Incentives to cooperate and fairness norms in the provision of water – cases of Namibian land reform projects

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Abstract

Achieving cooperation in natural resource management is always a challenge when incentives exist for an individual to maximise her short term benefits at the cost of a group. Various case studies demonstrated, however, that cooperation is possible to achieve. We assess the example of cooperation in water supply in land reform projects in Namibia. In the context of the Namibian land reform, beneficiaries share the operation and maintenance of water infrastructure in order to gain economies of scale. Taking a broad summary of the socio-ecological system as a starting point we assess how alternative fairness norms affect the probability of cooperation.

We applied diverse complementary methods i.e. framework based explorative assessments, theory, ecological-economic modelling, and economic experiments in order to understand the cooperation challenges of Namibian land reform beneficiaries. In particular the simulation model based experiments produced not only knowledge but provided support to stakeholders in their decision making and institution building.

Our study provides evidence that different fairness norms overlap. Land reform beneficiaries increase their contributions as the other group members increase their payments, as they are more productive and as they own more livestock. Different people carry simultaneously different fairness norms and make decisions considering the overall context. This means at the same time that a person who does not follow a particular fairness norm is not necessarily only materially self-interested.

Key words: cooperation, water management, land reform, participatory ecological-economic modelling, Namibia, Savannah, livestock production, rangeland management

1 Introduction

Achieving cooperation in natural resource management is always a challenge when incentives exist for an individual to maximise her short term benefits at the cost of a group. Since everybody in the group has the same rationality the group would be trapped in a situation missing out potential gains. The Prisoners dilemma or Hardin’s Tragedy of the Commons (Hardin 1994) are illustrations of this problem (Bardhan 1993). From a more natural scientist point of view Nowak (2006) argues that defectors in a group of cooperators have a higher average fitness and as a result of selection cooperators vanish from the system. Populations of only cooperators have, however, a higher average fitness.

Observations both of natural and social systems demonstrated that cooperation is possible to achieve (Nowak 2006, Ostrom 2010). Therefore, the focus of attention shifted towards the assessment of factors increasing or decreasing the probability of cooperation. Nowak (2006) compares five mechanisms for the evolution of cooperation which are kin selection, direct reciprocity, indirect reciprocity, network reciprocity, and group selection. Reciprocity received much attention also in game theory and experimental economics. Numerous public good experiments have shown that people are willing to contribute more to a public good the more others are contributing. One explanation for this phenomenon is people’s propensity to cooperate even though it leaves voluntary cooperation in a fragile state (Fischbacher & Gächter 2010). Buckley & Croson (2006) emphasize that individuals must feel that they contribute a fair share to the public good. But is there a universal concept and perception about what is fair?

We assess the case of cooperation in water supply in land reform projects in Namibia. In the context of the Namibian land reform, beneficiaries share the operation and maintenance of water infrastructure in order to gain economies of scale. Even though there are small groups with direct communication possibilities, it is not uncommon that groups can not come to an agreement and water points are not maintained in time causing additional costs. Taking a broad summary of the socio-ecological system as a starting point we will pay special attention to alternative fairness norms which are: a) the congruence of appropriation and provision (Ostrom 2010, design principle 2B); b) inequality aversion (Fehr & Schmidt 1999), and c) norms of conditional cooperation (Fischbacher & Gächter 2010). Specifically, we want to answer the following questions:

> How does the congruence of appropriation and provision of alternative payment systems change incentives to cooperate amongst Namibian land reform beneficiaries?

Which fairness norms dominate in our sample? Is fairness understood as congruence of appropriation and provision, inequity aversion, or as conditional cooperation?

Adhering to Ostrom's (2007) calls, we applied diverse complementary methods i.e. framework based explorative assessments, theory, ecological-economic modelling, and economic experiments in order to understand the cooperation challenges of Namibian land reform beneficiaries. Our cooperation partners, namely the Emerging Commercial Farmer Support Programme (ECFSP), the GIZ Namibia, and the Namibian Ministry of Agriculture, Water, and Forestry (MAWF) expected to receive decision support. Our third research question was therefore:

Which policy implications can be drawn for the development of cooperation patterns in land reform implementation in Namibia?

In the following section we will describe our methodological approach. Section 3 summarizes our results. It is subdivided in an explorative assessment of the cooperation situation based on the Socio Ecological System Framework of Ostrom (2010). We will further present our theoretical and empirical results. All results are discussed in Section 4 and conclusions are drawn in Section 5.

2 Methods

2.1 Explorative assessment based on Socio-Ecological System (SES) Framework

Cooperation patterns of land reform beneficiaries are the outcome of complex features of a socio-ecological system. For our analyses we apply in a first step the SES framework according to Ostrom (2010). Consequently our explorative analysis is structured according to the four main sub-systems: a) actors, b) governance system, c) resource system, and d) resource units. This framework facilitates the consolidation of multidisciplinary research efforts in order to build a better understanding of complex SESs.

2.2 Experiments based on ecological-economic modelling

For our experimental assessment we applied an ecological-economic modelling approach. We used an existing vegetation model (Tietjen et al., 2010) and parameterised it for the Omaheke region/Namibia based on empirical field work, expert knowledge and literature review. The model simulates the dynamics of natural resources depending on environmental conditions (precipitation/climate, hydrology, ecological interactions) and land use impacts. This ecological model was then dynamically linked to an economic model that allows for inclusion of livestock related decisions of farmers as well as cooperation in water management. For a more detailed model description please see Appendix 1.

The ecological-economic model is applied in a computerized public good experiment simulating the basic farming business and the voluntary contribution to water provision. We designed a user interface that allows the communication between the facilitator and the model. The interface presents a model output of all important state variables and allows for a subsequent input of the farmers' decisions (e.g. amount of money to be paid to a water fund). Based on illustratively communicated ecological and economic information calculated by the model, farmers make decisions regarding their stocking rates as well as their cooperative contribution to the maintenance of water infrastructure. The decisions on stocking rates are relevant for our assessment of cooperation patterns because the livestock numbers change opportunity costs of infrastructure maintenance. Our theoretical model will show that this alters incentives to cooperate. Depending on the players decisions new ecological and economic states (e.g. condition of livestock, account balance) are calculated, being again the basis for next steps' decisions.

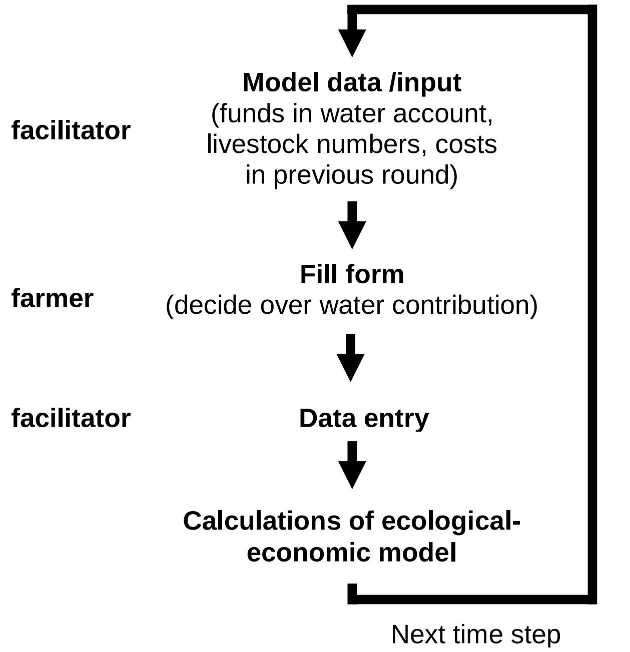
Outputs on the vegetation state are given using photographs taken from different vegetation states in the research region. The same approach of showing pictures is used for showing the body score of the livestock. Printout outputs are generated for every time step to present all other relevant numbers. Farmers receive a list in their mother tongue with the following information:

- rainfall in the previous experiment period,
- number of livestock at the beginning of experiment period,
- age structure of livestock at the beginning of experiment period,
- number of livestock losses in the previous experiment period,
- individual farmer's account balance at the beginning of experiment period,
- total farms expenses to be covered in experiment period,
- account balance of the group's water fund at the beginning of experiment period.

In every time step the farmers can make two kind of decisions: 1) they can buy or sell livestock, and 2) they have to decide how much to pay into their group's water fund. The game is set up in a way that all players always have the opportunity to communicate. Figure 1 illustrates the experiment process.

The modelled water infrastructure costs vary from year to year, reflecting randomly appearing maintenance costs. In the experiment each group shares a water infrastructure which consists of a diesel driven and a wind driven pump. The costs are modeled on the basis of expert interviews and set to on average N$ 2350 ($\sigma = 785$) for the diesel driven pump and on average N$ 750 ($\sigma = 250$) for the wind driven pump. Farmers are not informed about the periods' water costs before making their contribution and therefore have to make decisions under uncertainty.

Figure 1: The cyclic process of our computerized experiment



In case that the money available in the fund is insufficient to cover the maintenance costs the infrastructure breaks down. In reality the farmers usually take their cattle to the neighbouring farm where they have to pay, however, for getting access to water. We assume a hypothetical fee of N$ 50 per head of cattle which is based on interviews with farmers even though the amount strongly varies in reality.

Between January and April 2009 we conducted game sessions with 45 land reform beneficiaries on 14 resettlement farms. In an attempt to simulate the real life cooperation situation, the experiments where played in groups of farmers who in fact share a water point. They faced each other and could freely communicate. A more detailed description of the sample and the overall socio-ecological system is given in Section 3.1.

2.3 The theoretical model

The theoretical model uses the input data of the empirical model described above to analyze the cooperation incentives of every farmer in a group. The aim of this theoretical analysis is, based on a game theoretical model, to draw basic conclusions regarding the individual contribution and the free ride incentive of the farmers.

Each farmer *i* has to pay an amount C_i into the water fund to cover the water maintenance costs. The total contribution of all farmers in a group is C_N. Each group of farmers will have to choose whether to pay for water per head of livestock or per farmer and review the participation condition. A farmer may express to participate, although his participation condition is not fulfilled, because he intends to behave deceitful. In contrast to the experiment the theoretical model will only analyze the decision on the amount they want to pay into the water fund. The decision to sell or buy livestock is not part of the analysis in the theoretical model, because the value of the livestock exceeds by far the infrastructure maintenance costs and it is therefore unlikely that players adjust their livestock numbers in order to safe on these costs. The water infrastructure maintenance costs are modeled in the same way as in the experiment (see section 2.2). Other costs like production costs of the farm, transactions costs, etc. are neglected. There is no time preference and interest rate.

The basis condition for the use of a water infrastructure by a group of farmer is fulfillment of the group participation condition.

$\frac{C_N}{X_N} \leq OC_x$ or $C_N \leq OC_N$

The group contribution per head of livestock (C_N/X_N) should not be higher than the opportunity costs per head of livestock or the total contribution of the group should be smaller or equal the opportunity costs; otherwise it would not be cost-effective to use this water infrastructure. The cooperation decision process is set as follow:

1. If the infrastructure maintenance costs (K) are known, the group skips to the next step. If the costs are uncertain, the farmers have to decide which amount the group plans to collect. As a group the farmers can try to minimize their group expected costs (EC_N). The probability that the water infrastructure does not break down is the probability that the amount in the water fund covers the maintenance costs:

$$P = P(K \leq WF) = F(WF)$$

Therefore the expected costs function is[i]: $EC_N = (C_N - OC_x \cdot X_N) \cdot F(WF) + OC_x \cdot X_N$

2. In the next step, the group decides whether to share the amount equally per farmer *i* or per head of livestock *x*.
3. In the next step, each farmer takes his decision whether to participate or not. This decision is influenced by her opportunity costs OC_i. If her contribution (C_i) in the group is higher than her opportunity costs, she will not accept the deal and may leave the group. In this case, the other farmers have to reconsider the deal, because the resignation of a farmer increases their individual contribution.

4. The farmers pay their contribution. Note that, a farmer can announce to participate according to the group rule but behave deceitful in paying an amount lower than C_i.
5. The real water maintenance costs are known.
6. If the amount in the fund (WF) covers the maintenance costs, the residual amount in the fund is transferred in the next period (as in the experiment). If this amount is lower than the water costs, the farmers face opportunity costs.

The status of the water infrastructure at the end of one period is not transferred to the next period. In each period, the farmers play a new game.

2.4 The empirical data analysis and model

We identified groups agreeing to a rule by the standard deviation of their payments. If the group's standard deviation of the water payments was zero in an experiment period we concluded that the group was following the rule to pay equally per person. If the group's standard deviation of the water payments divided by livestock numbers was zero in an experiment period we concluded that the group was following the rule to pay per head of livestock. Descriptive statistics and correlation analysis where used for basic analyses.

In addition, the experiment data were analyzed calculating Fixed Effects and Random Effects regression models. These methods are applied to panel data sets where each research period of each player is analyzed considering dependencies between the behaviours of one player in different experiment periods. The empirical model explains for each year the individual's contribution to the maintenance of water infrastructure depending on the input variables in the experiment (see section 2.2) and group characteristics.

3 Results

3.1 Explorative description of the socio-ecological systems of land reform projects in central Namibia

This chapter summarizes the key features of the socio-ecological system of resettlement projects in the Omaheke region in Namibia. Acknowledging the overall context is relevant to understand the cooperation situation and in order to control whether the variation in the voluntary contributions is indeed dependent on fairness norms or rather the result of socio-ecological heterogeneity (compare with Cardenas' & Carpenter's 2008). Appendix 2 summarizes a random effects model which includes a number of control variables.

3.1.1 Governance System (GS)

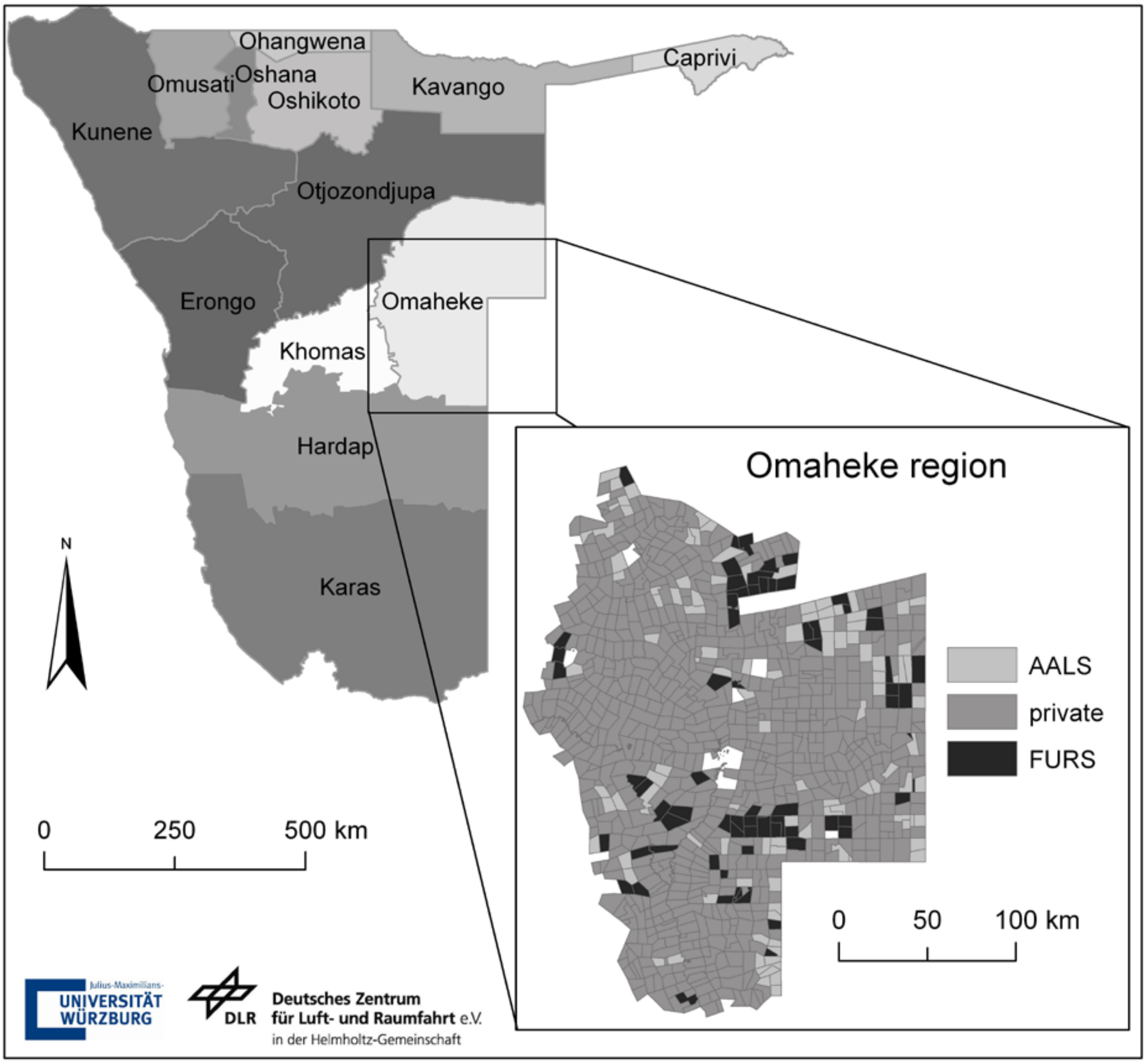
Land Reform is an important project of independent Namibia as it not only cures an unfair land distribution but also maintains political stability in the country. For more than 18 years, land has been redistributed to previously disadvantaged groups of the Namibian society using a broad range of instruments, such as group resettlement, subsidized loans, redistribution of government land and in a few cases also expropriation. In this paper we focus our attention on the *Farm Unit Resettlement Scheme* (FURS) which is based on the willing-seller willing-buyer principle. The acquisition is based on the preferential right of the Namibian state to purchase agricultural land whenever any owner of such land intends to dispose of it (RoN 1995a). The government divides the farms into smaller portions and any Namibian citizen who has been socially, economically or educationally disadvantaged by past discriminatory laws can apply for an allotment of land acquired for resettlement (e.g. RoN 2002). Successful applicants are supposed to receive a 99-year lease agreement with the government. In contrast to this we observe that exactly half of the FURS farmers did not receive a leasing contract from the Ministry of Lands and Resettlement which administers FURS. These beneficiaries therefore hold no written proof of their rights on the allotted land (Falk et al. 2010, Werner & Odendaal 2010). On reason for the delay in issuing the contracts is the obligation of the government to fully maintain and repair the water infrastructure on the farm before redistribution. The responsible units lack, however, the capacity to cover all farms in time. Insecure property rights to their farm units decrease incentives to maintain infrastructure (Deiniger & Feder 2009). In our regression including control variables (Appendix 2) can be seen that farmers who hold leasehold rights make higher contributions to the infrastructure maintenance.

FURS farmers can benefit from cooperation with neighbouring farmers especially because they use in tendency relatively small farm units and can accomplish economies of scale. The beneficiaries, however, face the challenge that they have to establish totally new constitutional, collective choice and operational rules and need to agree on a monitoring and enforcement system. The farmers did not know each other before resettlement and often come from different ethnic groups with different value sets.

3.1.2 Resource System (RS) and Resource Units (RU)

The research was conducted in the Omaheke region in central east Namibia (Figure 2). Our research concentrated on the eastern part of the region where the vegetation is dominated by

Figure 2: Map of Namibia and research region, *Source: Mendelsohn 2002*



an *Acacia-Terminalia* tree-and-shrub savannah of the Central Kalahari (Mendelsohn 2002). With an annual average rainfall between 300 mm – 400 mm, the region is considered to be a high potential livestock farming area. The carrying capacity is estimated to be between 12 and 18 ha/LSU (Mendelsohn, 2006).

All land reform beneficiaries in our sample are active in the agricultural sector of livestock farming mainly with cattle. FURS farmers are allotted individual clearly marked sections of land. The size of the farms, however, varies strongly between 50 ha and 2.000 ha within our sample. Repeatedly concerns have been expressed that government allotments are too small and thus economically unviable land units (Werner & Odendaal 2010). Too small land units limit the possibilities to accomplish economies of scale. This problem can be partly solved by establishing cooperation and collective action (GS6) between users of small farms as is common with regard to the management of water infrastructure. A lack or breakdown of water infrastructure restricts the opportunities to make full use of the land as well as to avoid localised degradation (e.g. around water points). On the farms in our sample one working pump had to serve between 50 and 2000 ha (mean = 1369 ha).

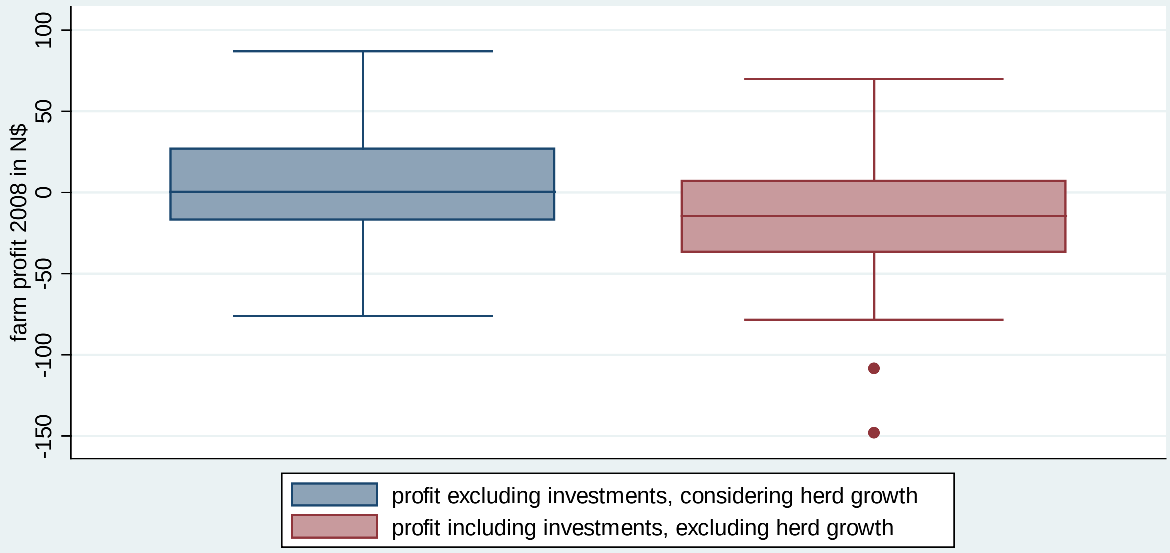
3.1.3 Land users as actors (A)

Our sample consists of individual farmers using one farm unit exclusively. Government's selection criteria for FURS beneficiaries have repeatedly changed but the program generally focuses on the poor. 60 percent of the household heads of the sample are full-time farmers. The remaining part-time farmers spend on average 75 days per year on the farm. In our experiment, farmers spending more time on the farm tended to make higher contributions (see Appendix 2). 80 percent of the respondents claimed to have non-farm income. 44 percent of the household heads did not finish secondary school, 47 percent finished secondary school as the highest degree, and 9 percent hold a technical or university degree. 72 percent of our sample had previous farming experience but only a minority of them in a commercial setting. Only 23 percent of the respondents received some kind of farming training. Our regression model including control variables (Appendix 2) shows that better educated players and those who received farm trainings made higher contributions to the maintenance of infrastructure.

The median of the size of the groups sharing one water infrastructure was 2.5 (min=2, max=6). In 43 percent of the groups more than one ethnic group was represented. Meinzen-Dick et al. (1997) highlight that in tendency more homogeneous water user associations are more effective. 40 percent of our sample was female. Male household heads made on average higher contributions in the experiment (Appendix 2).

The average annual gross profit of our respondents adding up all on-farm income, deducting only running costs and even adding the average annual herd growth was N$ 5,463 with a high standard deviation of σ = 32,466. Almost half of our sample was making losses under this most optimistic income calculation. The figures for the net farm profit, which include fixed costs, 2008 investment costs, and liability payments but exclude herd growth are even worse. The net farm loss was on average N$ 14,395 (σ = 37,708). According to this indicator almost two third of the sample was making losses (Figure 3, Falk et al. 2010). High financial pressure and in particular liquidity problems can be a challenge for cooperation efforts. In our experiment, more productive farmers tended to make higher contributions (Appendix 2).

Figure 3: Farm profit calculations considering herd growth and investments



N=65; own figure
(The band in the box represents the median, the box represent 25th and 75th percentiles, and the wiskers the lowest datum still within 1.5 interquartile range of the lower quartile, and the highest datum still within 1.5 interquartile range of the upper quartile.)

3.2 The Theoretical model

The aim of this theoretical analysis is to derive a projected contribution and free ride incentives of the farmers.

3.2.1 The water costs are certainly known

If the water costs are known, the farmers directly decide which payment system to use.

1) Payment per head of livestock

Since the group participation condition is considered to be give, the individual participation condition is also given. The farmer will always pay the amount assigned to each of them. Each farmer knows for sure, if he does not pay, the water infrastructure will break down and he will face the opportunity costs. Since he minimizes his costs, he has no incentives to free ride. This result will be the same for each experiment period.

2) Payment per farmer

Even if the group participation condition is given, the individual participation condition may not be fulfilled:

$\frac{C_i}{x_i} \leq OC_x$ or $C_i \leq OC_i$

Important in this case is the livestock a farmer owns. If farmer i has a very low number of livestock, he has no material incentive to accept this payment system, because his opportunity costs may be lower than his contribution to the group. He also has no incentive to behave deceitful, because the water infrastructure will break down. If he leaves the group, the individual contributions of other farmers must increase. Therefore it may be profitable for them to reconsider the payment system or the contribution of farmer i. As long as the group participation condition is given, the richer farmers in the group can increase their individual contribution and lower the contribution of the poorer farmers until it reaches the opportunity costs of the poorer farmers.

3.2.2 The maintenance costs are uncertain

If the water costs are uncertain, the farmers have to decide which amount to use to share the costs among them. As a group the farmers can try to minimize their group expected costs. $\mathrm{P} = \mathrm{P}(\mathrm{K} \leq \mathrm{WF}) = \mathrm{F}(\mathrm{WF})$

$\mathrm{EC_N} = \mathrm{C_N} \cdot \mathrm{F}(\mathrm{WF}) + \mathrm{OC_x} \cdot \mathrm{X_N}[1 - \mathrm{F}(\mathrm{WF})]\mathrm{EC_N} = (\mathrm{C_N} - \mathrm{OC_x} \cdot \mathrm{X_N}) \cdot \mathrm{F}(\mathrm{WF}) + \mathrm{OC_x} \cdot \mathrm{X_N}$

a) One period game

In the one period game, the amount in the water fund equals the total contribution of the farmers: $\mathrm{WF} = \mathrm{C_N}$. Since the water costs are uncertain, the group will try to minimize his expected water costs:

$$\underset{\mathrm{C_N}}{\mathrm{Min}}\, \mathrm{EC_N} = (\mathrm{C_N} - \mathrm{OC_x} \cdot \mathrm{X_N}) \cdot \mathrm{F}(\mathrm{C_N}) + \mathrm{OC_x} \cdot \mathrm{X_N}$$

The resulting total contribution of the group is given with[ii]:

$$\mathrm{C_N^*} = -\frac{\mathrm{F}(\mathrm{C_N})}{\mathrm{f}(\mathrm{C_N})} + \mathrm{OC_x} \cdot \mathrm{X_N}$$

There is a positive correlation between the number of livestock the group owns and the group contribution. If we assume that $\mathrm{C_N}$ must be higher than zero, the opportunity costs must reach a certain threshold to give the group an incentive to operate and maintain their water infrastructure.

In the next step the group chooses the payment system. The chosen payment system may not be accepted if the individual participation condition is not given.

1) Payment per head of livestock

Under this payment system the individual participation condition is always fulfilled.

2) Payment per farmer

Under this payment system the fulfillment of the group participation condition is not a guarantee for the individual participation condition. The livestock numbers and consequently the opportunity costs of an individual must be high enough to motive her to participate in the group's payment system.

- Free ride incentive

As an alternative to officially refusing to make a contribution, a farmer can announce to participate, even if his personal participation condition is not fulfilled, because he may intend to free ride and not pay the amount assigned to him. This behavior does not depend on the payment system. The next question in this case is: when does a farmer have the incentive to free ride? As long as his expected costs in paying $C_i' < C_i^*$ are lower, he will have an incentive to free ride. For

$EC_i' < EC_i^*$, farmer i can choose[iii]

$$C_i' < \frac{F(C_N^*)}{F(C_N')} \cdot C_i^* - OC_x \cdot X_i \cdot \left(\frac{F(C_N^*)}{F(C_N')} - 1\right)$$

Since we know that $\frac{F(C_N^*)}{F(C_N')} > 1$, and $\left(\frac{F(C_N^*)}{F(C_N')} - 1\right) > 0$, the higher the farmer's opportunity costs are, the lower will C_i' be which reduces his incentive to free ride. A farmer who has a low livestock number will have a high incentive to cheat. Furthermore, the higher the agreed individual contribution C_i^* in the group is, the higher is the farmer's incentive to cheat. If a farmer has few livestock, he will have a higher incentive to cheat, when the group shares the costs per farmer than when sharing the costs per head of livestock.

b) Multi period game

In the multi period game, the farmers have the possibility to consider a higher payment as assurance for other periods and the residual amount in the water fund. Compared to the case where the water costs are certain, the residual amount in the water fund is not only the result of a higher personal contribution of the farmer, but can also be the amount remaining if the real water costs are lower than the total contribution of the farmers. A positive balance in the group's water fund will not change the general decision process in following periods. At begin of each period, the group will compute the optimal total contribution. After that, they will deduct the amount available in the water fund from this optimal contribution. The remaining amount will be used to bargain the individual contribution; therefore the contribution of the farmers is negatively correlated to the amount in the water fund. We controlled for the balance in the water fund in our empirical models (Table 6). As explained above, the lower the farmer is supposed to contribute, the lower is his free ride incentive. If there is a residual amount in the water fund, the farmers will have a lower incentive to cheat.

3.3 The results of the interactive simulation experiment

In the experiment, eight out of 14 groups did not come to a reliable agreement and did not follow a clear payment system. One group agreed at the beginning of the experiment to pay per head of livestock but in round 2 one player defected and the cooperation could not be established again (Appendix 8: group 2). Six groups reliably agreed on a system (Appendix 8: groups 1, 3, 4, 5, 6, 14). Five groups cooperated from the first experiment round on and one group started to cooperate after round four (Appendix 8: group 3). Five groups agreed to the payment scheme per person (Appendix 8: groups 1, 3, 4, 5, 6) while one group switched in the course of the experiment from payment per person to payment per head of livestock (Appendix 8: group 14). There are negative correlations between the gini-coefficient of the livestock possession in a group and the fact that a group came to an agreement and, more specifically, the agreement to the rule to pay equally per person.[iv]

31 percent of our players are conditional cooperators increasing their payments if the other group members increase their contributions.[v] 13 percent of the sample adjusted their payments to their share of the group's livestock herd. Interestingly, the group which agreed on a payment system per head of livestock are not included in the second cluster.[vi] They changed the amount to be paid per head of livestock during the experiment, both paying, however, always the identical amount per animal in a particular period. The payments of another 13 percent of the players correlated both with the payments of the other players and the livestock numbers. This is possible if there is a relatively stable relation of livestock numbers amongst the group members. Half of them are unconditional cooperators who made in all experiment rounds the same contribution. The payments of 42 percent of the players neither correlated with the other group members' payments nor their share of the livestock herd. We do not observe consequent freeriding, which means that all players contributed to the maintenance of the water infrastructure.

All reliably cooperating groups had only two group members (Appendix 6). All reliably or not reliably cooperating groups were ethnically homogeneous (Appendix 7).

Table 2 indicates that in 15 percent of the experiment rounds over all groups the opportunity costs where higher than the actual payment of the person. The table further shows that in 14

Table 2: Participation conditions to agree to payment per person for experiment rounds with group agreement *(absolute frequencies of experiment rounds with relative frequencies in parentheses)*

	Relation between individual opportunity costs OCi and average maintenance costs M_N when distributing costs equally per person		Total
	$OC_i > M_N/N$	$OC_i < M_N/N$	
OC_i < payment in experiment	31 (6.89%)	38 (8.44%)	69 (15.33%)
OC_i > payment in experiment	320 (71.11%)	61 (13.56%)	381 (84.67%)
Total	351 (78.00%)	99 (22.00%)	450 (100.00%)

percent of the decisions the participation condition would not have been fulfilled according to the payment scheme per person but was fulfilled by adjusting the actual payment. In seven percent of the cases the participation condition was fulfilled according to the equal payment system per person but was not fulfilled under the actual payment made.

Table 3 summarizes the participation conditions only for experiment rounds where the group agreed on an equal payment per person. In this subsample the participation condition was proportionally less often fulfilled. There is in particular a growing share where it is neither fulfilled according to the actual payment nor the payment system per person.

Table 3: Participation conditions to agree to payment per person for experiment rounds with group agreement *(absolute frequencies of experiment rounds with relative frequencies in parentheses)*

	Relation between individual opportunity costs OCi and average maintenance costs M_N when distributing costs equally per person		Total
	$OC_i > M_N/N$	$OC_i < M_N/N$	
OC_i < payment in experiment	8 (8.51%)	16 (17.02%)	24 (25.53%)
OC_i > payment in experiment	66 (70.21%)	4 (4.26%)	70 (74.47%)
Total	74 (78.72%)	20 (21.28%)	94 (100.00%)

Analysing the voluntary experiment contributions using regression models (Table 6) reveals that players with lower livestock numbers tend to make lower contributions. It can be further observed that the higher the contributions of the other group members the higher is the own contribution. Contributions do not decline over the experiment periods. The lower the player's account balance in an experiment period the higher her contribution. When controlling for the group size we can see that members of groups which came to an agreement made higher contributions to the group funds.

We calculated a regression model including socio-ecological control variables (Appendix 2). The effects described above remain robust in this model.

Table 6: Fixed and Random effects regression models explaining the natural logarithm of the individual players' payment for covering the water infrastructure maintenance costs: coefficients and cluster robust standard errors in parenthesis (minimum of dependent variable = 0, maximum = 9.6)

Variable	Minimum and maximum of variable	Fixed effects model	Random effects model
1) experiment round t	0 - 9	0.0528128 (0.0381778)	0.0307661 (0.0355894)
2) natural logarithm of all other group member's payment in t	0 – 9.9	0.3125724* (0.1681309)	0.3241446** (0.1459897)
3) account balance in group water fund at beginning of t	0 – 28787	-0.0000831** (0.0000334)	-0.0000591** (0.0000271)
4) individual account balance at beginning of t	-494,954 – 414,650	0,00000483** (0,00000159)	0.00000343*** (0.00000116)
5) livestock number at beginning of t	0 - 151	0.0234265*** (0.0074976)	0.017607*** (0.0039261)
6) did the group come to an agreement	0/1	0.3762485 (0.4582575)	0.517213** (0.2533278)
7) number of farmers in group	2 – 5	constant over time	-0.251115*** (0.0906977)
Constant term		2.574068* (1.317077)	3.724459 *** (1.115715)
Number of observations		450	450
Number of individuals		45	45
Number of observations per individual		10	10
Prob > F/chi²		0.0012	0.0000
R^2 within		0.1363	0.1326
R^2 between		0.3586	0.4895
R^2 overall		0.2257	0.2799
Wooldridge test for autocorrelation Prob > F		0.7158	0.7158
			legend: * p<0.10 ** p<0.05; *** p<0.01;

4 Discussion

The explorative assessment of the socio-ecological systems of land reform projects shows that arbitrarily mixed groups of farmers are facing the challenge to solve the provision problem of a common pool resource. They can therefore not build on a long-enduring history of CPR management. The situation is aggravated if the newly formed groups are ethnically heterogeneous. In our small sample no mixed group came to an agreement. Forcing ethnically mixed groups into cooperation situations might supports nation building and potentially helps to overcome tribalism but in the short run the heterogeneity of norms makes it more difficult to establish a stable fundament of social capital. In our experiment only ethnically homogeneous groups came to an agreement (compare with Meinzen-Dick et al. 1997).

The two commonly used payment systems of rural water supply in Namibia are the payment per head of livestock and the payment per person (Bock et al. 2006, Falk et al. 2009). The two systems differ with regard to the congruence between provision and appropriation which according to Ostrom (2010) affects the probability of successful common pool resource management. The provision and appropriation is most congruent under the rule to pay per head of cattle, because livestock is consuming the greatest share of water provided by rural water pumps in Namibia (Bock et al. 2006, Falk et al. 2009). A payment system where each group member pays an equal amount is more in line with fairness norms of conditional cooperation which according to Fischbacher & Gächter (2010) supports cooperation.

Answering our first research question we can conclude from the results of the theoretical model that the payment system to pay per livestock provides more reliable incentives to cooperate. Meeting the group participation condition is not a guarantee for meeting the individual participation condition under the system to pay equal amounts per person. The livestock numbers and consequently the opportunity costs of an individual must be high enough to motive her to participate in an equal payment system. In addition, if a farmer has few livestock, he will have a higher incentive to cheat, when the group shares the costs per farmer than when sharing the costs per head of livestock.

Addressing our second research question we observe in contrast to the theoretical results that in our sample the fairness norm of conditional cooperation is more widespread than the one achieving congruence between provision and appropriation. In our experiment only one out of 14 groups has chosen to pay per animal. The regression model reveals, however, that even if the players did not agree on a clear payment system per head of livestock in tendency the ones owning more livestock are making higher contributions. Five groups shared the costs equally. The system to pay equal amounts achieves a relatively high congruence of provision and appropriation if the gini-coefficient of livestock possession is low in a group. Consequently, the fairness norms of congruence of provision and appropriation and the one of conditional cooperation match in groups with relatively equal distribution of livestock meeting. This could explain why these groups more probably cooperate. In our experiment there is a correlation between choosing the equal payment rule and the gini-coefficient of livestock possession in the group. Nonetheless, within the groups choosing the equal payment system per person the participation condition is proportionally less often fulfilled than in the overall sample. This could be an indication that fairness norms of conditional cooperation are in tendency stronger than the norm of congruence between provision and appropriation.

Taking the individual players' account balances in the experiment as endowment indicator we do not observe inequity aversion. In fact, players made higher contributions if their account balance was lower. We observe, however, that those players who are more productive in terms of net profits per ha made higher contributions in the experiment. Considering that livestock is also an important wealth indicator and that the livestock possession correlated with the water payments we can not reject the hypothesis that also inequity aversion norms play a role in the players decision making (compare with Bardhan 1993, Fehr & Schmitt 1999, Buckley & Croson 2006).

Our experiment design does not allow final conclusions regarding the relative importance of different fairness norms. There are additional factors which might play a role. The players could for instance perceive the real life opportunity costs to be higher and were therefore willing to make higher contributions. Our case could potentially by an example of a common-pool resource managed by small groups where the consequences of an infrastructure break down are so serious that each player would prefer to provide the good alone instead of hoping for the contribution of the other group members (compare with Bardhan 1993).

Another possibility is that the group provided enforcement which changed the payoff matrix of the player (Bardhan 1993). We did not include an explicit punishment option in our experiment nor did we observe any obvious enforcement. Nonetheless, the players knew each other, had the opportunity to criticise each other during the experiment, and face multiple contacts in real life. One can therefore assume that social enforcement based upon the human striving for praise and intimacy (Cummins 1996) and the endeavour to avoid blame (Smith [1789] 2004) played a role (compare with Vollan 2008, Cardenas & Carpenter 2008).

We used multiple methods to understand the cooperation challenge of land reform beneficiaries in Namibia. Only the combination of results allowed us to draw conclusions which are relevance not only for science but also for decision and policy makers. Our experiment based on ecological-economic modelling simulated the real life cooperation situation. The virtual environment was sufficiently similar to reality but simple enough to be played (Gurung et al., 2006). In this way we increase the potential to learn from the experiment about the real life behaviour of the players. Using the terminology of Roe & Just (2009) we increase our ecological validity as the extent to which the context of the research is similar to the context of interest. As a consequence, the possibility to replicate our results is limited. There is a high probability of the presence of uncontrolled variation in unobserved variables. We have controlled in the model presented in Appendix 2 for as many as possible factors. We also have only restricted control over subject characteristics but play the experiment with the subjects who are in the centre of the context of interest in order to make statements specifically about their behaviour. Applying an experimental setting we can control for learning effects.

At the same time, our approach reduced the risk that research results inferred under controlled conditions are not able to predict outcomes in a context of uncontrolled conditions (Roe & Just 2009). Defining the variation of stimuli and responses was informed by explorative research and should therefore represent relatively realistic restrictions.

In particular the simulation model based experiments produced not only knowledge but provided support to stakeholders in their decision making (Barreteau et al., 2001; Barreteau, 2003; Gurung et al., 2006; Guyot & Honiden, 2006; Becu et al., 2008). There was uniform response from the participants that they perceived the exercise as training rather than a research activity. Gurung et al. (2006) argue that one key objective of participatory modelling is to facilitate dialogue, shared learning, and collective decision making through interdisciplinary research to strengthen the adaptive management capacity of local communities. Modelling and in particular participatory modelling is a tool to play with rules and strategies and in this way explore probable ecological and economical consequences. It limits the costs of trial and error methods and shifts the approach from costly learning by doing towards learning by simulating (Barreteau et al. 2001). Our approach simultaneously deepens the understanding of cooperation processes and serves as a tool to encourage discussion and institution building. In this sense, we supported Namibian land reform beneficiaries in a current and relevant challenge.

This leads us to our third research question. Which policy implications can be drawn from our research? First of all the research confirms the ongoing challenge of institution building faced by land reform beneficiaries. This is not a short term issue anymore as some of the beneficiaries have been resettled more than 20 years ago (mean = 9 years). Considering the importance of water supply for farming in Namibia, pre- and post-resettlement support should not only pay attention to technical aspects of water infrastructure but should facilitate as well the process of institution building. Larger groups of farmers and less homogeneous ones in terms of livestock possession and ethnic origin need special attention. We further learned that there are no uniform fairness norms. Achieving congruence between provision and appropriation provides most reliable material incentives to cooperate. Nonetheless, any distribution of the expected costs works as long as the group reliably agrees to it. The intention should therefore not be to impose specific rules on groups but help them to come to an agreement.

5 Conclusions and research perspectives

Our study provides evidence that different fairness norms overlap. Land reform beneficiaries increase their contributions as the other group members increase their payments, as they are more productive and as they own more livestock. Different people carry simultaneously different fairness norms and make decisions considering the overall context. This means at the same time that a person who does not follow a particular fairness norm is not necessarily only materially self-interested.

6 Acknowledgement

This study was part of the BIOTA project, which was funded by the German Federal Ministry for Education and Research. Special acknowledgement goes to all surveyed communities for their time, assistance and hospitality. The study was conducted in cooperation with Bertus Kruger coordinating the Emerging Commercial Farmer Support Programme and Richard Kamukuenjandje lecturing at the Polytechnic of Namibia. We thank all student assistants who contributed to the study, in particular Reinhold Kambuli, Pombili Sheehama, Linnéa Koop, Nora Heil, Lisa Lebershausen, Daniela Neu, Anne Frank, and Muhammad Aneeque Javaid.

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[i] See Appendix 3 for a detailed illustration of the expected costs.

[ii] See Appendix 4 for a detailed illustration of this optimization problem.

[iii] See Appendix 5 for the calculation of C_i'.

[iv] Spearman rank correlation for variables "group came to agreement" and "gini-coefficient of livestock possession of group": coefficient: -0.3808, p=0.000, N=14; spearman rank correlation for variables "group agreed to pay per person" and "gini-coefficient of livestock possession of group": coefficient: -0.4564, p=0.000, N=14.

[v] Where there is a correlation between the own payment and the payments of the rest of the group in a particular experiment period (Pearson correlation calculated and considered to be correlated if p<0.05).

[vi] Where there is a correlation between the own payment and the share of the individual on the total livestock number of their group in a particular experiment period (Pearson correlation calculated and considered to be correlated if p<0.05).

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Appendix 1: The ecological-economic model

This Appendix describes the model version that has been used for the field experiments. The descriptions already include all adaptations that are needed for the interactive application. A detailed formal description of the applied sub-models can be found in Tietjen et al. (2009), Tietjen et al. (in review), and Lohmann et al. (in prep).

General structure

The application is based on two linked simulation models. Firstly, we adopted an existing eco-hydrological vegetation model (Tietjen et al., 2010, Lohmann et al. submitted) to the specific needs and conditions of this study, scaled up the resulting vegetation dynamics to the relevant spatial scales for rangeland management by using a state-and-transition approach Secondly, we linked that model to an economic farm model, simulation cattle individual and herd dynamics as well as running costs of the business.

This whole framework is used to conduct role-plays (computerized experiments) with land reform beneficiaries. By using this approach, we can analyze the farmers' behaviour based on scenarios that reflect our scientific understanding of the underlying systems' dynamics. In the following paragraphs we explain the different sub-models, the user interface and the schedule of the program during the role plays.

Ecological-economic model

Our spatially explicit, grid-based model describes horizontal and vertical surface water and soil moisture dynamics in two soil layers as well as vegetation dynamics of different grasses and woody vegetation. (Tietjen et al. 2010, Lohmann et al submitted). This eco-hydrological model calculates the productivity and ecological state of the ecosystem in dependence on the rainfall, the land use decisions and the environmental conditions. While environmental conditions, i.e. temperature and precipitation, are given as external scenarios, land use strategy is not simulated by the model version used here, but depends on input of the role-players at every time step.

The economic sub- model simulates the processes on a cattle farm assuming proper spatial management of the land such as spatially homogeneous grazing pressure. Hereby we consider animal growth, herd dynamics, running costs of the business and revenues from animal trading.

The individual growth of the animals is not calculated explicitly. Instead we calculate an average quasi weight score per individual based on the grass biomass availability, assuming that all individuals are adult cows and that the animals' biomass uptake is higher when biomass availability is higher. This can result in varying uptake rates during the year, with a high probability to lose weight at the end of a season. The result of the average weight score calculation is then transferred to animal state classes. These classes distinguish between animals from a very lean (body score 1) to a fat condition (body score 5) according to the Emerging Commercial Farmer Support Programmes' (ECFSP) definition. The body score classification is based on a commonly used classification system developed by Namibian rangeland experts. The score is communicated to the farmers and used as an argument for other functions of the model.

Animal numbers are influenced by simulated basic herd dynamics as well as by the farmers' decision what animals to sell or buy. Birth, weaning of calves, age and disease related mortality as well as starvation are the processes determining the herd dynamics. Livestock starves if there is not enough biomass to support the given number of animals. Individuals that reach the maximum age are assumed to be culled. The processes of herd dynamics depend on the animal state. The parameter values for these traits have been derived from data given by the Sandveld research station of the Namibian Ministry of Agriculture, Water, and Forestry.

The costs that need to be covered are calculated on base of simple rules so that we have relatively neutral and equal conditions for every run of the simulation game. We distinguished between fixed costs being dependent on the farm size and variable costs being dependent on the number of livestock. Both cost functions are assumed to be linear. In addition, the water related costs are derived by randomly drawing a value from a normal distribution. The mean of the water cost function is the empirical average maintenance cost of water points given by the Namibian government's Directorate of Rural Water Supply (Bock and Kirk, 2006). For the analyses of the cooperation behaviour we assumed that a group of farmers share one wind driven and one diesel driven water pump.

We assume stable livestock prices over the simulated years. Variations according to the season of the year, between buying and selling prices as well as for different types of livestock are considered and derived from the database of the Meat Board of Namibia. Interests for positive as well as negative account balances are calculated.

Appendix 2: Random effects regression model explaining the natural logarithm of the individual players' payment for covering the water infrastructure maintenance costs including socio-ecological control variables:

Variable	coefficients (cluster robust standard errors in parenthesis)
1) experiment round t	0.033568 (0.0340996)
2) natural logarithm of all other group member's payment in t	0.35644** (0.1706531)
3) account balance in group water fund at beginning of t	-0.0000746*** (0.0000254)
4) individual account balance at beginning of t	0,00000368*** (0,00000113)
5) livestock number at beginning of t	0.0173701*** (0.0041896)
6) did the group come to an agreement	0.4860238 (0.3382129)
7) number of farmers in group	-0.1983241 (0.1415458)
8) state of farm vegetation in experiment	0.0190186 (0.186016)
9) gini-coefficient of livestock possession in experiment round	-1.012843 (0.9947425)
10) average livestock condition score in experiment	-0.2612766 (0.1744979)
11) relative ethnic homogeneity	-1.606202*(0.9661208)
12) holding leashold rights	0.4082044** (0.2070546)
13) hectar per borehole	0.0003012 (0.0003518)
19) net profit per hectar	0.0126896*** (0.0028377)
20) having non-farm income	-0.0799386 (0.3234803)
21) age of household head	0.0172851** (0.0070105)
22) sex of household head	-0.5285444** (0.2507075)
23) days per year spend on the farm	-1.131665*** (0.3972897)
24) having access to another_farm	-0.7314308*** (0.2764382)
25) time since land redistribution	0.054712 (0.03445)
26) education level	0.4251584*** (0.1304993)
27) pre-resettlement farm experience	-0.3735901 (0.2864401)
28) received farming training in weeks	0.0233686*** (0.0081841)
Constant term	4.11277** (1.779365)
Number of observations	430
Number of individuals	43
Prob > F/chi²	0.0000
R^2 within	0.1513
R^2 between	0.7850
R^2 overall	0.4263
Wooldridge test for autocorrelation Prob > F	0.4391
	legend: * p<0.10 ** p<0.05; *** p<0.01;

Appendix 3: The expected costs function

The probability that the water infrastructure does not break down is the probability that the amount in the water fund covers the maintenance costs:

$$P = P(K \leq WF) = F(WF)$$

The break down probability is given with (1-p). Therefore the expected costs function is:

$$EC_N = C_N \cdot\ F(WF) + OC_x \cdot X_N[1 - F(WF)]$$

$$\Rightarrow EC_N = C_N \cdot\ F(WF) + OC_x \cdot X_N - OC_x \cdot X_N \cdot F(WF)$$

$$\Rightarrow EC_N = (C_N - OC_x \cdot X_N) \cdot\ F(WF) + OC_x \cdot X_N$$

Appendix 4: optimization problem in the one shot game when water costs are uncertain

$$\underset{C_N}{\mathrm{Min}}\, EC_N = (C_N - OC_x \cdot X_N) \cdot\ F(C_N) + OC_x \cdot X_N$$

The first order condition of this problem is:

$$\frac{\partial EC_N}{\partial x} = F(C_N) + f(C_N) \cdot (C_N - OC_x \cdot X_N) \overset{!}{=} 0$$

$$\Rightarrow f(C_N) \cdot (C_N - OC_x \cdot X_N) = -F(C_N)$$

$$\Rightarrow (C_N - OC_x \cdot X_N) = -\frac{F(C_N)}{f(C_N)}$$

$$\Rightarrow C_N^* = -\frac{F(C_N)}{f(C_N)} + OC_x \cdot X_N$$

The second order condition

$$\frac{\partial^2 EC_N}{\partial^2 x} = f(C_N) + \frac{\partial f(C_N)}{\partial C_N} \cdot (C_N - OC_x \cdot X_N) + f(C_N) > 0$$

$$\Rightarrow f(C_N) + \frac{\partial f(C_N)}{\partial C_N} \cdot (C_N - OC_x \cdot X_N) + f(C_N) > 0$$

$$\Rightarrow C_N > -\frac{2 * f(C_N)}{\frac{\partial f(C_N)}{\partial C_N}} + OC_x \cdot X_N$$

Appendix 5: Incentive to free ride

$$EC_i^{'} < EC_i^{*}$$

$$\Leftrightarrow EC_i^{'} = \left(C_i^{'} - OC_x \cdot X_i\right) \cdot\ F\left(C_N^{'}\right) + OC_x \cdot X_i < EC_i^{*} = (C_i^{*} - OC_x \cdot X_i) \cdot\ F(C_N^{*}) + OC_x \cdot X_i$$

$$\Rightarrow \left(C_i^{'} - OC_x \cdot X_i\right) \cdot\ F\left(C_N^{'}\right) < (C_i^{*} - OC_x \cdot X_i) \cdot\ F(C_N^{*})$$

$$\Rightarrow C_i^{'} < \frac{F(C_N^{*})}{F(C_N^{'})} \cdot (C_i^{*} - OC_x \cdot X_i) + OC_x \cdot X_i$$

$$\Rightarrow C_i^{'} < \frac{F(C_N^{*})}{F(C_N^{'})} \cdot C_i^{*} - \frac{F(C_N^{*})}{F(C_N^{'})} \cdot OC_x \cdot X_i + OC_x \cdot X_i$$

$$\Rightarrow C_i^{'} < \frac{F(C_N^{*})}{F(C_N^{'})} \cdot C_i^{*} - OC_x \cdot X_i \cdot \left(\frac{F(C_N^{*})}{F(C_N^{'})} - 1\right)$$

Appendix 6: Crosstabulation for number of group members and group coming to agreement *(absolute frequencies of groups with relative frequencies in parantheses)*

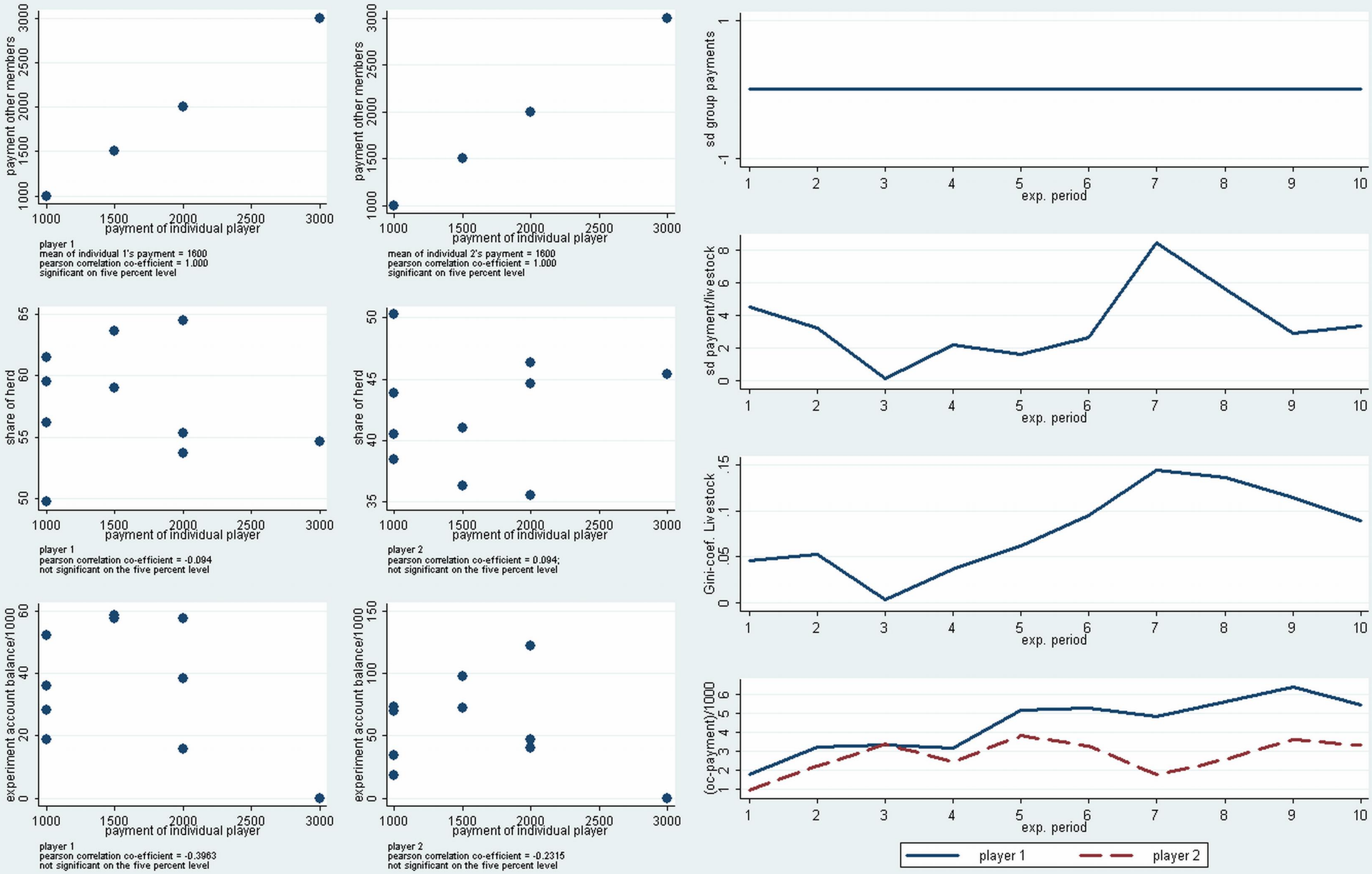
	number of farmers in group					Total
	2	3	4	5	6	
no agreement	1 (7.14%)	2 (14.29%)	1 (7.14%)	3 (21.43%)	0 (0.00%)	8 (57.14%)
came to agreement	6 (42.86%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (7.14%)	6 (42.86%)
Total	7 (50.00%)	2 (14.29%)	1 (7.14%)	3 (21.43%)	1 (7.14%)	14 (100.00%)

Appendix 7: Crosstabulation for ethnic heterogeneity and group coming to agreement *(absolute frequencies of groups with relative frequencies in parentheses)*

	number of ethnic groups in group			Total
	1	2	3	
no agreement	1 (7.14%)	3 (21.43%)	3 (21.43%)	8 (57.14%)
came to agreement	6 (42.86%)	0 (0.00%)	0 (0.00%)	6 (42.86%)
Total	8 (57.14%)	3 (21.43%)	3 (21.43%)	14 (100.00%)

Appendix 8: Figures of group 1

2 members; 1 ethnic group



player 1
mean of individual 1's payment = 1600
pearson correlation co-efficient = 1.000
significant on five percent level

mean of individual 2's payment = 1600
pearson correlation co-efficient = 1.000
significant on five percent level

player 1
pearson correlation co-efficient = -0.094
not significant on the five percent level

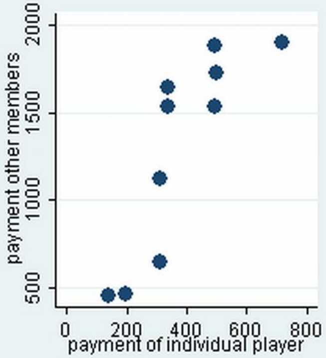
player 2
pearson correlation co-efficient = 0.094;
not significant on the five percent level

player 1
pearson correlation co-efficient = -0.3963
not significant on the five percent level

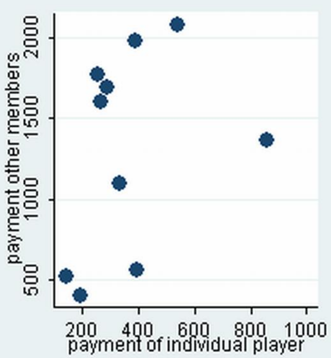
player 2
pearson correlation co-efficient = -0.2315
not significant on the five percent level

Appendix 8: Figures of group 2a

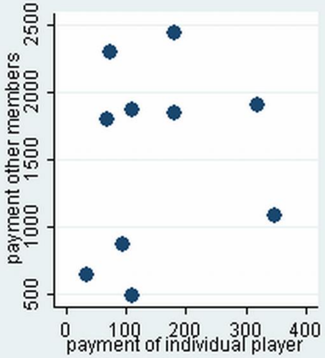
6 members; 1 ethnic group



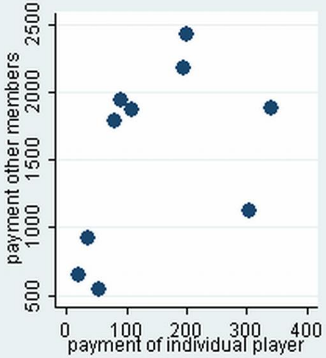
player 3
mean of individual 3's payment = 385
pearson correlation co-efficient = 0.840
significant on five percent level



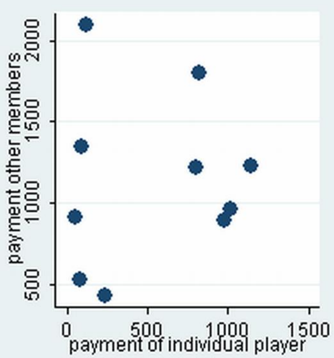
player 4
mean of individual 4's payment = 368
pearson correlation co-efficient = 0.329
not significant on five percent level



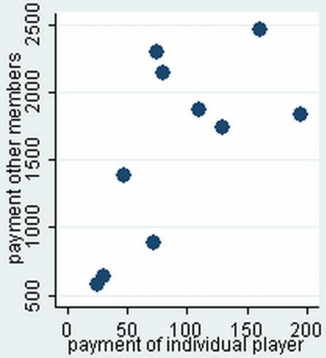
player 5
mean of individual 5's payment = 153
pearson correlation co-efficient = 0.151
not significant on five percent level



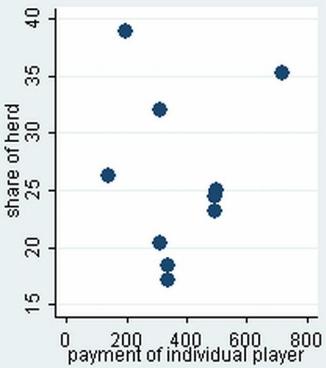
player 6
mean of individual 6's payment = 143
pearson correlation co-efficient = 0.449
not significant on five percent level



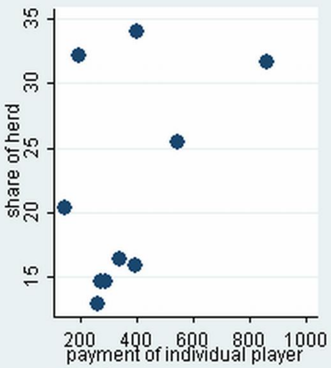
player 7
mean of individual 7's payment = 533
pearson correlation co-efficient = 0.083
not significant on five percent level



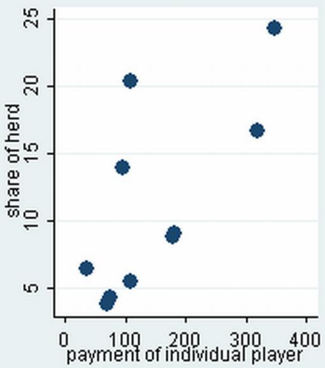
player 8
mean of individual 8's payment = 93
pearson correlation co-efficient = 0.660
significant on five percent level



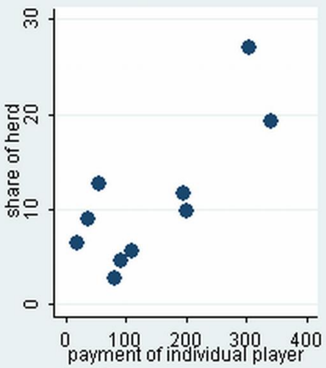
player 3
pearson correlation co-efficient = 0.071
not significant on the five percent level



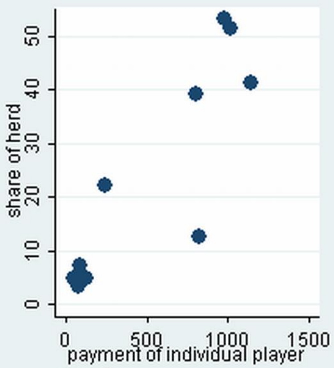
player 4
pearson correlation co-efficient = 0.432
not significant on the five percent level



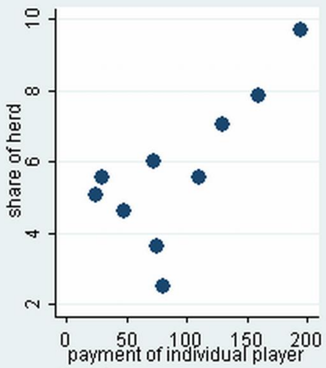
player 5
pearson correlation co-efficient = 0.695
significant on the five percent level



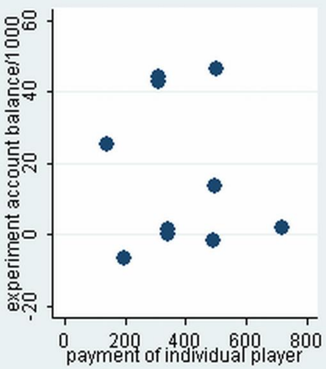
player 6
pearson correlation co-efficient = 0.780
significant on the five percent level



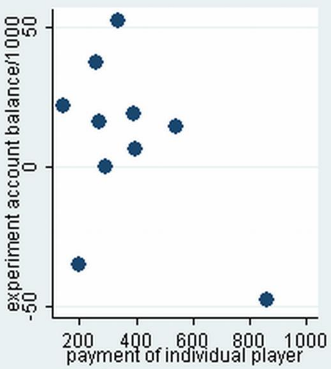
player 7
pearson correlation co-efficient = 0.872
significant on the five percent level



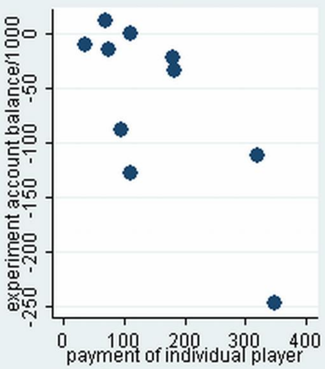
player 8
pearson correlation co-efficient = 0.741
significant on the five percent level



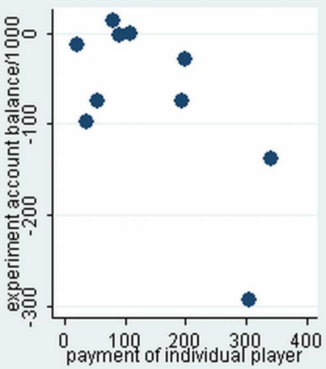
player 3
pearson correlation co-efficient = -0.1254
not significant on the five percent level



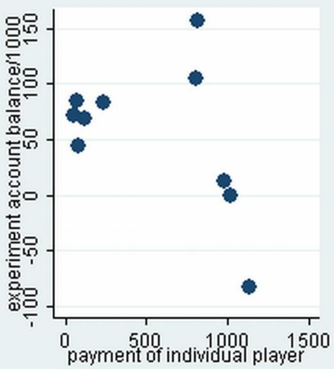
player 4
pearson correlation co-efficient = -0.4725
not significant on the five percent level



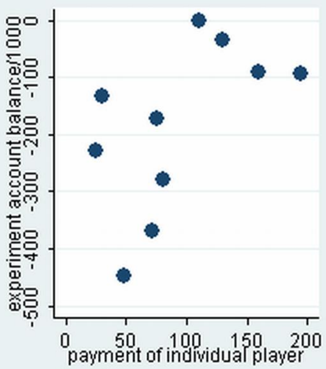
player 5
pearson correlation co-efficient = -0.7380
significant on the five percent level



player 6
pearson correlation co-efficient = -0.6669
significant on the five percent level



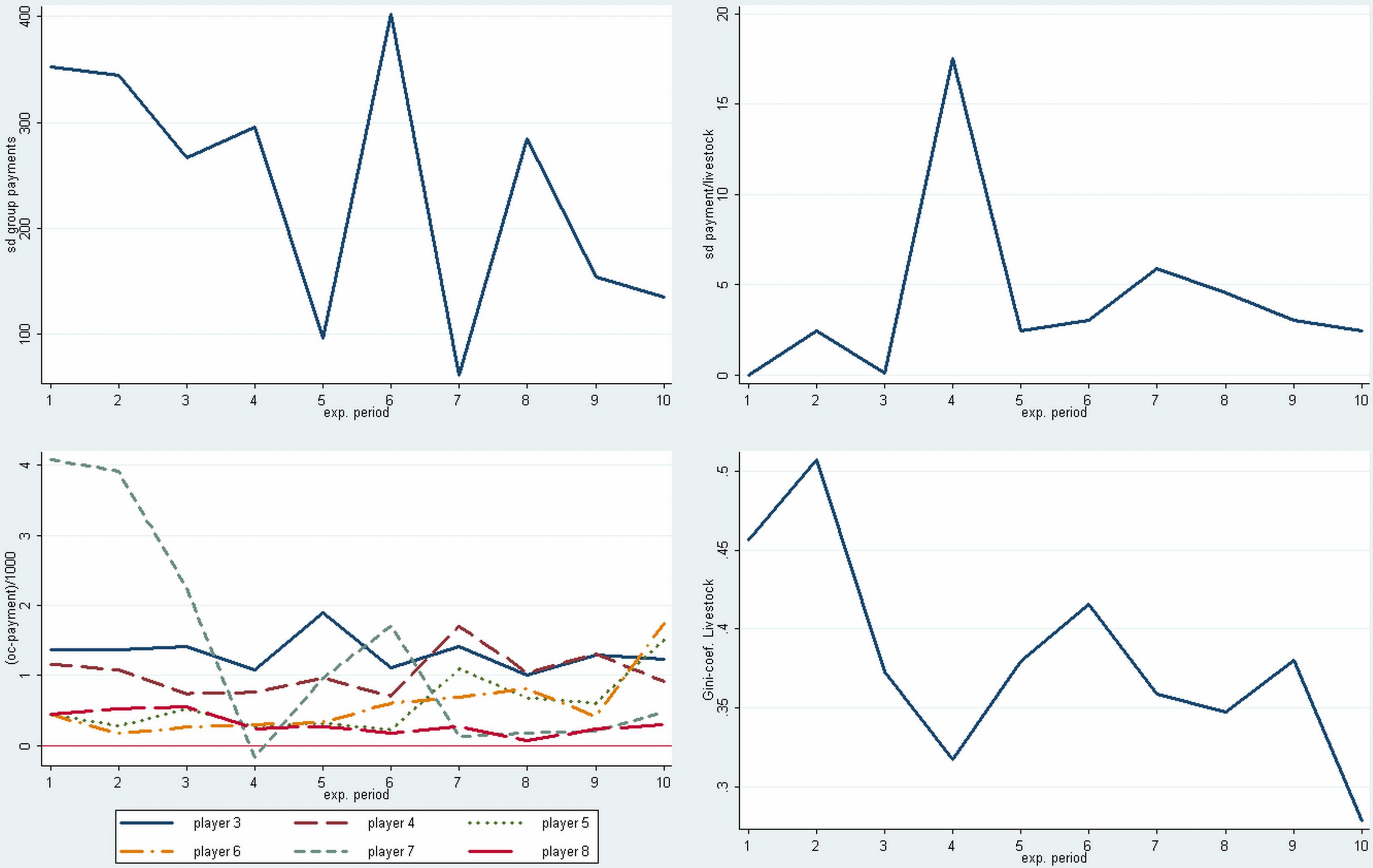
player 7
pearson correlation co-efficient = -0.4353
not significant on the five percent level



player 8
pearson correlation co-efficient = 0.7406
significant on the five percent level

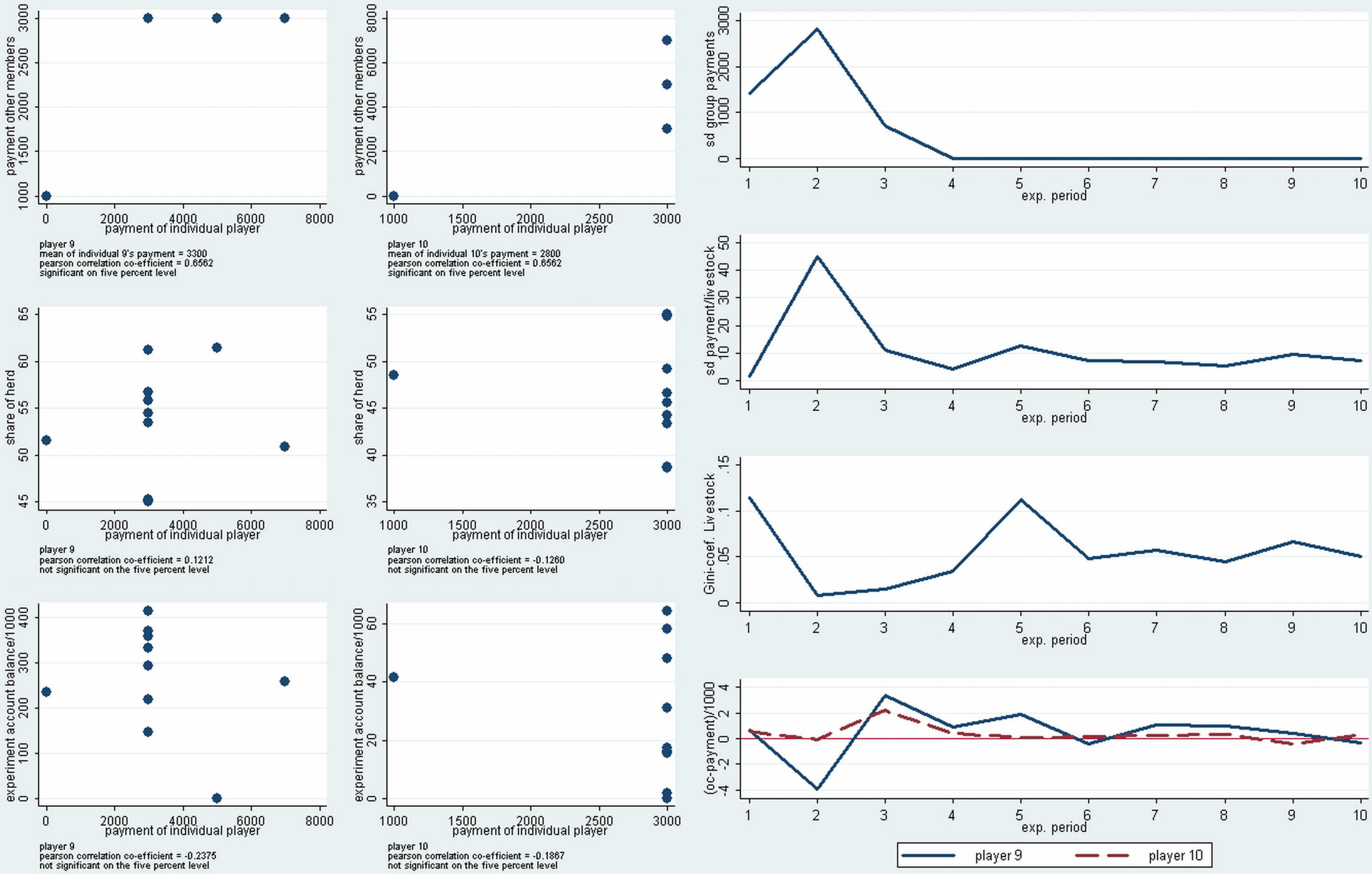
Appendix 8: Figures of group 2b

6 members; 1 ethnic group



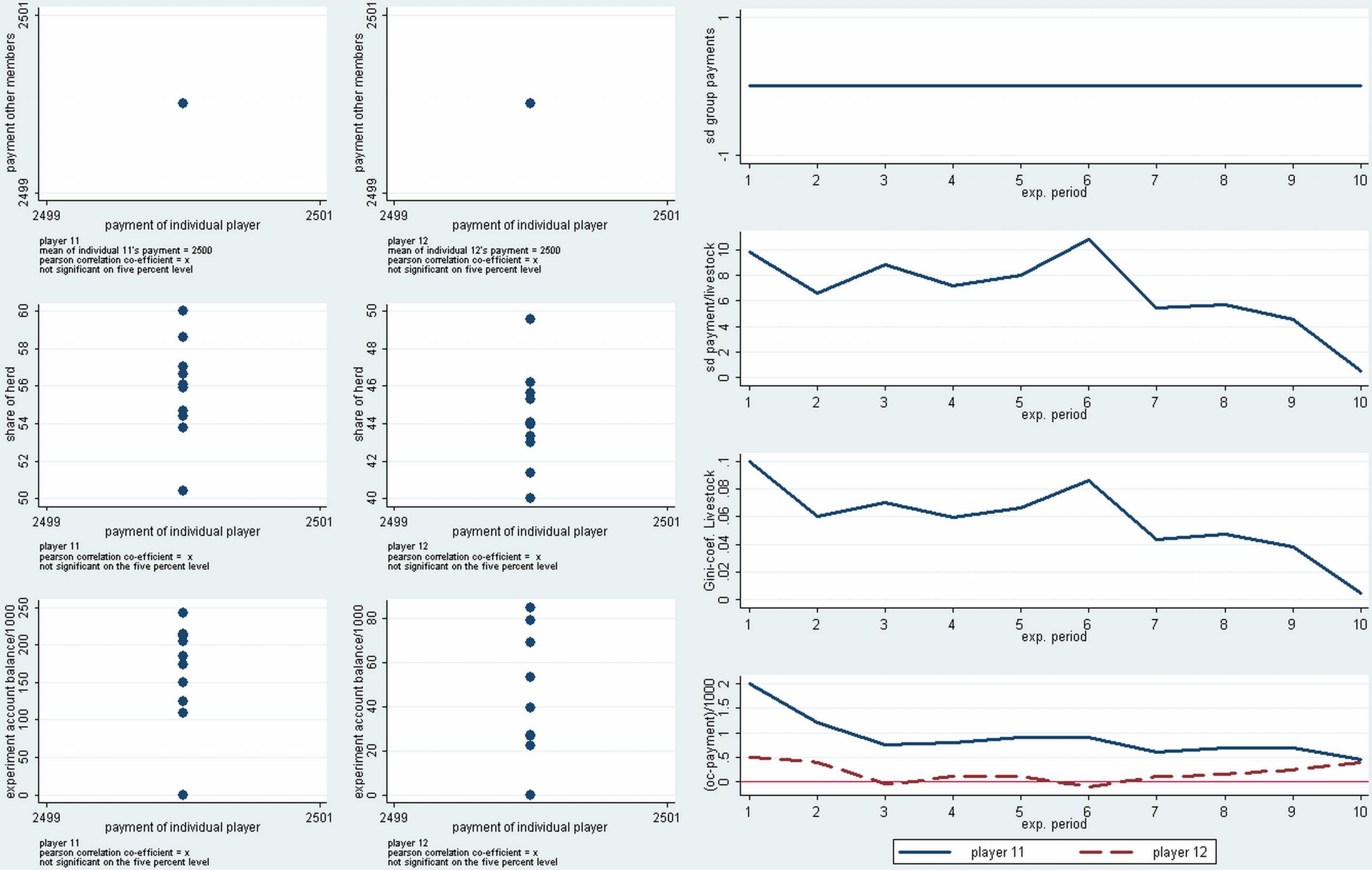
Appendix 8: Figures of group 3

2 members; 1 ethnic group



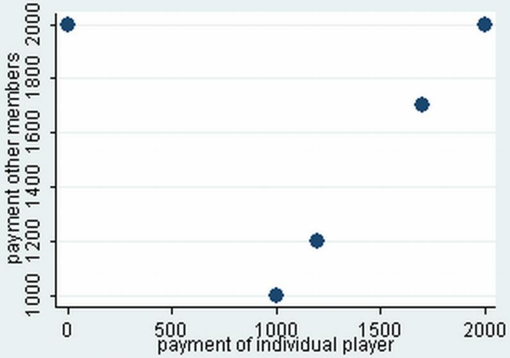
Appendix 8: Figures of group 4

2 members; 1 ethnic group

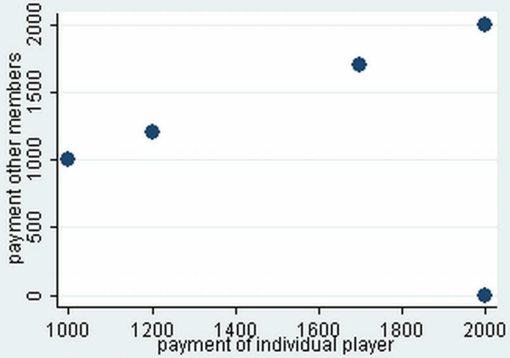


Appendix 8: Figures of group 5

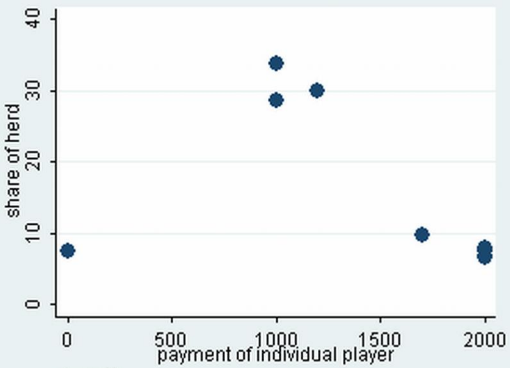
2 members; 1 ethnic group



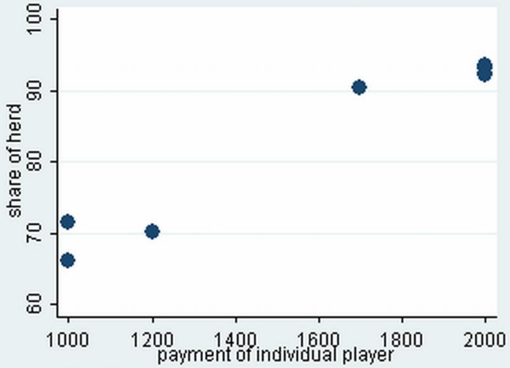
player 13
mean of individual 13's payment = 1390
pearson correlation co-efficient = 0.4288
not significant on five percent level



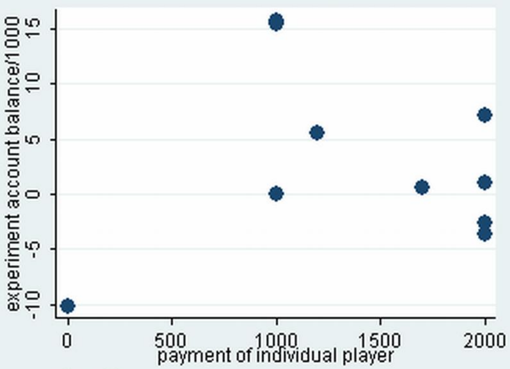
player 14
mean of individual 14's payment = 1590
pearson correlation co-efficient = 0.4288
not significant on five percent level



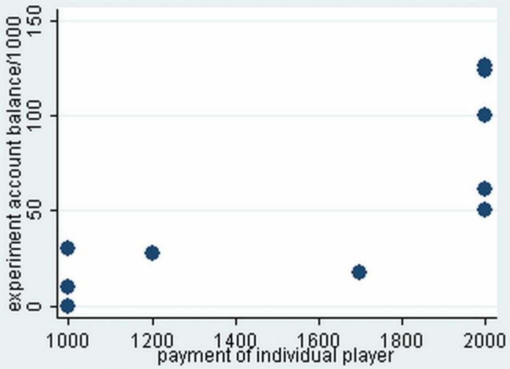
player 13
pearson correlation co-efficient = -0.4398
not significant on the five percent level



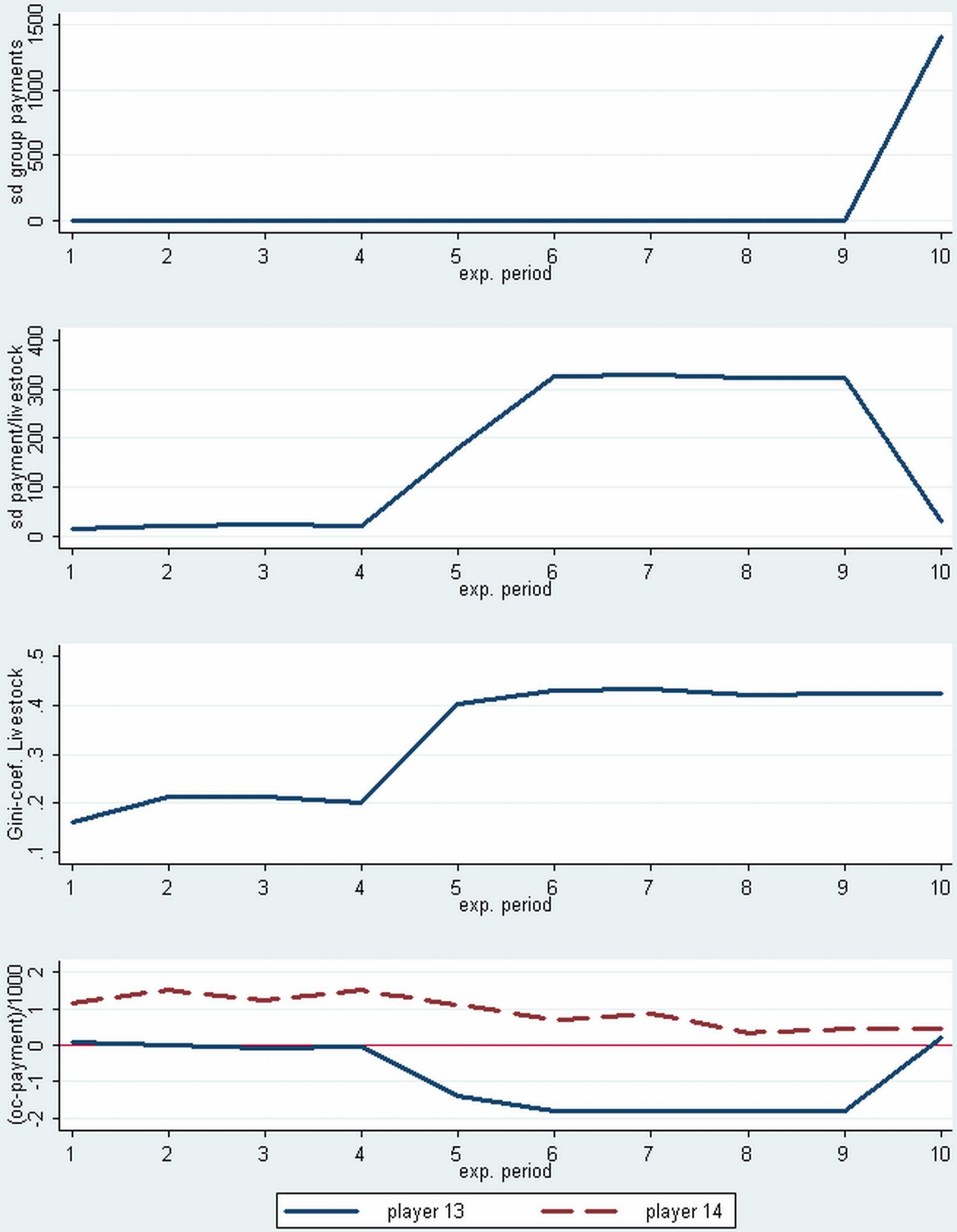
player 14
pearson correlation co-efficient = 0.9776
significant on the five percent level



player 13
pearson correlation co-efficient = 0.0454
not significant on the five percent level

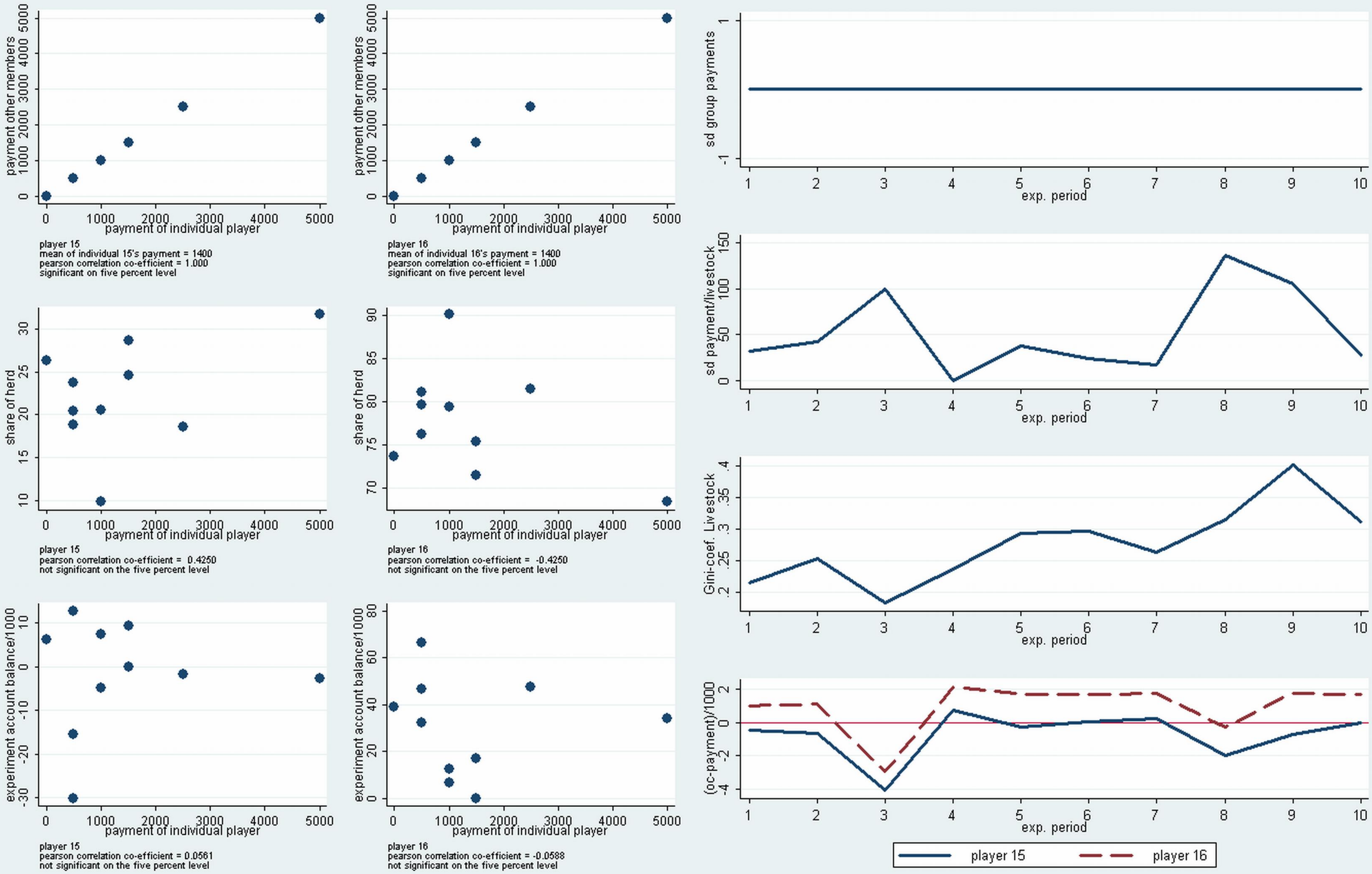


player 14
pearson correlation co-efficient = 0.7818
significant on the five percent level



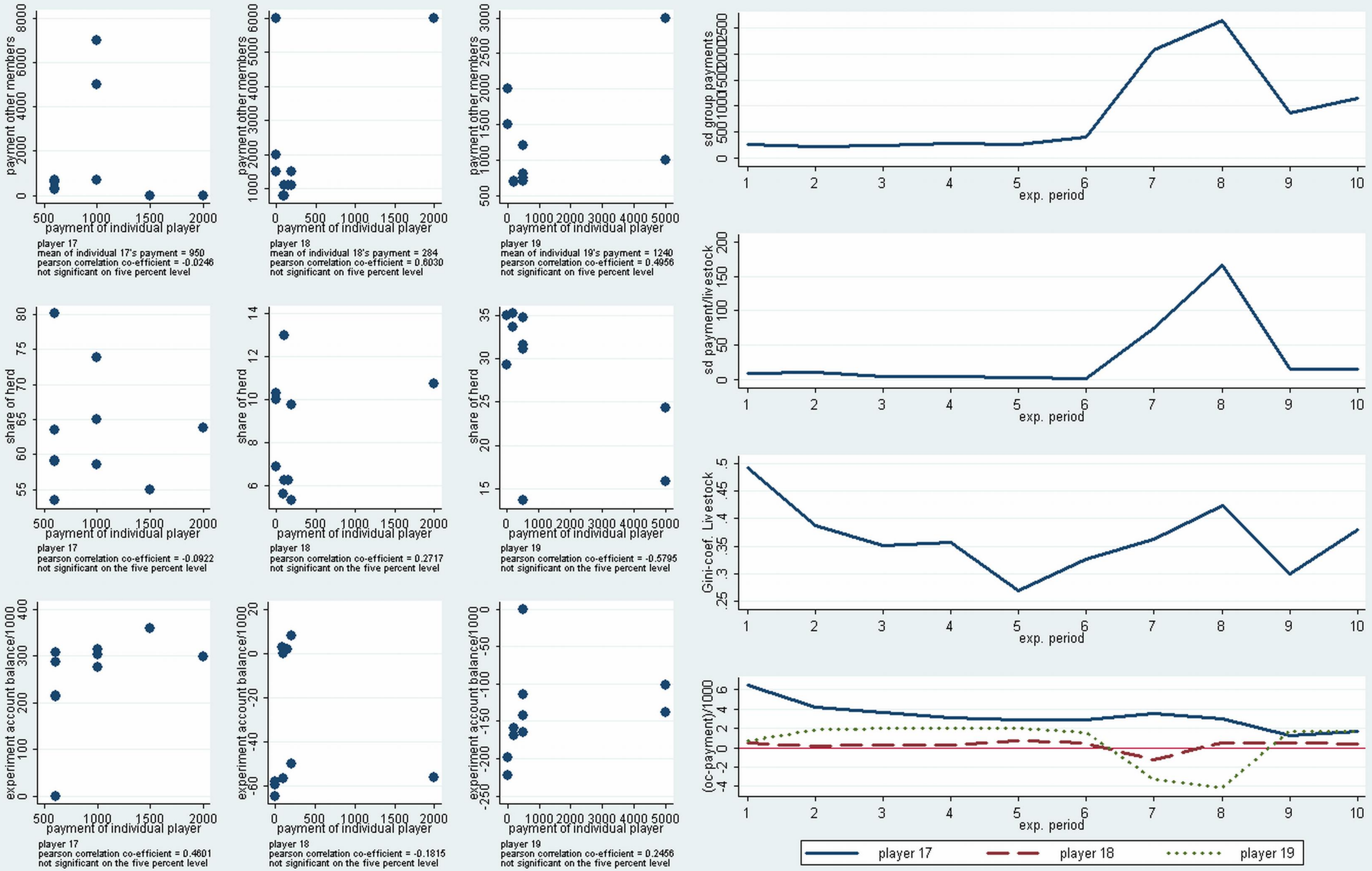
Appendix 8: Figures of group 6

2 members; 1 ethnic group



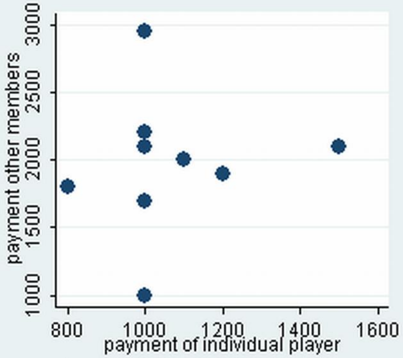
Appendix 8: Figures of group 7

3 members; 2 ethnic group

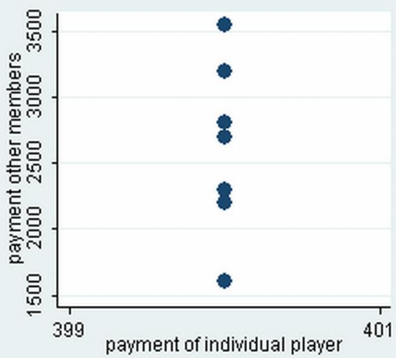


Appendix 8: Figures of group 8a

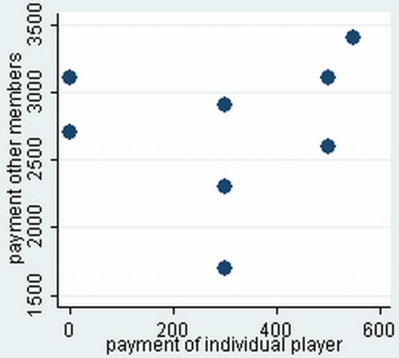
5 members; 3 ethnic group



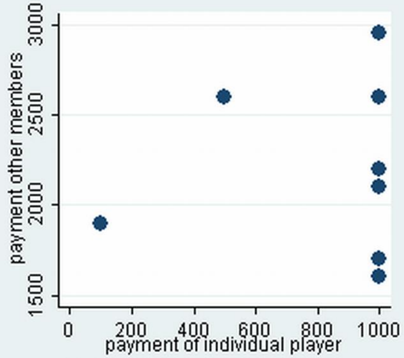
player 20
mean of individual 20's payment = 1080
pearson correlation co-efficient = 0.0957
not significant on five percent level



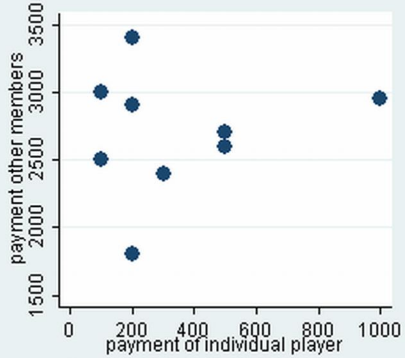
player 21
mean of individual 21's payment = 400
pearson correlation co-efficient = x
not significant on five percent level



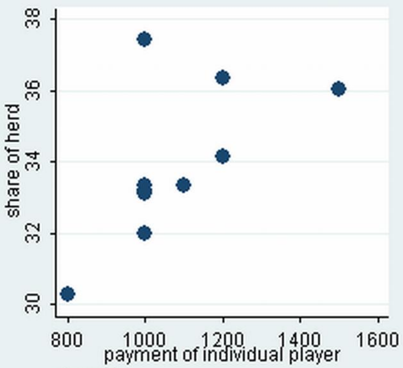
player 22
mean of individual 22's payment = 345
pearson correlation co-efficient = 0.0849
not significant on five percent level



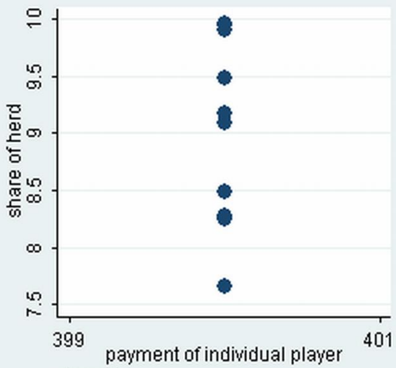
player 23
mean of individual 23's payment = 143
pearson correlation co-efficient = 0.449
not significant on five percent level



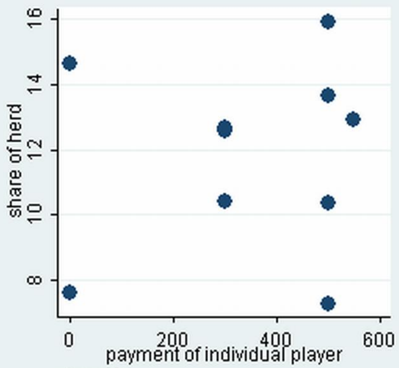
player 24
mean of individual 24's payment = 360
pearson correlation co-efficient = 0.1171
not significant on five percent level



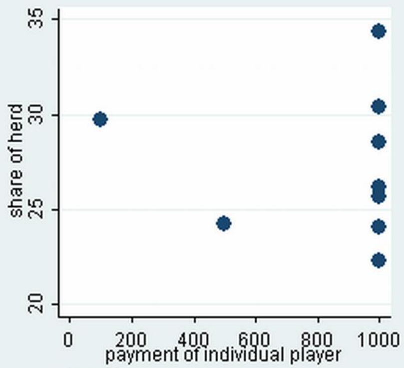
player 20
pearson correlation co-efficient = 0.6229
not significant on the five percent level



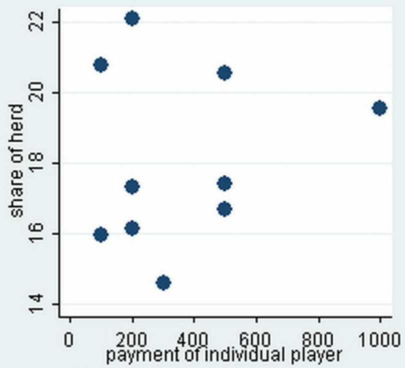
player 21
pearson correlation co-efficient = x
not significant on the five percent level



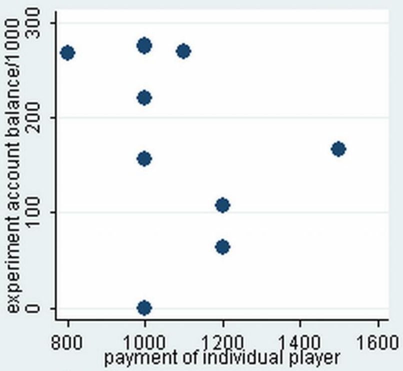
player 22
pearson correlation co-efficient = 0.1289
not significant on the five percent level



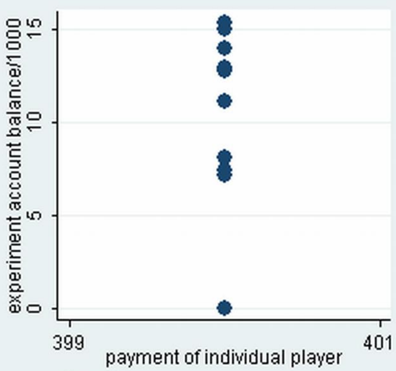
player 23
pearson correlation co-efficient = -0.0868
not significant on the five percent level



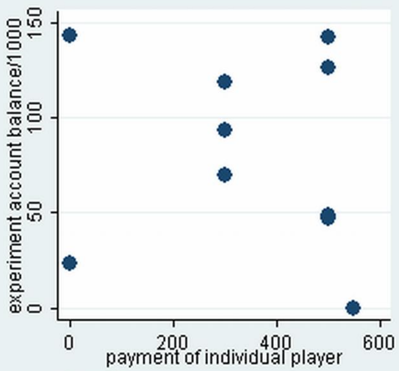
player 24
pearson correlation co-efficient = 0.1381
not significant on the five percent level



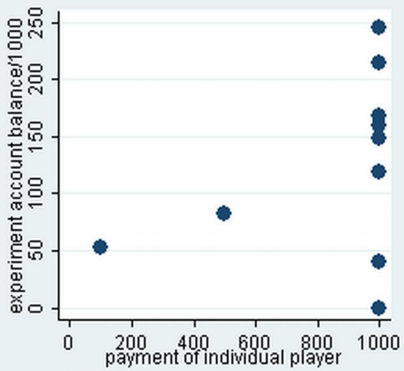
player 20
pearson correlation co-efficient = -0.3213
not significant on the five percent level



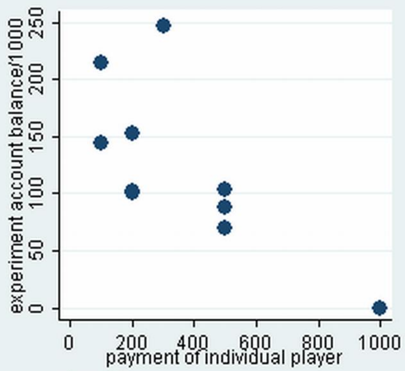
player 21
pearson correlation co-efficient = x
not significant on the five percent level



player 22
pearson correlation co-efficient = -0.1436
not significant on the five percent level

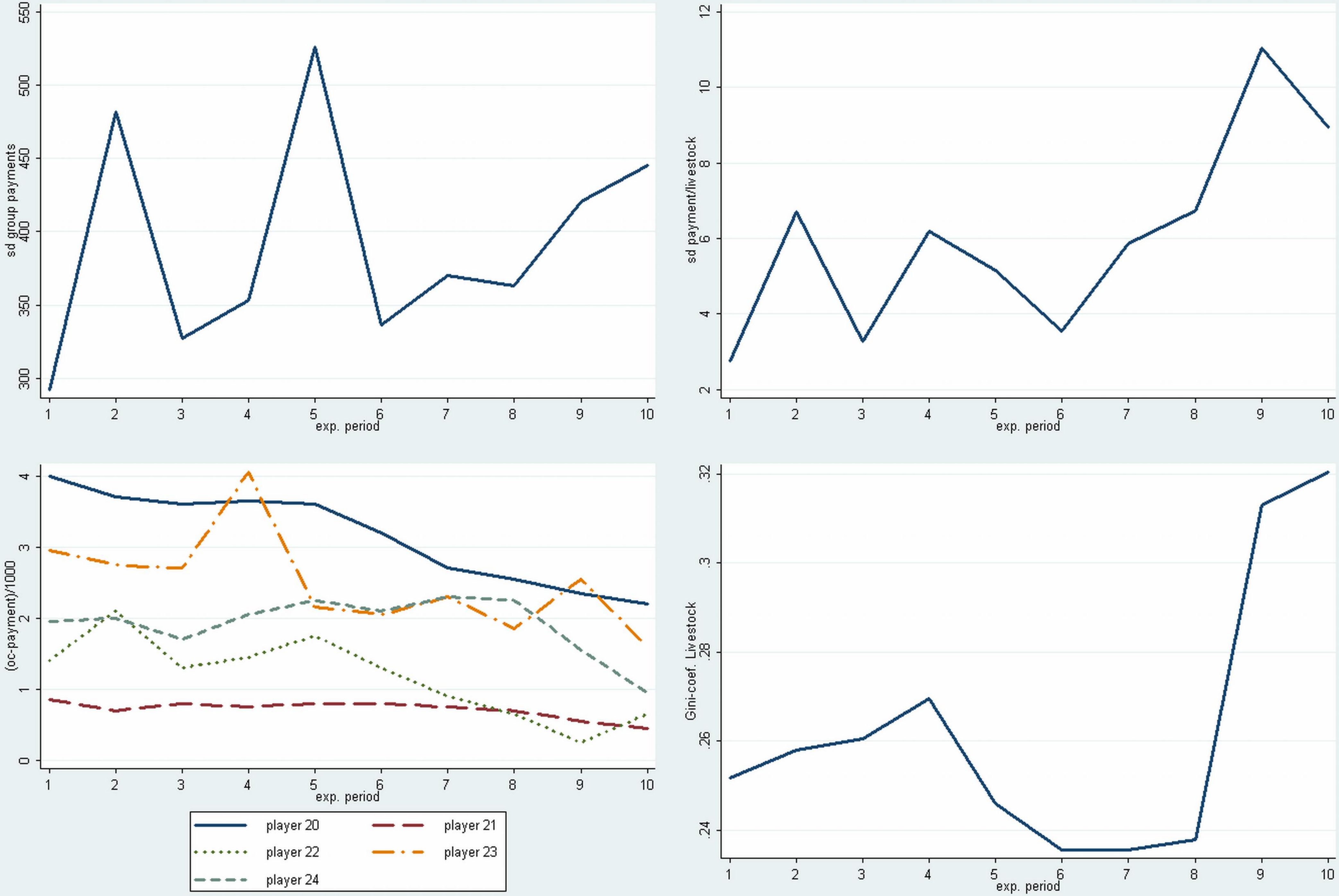


player 23
pearson correlation co-efficient = 0.3793
not significant on the five percent level



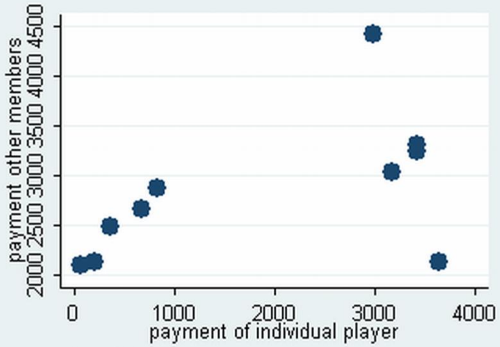
player 24
pearson correlation co-efficient = -0.7271
significant on the five percent level

Appendix 8: Figures of group 8b

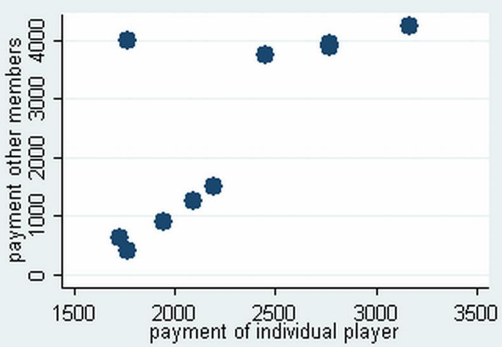


Appendix 8: Figures of group 9a

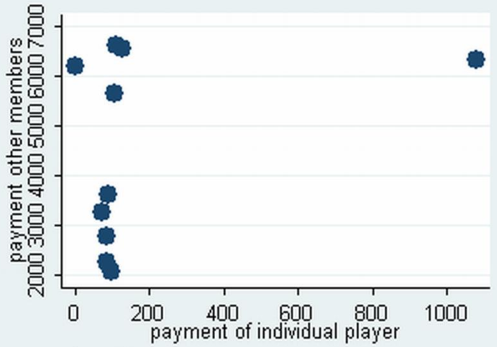
4 members; 1 ethnic group



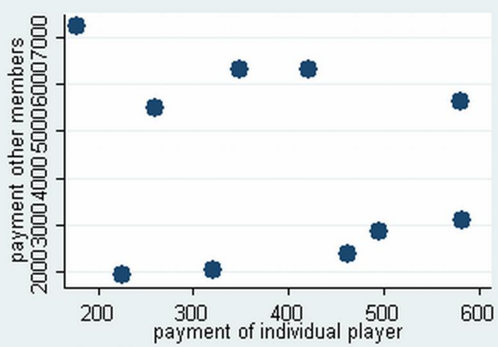
player 25
mean of individual 25's payment = 1879
pearson correlation co-efficient = 1879
not significant on five percent level



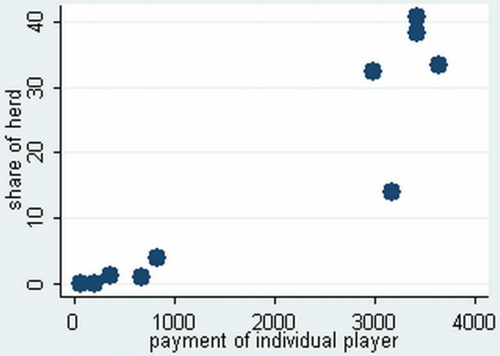
player 26
mean of individual 26's payment = 2264
pearson correlation co-efficient = 0.7232
significant on five percent level



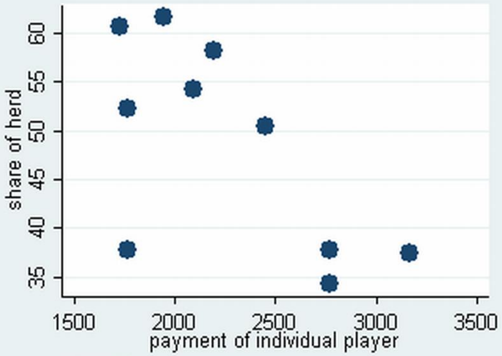
player 27
mean of individual 27's payment = 186
pearson correlation co-efficient = 0.3318
not significant on five percent level



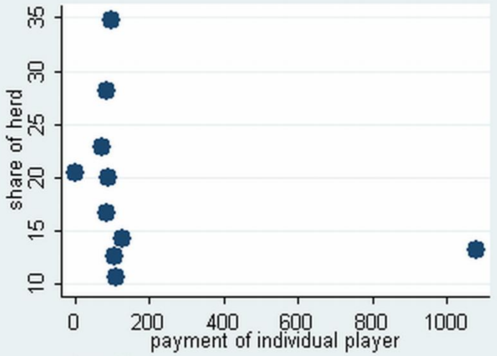
player 28
mean of individual 28's payment = 387
pearson correlation co-efficient = -0.1989
not significant on five percent level



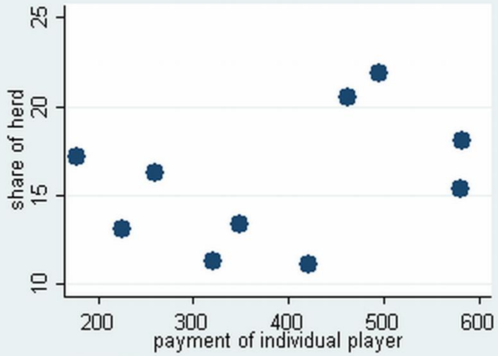
player 25
pearson correlation co-efficient = 0.9263
significant on the five percent level



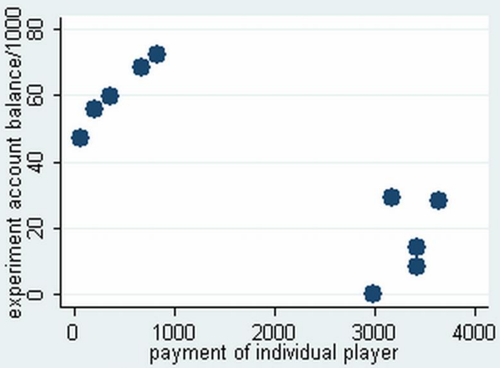
player 26
pearson correlation co-efficient = -0.6460
significant on the five percent level



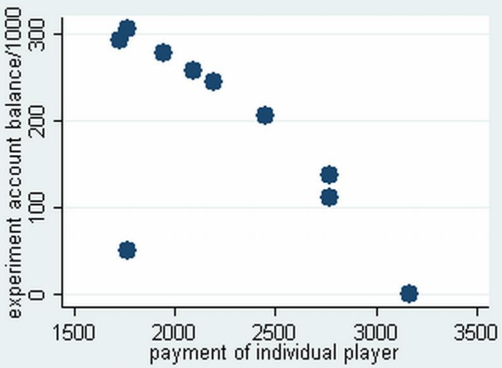
player 27
pearson correlation co-efficient = -0.3070
not significant on the five percent level



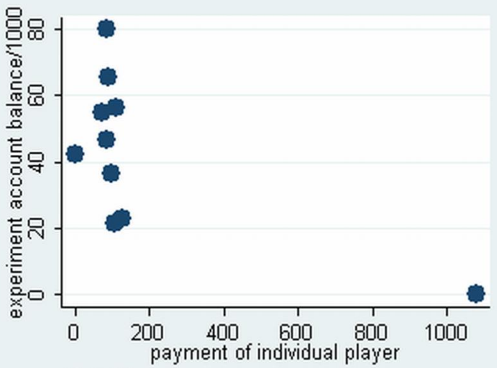
player 28
pearson correlation co-efficient = 0.3582
not significant on the five percent level



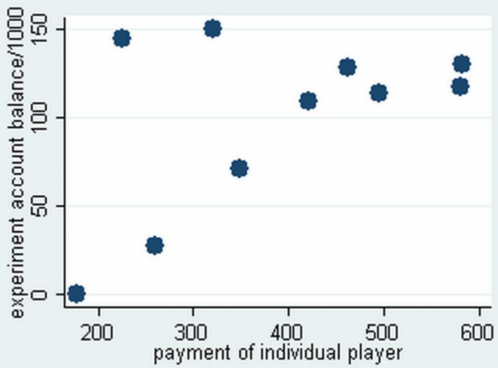
player 25
pearson correlation co-efficient = -0.8438
significant on the five percent level



player 26
pearson correlation co-efficient = -0.6585
significant on the five percent level

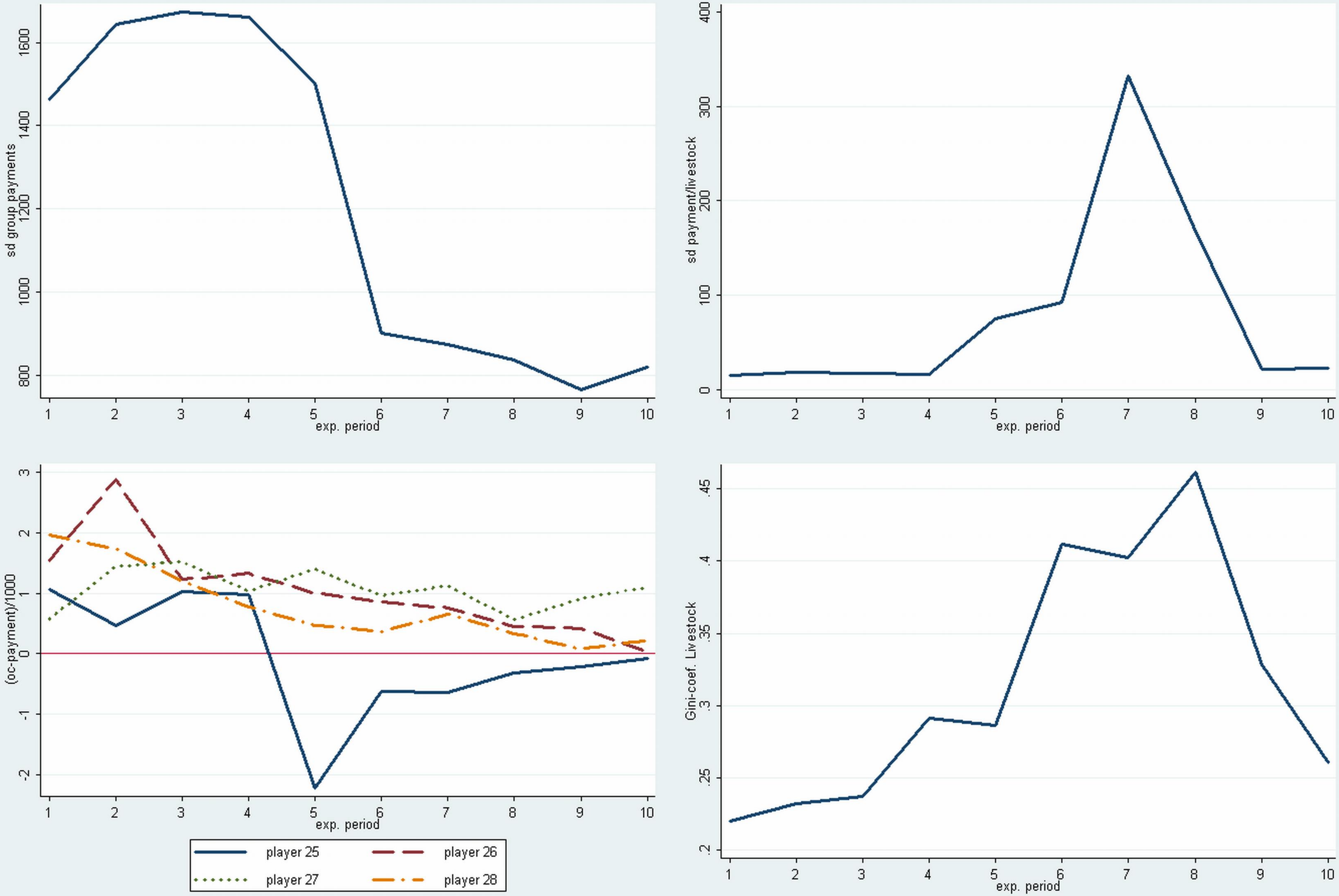


player 27
pearson correlation co-efficient = -0.6509
significant on the five percent level



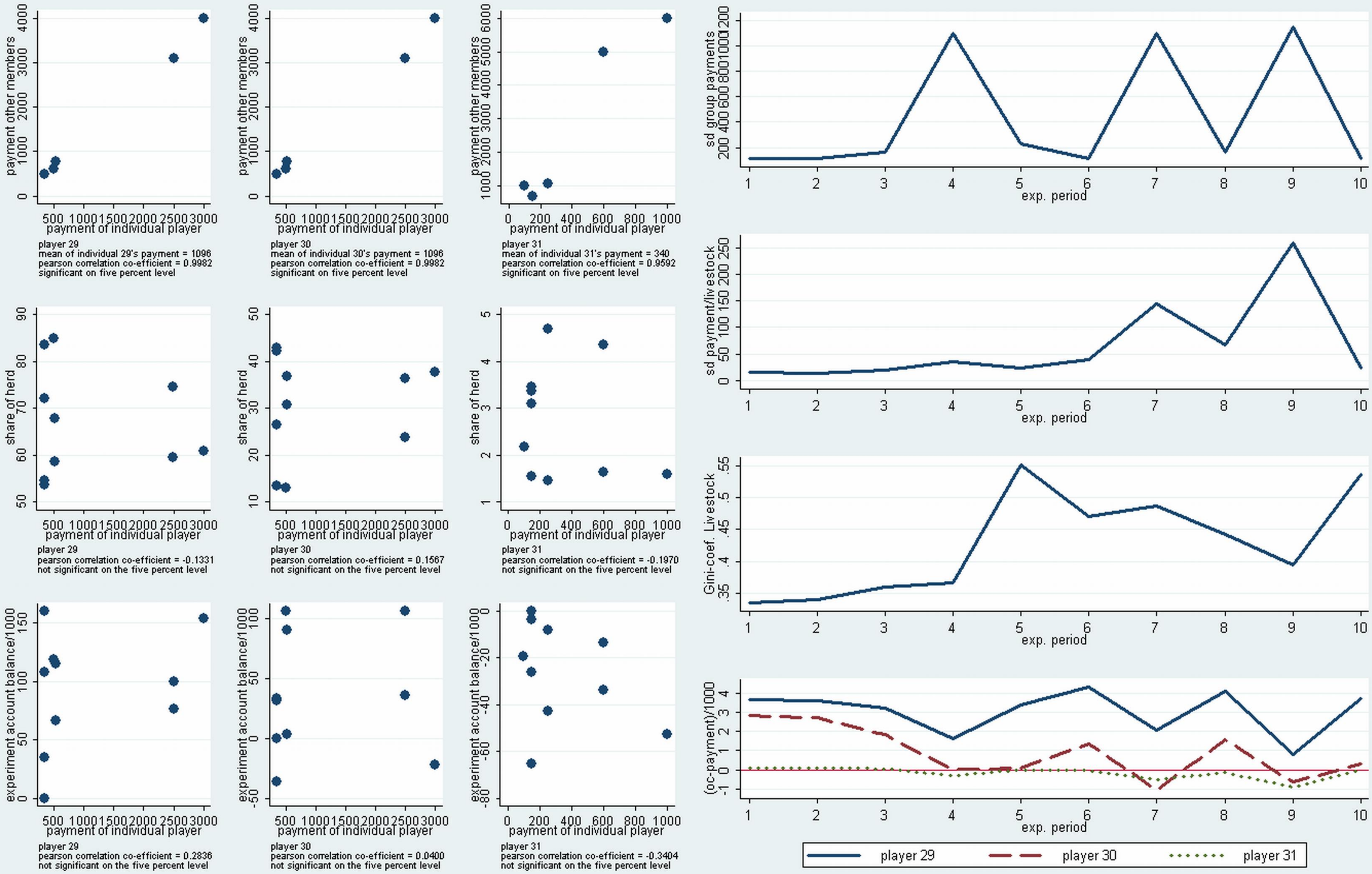
player 28
pearson correlation co-efficient = 0.5210
not significant on the five percent level

Appendix 8: Figures of group 9b



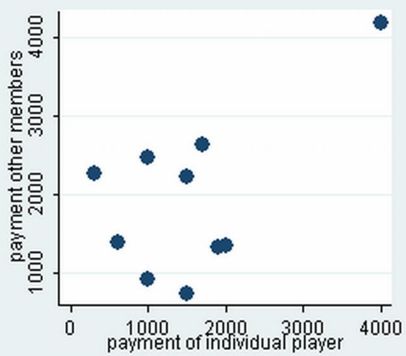
Appendix 8: Figures of group 10

3 members; 2 ethnic group

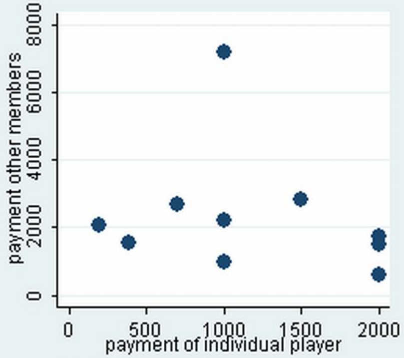


Appendix 8: Figures of group 11a

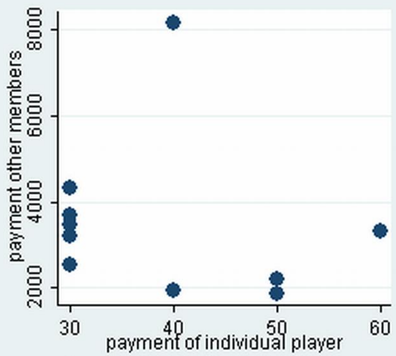
5 members; 3 ethnic group



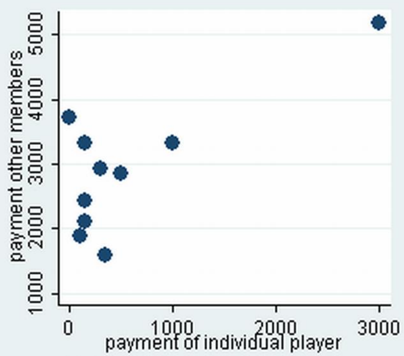
player 32
mean of individual 32's payment = 1550
pearson correlation co-efficient = 0.5865
not significant on five percent level



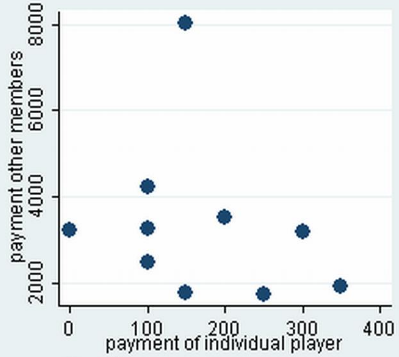
player 33
mean of individual 33's payment = 1178
pearson correlation co-efficient = -0.2104
not significant on five percent level



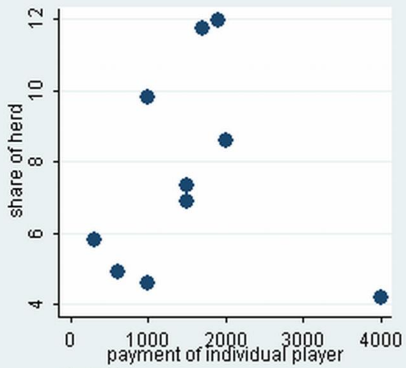
player 34
mean of individual 34's payment = 39
pearson correlation co-efficient = -0.1685
not significant on five percent level



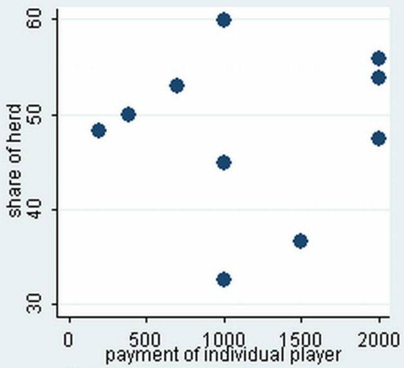
player 35
mean of individual 35's payment = 570
pearson correlation co-efficient = 0.7516
significant on five percent level



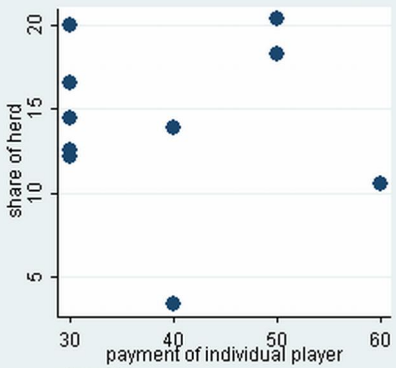
player 36
mean of individual 36's payment = 170
pearson correlation co-efficient = -0.2513
not significant on five percent level



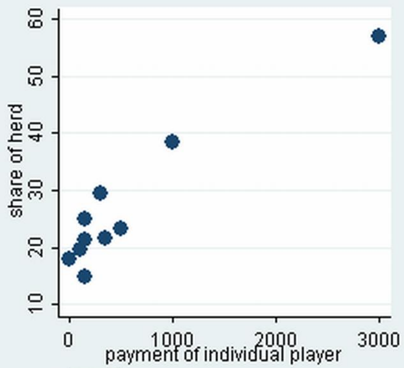
player 32
pearson correlation co-efficient = -0.0203
not significant on the five percent level



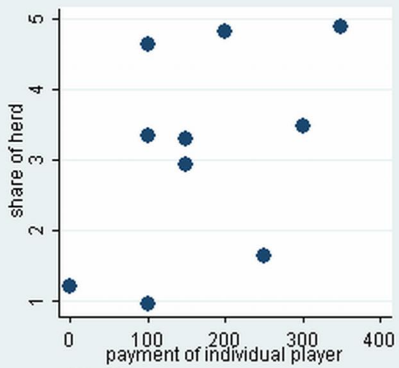
player 33
pearson correlation co-efficient = 0.0803
not significant on the five percent level



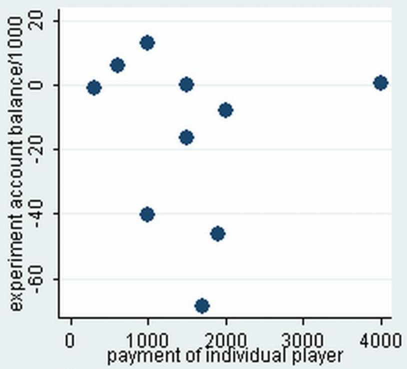
player 34
pearson correlation co-efficient = -0.0332
not significant on the five percent level



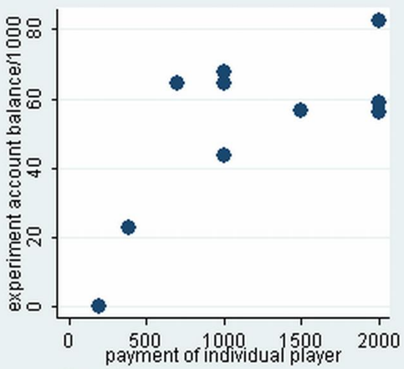
player 35
pearson correlation co-efficient = 0.9468
significant on the five percent level



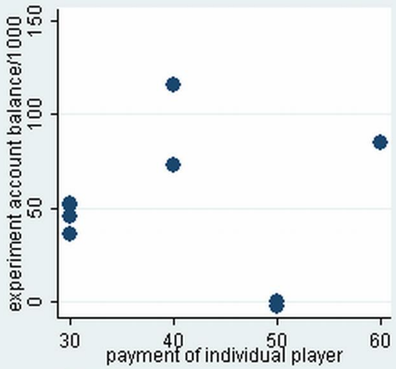
player 36
pearson correlation co-efficient = 0.4694
not significant on the five percent level



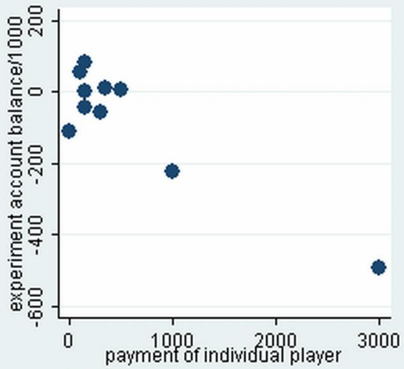
player 32
pearson correlation co-efficient = -0.0703
not significant on the five percent level



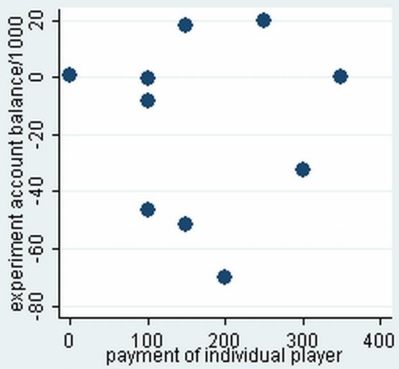
player 33
pearson correlation co-efficient = 0.6904
significant on the five percent level



player 34
pearson correlation co-efficient = -0.0530
not significant on the five percent level

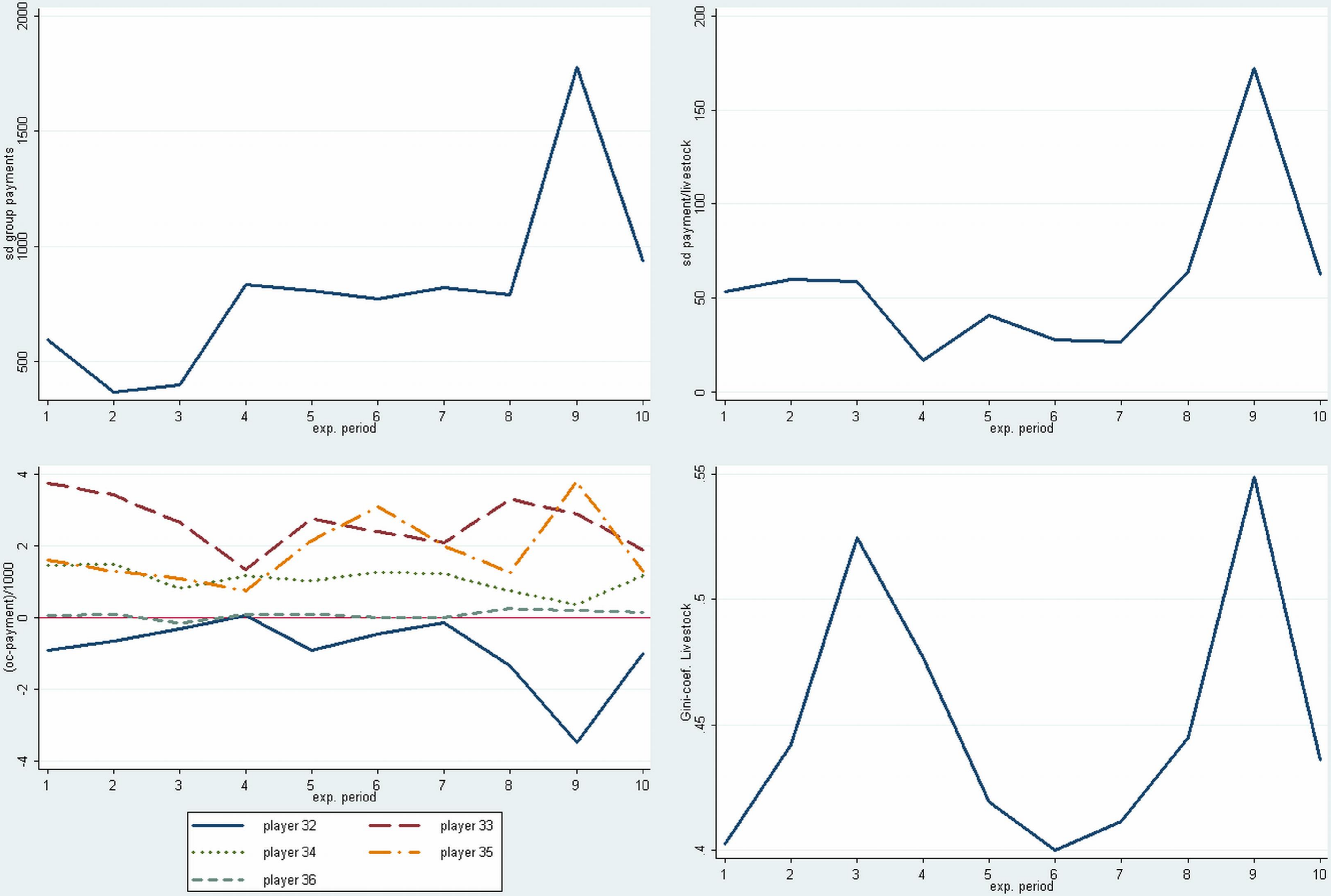


player 35
pearson correlation co-efficient = -0.9134
significant on the five percent level



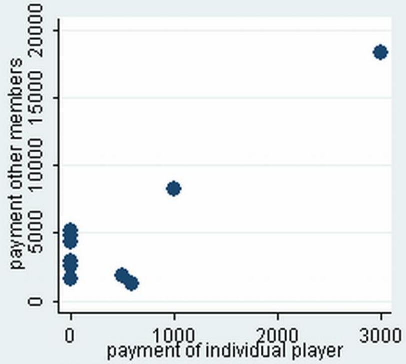
player 36
pearson correlation co-efficient = -0.0104
not significant on the five percent level

Appendix 8: Figures of group 11b

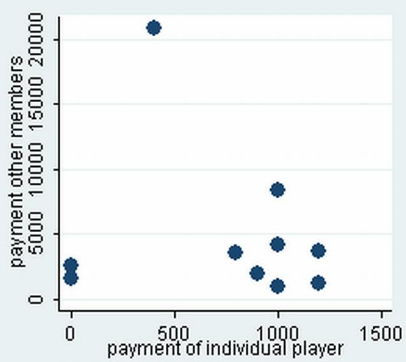


Appendix 8: Figures of group 12a

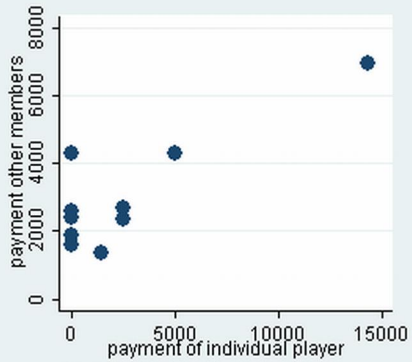
5 members; 3 ethnic group



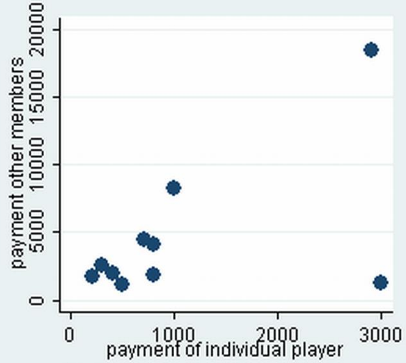
player 37
mean of individual 37's payment = 510
pearson correlation co-efficient = 0.8970
significant on five percent level



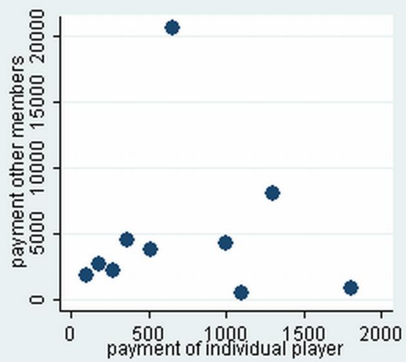
player 38
mean of individual 38's payment = 750
pearson correlation co-efficient = -0.1811
not significant on five percent level



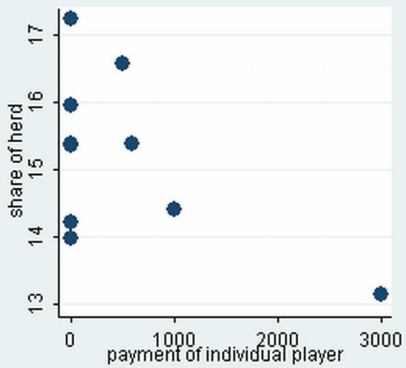
player 39
mean of individual 39's payment = 2583
pearson correlation co-efficient = 0.8411
significant on five percent level



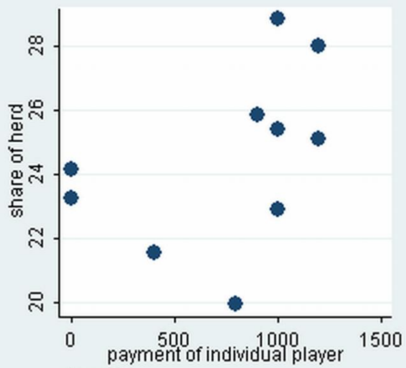
player 40
mean of individual 40's payment = 1060
pearson correlation co-efficient = 0.5576
not significant on five percent level



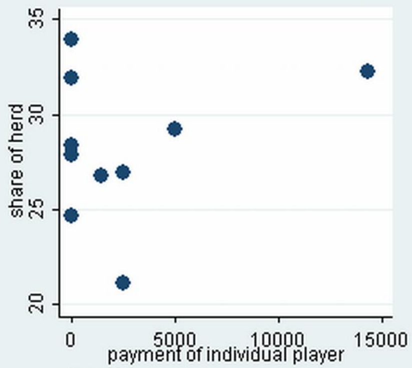
player 41
mean of individual 41's payment = 728
pearson correlation co-efficient = -0.0294
not significant on five percent level



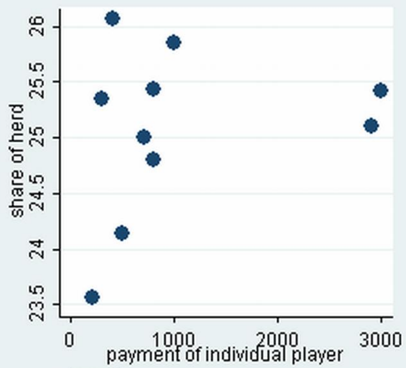
player 37
pearson correlation co-efficient = -0.5642
not significant on the five percent level



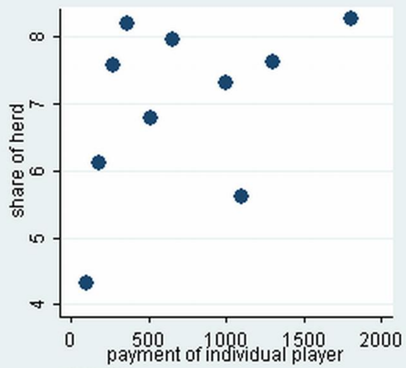
player 38
pearson correlation co-efficient = 0.4428
not significant on the five percent level



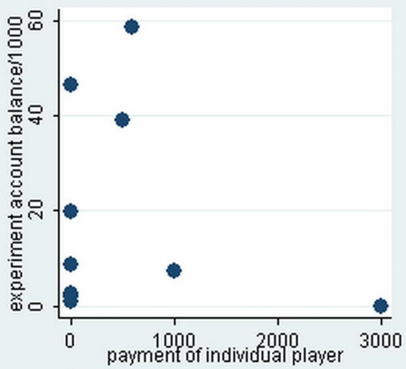
player 39
pearson correlation co-efficient = 0.2488
not significant on the five percent level



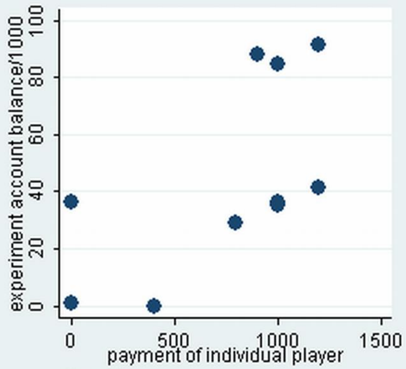
player 40
pearson correlation co-efficient = 0.2351
not significant on the five percent level



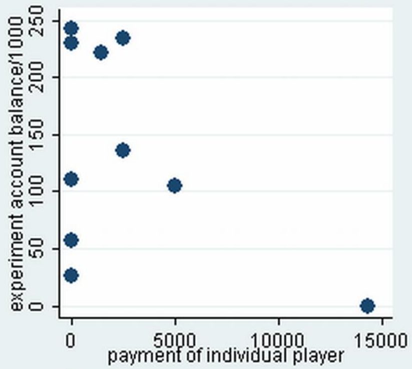
player 41
pearson correlation co-efficient = 0.4257
not significant on the five percent level



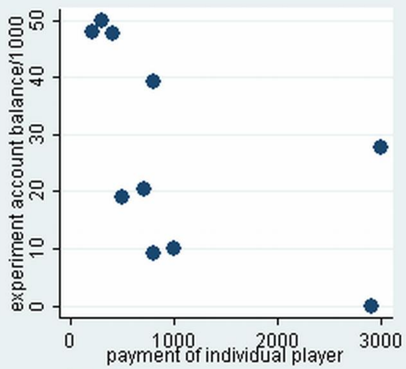
player 37
pearson correlation co-efficient = -0.1776
not significant on the five percent level



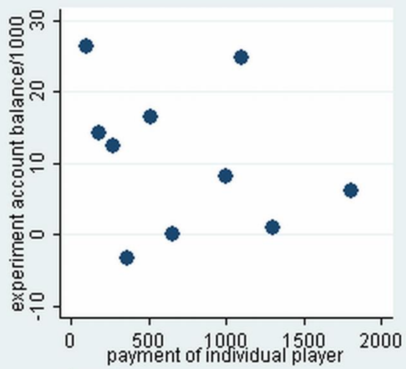
player 38
pearson correlation co-efficient = 0.6230
not significant on the five percent level



player 39
pearson correlation co-efficient = -0.4734
not significant on the five percent level

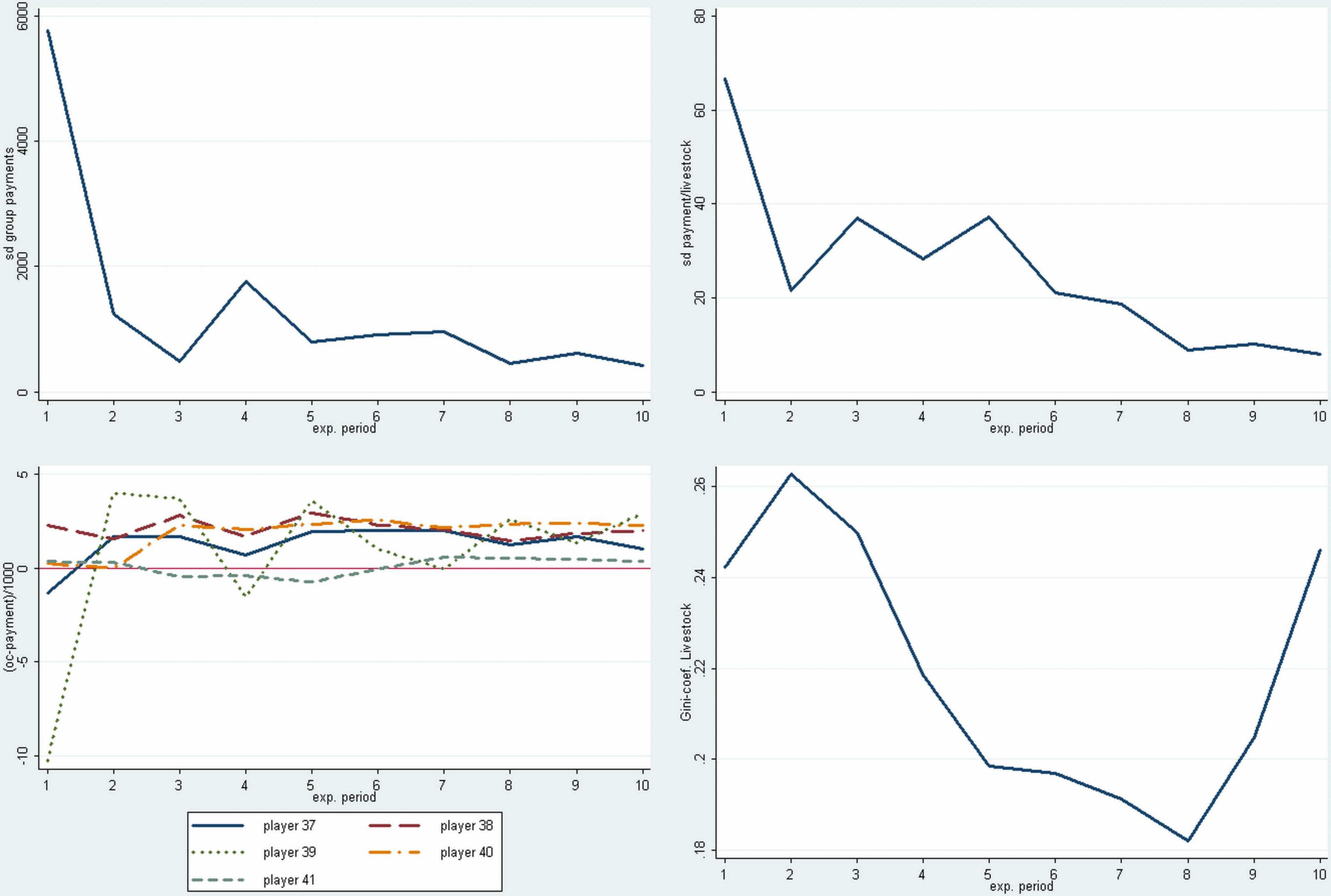


player 40
pearson correlation co-efficient = -0.5235
not significant on the five percent level



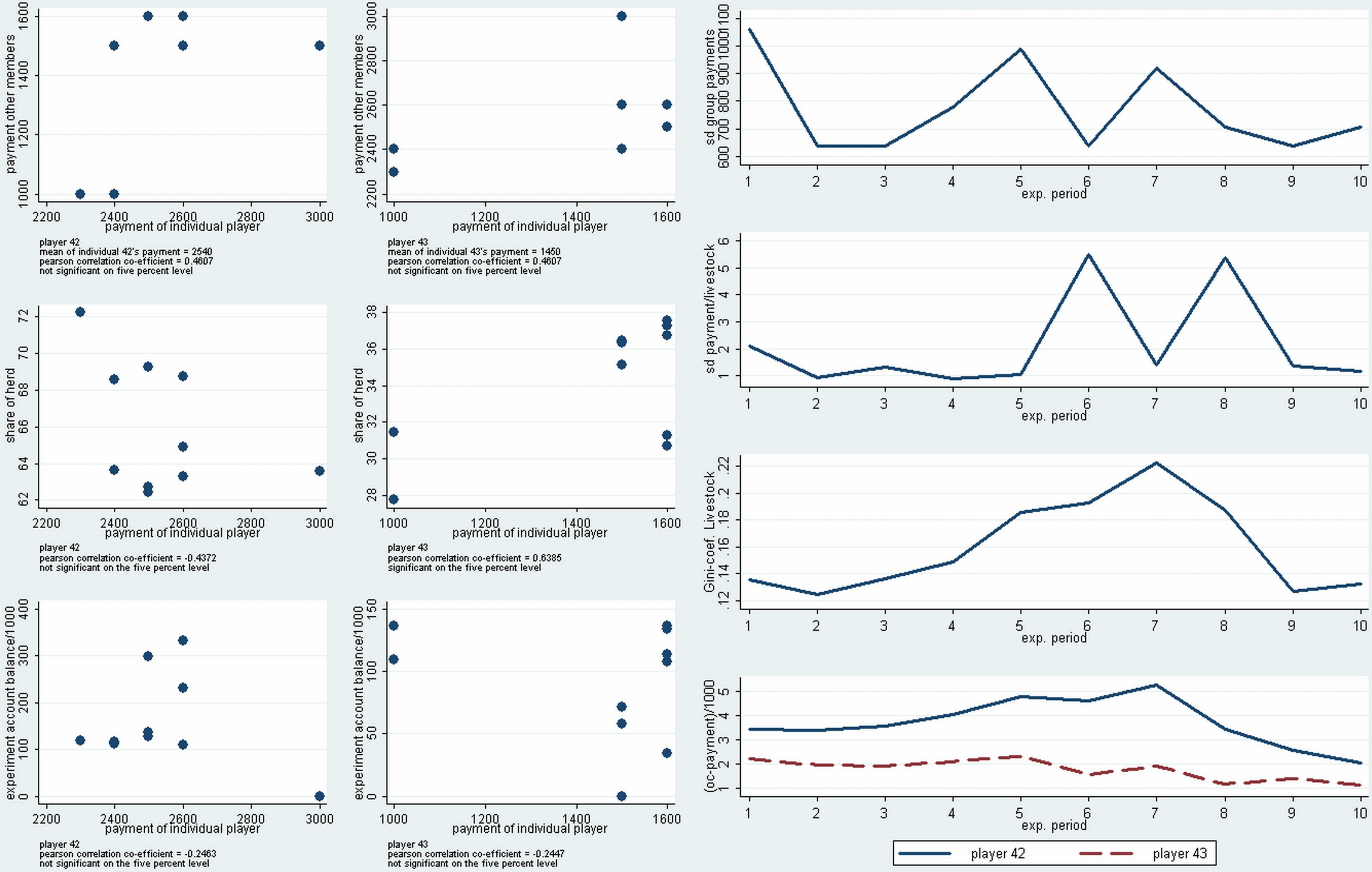
player 41
pearson correlation co-efficient = -0.2707
not significant on the five percent level

Appendix 8: Figures of group 12b



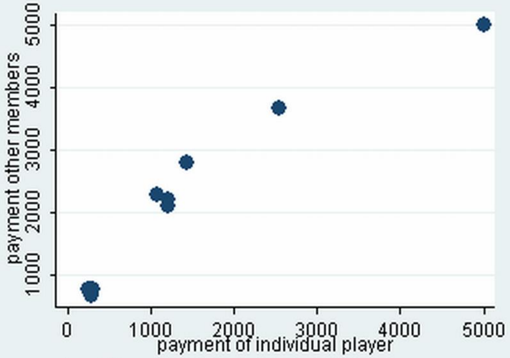
Appendix 8: Figures of group 13

2 members; 2 ethnic group

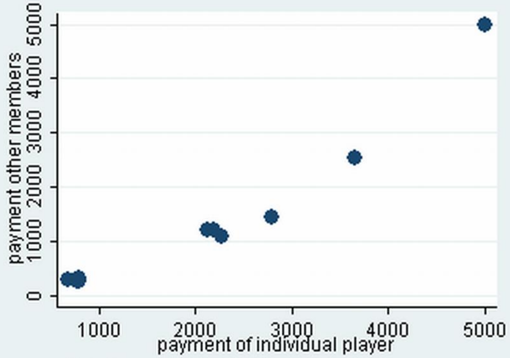


Appendix 8: Figures of group 14

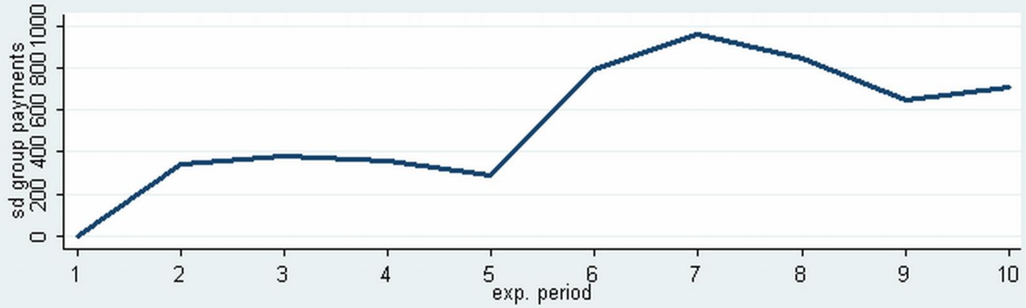
2 members; 1 ethnic group

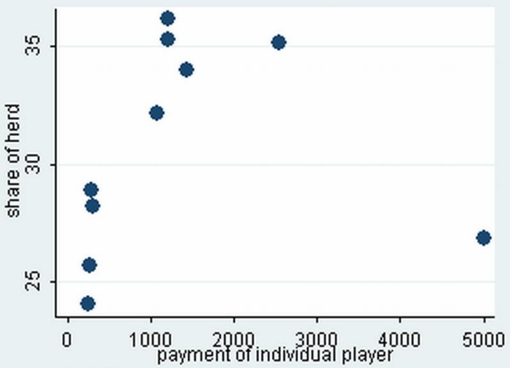


player 44
mean of individual 44's payment = 1357
pearson correlation co-efficient = 0.9567
significant on five percent level

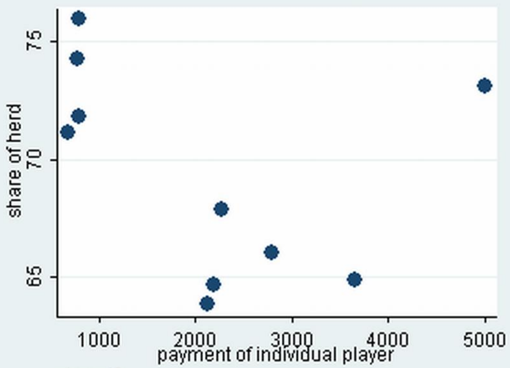


player 45
mean of individual 45's payment = 2111
pearson correlation co-efficient = 0.9567
significant on five percent level

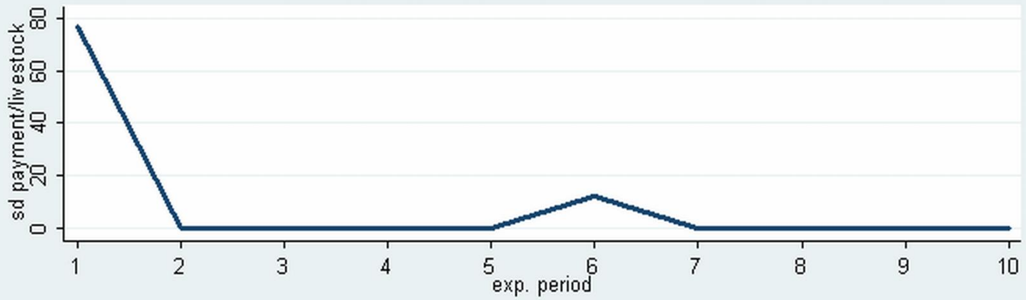


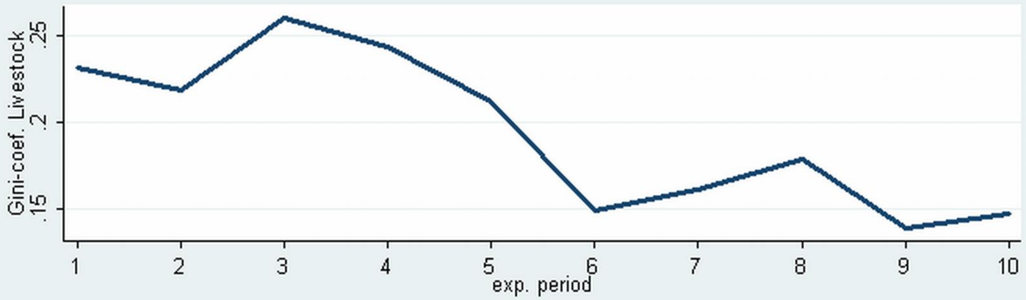


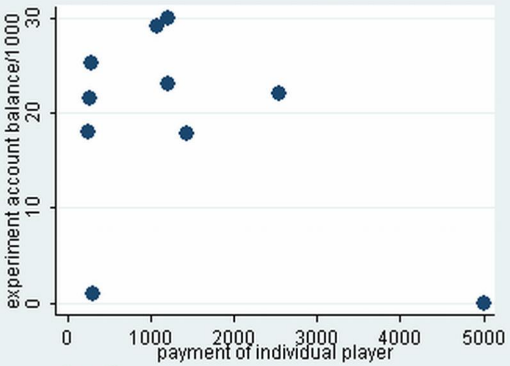
player 44
pearson correlation co-efficient = 0.1175
not significant on the five percent level



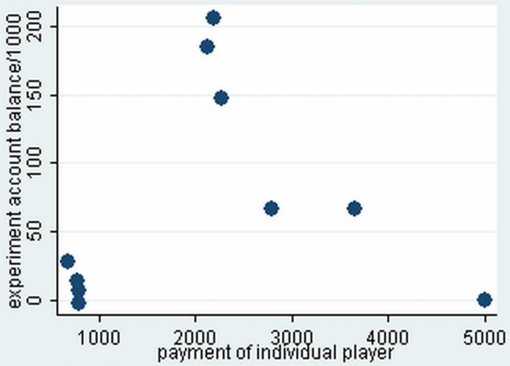
player 45
pearson correlation co-efficient = -0.3499
not significant on the five percent level







player 44
pearson correlation co-efficient = -0.4362
not significant on the five percent level



player 45
pearson correlation co-efficient = 0.1276
not significant on the five percent level