



Public-good games and the Balinese

Róbert F. Veszteg

*Departamento de Economía, Universidad Carlos III de Madrid,
Madrid, Spain, and*

Erita Narhetali

Faculty of Psychology, Universitas Indonesia, Depok, Indonesia

Abstract

Purpose – The Balinese have been successful for centuries in sustaining cooperation among the members of local communities in order to provide public goods through individual contributions. The purpose of this paper is to review and highlight the Balinese mechanism's remarkable features.

Design/methodology/approach – The paper surveyed the experimental literature on public goods and highlighted those features of the Balinese tradition that have been proven to be both effective in the experimental laboratory and successful in deterring free-riding on the field.

Findings – The most prominent features discussed are decentralization, democratic decision making, the use of two currencies, supervision, and the possibility of imposing severe sanctions for free-riding.

Social implications – The paper's findings not only can help to preserve the high level of cooperation among inhabitants in Bali threatened by migration flows and the increasingly intense reliance on the market mechanism, but they also provide general insights both for theoreticians and practitioners on how to create successful communities. In addition, the literature review sheds light on several features of public-good games that have not been satisfactorily explored yet by experimental economists.

Originality/value – The novelty of the paper's approach lies in looking at the Balinese tradition through the glasses of mechanism design theory and aligning the related findings of experimental economics in order to understand its success and problems.

Keywords Bali, Culture, Social norms, Communities, Local economies

Paper type Research paper

1. Introduction

Lietser and De Meulenaere (2003) describe from an anthropological point of view how Balinese sustain their ancient culture in spite of the growing influence of the outer world. The lesson to be learnt from the Balinese is not uniquely linked to religious activities, but to the successful provision of a larger set of public goods by the local communities.

The study of public goods has occupied a central place in social sciences since the 1950s (Samuelson, 1954; Olson, 1965) and has kept researchers busy ever since. The troublesome nature of the public goods lies in that they create a conflict between individual incentives and social welfare. While people may recognize that cooperation in providing the public goods represents a social optimum, they also may discover that free-riding on the others' contribution delivers a higher individual benefit.

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The traditional organization of local communities in Bali provides an exceptionally good example for a successful mechanism that mitigates this conflict and provides incentives for cooperation, i.e. to contribute to the public goods. The goods provided by the *banjar*, that rules the social, religious, and economic side of the community in Bali, and the *subak*, that rules the irrigation system, are categorized as classical public goods by economic theory for they are non-rival and non-exclusive[1]. The high degree of globalization of our world has raised concerns among the Balinese who fear the erosion of their culture and the deterioration of the community. Understanding what makes the Balinese mechanism successful also helps to find the best way to protect it.

In this article, we briefly review the vast and often-conflicting literature on public-good games from experimental economics in light of the rules set by the Balinese banjar that we shall refer to as the “Balinese mechanism” in the text. Our goal is to identify those features of the mechanism that have been making it successful on the field for centuries and have also been tested on abstract games in the experimental laboratory over the past decades. In doing so, although we avoid the usual mathematical details, we follow the mechanism-design approach (Jackson, 2003)[2]. When referring to the early literature we point to the review by Ledyard (1995) rather than to the original papers. Our philosophy is similar to Khwaja’s (2009) who analyzes field data from small communities in Northern Pakistan and argues that a good organization and careful (mechanism) design can make communities succeed even if they are otherwise poor on resources and lack social capital. In particular, he emphasizes the adverse effects of heterogeneity and social inequality, but claims that communication, the choice of projects that fit the community and leadership can compensate.

2. An economic public-good game

Economic theory describes the problem of public-good provision through individual contributions as a game in which players (i.e. the members of the community) have to decide how much money to contribute to the creation of a public good and how much to spend on private goods. Owing to the non-rival and non-exclusive nature of the public good, the equilibrium prediction is that players have incentives to free-ride on others and therefore individual contributions will be suboptimal (Ledyard and Roberts, 1975)[3]. This effect is known as a social dilemma in the broader literature including psychology and sociology.

Laboratory experiments on public goods have been present in the economic literature since the early 1970s (Bohm, 1972). In the typical experimental design based on Isaac *et al.* (1984), participants are endowed with a certain amount of money that they have to split and invest in a private and/or a public account. Investment decisions are made simultaneously and privately. The balance of the private account is cashed individually, while the balance of the public account is doubled (or multiplied by any other constant c larger than one, but smaller than the number of participants) and distributed among all participants in equal shares. free-riding arises as a theoretical equilibrium, because the gross individual benefit derived from every monetary unit contributed to the public good is $2/n$ (or c/n in the general case) that is smaller than one, which makes the net benefit of contributing negative. While the equilibrium prediction is that nobody contributes, the socially optimal outcome in the typical public-good experiment would be everybody contributing her whole endowment to the public account.

The usual feedback participants receive at the end of each period solely includes the aggregate contribution to the public account and their individual return on the investment. The game is generally repeated with changing groups for a number of times that may be specified or unspecified a priori[4]. This voluntary-contribution game offers a simple and clean example of a situation in which individual and collective interests are in conflict[5].

Ledyard (1995) surveys the early experimental literature whose main conclusions he summarizes in a three-points list:

- (1) Participants contribute more than predicted by economic theory. However, contributions are lower than the efficient level.
- (2) Individual contributions decline with repetition, but tend to remain strictly positive.
- (3) Communication can raise contributions.

The meta-analysis performed by Zelmer (2003) using 27 studies on public-good games confirms Ledyard's observations and conjectures in that communication among subjects does increase contributions and that contributions otherwise tend to fall sharply between the first and the last experimental period. In addition to these results, Zelmer (2003) finds that a higher marginal return on the public investment and the presence of heterogeneous initial endowments also have a positive effect, while the group size and its gender composition are unimportant as for the individual contributions. We shall come back to some of these effects later.

Two lines of the literature emerged from these findings that seem to be in contradiction with economic theory. One line follows Kim and Walker (1984) who argue that the situations created in the experimental laboratory often do not correspond to the problems addressed by economic theory. They talk about invalidating factors and, among others, they list the presence of "small groups", "insufficient economic motivation", "misunderstanding and vagueness", and "unknown group optimum" due to unobserved preferences as possible explanations for the unexpected weak free-riding results reported from experiments. The other line in the literature looks at behavioral effects and explains the observed deviations from theory by incorporating considerations of fairness, altruism, reciprocity, and/or inequality aversion in the underlying model (Fehr and Schmidt, 1999).

We follow this second line and review the literature of the past two decades that has been looking at features that enhance cooperation (and reduce the problem of free-riding). We discuss its findings that can be relevant to explain the success of the Balinese mechanism.

3. The *banjar*

The Balinese people have been living in complex social networks that influence both their religious and secular lives (Lorenzen *et al.*, 2005; Lietaer and De Meulenaere, 2003). They are not only inhabitants of their geographical village (*desa*), but also belong to a customary hamlet (*banjar*), a kinship group (*dadia*) and an agricultural irrigation network (*subak*). In spite of their name-specific goals, all of them impose social rules upon their members.

Banjars are usually composed by two units (Warren, 1993). The *banjar adat* deals with religious affairs that include praying and funeral services, while the *banjar dinas*

is responsible for civil affairs like issuing identification cards and other legal documents. The banjar dinas is defined strictly geographically and immigrants join it automatically. Newcomers are not forced into any banjar adat, but they can enter without turning to Hinduism. The public-good provision is the joint responsibility of both banjar units, therefore in what follows we consider them together and refer to them as the banjar.

The primary concern here is the provision of public goods, therefore our review focuses on the civil unit represented by the banjar[6]. Banjaras are defined by geographical boundaries such as roads, rivers, forests, or rice fields, and have been important for more than 1,000 years in organizing the Balinese's lives. Their size varies greatly from a few dozens to more than 1,000 members. The fundamental goal of the banjar is to sustain the community by directing its members' activities and interests towards cooperation in providing (public) goods for the entire community.

The most prominent features of the rules governing life in the banjar are decentralization, democratic decision making, the use of two currencies, supervision, and the possibility of imposing severe sanctions for free-riding.

3.1 Decentralization and democracy

The mere existence of the banjaras and other social units proves that the Balinese' everyday life is organized from below on a decentralized basis and is governed by the rules of a simple mechanism rather than an omnipotent ruler. Although each banjar has its leader, he is elected by majority vote, tends to be *primus inter pares*, does not receive any monetary compensation and can be dismissed by the majority at any point in time.

As many other social organizations across Asia, the banjar is ruled and run by men. Meetings are attended uniquely by men, while women are entrusted with different tasks. The differences between gender roles are rooted deep in Hindu beliefs and make the Balinese social structure strongly patrilineal. We do not discuss the conflict between this feature of the mechanism and the general democratic values.

The banjar meets regularly and decides all its activities democratically using the majority voting scheme. Projects are monitored constantly and can be cancelled whenever the majority decides so[7]. The importance of communication in promoting cooperation has been proved by the experimental literature (Ledyard, 1995).

We cannot but speculate on the further effects of the democratic organization of the banjar, given that experimental economics has paid scarce attention to it. The only experimental results on related issues that we are aware of are presented by Anesi (2008), Mittone and Bortolami (2007) and Tyran and Feld (2006).

Anesi (2008) builds on the theoretical work by Bénabou and Tirole (2006) who show that incentives to promote pro-social behavior may actually reduce the total contribution, because these make signaling one's intrinsically pro-social nature more difficult and affect personal motivations (over-justification effect). The experimental design by Anesi (2008) let participants vote on the monetary incentives to be provided in the future interaction. He finds that even if people attach a high value to participation in the community, they may choose very weak incentive schemes to promote such behavior due to social reputation and self-esteem concerns.

Mittone and Bortolami (2007) assigned participants into two groups. One of them, the constituent group, had the opportunity to create a punishment (or incentive) scheme to promote cooperation among members by discussing and determining who and exactly

how should be punished. Then, the usual public-goods game was played and the scheme was implemented both in the constituent group and in the other (control) group for which it represented an exogenously imposed rule. The authors find that self-determination creates a higher level of efficiency as compared to the exogenously given case.

Tyran and Feld (2006) studied a similar design. In one treatment, a “mild law”, i.e. a weak punishment mechanism that is unable to induce cooperation or a high contribution level, was imposed on the participants, while in the other treatment the same law could be endogenously introduced. They find that a mild law has no effect on contributions if it is exogenously introduced, but it boosts cooperation if it is self-imposed.

The fines imposed by the banjar on non-cooperating members are determined at the meeting for each project separately. They vary according to the characteristics of the project and also according to the economic status of each member. It is usually adjusted to the targeted person’s wealth and tends to lower than the average hourly wage (around 15,000 IDR, i.e. approximately \$1.5). Note that the principal role of these fines is not to threaten the target’s economic situation, but to tag his reputation and status as a member of the banjar.

Many banjars not only vote and determine the monetary fine that must be paid for each time block missed and with it tailor the incentives, but they most importantly use majority voting to select among public projects. To the best of our knowledge, the effect of this feature has not yet been explored in the experimental laboratory.

3.2 *Two currencies*

The banjar budgets all its activities in two currencies: in rupiah (the Indonesian national currency, IRP) and *nayahan banjar*, i.e. roughly three hours of work for the banjar, or simply time. Both currencies are scarce, although their relative scarcity differs across banjars. The striking difference between the two is that time cannot be stored or accumulated and everyone receives the same endowment of it day by day. Even if the opportunity cost of contributing one’s time to the community may differ among people, the fact that banjar members with more money tend to have a higher opportunity cost and those with less money a smaller opportunity cost helps to balance wealth across people in aggregate terms[8].

Even if the use of two currencies, especially money, may seem to be equivalent to the canonical mechanism with monetary fines, we discuss this feature separately and later refer to the practice of ostracism as the punishment scheme in the Balinese mechanism.

Possibly the use of two currencies is the most prominent and distinguishing feature of the mechanism that calls for future investigation in the experimental laboratory. On one hand, it represents a democratic system in which agents are allowed to choose the form of their contributions. On the other, it seems fair, because even if money is not distributed evenly among agents, their time budget is completely homogeneous.

3.3 *Heterogeneity*

There do not exist clear-cut theoretical or experimental results on the effect of heterogeneity on the level of individual contribution in public-good games. Even if agents differ in several economic and non-economic aspects in real-life problems, economic theory tends to focus on the representative agent and ignore heterogeneous groups.

With the help of a theoretical model, Bergstrom *et al.* (1986) show that the aggregate contribution does not depend on small reallocations of agents' endowments, i.e. heterogeneity has no effect on the equilibrium. The experimental papers that address the issue of heterogeneity reviewed by Ledyard (1995) find either no effect or some negative effects on the aggregate level of contribution.

Chan *et al.* (1999), in line with the sociology literature, report experimental results showing that heterogeneous environments may increase the probability of finding a critical group of agents who are willing to contribute to the public good. However, they use a non-linear setup and conjecture that the finding that heterogeneity has a positive effect on aggregate contributions may be applicable only to that particular case.

Cherry *et al.* (2005) revisit the linear public-good game and confirm that "contribution levels were significantly lower when groups had heterogeneous rather than homogeneous endowments, with this finding being independent of the origin of endowment." Also Kopelman (2008) suggests that group culture plays a significant role in how people think, feel, and behave in resource allocation settings.

Some other authors also expect and find that inequalities make people less willing to cooperate with each other. Castro (2008) observes that British subjects contribute significantly more in public-good experiments when interacting in nationally homogeneous groups, while they contribute less in heterogeneous ones (when playing together with Italian subjects). Alesina and La Ferrara (2000) use survey data from the USA to confirm that "participation in social activities is significantly lower in more unequal and in more racially or ethnically fragmented localities." They measure heterogeneity both in term of race and income, and proxy participants' participation in the community by using information on their membership in different organizations (political groups, religious groups, unions, school associations, service groups, fraternities, sports and hobby clubs, etc.). This latter approach does not seem to fit to the banjar, because the question is not whether to be a member or not (it is determined geographically), but whether to be an active, participating (contributing) member or not.

The discussion on the effects of heterogeneity in Balinese mechanism is still open, although it still seems to be a topic of rather minor importance, since Balinese banjars are ethnically and religiously homogeneous units. Hindus represent approximately 95 percent of the population and therefore the members of the banjars. The Balinese society is heterogeneous along other characteristics, i.e. in terms of the caste that people belong to.

3.3.1 Valuation of the public good. The democratic decision-making process to choose among public projects makes contributions more meaningful, because in a way it makes the project more equally important to all banjar members. This also means that the projects are more likely to be carried out. One could argue that this translates into a higher return on investing in the public good that has been shown to raise individual contributions (Ledyard, 1995).

The banjar provides numerous public goods that can be important to its members in different ways. However, religious rituals and the event that the Balinese are most concerned about are typically organized by the banjar. The perhaps most important ritual, the funeral ceremony (*ngaben*), is also provided in a collective way.

3.3.2 Status and wealth. Status has been proved to have a significant effect on economic performance even it is earned on a purely random basis. Ball *et al.* (2001) report that subjects with a higher status tend to capture a larger share of the surplus to be divided on a competitive market.

Anderson *et al.* (2006) study the effect of status differences in a classic public-good game by assigning different amounts of money as show-up fee to participants in the experiment. They find that the general level of contributions is significantly lower when the presence of inequality is public knowledge. It is interesting that this between-treatments variation is not accompanied by a more disperse distribution of individual contributions.

This effect could give a serious challenge for the banjar as it is a rather heterogeneous group in term of its members' castes. In the Balinese society, one's caste symbolizes one's status, and also one's rights and liabilities in the banjar. However, caste and wealth are not perfectly correlated, and sometimes people from a lower caste are more affluent than those from a higher one[9].

3.3.3 Members. Since banjars are defined geographically and culturally, their membership does not change in large extent over time. This fact can be particularly important in the formation of the governing social norms. Duffy and Ochs (2009) show that with experience, i.e. with repetition or with time, cooperation emerges as a norm if groups are fixed, while non-cooperation becomes the norm otherwise. They report data from a series of two-person prisoner's dilemma games with different matching rules and find that trying to establish cooperation as a social norm when groups are random (change radically from period to period) is futile. It is interesting that a change in the matching rule will have the described effect in spite of the existence of a well-established social norm with sufficient history.

Banjars tend to be rather stable social units. While it is not unheard of people changing their memberships, there must exist a very special reason for doing so. Typically it is the consequence of having received the most severe of all possible punishments from the banjar, that is expulsion (*kasepehang*).

Although Balinese do not change their banjar membership unless they are forced to do so, immigration does induce constant changes and introduces more heterogeneity. While the banjar needs people in order to accomplish its social, cultural, and religious duties, the newly arrived immigrants often refuse to participate. Nowadays, there is a growing concern on these negative effects of immigration and Balinese are considering a total ban on purchasing land and properties targeted at non-Balinese. Possibly, the negative effects of immigration pose the most important threats to the existence and success of the banjars.

3.4 Sanctions

The largest part of the recent experimental literature on public-good games has focused on the role of costly punishment in enhancing cooperation ever since the possibility of punishment first appeared in the experimental design of Fehr and Gächter (2000). Kosfeld and Riedl (2004) divide the studies in two groups according to who punishes. In the decentralized-punishment group punishment is exercised by participants individually, while in the centralized-punishment group it is delegated to a central authority. In any case, the main question whose answer is being looked for by the literature is whether participants are willing to punish or not.

The banjar does not fit into the existing body of literature, since its punishment rules and institution are determined by the tradition and do not allow for modifications. The banjar makes its decisions on punishment by majority voting and they are executed in a centralized form. This feature reduces the possibility of punishment

triggered by non-strategic motives such as anger and disapproval (Rabin, 1993; Falk and Fischbacher, 2006), or inequality aversion (Fehr and Schmidt, 1999).

Punishment technically appears in three forms; monetary, religious, and physically. On one hand, members can decide to pay a pre-determined amount of money (that typically depends on the relative size of the public project to be carried out as compared to the size and possibilities of the banjar) instead of contributing physical work to the community. While it is often considered as a monetary fine, technically it is part of the individual contribution to the public good, since it cannot be fully enforced. On the other hand, non-cooperating members are excluded from the banjar. This technique of ostracism represents the ultimate punishment and threat whose severe consequences people describe as “lie down and die”[10]. While other forms of punishment have been extensively studied in the experimental laboratory, ostracism has appeared only in a few designs.

3.4.1 Decentralized punishment. Fehr and Gächter (2000) have shown that subjects are willing to punish free-riders even if it is costly and does not give immediate monetary benefits, given that their experimental design had an ex-ante known finite horizon and randomly changing groups from round to round[11]. They report that individual contribution levels converge to very low levels in the no-punishment treatment, while an average contribution rate between 50 and 95 percent (of the individual endowment) is maintained in the punishment treatment. Although some authors identify the detrimental effect of sanctions (Fehr and Rockenbach, 2003; Houser *et al.*, 2005), most experiments show that punishment is a successful device to promote cooperation even if punishment is non-strategic, i.e. cannot serve to build up reputation[12]. Punishment tends to be directed towards free-riders, although Cinyabugama *et al.* (2006) estimate by using previous experimental data (Fehr and Gächter, 2000) that roughly 15 percent of the punishment was targeted at the highest contributor and around 25 percent at above-average contributors.

These results are robust to changes in the group size (from five to ten) and the amount of information participants hold (Carpenter, 2007). While group size does not seem to have a significant effect on the probability and the amount of punishment, the more participants can observe and punish, the higher is the aggregate contribution level. Nikiforakis and Normann (2008) show that individual contribution levels depend on the effectiveness of the punishment technology. They find that high effectiveness, i.e. a high fine-to-fee ratio, translates into a higher level of contribution. Also, punishment is unable to induce cooperation below a certain fine-to-fee ratio. Also, Casari (2005) notes this problem and calls for controlling the effect of a changing fine-to-fee ratio before deriving conclusions.

Anderson and Putterman (2005) show that punishment responds to the law of demand in that a lower punishment cost makes punishment more frequent. However, it is interesting that subjects punish even if the cost of punishment is higher than the fine imposed.

Masclot *et al.* (2003) report data from a treatment in which participants could not impose monetary fines, but only express their disapproval by assigning “disapproval points”. The authors replicate the standard results on punishment by Fehr and Gächter (2000). The striking conclusion is that non-monetary sanctions are also able to maintain a high contribution level, although monetary sanctions are more effective. Similarly, Fudenberg and Pathak (2010) find that agents keep punishing even if punishment is not observed

until the very end of the experiment, and more importantly they keep cooperating. This shows that, on one hand, agents enjoy punishing and also that they expect free-riders to be punished. Casari and Luini (2009) observe similar patterns: even if a consensus is required to carry out a punishment, agents do not coordinate on punishing, i.e. agents seem to derive satisfaction from the act of punishing directly and not from the results that the punishment achieves in others' behavior. Brandts and Rivas (2009) add that harsher punishment possibilities have a significant positive effect on agents' well-being.

When describing decentralized incentive schemes a natural question is whether reward can have the same positive effect on promoting cooperation as punishment. Sefton *et al.* (2007) find that rewarding is less effective, especially if long-run contributions are considered. In particular, subjects tend to punish free-riders more often than to reward those who contribute above average. In light of the previously mentioned results on non-monetary sanctions, it seems that the mere threat of being punished or disapproved is enough to deter from free-riding, while rewards must actually be paid in order to have an effect. A related study (Gürerk *et al.*, 2009) shows that group leaders prefer rewards to sanctions initially, but this changes over time. A switch to sanctions raises aggregate contributions immediately and durably, while in groups that keep using rewards contributions tend to decrease.

3.4.2 Endogenous rules. Rockenbach and Wolff (2009) present results from an interesting experimental design in which participants are free to decide the rules for punishment. They find that punishment is widely used, however it diminishes over time and subjects seem to contextualize the situation. The main implication of their study is that subjects design centralized punishment schemes[13]. It puts the banjar rules into perspective and may explain the centralized nature of their punishment scheme even if it is determined democratically by the majority-voting scheme.

The experimental design by Casari and Luini (2009) lies close to the punishment rule used by the banjars based on a voting procedure. The authors organized participants into groups of five and conditioned punishments to the support of a coalition of at least two members (consensual rule). In other words, they required the consent of at least 50 percent of the agents (not counting the to-be-punished one). They find that the consensual rule greatly enhances cooperation.

Also Ertan *et al.* (2009) find that punishment schemes can evolve endogenously to mitigate the free-riding problem. More importantly they observe that perverse punishment (punishing agents who contribute above the average) is easily controlled and eliminated if the punishing strategy is determined by voting.

3.4.3 Centralized punishment. Apart from the above observations on centralized punishment schemes emerging endogenously, Kosfeld and Riedl (2004) argue that agents may lack the necessary information and punishment technology to carry out punishments in a decentralized form. Moreover, individual punishment may be too costly. Therefore, agents would opt for creating a central monitoring and sanctioning agency that is often called Leviathan in the literature.

Kosfeld and Riedl (2004) find that in 60 percent of the cases subjects implement a centralized punishment institution that helps to achieve the socially efficient outcome, and even if in the remaining 40 percent of the cases such an institution does not emerge, contribution levels tend to be high (especially in the later rounds of the experiment)[14].

O'Gorman *et al.* (2009) show that centralized punishment, i.e. allowing a single group member to punish is as successful in maintaining cooperation as the

decentralized punishment scheme. Moreover, it is more efficient (it results in a larger group benefit), because it avoids unnecessary over-punishment.

The literature on centralized punishment is scarce and leaves wide room for further studies on how these schemes emerge, how their cost and punishment technology determine their success in promoting cooperation.

3.4.4 Ostracism. Although experimental studies on public-goods games with voluntary contributions have shown that the possibility of individual and/or centralized punishment enhances cooperation and raises the total contribution towards the public good, we must not forget about some interesting negative results on monetary incentives presented by Gneezy and Rustichini (2000). They used a field experiment to check the effectiveness of monetary penalties in inducing punctuality to parents who normally used to arrive rather late to collect their children at several day-care centers. The authors find that after the introduction of a monetary fine for late coming, the number of late-coming parents increased significantly, while the abolition of the incentive scheme left the situation unchanged. It seems that the usual homogeneity assumption in economic theory that operates with a representative agent is violated. This makes the problem similar to a principal-agent relationship with incomplete contracts and explains the unexpected change in individual behavior. Also, many experimental results show that maintaining a high level of cooperation is difficult over a long period of time (Isaac and Walker, 1988).

While ostracism can be deemed to be an extremely harsh punishment and incentive scheme, it avoids the above-described adverse affect of monetary incentives. Ostracism is also an empirical phenomenon that has appeared in many situations and points in time (Gruter and Masters, 1986). Maier-Rigaud *et al.* (2005) report that ostracism as a punishment scheme increases the aggregate contribution levels (above ones in the usual public-good games) and its net effect is positive even if we account for losses due to a smaller group size[15]. In the Balinese mechanism this loss is minor, since banjars tend to be rather big when compared to the typical experimental subject pool.

Similarly, to the previously discussed unobserved and non-monetary decentralized punishments, the mere threat of ostracism can sustain high cooperation levels (Kerr, 1999). Just like it is done in practice by the banjars, Cinyabuguma *et al.* (2005) let subjects practice ostracism based on the majority voting scheme. It turns out that as a consequence, non-excluded agents contribute at a close-to-maximum level.

Riedl and Ule (2003) find similar effect in an experiment on the prisoner's dilemma game in a network of six agents. In spite of theory suggesting against it, agents tend to choose not to play with defecting neighbors. Free choice of social links increases cooperation levels drastically and especially so in groups that stay connected after having excluded some of their members. Similarly to other sanctioning schemes, ostracism is also affected by the amount of information agents hold. High information implies high cooperation.

3.5 Information

Banjars are stable social institutions in which members share a large amount of information among each other. Experimental results suggest that also this feature is important to sustain cooperation.

Duffy and Ochs (2009) based their experiments on the two-player prisoner's dilemma game that does not allow for punishment. They find that randomly formed

and ever-changing groups are unable to establish cooperation as a social norm. Interestingly, this is the case even if members carry their personal history and can check the others' personal history before playing the game.

Similarly, Carpenter (2004) brings the psychological idea of conformity into picture and argues that people tend to conform in case they lack information and/or cannot figure out what is the most beneficial action. He claims that most participants are confused at the beginning of the experiments and look at others to find out (to copy) what to do. In light of these thoughts, it does not matter whether groups are changing or not, agents learn together and eventually they learn to free-ride.

Croson and Shang (2008) conducted a field experiment linked to a fund-raising campaign of a local radio station. Renewing members were given some information related to the others' contribution. It turns out that agents tend to change their contributions in direction towards the social information, and this works both upwards and downwards. Interestingly, the effect of downward information (the social information is higher than the previously observed individual contribution) is stronger. This suggests that social comparison theory (Festinger, 1954) accounts for observed behavior and that people wish to conform the social rules and wish to do it cheaply. In other words, agents do compare themselves to others, especially when objective standards for enough cooperation/contribution are not available.

There is no such competition among members of the banjar in terms of their contributions to the public projects. As discussed before, the threat of ostracism plays the role of an ultimate punishment, there does not exist other negative or positive incentives in the Balinese mechanism.

Related to the punishment technology, Dickinson (2001) shows that the best way of enhancing contributions toward a public good is through "handicapping", i.e. tailor the rewards and fines according to the individual contribution compared to the endowment. Unfortunately, that amount of information may not be readily available for agents or the central sanctioning agency.

This observation is in line with the previously discussed effects of information according to which cooperation increases when more agents can be monitored and/or the monitoring technology improves.

However, information may have surprising effects as reported by Nikiforakis (2010). He finds that cooperation is lower when agents receive informational feedback on the evolution of payoffs instead of the contributions as it is usually the case (following the original experimental design by Fehr and Gächter, 2000). The difference is significant even if agent should be able to transform any of these types of information into the other.

4. Conclusions

The secret of the long historical effectiveness of lively Balinese communities seems to lie in the rules imposed by centuries-old tradition. The Balinese mechanism joins a number of features that deliver incentives to promote individual contribution to public goods whose success has been proven in numerous experiments in distant locations with culturally very different participants.

Not only has experimental economics produced fairly general scientific proofs to understand the Balinese mechanism, but the latter also suggests interesting paths for future research on public goods created by individual contributions. For example, to explore the two-currency system in the experimental laboratory. We hope that our

review can help to protect the Balinese mechanism by highlighting its remarkable features without which it would lose its effectiveness and its ultimate *raison d'être*. The most challenging problems that the banjars face in the present are linked to heterogeneity, in particular to immigration and to the increasingly more frequent use of monetary contributions instead of time and personal work that breaks the banjar's historical equilibrium.

Notes

1. Lietaer and De Meulenaere (2003) point out that most of them are created for the benefit of the local community, although a small portion is destined to tourists. Even the latter case falls under the economic category of public goods since the benefits raised from tourism are typically shared by the whole community.
2. The goal of mechanism design is to study how the institutions in which strategic people interact influence the outcomes, and also to provide mechanisms that deliver efficient ones. The assumption of strategic, i.e. rational and selfish, participants is rooted in game theory that provides the technical tools to mechanism design.
3. Suboptimal as compared to the efficient, i.e. socially desirable, level. The incentives are usually strong in this game and make free-riding a dominant strategy.
4. The importance of not determining how many times the game would be repeated is to approximate the theoretical model of an infinitely repeated game in which cooperation, i.e. positive contributions, can arise as an equilibrium.
5. The so-called prisoner's dilemma appears also frequently in the literature on cooperation and public goods, because it has a dominant-strategy equilibrium that is not Pareto efficient. It can be considered as a special two-player version of the discussed public-goods game, therefore we do not study it separately.
6. Refer to Warren (1993) and Lietaer and De Meulenaere (2003) for a more detailed description and a broader anthropological study.
7. Although there is evidence that the sequential nature of real-life contributions to public goods may achieve a higher level of efficiency, i.e. aggregate contribution (Coats *et al.*, 2009), we concentrate on the simultaneous problem here as typically do the experimental and theoretic literature.
8. The opportunity cost of a decision is an economic term that represents the highest lost net benefit that could have been obtained by choosing a different alternative. In case of dedicating time to community work, the opportunity cost can embed lost salaries or the personal value of unperformed recreational activities.
9. Banjars can have members from several different castes. In that case all members would have the same rights, while their liabilities would differ.
10. The threat of ostracism has a very powerful effect that complements that of possible monetary fines. For example, not attending the banjar meeting usually implies a small fine of 1,000 IDR (about \$0.1) that is collected every six months. Anecdotal evidence shows that if Balinese decide to show up, they mainly do so in order to not to create a bad reputation and risk the severe punishment of ostracism.
11. Precisely these two features, i.e. the lack of material incentives to punish, make their study different from the seminal paper by Ostrom *et al.* (1992).
12. The non-strategic nature of the observed punishment goes beyond the game-theoretic folk theorem that applies to repeated games and shows that cooperative Nash equilibria may arise.

13. Rockenbach and Wolff (2009) categorize their experiments as third generational, for subjects do not only use exogenously-given punishment rules (first generation) or choose between two possible punishment schemes (second generation). The Balinese mechanism is closest to the first generation, since rules are given by tradition, although banjar members are free to decide whom to punish.
14. The related theoretical results are provided by Okada (1993).
15. For a theoretical discussion refer to Hirshleifer and Rasmusen (1989).

References

- Alesina, A. and La Ferrara, E. (2000), "Participation in heterogeneous communities", *Quarterly Journal of Economics*, Vol. 115 No. 3, pp. 847-904.
- Anderson, C.M. and Putterman, L. (2005), "Do non-strategic sanctions obey the law of demand? The demand for punishment in the voluntary contribution mechanism", *Games and Economic Behavior*, Vol. 54 No. 1, pp. 1-24.
- Anderson, L.R., Mellor, J.M. and Milyo, J. (2006), "Inequality and public good provision: an experimental analysis", *Journal of Socio-Economics*, Vol. 37 No. 3, pp. 1010-28.
- Anesi, V. (2008), "Incentives and prosocial behavior in democratic societies", *Journal of Economic Psychology*, Vol. 29 No. 6, pp. 849-55.
- Ball, S., Eckel, C., Grossman, P.J. and Zane, W. (2001), "Status in markets", *Quarterly Journal of Economics*, Vol. 116 No. 1, pp. 161-88.
- Bénabou, R. and Tirole, J. (2006), "Incentives and prosocial behavior", *American Economic Review*, Vol. 96 No. 5, pp. 1652-78.
- Bergstrom, T.C., Blume, L.E. and Varian, H.R. (1986), "On the private provision of public goods", *Journal of Public Economics*, Vol. 29 No. 1, pp. 25-49.
- Bohm, P. (1972), "Estimating demand for public goods: an experiment", *European Economic Review*, Vol. 3 No. 2, pp. 111-30.
- Brandts, J. and Rivas, M.F. (2009), "On punishment and well-being", *Journal of Economic Behavior & Organization*, Vol. 72 No. 3, pp. 823-34.
- Carpenter, J.P. (2004), "When in Rome: conformity and the provision of public goods", *Journal of Socio-Economics*, Vol. 33 No. 4, pp. 395-408.
- Carpenter, J.P. (2007), "Punishing free-riders: how group size affects mutual monitoring and the provision of public goods", *Games and Economic Behavior*, Vol. 60 No. 1, pp. 31-51.
- Casari, M. (2005), "On the design of peer punishment experiments", *Experimental Economics*, Vol. 8 No. 2, pp. 107-15.
- Casari, M. and Luini, L. (2009), "Cooperation under alternative punishment institutions: an experiment", *Journal of Economic Behavior & Organization*, Vol. 71 No. 2, pp. 273-82.
- Castro, F. (2008), "Where are you from? Cultural differences in public good experiments", *Journal of Socio-Economics*, Vol. 37 No. 6, pp. 2319-29.
- Chan, K.S., Mestelman, S., Moir, R. and Muller, R.A. (1999), "Heterogeneity and the voluntary provision of public goods", *Experimental Economics*, Vol. 2 No. 1, pp. 5-30.
- Cherry, T.L., Kroll, S. and Shogren, J.F. (2005), "The impact of endowment heterogeneity and origin on public good contributions: evidence from the lab", *Journal of Economic Behavior & Organization*, Vol. 57 No. 3, pp. 357-65.
- Cinyabuguma, M., Page, T. and Putterman, L. (2005), "Cooperation under the threat of expulsion in a public goods experiment", *Journal of Public Economics*, Vol. 89 No. 8, pp. 1421-35.

-
- Cinyabuguma, M., Page, T. and Putterman, L. (2006), "Can second-order punishment deter perverse punishment?", *Experimental Economics*, Vol. 9 No. 3, pp. 265-79.
- Coats, J.C., Gronberg, T.J. and Grosskopf, B. (2009), "Simultaneous versus sequential public good provision and the role of refunds – an experimental study", *Journal of Public Economics*, Vol. 93 Nos 1/2, pp. 326-35.
- Croson, R. and Shang, J.Y. (2008), "The impact of downward social information on contribution decisions", *Experimental Economics*, Vol. 11 No. 3, pp. 221-33.
- Dickinson, D.L. (2001), "The carrot vs. the stick in work team motivation", *Experimental Economics*, Vol. 4 No. 1, pp. 107-24.
- Duffy, J. and Ochs, J. (2009), "Cooperative behavior and the frequency of social interaction", *Games and Economic Behavior*, Vol. 66 No. 2, pp. 785-812.
- Ertan, A., Page, T. and Putterman, L. (2009), "Who to punish? Individual decisions and majority rule in mitigating the free rider problem", *European Economic Review*, Vol. 53 No. 5, pp. 495-511.
- Falk, A. and Fischbacher, U. (2006), "A theory of reciprocity", *Games and Economic Behavior*, Vol. 54 No. 2, pp. 293-315.
- Fehr, E. and Gächter, S. (2000), "Cooperation and punishment in public goods experiments", *American Economic Review*, Vol. 90 No. 4, pp. 980-94.
- Fehr, E. and Rockenbach, B. (2003), "Detrimental effects of sanctions on human altruism", *Nature*, Vol. 422 No. 13, pp. 137-40.
- Fehr, E. and Schmidt, K. (1999), "A theory of fairness, competition, and cooperation", *Quarterly Journal of Economics*, Vol. 114 No. 3, pp. 817-68.
- Festinger, L. (1954), "A theory of social comparison processes", *Human Relations*, Vol. 7 No. 2, pp. 117-40.
- Fudenberg, D. and Pathak, P.A. (2010), "Unobserved punishment supports cooperation", *Journal of Public Economics*, Vol. 94 Nos 1/2, pp. 78-86.
- Gneezy, U. and Rustichini, A. (2000), "A fine is a price", *The Journal of Legal Studies*, Vol. 29 No. 1, pp. 1-17.
- Gruter, M. and Masters, R.D. (1986), "Ostracism as a social and biological phenomenon: an introduction", *Ethology and Sociobiology*, Vol. 7 Nos 3/4, pp. 149-58.
- Gürerk, Ö., Irlenbusch, B. and Rockenbach, B. (2009), "Motivating teammates: the leader's choice between positive and negative incentives", *Journal of Economic Psychology*, Vol. 30 No. 4, pp. 591-607.
- Hirshleifer, D. and Rasmusen, E. (1989), "Cooperation in a repeated prisoners' dilemma with ostracism", *Journal of Economic Behavior & Organization*, Vol. 12 No. 1, pp. 87-106.
- Houser, D., Bechara, A., Keane, M., McCabe, K. and Smith, V. (2005), "Identifying individual differences: an algorithm with application to Phineas Gage", *Games and Economic Behavior*, Vol. 52 No. 2, pp. 373-85.
- Isaac, R.M. and Walker, J. (1988), "Group size effects in public group provision: the voluntary contributions mechanism", *Quarterly Journal of Economics*, Vol. 103 No. 1, pp. 179-99.
- Isaac, R.M., Walker, J.M. and Thomas, S.H. (1984), "Divergent evidence on free riding: an experimental examination of possible explanations", *Public Choice*, Vol. 43 No. 2, pp. 113-49.
- Jackson, M.O. (2003), "Mechanism theory", in Derigs, U. (Ed.), *Optimization and Operations Research, The Encyclopedia of Life Support Systems*, EOLSS Publishers, Oxford.

- Kerr, N.L. (1999), "Anonymity and social control in social dilemmas", in Foddy, M., Smithson, M., Schneider, S. and Hogg, M. (Eds), *Resolving Social Dilemmas*, Psychology Press, Philadelphia, PA.
- Khwaja, A.I. (2009), "Can good projects succeed in bad communities?", *Journal of Public Economics*, Vol. 93 Nos 7-8, pp. 899-916.
- Kim, O. and Walker, M. (1984), "The free rider problem: experimental evidence", *Public Choice*, Vol. 43 No. 1, pp. 3-24.
- Kopelman, S. (2008), "The herdsman and the sheep, mouton, or kivsa? The influence of group culture on cooperation in social dilemmas", in Biel, A., Eek, D. and Gärling, T. (Eds), *New Issues and Paradigms in Research on Social Dilemmas*, Springer, New York, NY.
- Kosfeld, M. and Riedl, A. (2004), "The design of (de)centralized punishment institutions for sustaining cooperation", Timbergen Discussion Papers 04-025/1.
- Ledyard, J. (1995), "Public goods: a survey of experimental research", in Roth, A.E. and Kagel, J.H. (Eds), *The Handbook of Experimental Economics*, Princeton University Press, Princeton, NJ.
- Ledyard, J. and Roberts, J. (1975), "On the incentive problem with public goods", Discussion Paper 116, Center for Mathematical Studies in Economics and Management Science, Northwestern University, Evanston, IL.
- Lietaer, B. and De Meulenaere, S. (2003), "Sustaining cultural vitality in a globalizing world: the Balinese example", *International Journal of Social Economics*, Vol. 30 No. 9, pp. 967-84.
- Lorenzen, S., Lorenzen, R.P. and Perez, P. (2005), "'I am just borrowing water but I will return it in an hour', How Balinese farmers negotiate their daily use of irrigation water", mimeo.
- Maier-Rigaud, F.P., Martinsson, P. and Staffiero, G. (2005), "Ostracism and the provision of a public good: experimental evidence", Working paper Series of the Max Planck Institute for Research on Collective Goods, No. 2005-24, Bonn.
- Masclot, D., Noussair, C., Tucker, S. and Villeval, M.C. (2003), "Monetary and non-monetary punishment in the VCM", *American Economic Review*, Vol. 93 No. 1, pp. 366-80.
- Mittone, L. and Bortolami, F. (2007), "Free-riding and norms of control: self-determination and imposition. An experimental comparison", CEEL Working Papers 0704, University of Trento, Trento.
- Nikiforakis, N. (2010), "Feedback, punishment and cooperation in public good experiments", *Games and Economic Behavior*, Vol. 68 No. 2, pp. 689-702.
- Nikiforakis, N. and Normann, H.T. (2008), "A comparative statics analysis of punishment in public good experiments", *Experimental Economics*, Vol. 11 No. 4, pp. 358-69.
- O'Gorman, R., Henrich, J. and Van Vugt, M. (2009), "Constraining free riding in public goods games: designated solitary punishers can sustain human cooperation", *Proceedings of the Royal Society B*, Vol. 276 No. 1655, pp. 323-9.
- Okada, A. (1993), "The possibility of cooperation in an n-person prisoners' dilemma with institutional arrangements", *Public Choice*, Vol. 77 No. 3, pp. 629-56.
- Olson, M. (1965), *The Logic of Collective Action*, Harvard University Press, Cambridge, MA.
- Ostrom, E., Walker, J. and Gardner, R. (1992), "Covenants with and without a sword: self-governance is possible", *The American Political Science Review*, Vol. 86 No. 2, pp. 404-17.
- Rabin, M. (1993), "Incorporating fairness into game theory and economics", *American Economic Review*, Vol. 83 No. 5, pp. 1281-302.
- Riedl, A. and Ule, A. (2003), "Exclusion and cooperation in social network experiments", mimeo, University of Amsterdam, Amsterdam.

- Rockenbach, B. and Wolff, I. (2009), "Institution design in social dilemmas: how to design if you must?", MPRA Paper 16922, University of Munich, Munich.
- Samuelson, P. (1954), "The pure theory of public expenditure", *The Review of Economics and Statistics*, Vol. 36 No. 4, pp. 387-9.
- Sefton, M., Shupp, R. and Walker, J. (2007), "The effect of rewards and sanctions in provision of public goods", *Economic Inquiry*, Vol. 45 No. 4, pp. 671-90.
- Tyran, J.R. and Feld, L.P. (2006), "Achieving compliance when legal sanctions are non-deterrent", *Scandinavian Journal of Economics*, Vol. 108 No. 1, pp. 135-56.
- Warren, C. (1993), *Adat and Dinas: Balinese Communities in the Indonesian State*, Oxford University Press, Kuala Lumpur.
- Zelmer, J. (2003), "Linear public goods experiments: a meta-analysis", *Experimental Economics*, Vol. 6 No. 3, pp. 299-310.

About the authors

Róbert F. Veszteg is a visiting professor at the Department of Economics at the Universidad Carlos III de Madrid (Madrid, Spain). His research interest is focused on mechanism design, applied game theory and experimental economics. Róbert F. Veszteg is the corresponding author and can be contacted at: rveszteg@gmail.com

Erita Narhetali is a lecturer at the Faculty of Psychology at Universitas Indonesia (Jakarta, Indonesia). Her research interest is focused on economic psychology.