to what is actually needed), and those who are asked for help are bound by honor to give if they can. There is no expectation that gifts will necessarily balance out over time. If one partner is unlucky and thus in need more often than the other one, then transfers may be mostly in one direction. As a result, gifts in this system do not create debt and are not seen as payments. These relationships are seen as great responsibilities, and the partners treat each other with great respect. Asking for something that you do not really need or refusing to give when you can afford to do so are both seen as violations of the rules of the system. Computer models suggest that this system helps each individual herder maintain a viable herd longer despite the problems of drought, disease, and theft because of the way that it insulates individuals from the variability of the environment.

This system of risk pooling is called osotua. The literal meaning of osotua is umbilical cord, so by using it to refer to gift-giving relationships Maasai are making a metaphorical connection between such relationships and the life-giving relationship between a mother and her child. Osotua relationships are some of the most important ties that Maasai have with each other, and osotua as a principle is one of the cornerstones of Maasai social life.

In the environments in which the Maasai live, there are often local droughts and diseases that affect some herders more severely than others. During any given year, one herder may find himself with a surplus of livestock while another may have too few livestock to support his family. In the osotua system, a herder in this predicament can ask a more fortunate herder for assistance. The more fortunate herder would then fulfill the request as long as he had enough livestock to fulfill the request without putting his own family in jeopardy, and would not expect repayment since osotua is not a system of debt.

C.3 Instructions (Unlabeled)

Introduction

You are about to participate in an experiment to study how people make decisions when faced with uncertainty. Various research foundations have provided the funding for this study. You will be paid for your participation and according to your performance in the game, as explained below.

Playing the Game

Your goal is to manage and harvest a resource over time. You will play four separate rounds, in each of which there will be 20 decision making periods. During each period, the resource level will change based on the growth of the resource. If the resource level is too low, it will shrink rather than grow. Likewise, if the resource level is too high, it will shrink rather than grow. By harvesting the right amount of the resource, you can keep it at a level where it will grow quickly. However, there are also random changes to your resource level, called Shocks. These shocks may make it harder to manage your resource by unexpectedly increasing or decreasing the size of your stock. Each time period you will have the opportunity to ask for resources from another participant, and another participant may request resources from you. Your earnings in each round will be based on the total amount of resources that you harvested over all the time periods in that round, and the total size of your current stock at the end of the round.

After an initial practice round of 7 periods in which there are no random shocks and no ability to request, we will begin the first paying round. Each period will be made up of several separate steps/decisions:

a) Make Harvest Decision:**You will be asked to decide how much of your resource you want to harvest in the current time period.**

b) Option to Make Request:**You will have an opportunity to make a request from the person with whom you are paired.**

c) Option to Fulfill Request:**You will have the opportunity to transfer resources to your partner if your partner made a request.**

d) Natural Growth Rule Applied to Resource stock:**Once all decisions are made, the natural growth of your resource stock will be calculated.**

e) Random Shock Applied:**The random shock to your resource level will be determined and applied to your resources.**

f) Feedback: **The total of your natural growth plus your random shock will be displayed, along with the resulting final level of your resource stock for the period. You will also be able to see this same information about the person you are paired with, and vice-versa.**

g) System Checks Resource Level **If your resource level is 0 for two consecutive time periods, your play of the current round will end.**

Understanding Random Shocks

Because of shocks, your resource might increase (positive shock) or decrease (negative shock) unexpectedly. The average size of these shocks is 0, but since there are both positive and negative shocks, there will often be rounds when your resource level changes in an unpredictable way. The size of the random shock is independent of size of your resource stock. However, if you have a large negative shock, this may reduce your resource stock to 0. These random shocks will require you to think more carefully about how much you harvest during a given time period. If you have a large loss, you might want to harvest less and if you have a large gain, you might want to harvest more.

Requests for Resources

You will be paired with another participant at the start of each round (each round is a set of 20 time periods). You will manage your own resource stock, and the participant with whom you are paired will manage his/her own resource stock. However, you will have the opportunity during every time period to make a request for some amount of resources from the other participant, and the other participant can also make a request from you. If a request is made of you, you will have the opportunity to respond to that request by giving the other participant an amount of resources, which you can specify (it can be the same as, less than, or more than the request amount). The other participant will also have the opportunity to fulfill your request in the same fashion.

Your earnings for the Game

You will earn $5 for having shown up to the experiment today. For every 15 units of the resource that you harvest, you will earn one U.S. Dollar. For example, if you manage to harvest an average of 60 resource units per 20 period round (including the leftover capital stock), then you would earn (4 x 60) = 240 game points, which is $16 US, plus the $5 show up payment for a total of $21 US. Earnings may vary due to random luck and the exact decisions that you make, so this is not a guarantee, just an estimate.

C.4 Instructions (Labeled)

The Osotua [or Rancher] Game

You are about to participate in an experiment to study how people make decisions when faced with uncertainty. Various research foundations have provided the funding for this study. You will be paid for your participation and according to your performance in the game, as explained below.

Playing the Osotua [or Rancher] Game

Your goal is to manage and harvest a resource over time. You will play four separate rounds, in each of which there will be 20 decision making periods. During each period, the resource level will change based on the growth of the resource. If the resource level is too low, it will shrink rather than grow. Likewise, if the resource level is too high, it will shrink rather than grow. By harvesting the right amount of the resource, you can keep it at a level where it will grow quickly. However, there are also random changes to your resource level, called Shocks. These shocks may make it harder to manage your resource by unexpectedly increasing or decreasing the size of your stock. Each time period you will have the opportunity to ask for resources from another participant, and another participant may request resources from you. Your earnings in each round will be based on the total amount of resources that you harvested over all the time periods in that round, and the total size of your current stock at the end of the round.

After an initial practice round of 7 periods in which there are no random shocks and no ability to request, we will begin the first paying round. Each period will be made up of several separate steps/decisions:

a) Make Harvest Decision:**You will be asked to decide how much of your resource**

you want to harvest in the current time period.

b) Option to Make Request:**You will have an opportunity to make a request from the person with whom you are paired.**

c) Option to Fulfill Request:**You will have the opportunity to transfer resources to your partner if your partner made a request.**

d) Natural Growth Rule Applied to Resource stock:**Once all decisions are made, the natural growth of your resource stock will be calculated.**

e) Random Shock Applied:**The random shock to your resource level will be determined and applied to your resources.**

f) Feedback: **The total of your natural growth plus your random shock will be displayed, along with the resulting final level of your resource stock for the period. You will also be able to see this same information about the person you are paired with, and vice-versa.**

g) System Checks Resource Level **If your resource level is 0 for two consecutive time periods, your play of the current round will end.**

Understanding Random Shocks

Because of shocks, your resource might increase (positive shock) or decrease (negative shock) unexpectedly. The average size of these shocks is 0, but since there are both positive and negative shocks, there will often be rounds when your resource level changes in an unpredictable way. The size of the random shock is independent of size of your resource stock. However, if you have a large negative shock, this may reduce your resource stock to 0. These random shocks will require you to think more carefully about how much you harvest during a given time period. If you have a large loss, you might want to harvest less and if you have a large gain, you might want to harvest more.

Requests for Resources

You will be paired with another participant at the start of each round (each round is a set of 20 time periods). You will manage your own resource stock, and the participant with whom you are paired will manage his/her own resource stock. However, you will have the opportunity during every time period to make a request for some amount of resources from the other participant, and the other participant can also make a request from you. If a request is made of you, you will have the opportunity to respond to that request by giving the other participant an amount of resources, which you can specify (it can be the same as, less than, or more than the request amount). The other participant will also have the opportunity to fulfill your request in the same fashion.

Your earnings for the Game

You will earn $5 for having shown up to the experiment today. For every 15 units of the resource that you harvest, you will earn one U.S. Dollar. For example, if you manage to harvest an average of 60 resource units per 20 period round (including the leftover capital stock), then you would earn (4 x 60) = 240 game points, which is $16 US, plus the $5 show up payment for a total of $21 US. Earnings may vary due to random luck and the exact decisions that you make, so this is not a guarantee, just an estimate.

C.5 Tips: Lo to Hi-Risk

Practice Round Tips

Tips for managing your resource stock

In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 17. If your resource is higher or lower than 17, it will grow less quickly. If your resource falls below 2, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock. Use this practice round to familiarize yourself with the resource behavior. This round will not count towards your payment.

Round 1 Tips

Start Paying Periods

You are now playing for money. Random shocks will be applied, and you will have the ability to request resources from your randomly matched partner.

Tips for managing your resource stock

In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 17. If your resource is higher or lower than 17, it will grow less quickly. If your resource falls below 2, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

Round 2 Tips

Tips for managing your resource stock

In this second round, you have been matched with a different partner. Again, in order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 17. If your resource is higher or lower than 17, it will grow less quickly. If your resource falls below 2, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

Round 3 Tips

Tips for managing your resource stock

In this third round, you have again been matched with a different partner. However, the resource behavior has changed. In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around **18** (this is different than prior rounds). If your resource is higher or lower than 18, it will grow less quickly. If your resource falls below **8** (this is different from prior rounds), it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

Round 4 Tips

Tips for managing your resource stock

In this fourth round, you have again been matched with a different partner. The resource behavior is the same as the last round you played. In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 18. If your resource is higher or lower than 18, it will grow less quickly. If your resource falls below 8, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

C.6 Tips: Hi to Lo-Risk

Practice Round Tips

Tips for managing your resource stock

In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 18. If your resource is higher or lower than 18, it will grow less quickly. If your resource falls below 8, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock. Use this practice round to familiarize yourself with the resource behavior. This round will not count towards your payment.

Round 1 Tips

Start Paying Periods

You are now playing for money. Random shocks will be applied, and you will have the ability to request resources from your randomly matched partner.

Tips for managing your resource stock

In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 18. If your resource is higher or lower than 18, it will grow less quickly. If your resource falls below 8, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

Round 2 Tips

Tips for managing your resource stock

In this second round, you have been matched with a different partner. Again, in order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 18. If your resource is higher or lower than 18, it will grow less quickly. If your resource falls below 8, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

Round 3 Tips

Tips for managing your resource stock

In this third round, you have again been matched with a different partner. However, the resource behavior has changed. In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around **17** (this is different than prior rounds). If your resource is higher or lower than 17, it will grow less quickly. If your resource falls below **2** (this is different from prior rounds), it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

Round 4 Tips

Tips for managing your resource stock

In this fourth round, you have again been matched with a different partner. The resource behavior is the same as the last round you played. In order to maximize your earnings in the game, you should maintain your resource at the level at which it grows most quickly. Your resource grows most quickly if you harvest enough to keep it around 17. If your resource is higher or lower than 17, it will grow less quickly. If your resource falls below 2, it will shrink in subsequent time periods. If your resource level is higher than 25, it will shrink as well. Your earnings will be based both on the amount that you harvested and the remaining resource stock at the end of each round, so you do not lose money by refraining from harvesting all of the resource stock.

C.7 Rancher Quiz

The following are the quiz questions asked of the Rancher frame subjects. Correct answers are in **bold**.

1) American ranchers live in
   - Texas.
   - Arizona.
   - Colorado.
   - **all of the above.**
2) American ranchers live in a region dominated by
   - swamps.
   - forests.
   - lakes.
   - **grasslands.**
3) The species of livestock raised by herders around the world include
   - cattle.
   - sheep.
   - llamas.
   - **all of the above.**
4) American ranchers' herds consist mainly of
   - cattle, goats, and sheep.
   - **cattle and sheep.**
   - camels.
   - llamas and alpacas.
5) Population densities among herders are usually
   - **low.**
   - moderate.
   - high.
   - all of the above, depending upon local circumstances.
6) The areas in which American herders live tend to be prone to
   - floods.
   - **droughts.**
   - earthquakes.
   - all of the above.
7) In the risk-pooling system used by American ranchers, requests for help
   - **are limited to what one actually needs.**
   - are usually made when no help is actually needed.

- may be made whether or not help is needed.
- none of the above.

8) In the risk-pooling system used by American ranchers, a person who receives a request
   - **is expected to honor it, if possible.**
   - is expected to ignore it until it is repeated.
   - keeps track of the debt that results from the gift.
   - none of the above.
9) In the risk-pooling system used by American ranchers, gifts between two herders
   - are expected to balance out over time.
   - **are not expected to balance out over time.**
   - create a patron-client hierarchy.
   - none of the above.
10) In the risk-pooling system used by American ranchers, herders who receive gifts are expected to
    - repay them as soon as they can.
    - repay them, plus interest.
    - **honor future requests from their partners.**
    - none of the above.

C.8 Maasai Quiz

The following are the quiz questions asked of the Maasai frame subjects. Correct answers are in **bold**.

1) The Maasai live in
   - Kenya.
   - Tanzania.
   - The Great Rift Valley.
   - **all of the above.**
2) The Maasai live in a region dominated by
   - swamps.
   - forests.
   - lakes.
   - **grasslands.**
3) The species of livestock raised by herders around the world include
   - cattle.
   - sheep.
   - llamas.
   - **all of the above.**
4) Maasai herds consist mainly of
   - **cattle, goats, and sheep.**

- cattle and sheep.
- camels.
- llamas and alpacas.

5) Population densities among herders are usually
   - **low.**
   - moderate.
   - high.
   - all of the above, depending upon local circumstances.

6) The areas in which Maasai live tend to be prone to
   - floods.
   - **droughts.**
   - earthquakes.
   - all of the above.

7) In the Maasai risk-pooling system, requests for help
   - **are limited to what one actually needs.**
   - are usually made when no help is actually needed.
   - may be made whether or not help is needed.
   - none of the above.

8) In the Maasai risk-pooling system, a person who receives a request
   - **is expected to honor it, if possible.**
   - is expected to ignore it until it is repeated.
   - keeps track of the debt that results from the gift.
   - none of the above.

9) In the Maasai risk-pooling system, gifts between two herders
   - are expected to balance out over time.
   - **are not expected to balance out over time.**
   - create a patron-client hierarchy.
   - none of the above.

10) In the Maasai risk-pooling system, herders who receive gifts are expected to
    - repay them as soon as they can.
    - repay them, plus interest.
    - **honor future requests from their partners.**
    - none of the above.

C.9 Financial Security Questions

All subjects were asked the following six questions and responded with either Strongly Disagree, Disagree, Somewhat Disagree, Neither Agree nor Disagree, Somewhat Agree, Agree, or Strongly Agree to each of them.

- My family usually had enough money for things when I was growing up.

- I grew up in a relatively wealthy neighborhood.
- I felt relatively wealthy compared to the other kids in my school.
- I have enough money to buy things I want.
- I don't worry too much about paying my bills.
- I don't think I'll have to worry about money too much in the future.