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The Kula Ring of Bronislaw Malinowski

A Simulation Model of the Co-Evolution of an Economic and Ceremonial Exchange System

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1. Introduction

The Kula ring described by Bronislaw Malinowski in 1922 is an often cited and analyzed system for the ceremonial exchange of gifts among a number of tribal societies inhabiting various island groups in the Massim region east of Papua New Guinea.[1] In his famous "Essai sur le don" Marcel Mauss (1969)[2], the nephew of Emile Durkheim, formulated the threefold principle of reciprocity – to give, accept and reciprocate –, pointing out its function for creating and sustaining solidarity and emphasizing the non-economic character of social exchange. Scholars have been fascinated by the specific pattern of the exchange network, which links numerous partners directly and indirectly in a ringlike structure, and where two ceremonial gifts (*vaygu'a*) continually circulate in opposite directions. The whole structure has not been intentionally designed by either the individual actors or a central authority. It is the unintended by-product of many actions and at the same time provides favorable conditions for its reproduction.

1.1 Embeddedness of Economic Trade in Social Relations

The ceremonial exchange of the Kula and the work of Bronislaw Malinowski have been cited and analyzed by anthropologists (e.g. Firth 1957, 1967; Lévi-Strauss 1969; Sahlins 1965, 1974) as well as sociologists (Blau 1964: ch. 4; Cook 1987; Emerson 1976; Gouldner 1960; Gross 1961; Homans 1958, 1961, 1974; Mauss 1969). It is considered to be a paradigmatic example of the difference between "economic exchange" and "social exchange" (Ekeh 1974; Heath 1976) and between "commodities" and "gifts"

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[1] The bibliography of Martha Macintyre (1983a) contains 625 publications that have dealt with the phenomenon of the Kula.

[2] The essay was first published in L’Année sociologique (1923/24).

(Gregory 1982; Carrier 1991).[3] While economic exchange is voluntary and overtly self-interested, ceremonial exchange is a pretense of disinterested generosity and no haggling takes place. The transaction itself is based on obligation. The gift received puts the recipient in debt to the donor, and failure to meet the "norm of reciprocity" (Gouldner 1960) by not making an equivalent return lowers his reputation and status. Gift exchange transforms the relationship between the partners, creates trust and establishes a bond of solidarity between donor and recipient. While economic transaction is "restricted exchange" among (isolated) dyads on an (anonymous) market, social exchange is "generalized exchange" with a diffuse obligation to reciprocate perhaps not only to the donor but to a (yet unspecified) third person.

Malinowski argued emphatically against a simplistic interpretation of the ceremonial exchange as economic trade, emphasizing what he called its social and psychic functions; nevertheless he stressed the close relationship between economic and ceremonial exchange: "barter of goods and services is carried on mostly within a standing partnership, or is associated with definite social ties or coupled with a mutuality in non-economic matters. Most if not all economic acts are found to belong to some chain of reciprocal gifts and counter-gifts, which in the long run balance, benefiting both sides equally" (Malinowski 1951: 39-40). According to the prevailing interpretation in anthropological literature (Leach 1983) the main function of the Kula is to create social order by establishing a network of stable, peaceful relationships among stateless tribal societies, thereby fostering economic trade among them.

The theoretical interpretations of the Kula have mainly concentrated on the functions of this institution, which could also

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[3] There are other ceremonial exchange systems of gifts and counter-gifts among different Melanesian tribal communities described in ethnographic literature: e.g. the Melpa moka in Mount Hagen of Papua New Guinea (Strathern 1971, 1983), the Enga Tee on the highlands of Papua New Guinea (Meggitt 1972, 1974) or the traders of the Vitiaz Strait (Harding 1967). However, none of these exchange systems received as much attention in the general social science literature as the Kula.

help to explain its maintenance. However, an unsolved problem remains:

> What kind of *starting mechanism* could account for the spontaneous emergence of a peaceful exchange that builds only upon the strategic situation of dyadically interacting potential partners who have incentive to trade but uncertainty about the intentions of potentially hostile foreigners and who (at least in the beginning) are not bound by a universally accepted "norm of reciprocity" that applies to clan members as well as strangers?

We follow the advice of Mark Granovetter (1985: 493) by avoiding the oversocialized approach of generalized morality and the undersocialized approach of impersonal, institutional arrangements, modelling instead the *emergence* of concrete patterns of social relations.

Analyzing the generalized exchange of women among Aborigines of Groote Eylandt, an island off Australia, Peter Bearman deals with the same kind of problem: "the identification of possible microlevel sources of cyclic exchange, focusing first on identifying operators that work to *reproduce* existing cyclic exchange structures, and second, on identifying operators that may be tied to the *generation* of such systems" (1997: 1410, emphasis added). We combine both problems by asking whether the generating mechanism produces stable configurations.

1.2 Outline of the Argument

After a brief description of the social system of Kula exchange, we discuss three processes underlying the development of such a complex macro-structure: the development of an economic trading network, the spread of peaceful relationships and the evolution of a ceremonial exchange system. Before elaborating the assumptions of our simulation model in detail, we present the methodological approach and describe the explanandum – the "observed" Kula ring – and the empirical boundary conditions.

In the following chapters we discuss the three processes in detail. The behavioral assumptions are derived from game-theoretic reasoning.[4] Special emphasis is given to the importance of cheating and trust and the controlling influence of reputation. We then ask how such a macro-structure may have arisen out of the individual actions of multiple groups of actors. A simulation model of the starting mechanism is developed to account for the emergence and stability of the observed pattern of peaceful trade and the circular exchange of the two ceremonial gifts. Differentiating among separate "historical phases" improves the empirical fit of the simulation model. Results are then presented to demonstrate the implications of "counterfactual" assumptions about the empirical boundary conditions. Thereafter, we briefly discuss changes of the historical Kula ring observed in the 1970's and describe how these may be explained. In the concluding section, we summarize the basic argument, discuss limitations of our approach, and close with some open problems for further research.

Our *basic aim* is twofold: (1) to theoretically derive the behavioral assumptions of a starting mechanism for the emergence and co-evolution of a peaceful system of economic and ceremonial exchange and (2) to use simulation as a methodological device in order to demonstrate the macro-social consequences of a multi-level, multi-agent, dynamic system.

[4] Görlich (1992) discusses various theoretical approaches for explaining ceremonial and economic exchange processes and puts these in a game-theoretical perspective.

2. The Social System of Kula Exchange

To repeat, the Kula is a system of gift exchange among a number of tribal societies inhabiting various island groups in the Massim region east of Papua New Guinea. They are culturally, especially linguistically, heterogeneous[5], are internally organized in clans and local communities, and are predominantly matrilineal. They are called stateless societies, as the positions of chiefs and "Big Men" are not integrated into an overall authority system.

Leach and Leach (1983: IX-XI) provide a geographical map of the Massim area with a detailed island and village index. This map is reproduced in Figure 1 with the observed Kula ring among the 18 Kula communities added.

Malinowski describes the system of Kula exchange among these tribal societies as follows: "The Kula trade consists of a series of ... periodic overseas expeditions, which link together the various island groups, and annually bring over big quantities of

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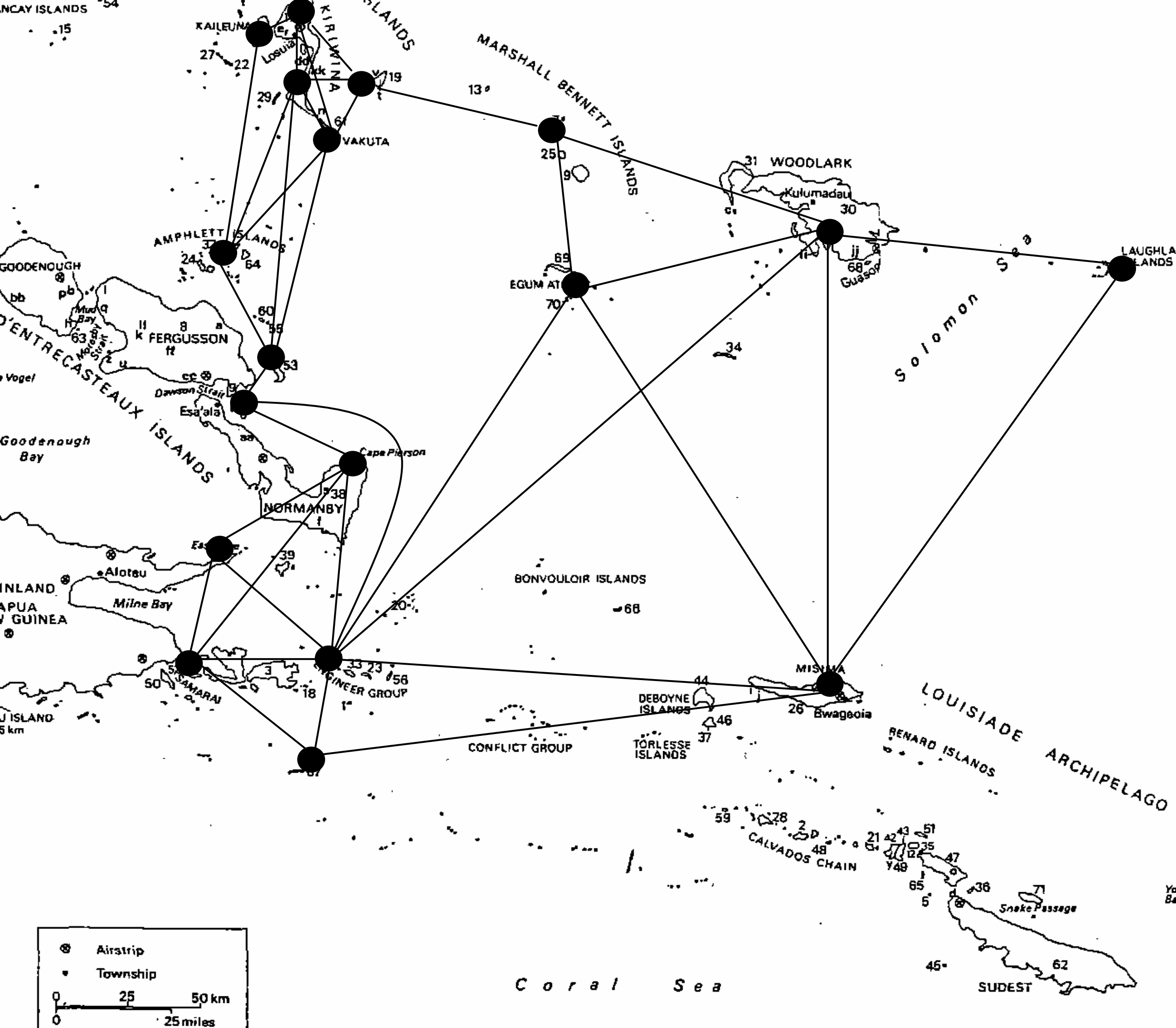
[5] "Except for Yela (Rossel), all the languages of the Massim are Austronesian and there is considerable sharing of basic terms as well as other vocabulary around the region (Lithgow 1976). Grammatical structures are very similar across the northern Massim but shift substantially with the D'Entrecasteaux and the southern islands (Capell 1969: 126-9). The best available evidence to date (Lithgow 1976) on the mutual intelligibility or otherwise (ignoring the controversy over how to organise the languages into family-type groupings) of the languages of the islands of the Massim indicates five kula-area languages." (Leach and Leach 1983: 19) Including East Cape and East End Islands, which have been members of the historical Kula ring we can group our 18 Kula communities into seven language areas (see Map 2 in Leach and Leach 1983: 22):

Kilivila-region:	Kayleula, Kiriwina, Sinaketa, Vakuta, Kitava, Marshall Bennets, Woodlark, Laughlan
Gumasi-region:	Amphletts
Dobu-region:	NW Dobu, Dobu
Duau-region:	SE Dobu, Tubetube, Wari
Taupota-region:	East Cape
Suau-region:	East End Islands
Misima-region:	Misima, Alcesters



c. Boagis, Bovagisa
d. Boboghagha, Western Point
e. Boitalu, Bwoytalu
f. Bunama
g. Bwaiowa
h Bwaidoka
i. Ebora, Ebola
j. Ewina, Ewena
k. Fagalulu
l. Fatavi
m. Fayayana, Faiaiana, Paiaiana
n. Gilibwa
o. Hebwaun, Bwailahine
p. Kalauna
q. Kalokalo
r. Kavataria
s. Kerorogea
t. Kodeuri, Kudayuri
u. Kukuya, Kukuia
v. Kumwagea
w. Liak, Liag
x. Loboda
y. Mamanila
z. Mapamoiwa
aa. Miadeba
bb. Moratau
cc. Nade
dd. Obulaku, Oburaku
ee. Omarakana
ff. Salakahadi, 'Ebadidi
gg. Seghe, East Point
hh. Sinaketa
ii. Suloug, Suloga, Siloga
jj. Wabunun,
kk. Wawela
ll. Yamalele, Iamelele

vaygu'a and of subsidiary trade from one district to another. The trade is used and used up, but the vaygu'a – the armshells and the necklets – go round and round the ring." (1966a: 103) The two ceremonial gifts always circulate in opposite directions: necklaces (*soulava*) clockwise and armshells (*mwali*) counterclockwise.

The ceremonial exchange of gifts is strictly regulated. Twice a year, oversea expeditions take place under the leadership of "Big Men". The dates are scheduled in advance, and depend both on the prevailing direction of the monsoon winds and the periods of harvesting. The visitors themselves do not bring *vaygu'a*, but start the exchange with a small opening gift. The hosts then reciprocate by offering the Kula gift, e.g. necklaces. Only on a later trip do the visitors – now acting as hosts – present the complementary *vaygu'a* i.e. armshells. By this pattern of delayed reciprocity, each actor is alternatingly indebted to his partner. If a host does not have the proper *vaygu'a*, he may give an intermediary gift (*basi*), which also has to be accepted and reciprocated. No one may keep a gift too long, thereby running the risk of loosing his reputation and his partners. "A man who is in the Kula never keeps any article for longer than, say, a year or two. Even this exposes him to the reproach of being niggardly and certain districts have the bad reputation of being 'slow' and 'hard' in the Kula" (Malinowski 1966a: 94). Through public ceremonies, magical rites and rhetorical skills one tries to induce partners to give generously.

The Kula exchange does not take place on an anonymous market, but creates lifelong partnerships that are transferred to the heirs by mortuary rites symbolizing the stability of the relationship (Uberoi 1962: 107). One also does not join the Kula, but is introduced to it by members, usually close relatives. This principle of co-optation into a "club" enhances the trustworthiness of the new entrants and the stability of the relationships. The number of one's partners as well as the distance covered by the exchange varies with social rank. But even the most influential chief does not exchange beyond a certain geographical distance. Yet, he as well as the common members know the names of their partners' partners, and the sense of belonging to a closed system is widespread.

The principle of delayed reciprocity and the possibility of intermediary gifts may strategically be used to establish new partnerships with a limited fund of *vaygu'a*. As one informant reports: "I have become a great man by enlarging my exchanges at the expense of blocking theirs for a year. I cannot afford to block their exchange for too long, or my exchanges will never be trusted by anyone again. I am honest in the final issue." (Fortune 1989: 217)

Protected by the peaceful social relationships of the Kula, which are stabilized by the ceremonial exchange of gifts, a heavy trade of commodities (*gimwali*) takes place. Bartering and haggling occurs, but never between Kula partners themselves, though always within their villages. "The trade takes place between the visitors and local natives, who are not their partners, but who must belong to the community with whom the Kula is made." (Malinowski 1966a: 362)

This short description of the Kula exchange obviously does not present all the details of this complex and highly differentiated social institution, but concentrates on the main characteristics of the relationships *between* the Kula communities, which are important for the explanation sketch. We especially neglect the internal functions of the Kula, such as competition and enhancement of social status, and the great symbolic importance of the Kula valuables for ceremonial activities, marriages and mortuary rites.[6]

[6] The most important primary sources about the early Kula are Fortune (1989 [1932]); Malinowski (1920, 1966a [1922], 1966b [1935]) and Seligman (1910); about more recent developments Leach and Leach (1983). Belshaw (1955), Damon (1990), Uberoi (1962) and Weiner (1976) present detailed analysis of various aspects of the social institution.

3. The General Problem of Explanation: Social Order, Barter and Ceremonial Exchange

In his introductory article to the volume developed from the "Proceedings of the Kula and Massim Exchange Conference" held at King's College, Cambridge, in 1978, Jerry W. Leach discusses the attempts to find the underlying *raison d'être* of the Kula system. He mentions three basic interpretative themes:

(1) "The argument of interpretation R – recirculation of material resources – is that the exchange of kula valuables is an elaborate constantly self-renewing treaty-like contract which sustains peace between otherwise hostile local groups that lack centralized authorities, allowing them the security to trade valued resources which are differentially distributed throughout quite varied island ecologies." (Leach 1983: 5-6)

(2) "The argument of interpretation P – prestige competition – is that the kula is a process through which the members of small local descent groups, who would find openly aggressive face-to-face competition intolerably disruptive, are able to compete against one another as individuals by seeking prestige in an external field of action, the theatrical trading of kula shells." (Leach 1983: 6-7)

(3) "The argument of interpretation S – social communication – is Durkheimian. It suggests that the exchange of kula valuables is an externalized concrete expression of an abstraction, the valued network of person-to-person relationships which constitutes the social order. ... Following this line of argument, manifested exchanges of 'useless' but symbolic objects help to hold society together, make the social world safer, and allow the accomplishment of a wider range of human ends than would otherwise be possible, especially in the absence of centralized structures of authority." (Leach 1983: 7-8)

Without pretending to be able to explain every detail of the institution and account for all its functions, we argue that the basic reason why the Kula system came into being and developed its peculiar geographical shape has been the mutual advantage of economic exchange (interpretation R), and that the ceremonial exchange of gifts is an important mechanism for establishing a peaceful social order (interpretation S). Prestige competition (interpretation P) seems to not have been an important factor for the *emergence* of the Kula, but – as will especially be shown in the final section – plays an important role in maintaining and changing its structure.

Although Malinowski calls the interinsular trade a secondary activity, he makes clear that this is a question of ethnographic description and not of sociological analysis: "Indeed, it is clear that if we look at the acts from the outside, as comparative sociologists, and gauge their real utility, trade and canoe-building will appear to us as the really important achievements, whereas we shall regard the Kula only as an indirect stimulus, impelling the natives to sail and to trade." (Malinowski 1966a: 100)

Three processes will be distinguished in the simulation model: the development of an economic trading network, the spread of peaceful relationships and the evolution of a ceremonial exchange network of Kula valuables. These processes will be systematically linked to model the spontaneous emergence and co-evolution of the Kula ring.

4. The Methodological Approach

4.1 Aims and Limitations of the Simulation Model

By using a simulation model[7], we have attempted to account for the development of a trading network and the circular exchange, in which necklaces move in one and armshells in the opposite direction. Intuitive reasoning about the behavior of *dynamic multi-agent, multi-level systems* leads to conjectures, which sometimes may be misleading; it can not offer a stringent proof of what *logically* follows from certain behavioral assumptions and boundary conditions at the meso-level to account for the emerging features of the macro-structure (Kolo 1997). Simulation can demonstrate these logical implications "more geometrico", as René Descartes would have said.[8] This is its main methodological advantage and purpose. Simulation helps map the implications of alternative scenarios, i.e. variations of boundary conditions and behavioral assumptions, and tests the sensitivity of outcomes with regard to (small) variations of input parameters.

However, we do not use simulation as a "computer-assisted thought experiment" only, but try to validate it by comparing its outcomes with empirical data. We investigate which assumptions at the meso-level make a better empirical fit with structural measures at the macro-level. As always in theoretically guided empirical research, this testing is tentative and open to critique. The theoretical assumptions are simplifying abstractions devoid of many details, and the empirical data is often incomplete and unreliable. They might be called "stylized facts".

An important limitation of our analysis is the lack of information about the development of the Kula ring. We do not have empirical data to describe its historical evolution in order to test our dynamic model in more detail. The "observed" Kula ring therefore is considered to be the "end-product" of a hypothetical process. We also treat the Kula as a "closed system". Why just

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[7] The model has been programmed in QuickBASIC 4.5.

[8] Of course a mathematical model would be superior, but it is usually too complex to be analytically solvable. This is one of the reasons to use simulation models. (Gilbert and Doran 1994; Gilbert and Conte 1995)

these 18 communities became members of the Kula ring and others remained outside (or left it) is simply unknown.

4.2 Game-theoretical Analysis of Strategic Situations and Derived Strategies of Behavior

The substantive assumptions of our simulation model refer to strategies of behavior of the participating actors. Consistent with our theoretical approach, these behavioral assumptions only refer to dyadically interacting communities and no information beyond distance 2, i.e. one's neighbor's neighbors, is required. Once established, the network of transactions may function like a system of "generalized exchange" (Ekeh 1974: 208-9; Heath 1976: ch. 6), but we argue that this is not the way it came into being.

We base our behavioral assumptions on a game-theoretical analysis of (usually dyadic) strategic situations and try to "derive" them from Nash equilibrium strategies. A comment is necessary with regard to this aspect of our simulation model. Our behavioral assumptions refer to the micro-level of individual actors, while the simulation algorithm models the meso-level of island communities in order to derive properties of the evolving macro-structure. Neglecting the internal dynamics of the micro-meso-relationship we take advantage of the well-established empirical fact that all who travel between islands do so as part of a multi-party expedition. Sailing abroad is too dangerous for a single boat, but requires a coordinated effort. Monsoon winds and periods of harvesting determine the times it is feasible at all. Moreover, the strategic situation analyzed by game-theoretic considerations and the distribution of supply and demand are similar for all members of an island community. Mauss provides another, theoretical argument in support of the group approach: "In the systems of the past we do not find simple exchange of goods, wealth and produce through markets established among individuals. For it is groups, and not individuals, which carry on exchange, make contracts, and are bound by obligations; the persons represented in the contracts are moral persons – clans, tribes and families; the groups, or the chiefs as intermediaries for the groups, confront and oppose each other." (1969: 3)

5. The Empirical Data

5.1 The "Empirically Observed" Kula Ring

It is extremely difficult, perhaps even impossible, to pin down *the* real structure of the Kula network for three reasons. First, ethnologists dispute whether a *stable* Kula network existed prior to colonization, and, if so, how it might have changed under the influence of early colonization.[9] Second, the most important informants on the early Kula network (Fortune [1932] 1989; Malinowski 1920, [1922] 1966a; Seligman 1910) had firsthand experience as field researchers only in certain parts of the Melanesian islands. Third, the figures presented and the descriptions given in the texts are often ambiguous and sometimes contradictory, even within a single author's work. The "observed" Kula ring reported here, which is based on a systematic survey of the ethnographic literature, must therefore be considered as a "dense description”, a kind of "ideal type".

Graphical representations of the Kula ring may be found in Malinowski (1920: 101; 1966a, map V on p. 82); Belshaw (1955, Map I); Brookfield and Hart (1971, Figure 13.3 on p. 325); Brunton (1975: 546 and 548); Fortune (1989: 203); Grofman and Landa (1983: 351); Hage (1977: 28); Hage and Harary (1991: 13); Hage, Harary, and James (1986: 111; reprinted in Hage and Harary 1991: 159); Irwin (1983: 55); Landa (1983: 140; graphically better represented in Landa 1994: 145); Lauer (1970: 168); Leach and Leach (1983: 20-1); Macintyre and Young (1982:

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[9] Based on archaeological evidence, it is assumed that the Kula existed long before colonization started: "Thus even though armshells and necklace units are known to have an antiquity of nearly 2,000 years in the region, the kula as such probably developed only in the last 500 years." (Irwin 1983: 70-1; see also Egloff 1978; Kirch 1991: 150-2; Lauer 1970) However, Macyntyre argues against Malinowski: "The bellicose activities of Tubetube traders make Malinowski’s insistence on the closed circuit model of the *kula* historically implausible. ... It is my contention that such incessant circulation could only occur after pacification. The *kula* as a closed circuit is a modern institution." (1983c: 12)

209); Shack (1985: 11); Uberoi (1962, title page). They vary in the amount of detail, printing quality and cartographic or schematic form and partially refer to different historical periods. Some rely on personal empirical research, others upon the secondary analysis of ethnographical reports without always citing them exactly. Contradictory descriptions occassionally appear in the same text.

The starting point of most graphical representations is map V from Malinowski (1966a: 82). It contains 18 Kula communities, which Malinowski describes as follows: "A Kula community consists of a village or a number of villages, who go out together on big overseas expeditions, and who act as a body in the Kula transactions, perform their magic in common, have common leaders, and have the same outer and inner social sphere, within which they exchange their valuables" (1966a: 103). Even when two Kula communities accidentally share the same goal they act independently (Malinowski 1966a: 469). Table 1 depicts the geographical links upon which our analysis is based. They essentially correspond to Map V, but contain some modifications as explained below. A "+" means that this link is contained in the corresponding graphic, a "–" that it is missing, and a "?" that the graphical representation is illegible or that it does not contain the Kula community at all.

Regarding the number of communities in our analysis: We restrict our analysis to 18 Kula communities in contrast to Brunton, who adds the islands Bonvouloir and Panamoti. Bonvouloir is mentioned as an intermediate stop on the way from Tubetube to Woodlark but not as an independent Kula community, and Panamoti is combined with Tokuna in the Alcesters group by Malinowski in his Map V.

The representations of Brunton as well as Hage and Harary contain the villages of Wawela and Okayaulo, which are directly connected with Kitava and Sinaketa (compare the special map of Brunton 1975: 548). Malinowski (1966a: 277) stresses "that no man in Sinaketa has any partner in Kitava." This implies that there are no *direct* link between Sinaketa and Kitava; the connection shown in Map V is mediated by Wawela and Okayaulo as Malinowski himself (1966a: 497) mentions.

	Malinowski Map V	Uberoi 62; Grofman/ Landa 83; Landa 83	Brookfield/ Hart 71	Brunton 75	Hage 77	Irwin 83	Hage/ Harary/ James 86	Own Kula ring
Kitava–Sinaketa	+	+	–	–[1]	–	+	–[1]	+[2]
Kiriwina–Sinaketa	?	?	–[3]	+	+	+	+	+[4]
Kiriwina–Kayleula	?	?	+	–[3]	+	+	+	+[5]
Kiriwina–Vakuta	?	?	–[3]	–	+	–	–	+[6]
Sinaketa–Vakuta	?	?	–	+	+	+	+	+[7]
Sinaketa–Amphletts	–	–	+	+	+	+	+	+[8]
Vakuta–Amphletts	–	–	+	+	+	+	+	+[9]
NW Dobu–SE Dobu	–	–	?[10]	–	–	–	+	–[11]
NW Dobu–Tubetube	–	–	?[10]	–	–	–	+	–[12]
Dobu–Tubetube	–	–	+	–	+	+	+	+[13]
SE Dobu–Woodlark	–	–	+	–	–	+	–	–[14]
Misima–Laughlan	+	+	–	–	+	+	+	+[15]
Misima–Woodlark	–	–	+	–	–	+	–	+[16]
Alcesters–Marshall Bennets	+	+	?[17]	–	+	–	+	+[18]

Table 1: Construction of the "Observed" Kula Ring

Note: + this link is contained in the corresponding graphic
– this link is missing in the corresponding graphic
? the graphical representation is illegible or it does not contain the Kula community at all

[1] Indirect link by Okayaulo and Wawela
[2] For more information see text.
[3] Indirect link by Kavataria
[4] Malinowski (1966a: 93, 165, 277, 381, 468f, 497)
[5] Malinowski (1966a: 468, 476)
[6] Malinowski (1966a: 165)
[7] Malinwoski (1966a: 165)
[8] Malinowski (1966a: 93)
[9] Malinowski (1966a: 381)
[10] Fig. 13.3. does not contain NW Dobu.
[11] For more information see text. Thune (1983: 352) refers to this link but only very vaguely. "Loboda and Kwanaula (these are traditional Kula-communities in Duau, i.e. SE Dobu - RZ) people always sailed west to Dobu and adjacent districts of East Fergusson in search of mwali."
[12] Malinowski (1966a: 497) explicitly only mentions "Dobu Island proper" and Duau (= SE Dobu) as Kula-partners of Tubetube.
[13] Malinowski (1966a: 496f); Thune (1983: 354)
[14] For more information see text.
[15] Malinowski (1966a: 495)
[16] Brookfield and Hart (1971) as well as Irwin (1983), whose representations show a direct link between Misima and Woodlark, refer to the work of Malinowski and Fortune, though Irwin puts little weight on this link. The earlier book by Seligman (1910: 530) does also mention this contact: "It is however known that Murua waga frequently visit the Louisiades and doubtless these bring the products of the northern Massim to this archipelago."
[17] Fig. 13.3 does not contain the island group of the Alcesters.
[18] The missing link between the Alcesters and the Marshall Bennetts seems to be a printing error as the explanations of Fig. 1 show (Irwin 1983: 59).

However, Malinowski describes these villages on the Trobriand islands as "imperfect Kula-communities" (1966a: 476-7), which do not go on inter-insular expeditions, but only take part in the "inland-Kula", which is different from the interinsular Kula exchange (Malinowski 1966a: ch. XIX). As our theoretical argument refers to the interinsular exchange, we exclude these "imperfect Kula-communities" from our analysis and treat the connections established by the inland-Kula as direct links. This also holds true for the link created by Kavataria between Kiriwina and Kayleula, as shown in the detailed map of the Trobriand islands (Brunton 1975: 548).

Thus, we take the links among the 18 communities from Malinowski's Map V with certain additions and modifications as indicated in the last column of Table 1 and explained in the annotations.[10] Four comments have to be added:

First, because of the small size of the Trobriand islands, the exact links among the Kula communities there cannot be determined from map V, but are described in Malinowski's text: Kiriwina–Sinaketa (1966a: 93, 165, 277, 381, 468-9, 497); Kiriwina–Kayleula (1966a: 468, 476); Kiriwina–Vakuta (1966a: 165); Sinaketa–Vakuta (1966a: 165).

Second, there are some links not shown in Malinowski's map V but that he describes in his text: Amphletts–Sinaketa (1966a: 93); Amphletts–Vakuta (1966a: 381); Dobu–Tubetube (1966a: 496-7).

Third, the links among NW Dobu, Dobu and SE Dobu are not visible on Map V, and Malinowski's description of the Dobu region (1966a: ch. XIV) is imprecise. Often he speaks of "Dobu", when it is not clear whether he refers to NW Dobu (i.e. Sanaroa, Tewara and Fergusson Island north of Dawson Strait), to "Dobu island proper" or to SE Dobu (Duau = Normanby Island). We therefore have decided in favor of linkages that can be inferred from various sources relatively unambigously.

Fourth, our modifications mostly agree with Irwin's map 7 (1983: 55) with two major exceptions. Irwin (1983: 58) authenticates his link SE Dobu–Woodlark by referring to Fortune (1989: 202). However, this seems to be a false interpretation. Fortune merely says that the people of Tubetube make a stop in SE Dobu (= Duau) on their way to Woodlark (= Murua): "Dobu is the nearest receiving station to Tubetube, and although Tubetube canoes go to Murua they always go by way of Duau, a Dobuan district. ... Dobuan canoes go to the Amphletts, to the Trobriands, and to Tubetube" (Fortune 1989: 202).[11] We also kept the missing link Alcesters – Marshall Bennetts, as it is included in all other detailed Figures of the Kula ring except for that of Brunton (1975).

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[10] See also chapter XXI in the book of Malinowski (1966a).

[11] See also an early account by Seligman and Strong (1906).

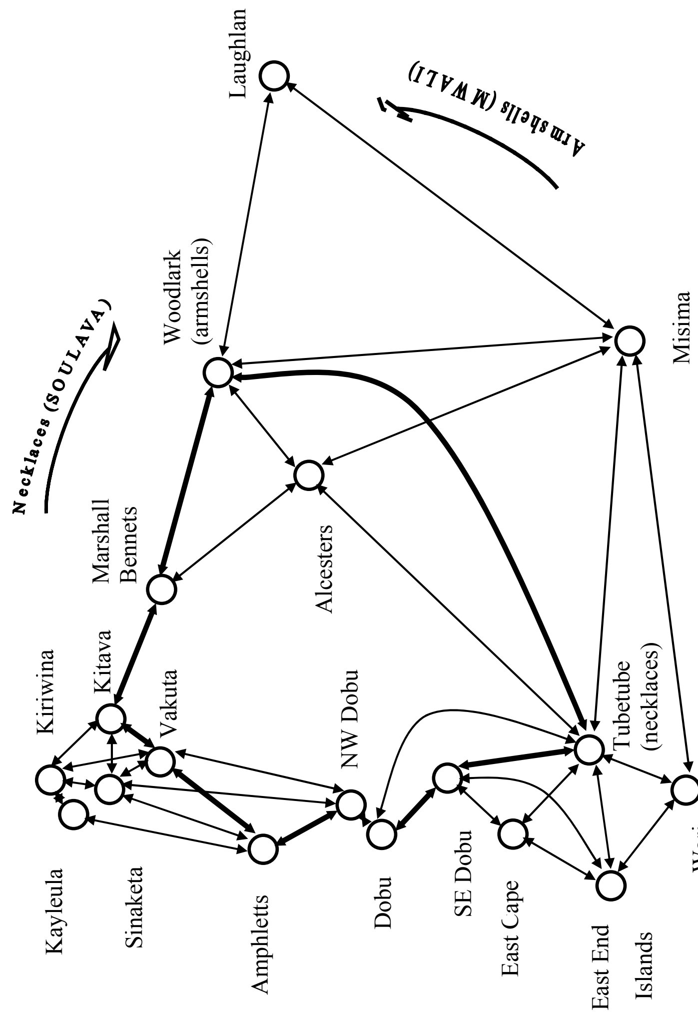

Figure 2: Schematic Representation of the "Observed" Kula Ring
Note: Bold arrows indicate the Ur-Kula ring

It is not necessary to discuss the other sources mentioned above. Either the representations are much less detailed or do not contain additional information – for example Fortune (1963: 203), Lauer (1970: 168), Macyntire and Young (1982: 209), Shack (1985: 1) – or they explicitly describe the Kula network of later historical periods, e.g. Belshaw (1955, Map I) or Leach and Leach (1983: 20-1) in the 1970's.

Based on this review of the relevant ethnological literature, we have taken the Kula network from Figure 2, with 18 communities and 36 links, as the empirical basis of our simulation model.[12] At four places, the *vaygu'a* are either produced or imported from outside the Kula: armshells produced from the trocus shell in Kayleula and Woodlark and necklaces made from the spondylus shell in Tubetube and Wari (Malinowski 1966a: ch. XXI; Fortune 1989: 202-3; Irwin 1983: 58; Leach 1983: 23).

5.2 Empirical Boundary Conditions

The empirical boundary conditions refer to the geographical distances between the 18 tribal societies and the location where 25 goods were produced and/or demanded, i.e. consumed but not produced. The distances were measured from the enlarged map of Figure 1, while the latter information was collected from about 470 references[13] in ethnological literature (see Appendix). A third boundary condition was the input of Kula valuables at four

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[12] The meaning of the bold links indicating the Ur-Kula is explained below. It differs slightly from our previous description (Ziegler 1990: 151) as well as that of Grofman and Landa (1983). There the Marshall Bennetts have been represented by two separate islands Iwa and Gawa while Malinowski stresses: "The islands East of Kitava, Iwa, Gawa, and Kwayawata form one community. This is shown on Map V, where each 'Kula community' is represented by one circle." (1966a: 488)

[13] They are collected from the works of Austen 1945; Belshaw 1955; Berde 1983; Brookfield and Hart 1971; Brunton 1975; Damon 1983, 1990; Fortune 1989; Irwin 1983; Landa 1983; Lauer 1970, 1971; Lepowsky 1983; Macintyre 1983b, 1983c; Malinowski 1966a, 1966b; Scoditti and Leach 1983; Seligman 1910; Seligman and Strong 1906; Shack 1985; Thune 1983; Uberoi 1962; Weiner 1976.

places: as mentioned above armshells were produced in Kayleula and Woodlark and necklaces were made in Tubetube and Wari.

5.3 Measures of "Goodness-of-Fit"

In order to evaluate the outcomes of the simulation model several descriptive measures of "goodness-of-fit" were used.

(1) The first and perhaps most fundamental property is the emergence of a *coherent* network. The transaction network should not fall apart into several disjoined networks. In graph-theoretical terms it should form *one strong component*.

(2) Economic exchange presupposes the existence of *peaceful relationships*. Therefore the number of cooperative actors at the end of an iteration is another fundamental measure.

(3) A third basic property is the *degree of need satisfaction* measured by the number of communities able to satisfy all their consumptive needs.

(4) The model distinguishes between visitor and host, and the simulated network therefore is basically asymmetric. However, the observed Kula ring is reported to be symmetric: two connected Kula communities are alternatingly visiting each other. We therefore restrict the analysis to the simulated trading network of symmetrically linked communities and report the *percentage of symmetric trading relations*.

Though we cannot of course expect a perfect fit, we used some measures to indicate the model's overall correspondence with the observed network:

(5) The *density* of the simulated trading network is compared with the observed density. As there are 36 (symmetric) links among the 18 communities the observed density equals (2*36)/(18*17)=.235.

(6) The *similarity* of simulated and observed trading networks is measured by the Jaccard coefficient, which does not take into account the absent ties in both networks.

similarity := a/(a+b)
a = number of links present in both networks
b = number of links present in only one network

The maximum value of 1 can be reached only if both networks have the same density.

(7) As the model tries to simulate – in a highly simplified and abstract way – a hypothetical historical process, the question has to be raised whether the iteration procedure converges at all towards a (relatively) stable configuration of ceremonial exchange within a coherent transaction network. If – given the boundary conditions and the behavioral assumptions – there are no "fixed points" to be found and the iteration process wildly fluctuates, the model would be seriously flawed. Convergence towards (relatively) stable fixed points is a necessary condition and the *proportion of fixed points* of the ceremonial exchange network within the coherent transaction network is an important indicator of goodness-of-fit. All other goodness-of-fit measures will be taken on the basis of the fixed point configurations only.

(8) Scholars have been fascinated by the *circulation* of ceremonial exchange: necklaces clockwise and armshells counterclockwise. From the Massim map of Figure 1 we inferred clockwise and counterclockwise direction among all pairs of communities and defined the following measure:

circulation := (a–b)/(a+b)

a = number of links in which the direction of observed/inferred and simulated gift exchange is identical

b = number of links in which observed/inferred and simulated gift exchanges are in opposite direction

This measure was calculated separately for both valuables and leads to a scale score of +1 if there is perfect agreement in all links, and –1, if the simulated flow is always in the exact opposite direction to the observed/inferred one.

Besides these relatively strict measures of goodness-of-fit we used other indices to measure different theoretically interesting features of the observed "circular structure" of the Kula ring. Though the simulated network may fit the observed one poorly it may still possess these – in a way more fundamental – properties, which are necessary conditions of some of the observed ones:

(9) All economic transactions should be accompanied by a reciprocal exchange of Kula valuables. This degree of *ceremonial reciprocity* in trading relations is defined as:

reciprocity:= (a+n)/t with
a = number of links with armshells given
n = number of links with necklaces given
t = number of links in the transaction network

The index varies between zero (no gifts are presented) and one (complete reciprocity of ceremonial exchange in trading relations).

(10) In the observed ceremonial network, armshells and necklaces are exchanged complementarily. The degree of *complementarity* is defined as:

complementarity := (a–b)/(a+b)
a = number of complementary exchanges
b = number of gift exchanges, when both actors present the same kind of valuable

The maximum value of +1 will be obtained if the two valuables are exchanged complementarily in *all reciprocal* transactions. The minimum value of –1 is reached if the *same* valuables are exchanged in *all reciprocal* transactions. It should be noted that the indices of reciprocity and complementarity could independently reach their maximum values.

(11) In the observed Kula ring the two asymmetric networks of gift exchange have the following theoretically important properties: (a) each digraph is strongly connected and forms one single strong component (Hage and Harary 1991: 58), i.e. armshells (or respectively necklaces) may travel from one community to all others, possibly along several different routes. (b) The two ceremonial networks are disjoint. (c) Their union is identical with the symmetric transaction network. A necessary and sufficient condition, that two such digraphs *can* be constructed, is the *absence of bridges*[14] in the symmetric transaction network.

(12) We separately measured property (11a) by the degree of *reachability*, defined as the percentage of (the 18*17/2=153) pairs of communities, which are mutually reachable in the two asymmetric networks of gift exchange.

(13) A closer examination of Figure 2 shows that there are 21 (connected) triads, i.e. three communities which are directly linked, such as e.g. Vakuta–Amphletts–NW Dobu. All of these

[14] A bridge is a link that, if removed, leads to a disconnected network.

21 triads are "transitively closed" (Holland and Leinhardt 1977: 65), meaning that if A gives armshells (or respectively necklaces) to B, and B to C, then A will also give armshells (or respectively necklaces) to C (but not C to A). This transitive closure enables the emergence of a larger "circular structure" by preventing the ceremonial network from being decomposed into small cycles of length 3. The *number of triads* and the *proportion of transitively closed triads* in the two ceremonial exchange networks therefore are further measures of goodness-of-fit.

A word has to be said about the structural properties of a network, which facilitate the spread of information. Reputation diffuses more rapidly and accurately in "small world" networks, which are characterized by high clustering of local neighborhoods, with relatively short global distances among all points. Watts and Strogatz (1998) give a formal definition. The clustering coefficient C, which measures average density of the observed ego-centric networks, must be very much larger than that of a random network with the same average density, but characteristic path length L, i.e. average geodesic distance, should only be slightly larger in the observed as compared with the corresponding random network. The values of these coefficients for the observed Kula ring turn out to be: $C_{observed} = .46 \gg .20 = C_{random}$ and $L_{observed} = 2.56 \geq 2.13 = L_{random}$. The observed Kula ring therefore is a "small world" network.

(14) As a measure of *local clustering* we use the percentage of links contained in cycles of length 3 or 4. In the observed network 32 of the 36 directly linked communities have a common neighbor, i.e., their link is contained in a cycle of length 3; out of the remaining 4 links 2 are contained in a cycle of length 4, i.e., another neighbor of EGO is directly linked to a neighbor of OTHER. The amount of observed local clustering therefore is $34/36 = 94{,}4\%$. Only the two links Kitava - Marshall Bennets and NW Dobu – Dobu are contained in longer cycles of (at least) length 7.

The simulation model contains stochastic elements in order to avoid artificial outcomes due to a deterministic sequential algorithm. Therefore it is to be expected that the outcomes will differ even if the process converges towards fixed points. It is common practice in simulation research (Conte and Paolucci 2002: ch. 5; Gilbert and Troitzsch 1999) to report average values (and measures of dispersion) based on a fairly large number of iteration runs. We use two kinds of averaging procedures to describe the "most likely" outcome of our simulation model. First, we report *mean* values of our fitness measures (and sometimes their range) based on all fixed points reached in 1000 simulation runs. Second, as our basic assumptions refer to dyadic relationships, we dichotomize the sum of links of all fixed points and calculate the goodness of fit measures of this "*aggregate* simulated Kula ring". The cutting point of dichotomization is chosen in such a way that the density of the aggregate network (approximately) equals the average density of all fixed points.

6. Process I: The Development of an Economic Trading Network

6.1 Conditions of Successful Trade: Double Coincidence of Wants

As said above, based on a survey of ethnographic literature the supply and demand of some 25 goods were determined. This information and the geographical distances among the 18 Kula communities are the empirical input to a simulation model of the emergence of a trading network. We will briefly describe the basic structure of its algorithm.[15]

(T1) In each round all actors decide – in random order – whether to sail and whom to visit. Each actor will first visit his nearest neighbor trying to barter with him.[16]

(T2) The potential traders can supply goods that they have either produced themselves or stored from previous exchanges if acting as middlemen. The demand is determined by the consumptive needs and/or – if they act as middlemen – the demand of other potential exchange partners they want to trade with (but whose demands could not be fulfilled in previous contacts).

(T3) A successful exchange takes place if the "double coincidence of wants" is fulfilled, i.e., if both actors have something to offer, which the other asks for. We have simplified our model by not taking into account "exchange ratios" between different types of goods, though these are mentioned in literature (e.g. Malinowski 1966a: 363-4; Belshaw 1955: Appendix IV). We simply assume that all goods available from actor A and demanded by actor B are exchanged for all goods available from actor B and demanded by actor A.

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[15] The assumptions of the model will be numbered and distinguished by T(rade), P(eace) and C(eremonial).

[16] Besides economizing on time of sailing needed there seems to be another reason for geographic distance influencing search behavior. "Language differences tend to magnify as transactors move further from home. This may be a factor in explaining why participants exchange in roughly adjacent sectors of the total ring." (Leach 1983: 19)

(T4) If at the end of a round an actor's total *consumptive* needs are not satisfied he will search for trading partners at successively larger distances in successive rounds.

(T5) There are two stopping rules. Each actor will stop searching for new partners farther away if his total *consumptive* demand is satisfied and if he has at least two partners with whom he exchanges reciprocally in order not to be dependent on a "monopolist". This means that the minimum degree of the symmetric trading network is 2, which is a necessary (but not sufficient) condition for the absence of bridges.

(T6) The whole process will stop either if all actors' consumptive needs are satisfied or if the unsatisfied actors have (unsuccessfully) contacted all (i.e. 17) potential partners.

We have added two slight modifications of the model that improve its goodness-of-fit.

(T7) Food shortages due to droughts are mentioned in the ethnographic reports (e.g. Jenness and Ballantyne 1920: 32 cited in Chowning 1983: 418; Malinowski 1966b: 160-2) and may be aggravated because some food can not be stored. To simulate the impact of these shortages on the economic exchange process, with probability .25 the *food* supply of a producer was interrupted in each round.

(T8) Another small stochastic disturbance was added with regard to the supply of goods by middlemen. With probability .05 their store was empty and they were unable to provide the goods in demand unless they produced them themselves.

6.2 The Importance of Trading by Middlemen

The main simulation results are very clear and may be briefly summarized. Each test variant was iterated 1000 times.

First, if actors are only motivated by their own consumptive needs *in no iteration* are all Kula communities able to satisfy their needs; moreover the fit with the observed Kula ring is very bad. Average number of satisfied communities is 8.9 (minimum: 4; maximum: 13); density (.128) and similarity (.178) are very low. 40,1% of the networks are divided in 2 to 4 components and all

1000 simulated networks contain bridges. This occurs though the maximal search radius is 16.6 (minimum: 13; maximum 17).

Second, if people also act as middlemen *all* Kula communities are *always* able to satisfy their consumptive needs. On the average each island has to contact 3 to 7 nearest neighbors only. Average density is .176 and similarity .496. 20,8% of the networks are divided in 2-3 components and 68,5% contain bridges. The process takes about 7.7 rounds until it stops.

These results underline the importance of middlemen for the emergence of a bilateral trading network, which has repeatedly been documented in the ethnographic reports.

6.3 Comparison with Previous Models

We will now compare our simulation model based on the assumptions (T1) to (T8) with two models that have been presented in literature: the proto-coalition model and the proximity model.

In their *proto-coalition model* (Grofman 1982) Bernard Grofman and Janet Landa (1983) specified a mechanism based on the following four assumptions:

(1) Two mutually nearest islands will trade and form a "subsystem";

(2) The distance between two subsystems equals the distance between their two nearest islands;

(3) Two subsystems unite and form a larger subsystem if they are nearest to each other.

(4) This iterative process goes on until all communities are directly or indirectly connected.

The *proximity model* of Geoffrey Irwin (1983) simply connects each Kula community to its 1^{st}, 2^{nd} and 3^{rd} next neighbor and symmetrizes the links.

Both approaches have serious theoretical and methodological deficiencies. First, they do not address the problem either of the *circular* exchange of Kula valuables or the *complementarity* of gift exchange. In fact, by definition all links are symmetric, i.e., if community A travels to community B, the latter will visit A and both communities will trade and exchange Kula valuables reciprocally and complementarily. Second, both models simply assume that there is always an incentive to trade either directly or via middlemen and that this incentive will cease if the graph is connected or if each community has established links to its 3rd next neighbor. They do not rely on any empirical data besides geographic distance. Third, the proto-coalition model is in principle unable to account for the ring-like structure of the Kula system because – as Hage and Harary (1991) pointed out – it is an algorithm to construct a "minimum spanning graph", i.e. a graph, which (directly or indirectly) connects all points and has minimal total length. However, such a graph is a tree and therefore has only bridges and does not contain any cycles.

Let us now compare our "aggregate"[17] simulation model of economic trade with the two models of Grofman and Landa as well as Irwin.

First, while the proto-coalition and the proximity model are static, the simulation model specifies a dynamic process, that changes supply and demand as it evolves.

Second, the implicit assumptions about information and incentives of middlemen and about searching and stopping rules have been made explicit and are based on a rational choice theory of goal-oriented behavior.

Third, the boundary conditions – geographical proximity, productive facilities and consumer demand – are empirically based. The extent to which all communities can satisfy their consumptive needs can therefore be tested and not simply postulated.

Fourth, the links generated are not symmetrized by fiat; the best fitting simulation model turns out to generate reciprocal links, which have a natural empirical interpretation. Both Kula communities have an incentive to sail to their partner with whom they successfully trade.

Finally, the empirical fit of the three models will be compared by five measures: (1) the density; (2) the Jaccard coefficient, which is an asymmetric measure of similarity between observed

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[17] As the two previous models are deterministic leading always to only one configuration, we do not present mean values but the aggregate trading network.

and predicted networks not taking into account the absent ties in both networks; (3) the degree of local clustering measured by the percentage of links, which are contained in cycles of length 3 or 4; (4) the existence of one strong component and (5) the absence of bridges.

	Observed Kula Ring	Proto-Coalition Model	Proximity Model	Aggregate Simulation Model
Density	.235	.111	.235	.196
Similarity	./.	.472	.565	.610
Percentage of links in cycles of length 3 or 4	94,4	0	91,7	86,7
Network forms one strong component?	yes	yes	yes	yes
Network has bridges?	no	yes	no	yes

Table 2: Empirical Fit of the Three Models

The proto-coalition model performs worst and shows a similarity coefficient of .472 and a density of only .111. Though it predicts no links that are not found in the observed Kula ring it misses 19 links. Since it generates a tree-structure it forms one strong component, but all links are bridges and there are no cycles.

The proximity model performs rather well. Density is .235 and its similarity coefficient is .565. It wrongly predicts 10 links and misses 10. It forms one strong component without any bridges and 91.7% of its links are contained in cycles of length 3 or 4.

Our simulation model wrongly predicts 5 links and misses 11 observed ones. Density is .196 and the similarity coefficient equals .610. It forms one strong component but has bridges. 86,7% of its links are contained in cycles of length 3 or 4.

Though its fit is not better than that of the proximity model the latter rests on many unsubstantiated assumptions.[18]

[18] Our final aggregate model with historical phases presented in chapter 9.4 (Table 4, second column) shows a better fit. It wrongly predicts 8 links and misses 7 observed ones. Density is .242 and the similarity coefficient equals .659. It forms one strong component and has no bridges. 89,2% of its links are contained in cycles of length 3 or 4.

7. Process II: The Spread of Peaceful Relationships

7.1 The Basic Prerequisites of Peaceful Trade: Recognizing Property Rights and Creating Trust

As mentioned previously, we hypothesize that the driving force behind the emergence of the Kula to have been the potential advantages of economic trade. However, it is well known that even the simplest economic transaction contains a prisoners' dilemma: both actors are better off if the exchange takes place, but each has an incentive to receive the desired good from the other without delivering his own. When the exchange is not a spot-transaction, the dilemma is sharpened. If one actor has to deliver first and the other at a later point in time, a problem of trust arises.[19] As Durkheim stressed, every contract is incomplete and relies on "non-contractual" norms that are enforced by the "collective conscience": "But wherever a contract exists, it is submitted to regulation which is the work of society and not that of individuals." (Durkheim 1964: 211)

But even more fundamental than the creation and enforcement of a meta-norm "pacta sunt servanda" is the problem of peaceful social order, i.e. the solution of Hobbes' problem of "Warre, as is of every man, against every man" (Hobbes 1968: 185), or as Mauss has formulated: "In order to trade, man must first lay down his spear. When that is done he can succeed in exchanging goods and persons not only between clan and clan but between tribe and tribe and nation and nation, and above all between individuals. It is only then that people can create, can satisfy their interests mutually and define them without recourse to arms" (1969: 80; see also Granovetter 1985: 488). Wars, looting and cannibalism are frequently mentioned in ethnographic literature[20] and show

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[19] In an earlier paper (Ziegler 1987), we used that argument. But the economic exchange in the Kula is a spot transaction and the problem of peaceful relations is much more fundamental (Ziegler 1990).

[20] See Berde 1983; Chowning 1983; Dalton 1977, 1978; Fortune 1989: Appendix VII; Landa 1983; Macintyre 1983b, 1983c; Malinowski

that Hobbes' problem was quite real among the Melanesian tribal societies in the times before colonial powers and Christian missionaries appeared. But even after colonial pacification had occurred, fear of witchcraft by hostile foreign tribes was still widespread (Fortune 1989: 208f).

Refraining from using force or black magic and recognizing property rights as a precondition of peaceful economic trade presuppose the solution of the basic prisoners' dilemma inherent in "the state of nature" (Buchanan 1975: ch. 4). In the one-shot game, using force is both a dominant offensive and defensive strategy. However, if the game is iterated and "the shadow of the future" is long enough, there will be an incentive for two actors to disarm. The peaceful strategy may spread in a population and become evolutionarily stable.

7.2 Types of Cooperative and Defecting Strategies

Starting with Axelrod's book on "The Evolution of Cooperation" (1984) a tremendous amount of research on the iterated Prisoner's Dilemma Game (Axelrod and Dion 1988; Axelrod and D'Ambrosio 1995) has demonstrated "The Complexity of Cooperation" (Axelrod 1997). Though strategy sets in (infinitely) repeated games are huge and complicated (Binmore 1992: ch. 8.4) we keep matters simple and restrict our analysis to three elementary strategies and three modifications, which adapt them to the peculiar situation of the Kula ring.

The two cooperative and one uncooperative basic strategies are well-known; the payoffs are named as usual and ordered $T > R > P > S$:

(1) ALL-C: The actor always cooperates, receives the reward R if his partner also cooperates, but gets sucker's payoff S if his partner defects.

(2) TFT: The TIT FOR TAT player is cooperating at the first move and then doing whatever the other player did on the previous move.

1966a: 321; Róheim 1954; Seligman 1910: chs. XLI-XLIII; Thune 1983; Young 1983.

(3) ALL-D: This player always defects, receives the temptation payoff T if his partner cooperates, but gets the punishment P if his partner defects too.

In order that the game can be played, the actors have to meet. This means that community A (the potential guest) has first to decide whether to sail to community B (the potential host) at all. Now it seems plausible that they will not sail if they expect the potential host to defect. The "forced iteration principle" has been critized as a too restrictive assumption of many simulation models (Schüßler 1990). In our model we therefore added an "*exit-option*" to the three basic strategies: (4) ALL-Ce, (5) TFTe or (6) ALL-De. However, this will only be effective if the player acts as a potential guest. Then he will not visit a potential host whom he expects to be hostile. In that round both players will receive the neutral payoff X foregoing positive outcomes, R or T, but also avoiding negative ones, P or S. On the other hand, if a host is visited by another actor, the outcome of the game will be determined by the basic strategies of the two players.

Figure 3 shows the strategic form of the infinitely iterated "War Game". It is asymmetric because one has to distinguish the effects of players' strategies if they act as (potential) guests or as (potential) hosts. To explain: Row Player A takes the initiative and decides whether to sail to Column Player B or not. In the first round all Row Players will take the chance and sail. Depending on the strategies used the payoffs are determined and both players will mutually recognize and remember their strategies. The derivation of payoffs will be demonstrated for four cells of the matrix.

Cell (TFTe,TFT): In the beginning Row Player A will sail to Column Player B. Since both behave conditionally cooperatively, they will both receive payoff R. In the second round B will return the visit, and the same outcome is obtained. When the third round comes, A – though he uses an exit-strategy – will sail again, because he expects B to behave conditionally cooperatively. The cumulative value of the sequence is:

$$\mathrm{R} + w\mathrm{R} + w^2\mathrm{R} + w^3\mathrm{R} + \ldots = \mathrm{R}/(1\text{-}w)$$

$0 < w < 1$ is the *discount parameter* and measures the weight of the next move relative to the current one. For two reasons the

		Column Player B					
		ALL-C	TFT	ALL-D	ALL-Ce	TFTe	ALL-De
Row Player A	ALL-C	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T/(1-w)$ $S/(1-w)$	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T/(1-w)$ $S/(1-w)$
	TFT	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T+wP/(1-w)$ $S+wP/(1-w)$	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T+wX/(1-w^2)$ $+w^2P/(1-w^2)$ $S+wX/(1-w^2)$ $+w^2P/(1-w^2)$
	ALL-D	$S/(1-w)$ $T/(1-w)$	$S+wP/(1-w)$ $T+wP/(1-w)$	$P/(1-w)$ $P/(1-w)$	$S+wX/(1-w^2)$ $+w^2S/(1-w^2)$ $T+wX/(1-w^2)$ $+w^2T/(1-w^2)$	$S+wX/(1-w^2)$ $+w^2P/(1-w^2)$ $T+wX/(1-w^2)$ $+w^2P/(1-w^2)$	$P+wX/(1-w^2)$ $+w^2P/(1-w^2)$ $P+wX/(1-w^2)$ $+w^2P/(1-w^2)$
	ALL-Ce	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T+wT/(1-w^2)$ $+w^2X/(1-w^2)$ $S+wS/(1-w^2)$ $+w^2X/(1-w^2)$	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T+wT/(1-w^2)$ $+w^2X/(1-w^2)$ $S+wS/(1-w^2)$ $+w^2X/(1-w^2)$
	TFTe	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T+wP/(1-w^2)$ $+w^2X/(1-w^2)$ $S+wP/(1-w^2)$ $+w^2X/(1-w^2)$	$R/(1-w)$ $R/(1-w)$	$R/(1-w)$ $R/(1-w)$	$T+wX/(1-w)$ $S+wX/(1-w)$
	ALL-De	$S/(1-w)$ $T/(1-w)$	$S+wP/(1-w^2)$ $+w^2X/(1-w^2)$ $T+wP/(1-w^2)$ $+w^2X/(1-w^2)$	$P+wP/(1-w^2)$ $+w^2X/(1-w^2)$ $P+wP/(1-w^2)$ $+w^2X/(1-w^2)$	$S+wX/(1-w^2)$ $+w^2S/(1-w^2)$ $T+wX/(1-w^2)$ $+w^2T/(1-w^2)$	$S+wX/(1-w)$ $T+wX/(1-w)$	$P+wX/(1-w)$ $P+wX/(1-w)$

Figure 3: Strategic Form of the Infinitely Iterated "War Game"
Note: Rank order of payoffs is $T > R > X > P > S$

future is less important than the present. The first is that players tend to discount values as the time of their obtainment recedes into the future. The second is that there is always a chance that the players will not meet again.

Cell (TFTe,ALL-De): At their first encounter the conditionally cooperative Row Player A will be a sucker and Column Player B will receive the highest payoff T. However, both realize that at the next encounter they both would defect. Therefore they exit and avoid any contact in future rounds. The expected payoffs are

for A: $S + wX + w^2 X + w^3 X \ldots = S + wX/(1-w)$ and

for B: $T + wX + w^2 X + w^3 X \ldots = T + wX/(1-w)$.

Cell (TFTe,ALL-D): The first round is identical to the previous example. However, while Column ALL-D Player B returns the visit in the second (fourth, sixth etc. round) despite leading to mutual punishment P, Row TFTe Player A exits, when it is his turn. The expected payoffs are

for A: $S + wP + w^2 X + w^3 P \ldots = S + wP/(1-w^2) + w^2X/(1-w^2)$ and

for B: $T + wP + w^2 X + w^3 P \ldots = T + wP/(1-w^2) + w^2X/(1-w^2)$.

Cell (ALL-Ce,ALL-De): The first round is again identical to the two previous examples. However, though in principle Column ALL-De Player B uses the exit option he will always return because he knows that A is unconditionally cooperative. On the other hand A will not sail, when it is his turn to decide. The expected payoffs are

for A: $S + wS + w^2 X + w^3 S \ldots = S + wS/(1-w^2) + w^2X/(1-w^2)$ and

for B: $T + wT + w^2 X + w^3 T \ldots = T + wT/(1-w^2) + w^2X/(1-w^2)$.

To determine the Nash equilibria (weakly) dominated strategies are successively deleted (Binmore 1992: 147-50). The payoffs of the basic game are ordered $T > R > X > P > S$.

Step 1: Delete row ALL-C and column ALL-C because they are weakly dominated by row TFT respectively column TFT.

Step 2: Delete row TFT and column TFT because they are weakly dominated by row TFTe respectively column TFTe.

Step 3: Delete row ALL-D and column ALL-D because they are weakly dominated by row ALL-De respectively column ALL-De.

Step 4: Delete row ALL-Ce and column ALL-Ce because they are weakly dominated by row TFTe respectively column TFTe.

This sequence of deletions leaves the double-framed 2x2 game. This game always has a (suboptimal) Nash equilibrium in the two defecting strategies ALL-De. It may have another Pareto-optimal Nash equilibrium in the two conditionally cooperative strategies TFTe, if and only if the following inequality is satisfied:

$R/(1-w) > T + wX/(1-w) \quad \text{iff} \quad w > [(T-R)/(T-X)]$

which means that the "shadow of the future" w must be sufficiently large. The game then is no longer a Prisoner's Dilemma but has the structure of an Assurance Game.

7.3 The Importance of Expectations, Reputation and Trust

So far an (isolated) dyad has been analyzed. But the Kula communities form a developing network. Therefore each actor does not have to rely solely on his own experience, but can use the information conveyed to him by third persons when forming his expectations about the strategies of potential partners. Furthermore, the reputation of an actor may not spread in his immediate vicinity only, but gradually diffuse over longer distances. The following assumptions characterize the process of expectation formation, reputation, trust and change of strategies.

(P1) The actors use one of two *exit strategies*: TFTe or ALL-De. Though the "shadow of the future" w is sufficiently large, inducing an isolated dyad to coordinate their choice of strategies on the Pareto-optimal cooperative solution, a player in a larger set of actors could profit by exploiting partners, whom he expects to be still "naïve". Therefore it is assumed that in the beginning all players use the uncooperative strategy ALL-De except the first pair of communities, which are able to trade successfully.[21]

(P2) All actors have *expectations* regarding the strategies and the state of knowledge of all others. They may expect another potential partner to conditionally cooperate (+1), to defect (–1) or

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[21] In 999 out of 1000 iterations peaceful cooperation still always spreads completely, even when all actors start with the uncooperative strategy ALL-De, as long as the fear of ostracism induces them to switch to the cooperative TFTe, but the goodness-of-fit is somewhat lower.

they don't know (0). In the beginning nobody knows anything about the other players.

(P3) If an actor has to decide whether to visit another player and has *no personal positive* experience about him he will explore his reputation. Even if he had a negative experience, an actor would check the reputation, because the other player may have changed his strategy in the meantime. The *reputation* of B in the eyes of A is the sum of expectations of all neighbors of A, who either had direct contact with B or had heard from their neighbors.[22] As this indirect hearsay is less reliable, it is weighed by a random factor p ($0 \leq p \leq 1$). If the majority opinion is positive, A will contact B, if it is negative, he will not. If the majority opinion is split or undecided (i.e. the sum equals zero), A's own experience will be decisive. If he himself has no opinion, he will visit B if he is trusting and will not contact him if he is mistrusting.

(P4) The behavioral consequences of the two strategies are different for visitors and hosts. As a hidden attack is more successful, ALL-De visitors will approach their potential victims calmly, secretly and cautiously. Therefore an openly announced arrival is a sign of peaceful intentions (TFTe) and a conditionally cooperative host (TFTe) will react cooperatively if he is *trusting* or – despite his own initial negative expectations – if the reputation of the visitor is positive.

(P5) The outcome of an encounter is the result of the strategies actually used by the two players. Both actors will *update their expectations* depending on whether they have been treated in a friendly way or not. Of course, if no contact has been made, the expectations will remain unchanged.

(P6) Only if both actors cooperate can an economic exchange take place – based on the double coincidence of wants.

(P7) After an encounter an ALL-De player will eventually *change his strategy* and become TFTe, if the number of his contacts passes a certain *threshold*. This assumption models his

[22] Reputation is assumed to diffuse in the "second order zone", i.e. among all actors linked to the anchor person by two steps. (Mitchell 1979:440-1)

growing fear of loss of reputation. An ALL-De player will no longer find naïve partners and runs the risk of being ostracized.

Figure 4 summarizes the assumptions (P1) to (P7) of the peace spreading process in schematic form.

<table>
<tr><td></td><td></td><td></td><td colspan="3">Strategy of Host B</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">TFTe</td><td>ALL-De</td></tr>
<tr><td></td><td></td><td>Expectations</td><td>B is trusting or A's reputation is positive</td><td>B is mistrusting and A's reputation is not positive</td><td>irrelevant</td></tr>
<tr><td rowspan="4">Strategy of Visitor A</td><td rowspan="2">TFTe</td><td>B is considered cooperative</td><td>potential trade (R,R) or (X',X); both expecta-tions positive</td><td>exploitation of A (S,T); both expecta-tions negative</td><td>exploitation of A (S,T); both expecta-tions negative</td></tr>
<tr><td>B is considered defecting</td><td colspan="3">no contact; outcome (X,X); expectations unchanged</td></tr>
<tr><td rowspan="2">ALL-De</td><td>B is considered cooperative</td><td>exploitation of B (T,S); both expectations negative</td><td>conflict (P,P); both expectations negative</td><td>conflict (P,P); both expecta-tions negative</td></tr>
<tr><td>B is considered defecting</td><td colspan="3">no contact; outcome (X,X); expectations unchanged</td></tr>
</table>

Figure 4: The Impact of Strategies, Expectations, Reputation and Trust

Note: The figure shows the outcomes and the change of expectations depending on strategies, expectations, reputation and trust.
X' := (neutral result X – costs of visiting)
Order of preference: T > R > X > X' > P > S

The results of the various scenarios are very clear and can briefly be summarized. First, without the reputation mechanism working – either restricted to the immediate neighborhood or diffusing over longer distances – a coherent network develops in at most 11 out of 1000 iterations, and only in a coherent network does peace always prevail, i.e. with all 18 communities being cooperative, and all satisfying their consumptive needs. On the other hand, if the reputation mechanism is working, *in all iterations all* actors become cooperative and satisfy their consumptive needs, even if the network is split into several components (as happens in 68 out of 1000 iterations).

Second, lack of trust has disastrous consequences. Only the initial cooperative dyad is eventually connected (in 665 out of 1000 iterations), while *all* other 16 communities are *always* isolated, though on the average 7.4 of them have become cooperative.

Third, fear of loss of reputation has a remarkable influence. A threshold value of 1 – which means that an uncooperative player adopts a cooperative strategy after having met two other players – turns out to be the best parameter value. Results deteriorate sharply if a threshold value of 2 is used, and a value of 3 (i.e. even less fear of ostracism) produces in 654 out of 1000 iteration runs a completely fragmented set of 16 isolated uncooperative players with the two initially cooperative actors forming an isolated dyad. In another 308 cases there exist no links at all among the 18 communities. Overall the mean number of cooperative actors is 1.5. These results clearly demonstrate the importance of expectations, reputation, trust and fear of ostracism.

Therefore in all simulations that include the peace-spreading module the following parameters have been used:

- all actors start with the defecting strategy;
- the first pair able to trade becomes cooperative;
- both direct and indirect reputation mechanisms are working;
- actors are (conditionally) trusting;
- defecting actors' fear of ostracism is medium, i.e. they change to a cooperative strategy after two contacts.

8. Process III: The Evolution of a Ceremonial Exchange Network

8.1 The Kula as a Signaling System of Peaceful Intentions

Thus far, the function of ceremonial exchange of gifts has not been dealt with. Thomas Hobbes explained the emergence of a peaceful social order through the existence of a benevolent, impartial and strict ruler upon whom the society members have transferred their "natural rights".[23] However, while the establishment of a monopoly of power in the hands of the Leviathan dissolves the underlying prisoners' dilemma – it is replaced by the problem "quis custodiet ipsos custodes?" –, the endogenous evolution of an "ordered anarchy" (Buchanan 1975) leaves the basic dilemma unaffected. "The gift, however, would not organize society in a corporate sense, only in a segmentary sense. Reciprocity is a 'between' relation. It does not dissolve the separate parties within a higher unity, but on the contrary, in correlating their opposition perpetuates it. Neither does the gift specify a third party standing over and above the separate interests of those who contract. Most important, it does not withdraw their force, for the gift affects only will and not right." (Sahlins 1974: 170)

The best strategy choice (peacefulness or use of force and black magic) depends on the durability of a social relationship. If both actors have a lasting interest, then they are both interested in reducing their uncertainty concerning their partner's strategy through a reliable signaling system. (Posner 1981: 170; Landa 1983: 152)

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[23] "And in him consisteth The Essence of the Common-wealth; which (to define it,) is *One Person, of whose Acts a great Multitude, by mutual Covenants one with another, have made themselves every one the Author, to the end he may use the strength and means of them all, as he shall think expedient, for their Peace and Common Defence.*" (Hobbes 1968 [1651]: 228)

It is our central thesis that the ceremonial exchange of gifts is a signaling system of the kind required to maintain social order, which has inbuilt mechanisms against cheating.[24]

This interpretation[25] accounts for many peculiarities that may not be understood when the exchange of gifts is thought of as a kind of commercial trade. Goods and services exchanged ceremoniously need not have use or exchange value (if traded by middlemen), but must convey clear and unmistakable meanings. Ritualism in exchanging gifts ensures the unambigiousness of signals. It also does not help to be niggardly. On the contrary, each has to give generously because a signal not being sent does not convey a message or a negative one. Even the pattern of delayed reciprocity now makes sense. Unilateral disarmament may induce the other to take advantage and defect. However, the ceremonial exchange of gifts is not aimed at solving a prisoner's dilemma, but at stabilizing the mutual expectations about what supergame one is engaged in. To be the first to signal one's lasting interest is by no means disadvantageous, but rather raises one's credibility. Accepting a gift demonstrates the same attitude on the receiver's side. A signal becomes more credible if the counter-gift is of equal value and is bestowed somewhat later, when the uncertainty about the continuing interest in the relationship has again increased. Signals staggered in time and alternately sent by both actors foster the shared trust in the durability of the relationship.

The signaling function of gift giving also explains why there is no haggling, although the gifts are expected to be of equal value even when "the equivalent rests with the giver, and cannot be enforced, nor can there be any haggling or going back on the exchange" (Malinowski 1966a: 98). Haggling presupposes social

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[24] Gift-giving as relational signaling and as a wide-spread starting mechanism for building up trust among previously unrelated actors has been analyzed by anthropologists, economists, sociologists and social psychologists from different perspectives (e.g. Akerlof 1982; Camerer 1988; Haas and Deseran 1981; Mauss 1969; Posner 1980; Schwartz 1967).

[25] The following passages until the end of chapter 8.3 have been taken from Ziegler 1990.

order and the acknowledgment of property rights, while the gift signals the basic choice between peace and war. "Although prestations and counter-prestations take place under a voluntary guise they are in essence strictly obligatory, and their sanction is private or open warfare" (Mauss 1969: 3).

8.2 Reducing Uncertainty about the Stability of Peaceful Relationships

In chapter 7.2 we analyzed the strategic form of the "War Game" and reduced it to the 2 by 2 double-framed supergame (see Figure 3). Depending on the "shadow of the future" it is a prisoner's dilemma or an assurance game. The choice of a strategy depends on the size of w, i.e. the importance of future transactions as judged by the actors. Actually there are four combinations (four different supergames) depending on whether both consider the relationship to be sufficiently durable, i.e. $w > [(T-R)/(T-X)]$, whether only one does or whether both have no lasting interest in the relationship, i.e. $[(T-R)/(T-X)] > \underline{w}$.[26]

Figure 5 shows the four supergames. The payoffs may be calculated from the double-framed part of Figure 3. They form a partial order: $a_w > b_w > c_w > d_w$; $b_{\underline{w}} > a_{\underline{w}} > c_{\underline{w}} > d_{\underline{w}}$; $a_w > a_{\underline{w}}$; $b_w > b_{\underline{w}}$; $c_w > c_{\underline{w}}$; $d_w > d_{\underline{w}}$. The analysis of these four supergames shows that only when both actors have a lasting interest in the relationship is it possible to obtain the Pareto optimal result (a_w, a_w) by solving a (trivial) coordination game, i.e. avoiding the Pareto-inferior equilibrium (c_w, c_w). In the other three cases there exists only one Pareto-inferior Nash equilibrium, which leaves both actors worse off than with the cooperative, but unstable outcome.

Now let us first assume that both actors have complete information on which supergame they are actually playing. Then two conclusions may be drawn from Figure 5.

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[26] It is assumed that the discount parameters lie strictly within the (0,1)-interval. From that it follows that $1 > w > \underline{w} > 0$.

(1) Every actor recognizes that a durable relationship is preferable to a transient one[27] *independent* of how the other evaluates its stability, because the equilibria are ordered $a_w \gg c_w > c_{\underline{w}}$.

(2) If an actor considers a relationship to be sufficiently durable, he would prefer the other to have a lasting interest too ($a_w \gg c_w$), otherwise he is indifferent to the other's estimation of the durability.

		B_w		$B_{\underline{w}}$	
		TFTe	ALL-De	TFTe	ALL-De
A_w	TFTe	a_w, a_w	d_w, b_w	$a_w, a_{\underline{w}}$	$d_w, b_{\underline{w}}$
	ALL-De	b_w, d_w	c_w, c_w	$b_w, d_{\underline{w}}$	$c_w, c_{\underline{w}}$
$A_{\underline{w}}$	TFTe	$a_{\underline{w}}, a_w$	$d_{\underline{w}}, b_w$	$a_{\underline{w}}, a_{\underline{w}}$	$d_{\underline{w}}, b_{\underline{w}}$
	ALL-De	$b_{\underline{w}}, d_w$	$c_{\underline{w}}, c_w$	$b_{\underline{w}}, d_{\underline{w}}$	$c_{\underline{w}}, c_{\underline{w}}$

Figure 5: Strategies and payoffs in the iterated "War Game" with different durations of the relationship (w = high; $\underline{w}$ = low)

$a = R/(1-w)$ $b = T + wX/(1-w)$ $c = P + wX/(1-w)$ $d = S + wX/(1-w)$

Pareto-inferior Nash equilibria are shown in dashed, the Pareto-optimal one in solid circles.

We will now drop the assumption of complete information and look at the need for receiving and providing information. Two further hypotheses may then be stated.

[27] The (subjectively evaluated) durability of a relationship is not a matter of choice, but reflects its constraints. A somewhat speculative question may nevertheless be raised. Might an actor try to change that constraint, i.e. his w or that of his partner, if he becomes aware of a situation like that in Figure 5?

(3) Every actor wants to obtain reliable information about the other’s estimation of durability, when he himself has a lasting interest, because without that information he may cooperate erroneously. That information is irrelevant if he regards the relationship to be transient, because then his defecting strategy is dominant.

(4) Finally, an actor is interested in reliably informing the other *if* both judge their relationship to be sufficiently durable.

The main result of this analysis is that *if* stable relations have been established, *both* actors are interested in reducing the uncertainty about what supergame they are in by communicating reliable messages.

8.3 Basic Problems of a Signaling System: Cheating and Trust

So far we have avoided the problem of cheating and mistrust. Therefore our argument has been weak and somewhat inconsistent, because if there is perfect information, there is no signaling problem, but if the information is incomplete, cheating and/or mistrust should not be neglected. The situation now becomes much more complex. The two actors not only evaluate the durability of the relationship as either lasting (w) or transient ($\underline{w}$), but also have to decide whether to be honest and whether to trust. While the durability reflects the restrictions – unknown to OTHER but known by EGO, though not to be chosen by him – to cheat and/or to trust are matters of choice. The possible combinations are shown in Figures 6a-d.

Bestowing a gift is assumed to signal the *shared* meaning of having a lasting interest. All actors have a common interest in the unambiguousness of this semantic code, especially those who want to cheat. What one *should* mean if one presents a gift is shared by all: a gift "should" indicate a lasting interest. A dishonest partner in particular has an interest that his gift is (falsely) interpreted as an indication of a lasting and sincere interest.[28]

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[28] To use an analogy: a marriage impostor is especially interested that his victim shares the same semantic code and interprets his gifts as a sign of his "true love".

However, without complete information an actor does not know whether his partner is honest and trusting. He only knows whether the other presents a gift or not. Depending on his own evaluation of the durability of the relation, on whether a gift was presented or not, and on his choice of being honest and trusting, he "defines the situation", i.e. determines the supergame he thinks they are playing. These estimations are shown in the first line of each cell; the letters before the comma refer to EGO's estimation, those after the comma to OTHER's definition of the situation. Based on the perceived situation, each actor chooses the equilibrium strategy and expects the other to do the same. This choice is shown in the second line; upper case letters indicate the strategy *chosen*, while lower case letters the strategy *expected*. The third line shows the anticipated payoff based on the perceived supergame. If the actual payoff (determined by the chosen strategies and the actual supergame the actors are engaged in) differs from the anticipated one, this is shown in brackets in the fourth line. An example is given in the following legend.

Note: The matrices in Figure 6a-d are explained as follows [the example refers to Figure 6a Cell (2,1)]:

The *first line* shows the situation as perceived by both actors, who have no information about honesty and trust of the other:

$w\underline{w},ww$: EGO perceives (incorrectly) the situation to be $w\underline{w}$
OTHER perceives (correctly) the situation to be ww

The *second line* shows the strategies chosen and expected by the actors depending on the (Pareto-optimal) equilibria in their perceived situation:

Dd,cC: EGO defects (D) and also expects OTHER to defect (d)
OTHER cooperates (C) and also expects EGO to cooperate (c).

The *third line* shows the payoffs anticipated by the actors depending upon the perceived situation and the choice of strategies:

c_w, a_w: EGO anticipates c_w; OTHER anticipates a_w

The *fourth line* shows the actual payoffs to the actors (in brackets) depending upon the actual situation and their choice of strategies (if different from the anticipated payoffs):

(b_w, d_w): EGO gets b_w; OTHER gets d_w

			Other *w* (durable)			
			Gift (honest)		No gift (dishonest)	
			Trust	Mistrust	Trust	Mistrust
Ego *w* (durable)	Gift (honest)	Trust	ww, ww Cc, cC a_w, a_w	$ww, \underline{w}w$ Cc, dD a_w, c_w (d_w, b_w)	$w\underline{w}, ww$ Dd, cC c_w, a_w (b_w, d_w)	$w\underline{w}, \underline{w}w$ Dd, dD c_w, c_w
		Mis-trust	$w\underline{w}, ww$ Dd, cC c_w, a_w (b_w, d_w)	$w\underline{w}, \underline{w}w$ Dd, dD c_w, c_w	ww, ww Cc, cC a_w, a_w	$ww, \underline{w}w$ Cc, dD a_w, c_w (d_w, b_w)
	No gift (dis-honest)	Trust	$ww, \underline{w}w$ Cc, dD a_w, c_w (d_w, b_w)	ww, ww Cc, cC a_w, a_w	$w\underline{w}, \underline{w}w$ Dd, dD c_w, c_w	$w\underline{w}, ww$ Dd, cC c_w, a_w (b_w, d_w)
		Mis-trust	$w\underline{w}, \underline{w}w$ Dd, dD c_w, c_w	$w\underline{w}, ww$ Dd, cC c_w, a_w (b_w, d_w)	$ww, \underline{w}w$ Cc, dD a_w, c_w (d_w, b_w)	ww, ww Cc, cC a_w, a_w

Figure 6a: (w,w) Perceived Situations, Choice of Strategies, Anticipated Payoffs, Actual Payoffs (in Brackets if Different from Anticipated), when both EGO and OTHER Estimate the Relationship as Durable

Looking at the four actual supergames (presented in the Figures 6a-d) the following general conclusions may be stated:

If both judge the relationships to be durable (Figure 6a; *ww*), there exist several (unstable) possibilities of exploiting and being exploited and *four* Pareto-optimal equilibria with both actors receiving the highest payoff a_w. Obviously there exists a co-ordination problem with many pitfalls.

			Other $\underline{w}$ (transient)			
			Gift (dishonest)		No gift (honest)	
			Trust	Mistrust	Trust	Mistrust
Ego w (durable)	Gift (honest)	Trust	$ww, w\underline{w}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$	$ww, \underline{ww}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$	$w\underline{w}, w\underline{w}$ Dd, dD $c_w, c_{\underline{w}}$	$w\underline{w}, \underline{ww}$ Dd, dD $c_w, c_{\underline{w}}$
		Mis- trust	$w\underline{w}, w\underline{w}$ Dd, dD $c_w, c_{\underline{w}}$	$w\underline{w}, \underline{ww}$ Dd, dD $c_w, c_{\underline{w}}$	$ww, w\underline{w}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$	$ww, \underline{ww}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$
	No gift (dis- honest)	Trust	$ww, \underline{ww}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$	$ww, w\underline{w}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$	$w\underline{w}, \underline{ww}$ Dd, dD $c_w, c_{\underline{w}}$	$w\underline{w}, w\underline{w}$ Dd, dD $c_w, c_{\underline{w}}$
		Mis- trust	$w\underline{w}, \underline{ww}$ Dd, dD $c_w, c_{\underline{w}}$	$w\underline{w}, w\underline{w}$ Dd, dD $c_w, c_{\underline{w}}$	$ww, \underline{ww}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$	$ww, w\underline{w}$ Cc, dD $a_w, c_{\underline{w}}$ $(d_w, b_{\underline{w}})$

Figure 6b: *($w,\underline{w}$)* Perceived Situations, Choice of Strategies, Anticipated Payoffs, Actual Payoffs (in Brackets if Different from Anticipated), when EGO Estimates the Relationship as Durable, but OTHER as Transient.

If EGO has a lasting interest but OTHER does not (Figure 6b; $w\underline{w}$), EGO recognizes the imminent danger that due to incomplete information he might misperceive the situation and actually get the lowest (d_w) instead of the anticipated highest (a_w) payoff. He also realizes that OTHER has an incentive to bring about those situations that would benefit him (OTHER gets $b_{\underline{w}}$ instead of $c_{\underline{w}}$).

			Other w (durable)			
			Gift (honest)		No gift (dishonest)	
			Trust	Mistrust	Trust	Mistrust
Ego $\underline{w}$ (transient)	Gift (dis-honest)	Trust	$\underline{w}w, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$	$\underline{w}w, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$	$\underline{ww}, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$	$\underline{ww}, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$
		Mis-trust	$\underline{ww}, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$	$\underline{ww}, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$	$\underline{w}w, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$	$\underline{w}w, \underline{w}w$ Dd, dD c_w, c_w
	No gift (honest)	Trust	$\underline{w}w, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$	$\underline{w}w, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$	$\underline{ww}, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$	$\underline{ww}, ww$ Dd, cC c_w, a_w $(b_{\underline{w}}, d_w)$
		Mis-trust	$\underline{ww}, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$	$\underline{ww}, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$	$\underline{w}w, \underline{w}w$ Dd, dD $c_{\underline{w}}, c_w$	$\underline{w}w, ww$ Dd, cC $c_{\underline{w}}, a_w$ $(b_{\underline{w}}, d_w)$

Figure 6c: *($\underline{w}$,w)* Perceived Situations, Choice of Strategies, Anticipated Payoffs, Actual Payoffs (in Brackets if Different from Anticipated), when EGO Estimates the Relationship as Transient, but OTHER as Durable

If, on the other hand, EGO has no lasting interest but OTHER has (Figure 6c; $\underline{w}w$), EGO realizes that there are situations he can take advantage of, i.e. receiving $b_{\underline{w}}$ instead of $c_{\underline{w}}$, at the expense of OTHER.

			Other $\underline{w}$ (transient)			
			Gift (dishonest)		No gift (honest)	
			Trust	Mistrust	Trust	Mistrust
Ego $\underline{w}$ (transient)	Gift (dis-honest)	Trust	$\underline{w}w, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{w}w, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{ww}, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{ww}, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$
		Mis-trust	$\underline{ww}, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{ww}, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{w}w, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{w}w, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$
	No gift (honest)	Trust	$\underline{w}w, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{w}w, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{ww}, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{ww}, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$
		Mis-trust	$\underline{ww}, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{ww}, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{w}w, \underline{ww}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$	$\underline{w}w, w\underline{w}$ Dd, dD $c_{\underline{w}}, c_{\underline{w}}$

Figure 6d: ($\underline{w}$,$\underline{w}$) Perceived Situations, Choice of Strategies, Anticipated Payoffs, Actual Payoffs, when both EGO and OTHER Estimate the Relationship as Transient.

Finally, if both actors consider the relationship to be transient (Figure 6d; $\underline{ww}$), it is irrelevant whether or not they cheat or trust. Although each choice leads to different "definitions of the situation", both actors always decide to defect, anticipate, and actually get the payoff $c_{\underline{w}}$.

How should EGO decide? A close analysis of Figure 6 (one must simultaneously look at Figure 6a and b, or c and d, respectively) suggests the following conclusions:

- If EGO has no lasting interest ($\underline{w}$) he should follow the rule: "Be honest, *if* OTHER is *mis*trusting you!" (or equivalently: "*If* he trusts you, cheat him!"). However, there is no need for EGO to decide whether to trust OTHER or not. His own trust is irrelevant for himself.

- If EGO has a lasting interest (*w*), he has to obey the following two rules at the same time: "Be honest, *if* OTHER is trusting you!" and "Trust OTHER, *if* he is honest!"

It is now easy to tell what kind of information EGO really needs. If his interest is transient ($\underline{w}$), he only wants to know whether OTHER is trusting or not. Whether OTHER is cheating him is irrelevant (because his use of the defecting strategy protects him from being exploited). He wants to cheat but can't be cheated!

If, however, EGO has a lasting interest (*w*), he needs information both about the honesty and the trust of OTHER – at least if OTHER also has a lasting interest. If OTHER's interest is transient, EGO needs only to know whether OTHER is honest or not.

If all actors would agree on the following *convention* (Lewis 1986): "Don't forget to present a gift, if you have a lasting interest!" the situation could be simplified. It would give a clear meaning to *non*participation in gift exchanges. "To refuse to give, or to fail to invite, is like refusing to accept – the equivalent of a declaration of war; it is refusal of friendship and intercourse" (Mauss 1969: 11). This convention would be equivalent to the rule that people with a lasting interest do not cheat. It would in effect mean that the feasible set of "definitions of the situation" would be restricted to the double-framed parts in Figure 6a-d. A closer look shows that there is a definite *common* interest in such a convention among all actors, who estimate the relationship to be durable. It drastically simplifies the coordination problem with other actors, who have a lasting interest (see Figure 6a) and does not make EGO *more* vulnerable to being cheated by OTHERS with no lasting interest (see Figure 6b). On the other hand, actors with no lasting interest cannot obstruct the convention and do not even have an incentive to do so because the convention does not prevent them from cheating (Figure 6c).

This convention may, therefore, be considered as the solution of a coordination game of a higher order. If it is established, it will reduce the need for information. For actors with a lasting interest, it now suffices to know whether the partner is honest or not.[29] If OTHER lies, EGO knows that OTHER has no lasting interest and he should mistrust him. If OTHER is honest and donates, EGO knows that OTHER has a lasting interest and he should trust him.[30] If OTHER is honest and does not present a gift, EGO knows that OTHER has no lasting interest, but he should nevertheless trust him.

In this way, the amount of information needed is reduced: both actors would only have to know about the sincerity of their partner or, equivalently, the durability of their interest.

8.4 The Preventive Role of Reputation

But what prevents a dishonest actor from being a "confidence racket" (Granovetter 1985: 491) pretending his lasting interest by presenting a gift and then misusing his victim's trust? It is, of course, the potential for exclusion from the system based on a bad reputation. Interest in remaining in the system is certainly higher than his interest in any specific dyadic relationship.

But who is ready to bear the costs of an information system? If the information is available to everyone, it is a public good, the provision of which causes problems. The public character of the ceremonial exchange of gifts reduces costs of information, but only locally. Much more efficient is the ringlike structure of two distinct gifts, armshells and necklaces, circulating always in opposite directions. This creates a self-enforcing mechanism ensuring the quick and accurate detection of black sheep, and the loss of their reputation. Because of the periodicity of the Kula

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[29] An equivalent condition would be, that EGO has to know how OTHER evaluates the durability of the relationship, because durability and donating define honesty, while honesty and donating allow for the evaluation of durability.

[30] This is the best strategy for EGO to solve the coordination problem left in the situation where he knows that both of them have a lasting interest (see the double-framed part of Figure 6a) Of course, he does not know whether OTHER perceives the situation correctly. So, he may still be in doubt whether OTHER inadvertently does not trust him (because, for example, OTHER assumes EGO to be dishonest).

expeditions and the circulation of gifts, a violation of the principle of reciprocity in ceremonial exchange is quickly detected as it blocks the supply of *vaygu'a*. However, no one wants to be falsely suspected merely because he lacks the "right" kind of gifts. He will inquire and – because of the fixed direction the gifts are circulating – knows where to look. "The Kula Ring with its double circuit of two different objects turns out to be a club-like arrangement in which everyone is watching everyone else, gossiping about each other, and monitoring each other's behavior. And because Kula partnerships are passed on from generation to generation, hence excluding outsiders, an 'unbroken chain' of Kula partners exists." (Landa 1983: 153) Over and above, the endurance of a Kula relationship beyond death, which is symbolized by mortuary rites, enhances the chances of co-operation by raising the value of w, i.e. enlarging the shadow of the future.[31]

Finally, we have to explain that the visiting partners of a local Big Man do trade and haggle within his village, but not with him personally. "The overseas partner is ... a host, patron and ally in a land of danger and insecurity." (Malinowski 1966a: 92) Of course, he also conducts *gimwali*, not with his personal partners but with other natives. There seem to be two reasons: first, one avoids using signals strategically in commercial trade, pretending a lasting interest that does not exist; second, the choice of a concrete partner for bartering is left open without endangering the estimation of the durability of the relationship. Flexibility of economic exchange and stability of social relationships are thereby combined.[32]

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[31] Landa cites two other club-like elements of the Kula. Barriers to entry are very high, because one has first to master the rites of the club and the initiation is controlled by the club members. Somebody is only accepted into the Kula if he has received *vaygu'a* from a club member who has tested his reliability.

[32] A more extended analysis would have to deal systematically with the internal functions of the Kula within the local communities, clans and tribes. On the one hand, Big Men enforce the constitutional contract with the stranger; among the commoners, on the other hand, the Kula exchange preserves and enhances their internal status.

Let us summarize the argument. If there is imperfect information about what supergame the actors are playing, there exists a need for a reliable signaling system. The ceremonial exchange of Kula gifts acts as a self-enforcing information system of the sort required. However, honesty – donating, if and only if one has a lasting interest – and trust, i.e. believing the (shared) meaning of the signal emitted, become problematic and a matter of choice. The rather complex situation becomes simplified by the establishment of the following convention, for which a common interest exists: if one has a lasting interest, one should present a gift. Then two kinds of information are sufficient: (1) everybody knows whether his partner is honest, and (2) everybody assumes that his partner knows whether he is honest or not. The first kind of information helps those with a lasting interest to solve their decision problem about whether to trust. The second assumption prevents those with a transient interest from cheating. Both kinds of information are provided by a well-functioning system of reputation. The peculiar structure of the Kula ring creates a self-enforcing mechanism for transmitting reliable information. As dishonest members are threatened with ostracism by loss of reputation, this mechanism also raises the effective level of w, which now refers to the interest in remaining in the whole system and not only to the durability of any specific dyadic relationship.

There is still another possibility for solving the problem of deciding whether to trust and to be honest. In addition to the second assumption stated above, the following has to be fulfilled: (3) all actors assume that everybody thinks that his partner knows whether he is honest, i.e. there is a shared belief that everybody else assumes that his cheating is visible. Then everybody has a rational basis for believing, that everybody else is induced to be honest. Assumptions (2) and (3) do not require a system of transmitting information about *specific* people as assumption (1) does, but a functioning system of reputation will quite likely give rise to and maintain these shared beliefs.

In an interesting book Conte and Paolucci (2002) made an important conceptual distinction. While "image" refers to the evaluative beliefs held by an "evaluator" about a given behavior of a "target" towards a "beneficiary", "reputation" is a social "meta-belief" of a "third person" and refers to the process and the effect of transmission of a target image. The transmission of "reputation" is a much more efficient mechanism of social control than the spread of "images", as e.g. third persons do not have to share the image of the target and may not be held responsible for its truth or falseness. The authors demonstrate the effectiveness of the transmission of reputation, in the sense defined, by a simulation model.

Now, if networks are locally clustered, information about cheaters ("targets") spreads easily. By "local clustering" we mean two linked actors lay on a cycle of length three or four. Then each victim ("beneficiary") has to know only his neighbor’s links in order to effectively warn other naive actors ("beneficiaries") about a dishonest person ("target"). If the cycle has length three, only images of targets by evaluators and beneficiaries are involved; if the length is four, only *one* "third person" is needed to transmit the target's reputation to a naïve beneficiary. As shown above, the Kula network is highly locally clustered.

9. Emergence and Co-Evolution of a Peaceful Economic and Ceremonial Exchange System

It follows from the game-theoretic analysis that if two actors have an interest in a long-term stable trading relationship, there will be an incentive to establish a reciprocal exchange of gifts in order to signal peaceful intentions. However, we would commit a well-known functionalist fallacy to infer the emergence and maintenance of certain macro-structural elements – i.e. the circular structure of the ceremonial exchange network and the opposite flow of two gifts – from their positive functions for pairs of individual actors. It may be that, from an outside observer's point of view, societies behave "as if" they were autopoetic systems, but Malinowski was quite explicit about the underlying problem: "... what appears to us an extensive, complicated, and yet well ordered institution is the outcome of ever so many doings and pursuits, carried on by savages, who have no laws or aims or charters definitely laid down. They have no knowledge of the *total outline* of any of their social structure. They know their own motives, know the purpose of individual actions and the rules which apply to them, but how, out of these, the whole collective institution shapes, this is beyond their mental range" (Malinowski 1966a: 83). The main task is to precisely specify the mechanisms and dynamic processes that explain the emergence and maintenance of such macro-structures from the interdependent actions of individual actors (or groups of actors).

According to our basic premise, ceremonial exchange functions as a signaling system among actors having an incentive to trade, but who are uncertain about the intentions of potentially hostile foreigners. Peaceful order is not established by a central authority, like in a central market place, nor by a collective "norm of (direct and/or generalized) reciprocity" (Gouldner 1960), a "fairness-based selective-giving strategy" (Takahashi 2000) or "altruistic motivations" (Ostrom and Walker 2003). This is not to deny the existence and importance of internalized moral sentiments (Frank 1988: ch. 3), but using them as a starting mechanism would beg the question as to how they emerged among (potentially hostile) foreigners in the first place or – if one assumes their ubiquity – how then hostile actions could occur at all and fear of hostility would remain widespread.

To simulate the emergence and co-evolution of a peaceful economic and ceremonial exchange system the three processes so far separately analyzed have to be linked. Figure 7 depicts in schematic form how they are coupled.

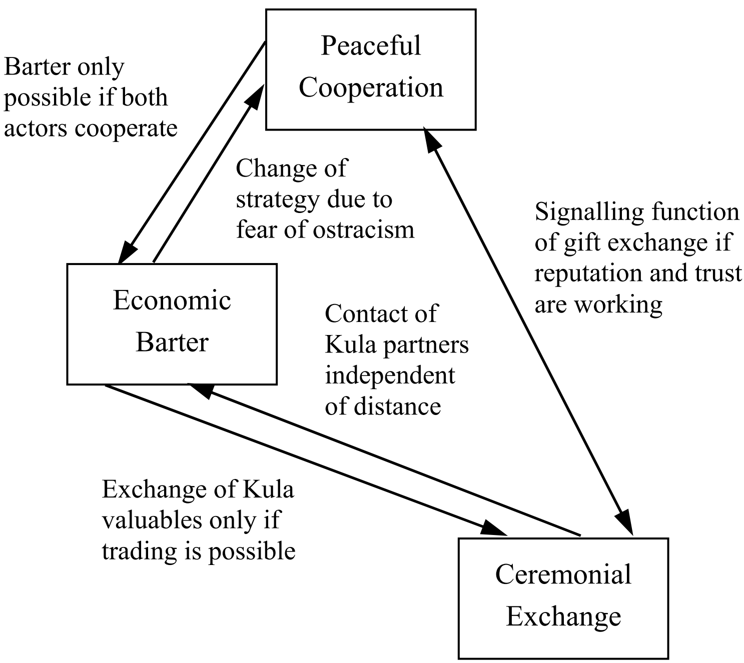

Figure 7: Coupling of the Three Basic Processes

Though in the beginning the gains from economic exchange are considered to be the driving force of development, establishment of peace is a necessary condition for barter to take place. In turn the reputation mechanism induces uncooperative actors to change their strategy because of fear of being ostracized. Both reputation and trust are necessary in order for ceremonial exchange of gifts to fulfill its signaling function. However, signals are only sent if successful trading creates a lasting interest. Once Kula partnerships are established, they will be given priority irrespectively of geographic distance when exploring possibilities of trading.

9.1 Basic Structure of the Simulation Model

The assumptions of the *baseline simulation model* are as follows:

(C1) Kula valuables are only exchanged if (a) a peaceful contact is made and (b) there is an opportunity for successful trading involving consumers, producers or middleman. Condition (a) is the result of the peace-spreading process (see page 41ff) and condition (b) the outcome of the trading module (see page 30ff).

(C2) If the hosts do have *vaygu'a*, they present it to their visitors. With probability .8 the four producing or importing islands – Kayleula, Woodlark, Tubetube and Wari – always have enough valuables available. The other communities possess Kula gifts if they have previously received them and have not already given them away. However, they will ration their valuables in order to be able to present *vaygu'a* to each visitor in the current round.

(C3) The strategy of giving is derived from a game-theoretic analysis. (a) If a host possesses both kinds of valuables, he will present a different Kula gift than he has obtained from his visitor at an earlier time. (b) If he has only one kind of Kula gift available, he will give it irrespectively of what he received previously. (c) If he received an intermediary gift (*basi*) from his partner on his previous visit – perhaps at that time his partner did not have any *vaygu'a* –, then he will give what he possesses or randomly choose one of the two kinds of valuables. (d) If he has nothing, he will present a *basi*, which is assumed to be always available.

(C4) If at the end of a round an actor's total *consumptive* needs are not satisfied, he will search for trading partners at successively larger distances in successive rounds. However, independently of the geographic distance, he will always first visit those communities with which he has *reciprocal* Kula partnerships.

(C5) If all *consumptive* needs of all actors are satisfied and everybody has at least two partners with whom he exchanges goods reciprocally (in order not to be dependent on a "monopolist"), the symmetric trading network forming one strong component is fixed. The Kula exchange goes on within this network until in one round everybody presents the same kind of Kula gifts to the same partners as he has done in the previous round, i.e., if a *fixed point* has been reached, as it is called. Then the *simulation run* is finished.

We will briefly comment on these basic assumptions. Assumption (C1) describes the link between the three processes. The preventive role of reputation against cheating is already incorporated in the peace-spreading module.

Assumption (C2) reflects the empirical boundary condition, the motivation to signal one's peaceful intentions and the internal dynamic of the circulation of valuables. There have been some estimates about the total amount of valuables circulating[33], which do not indicate a general shortage. However, there are reports of *vaygu'a* "leaking out" of the Kula ring (Brookfield and Hart 1971: 325). To meet possible objections that the simulation results depend on the assumption of a continuous inflow at these four places, we loosen this assumption and allow for a random "production or import stop" at these places with probability .2.[34]

Assumptions (C3a-d) are derived from a simple game-theoretic analysis. Figure 8 shows the matrix of outcomes depending on the kind of gift received and the kind of gift to be reciprocated. The prefered order of outcomes is: $A \geq B \geq C > D$. We only assume that refusing a gift (D) – which signals having no interest in a lasting relationship – is definitely considered to be the worst outcome. The other outcomes may be equally valued.

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[33] Firth (1983: 95-6) estimated a minimal figure of 3000 each of armshell pairs and of necklaces and a velocity of circulation of two to ten years to make the round.

[34] This random effect only influences the "production or import" of valuables. If one of these four communities has received *vaygu'a* in previous contacts these valuables are available for ceremonial exchange.

		Kind of gift received		
		Armshell	Basi	Necklace
Kind of gift reciprocated	Armshell	$\pi D + (1-\pi) B$	A	A
	Basi	C	C	C
	Necklace	A	A	$\pi D + (1-\pi) B$

Figure 8: Choice of Counter-Gift
Order of preference: $A \geq B \geq C > D$

If an actor returns the same kind of gift, with probability π it may be confounded with refusing, thus leading to the worst outcome (D). With probability $(1-\pi)$ it may be interpreted as a proper counter-gift (B) though perhaps not as highly valued as a complementary *vaygu'a* (A). Giving a *basi* (C) is always better than refusing a gift (D), but may be less valued than a proper *vaygu'a* (A). Now assumption (C3a) follows from $A \geq C$ and $A > \pi D + (1-\pi) B$. Assumption (C3b) holds either if an actor has a complementary gift or if the probability of misinterpretation is sufficiently low – i.e. $(B-C)/(B-D) > \pi$. Finally, assumption (C3c) is obvious because $A \geq C$.

Assumption (C4) is a modification of assumption (T4) on page 31 and models the influence of gift-relations on the search process.

Assumption (C5) is mainly a technical one required by the sequential nature of a dynamic simulation model and the need for a stopping rule. One iteration or simulation run consists of as many rounds necessary to reach a fixed point. If the process does not converge, the simulation run stops after 1000 rounds. The substantive reason for fixing the trading network is the following: the economic incentive to search for new partners ceases after all actors have satisfied their consumptive needs, but the Kula exchange goes on within this network of lasting interest relations. Figure 9 shows the flow diagram of the simulation model.

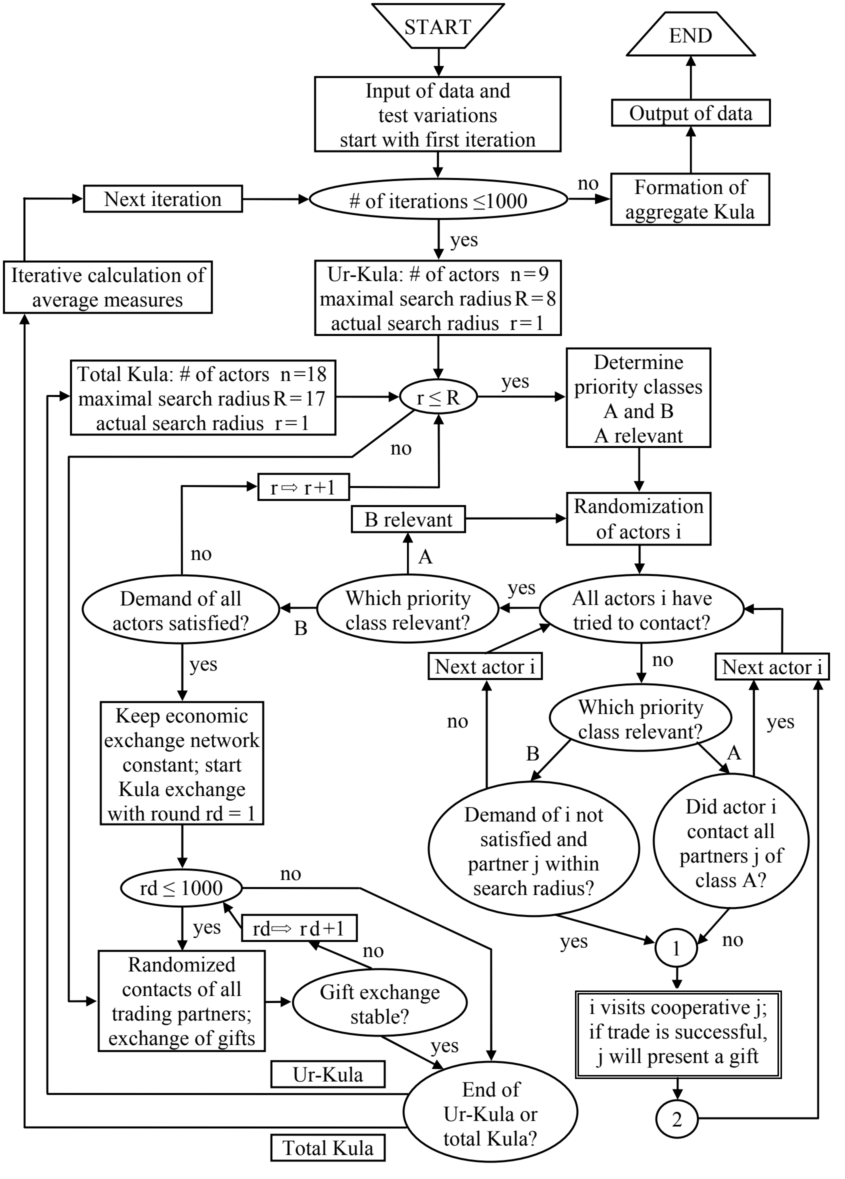

Figure 9a: Flow Diagram of Simulation Model

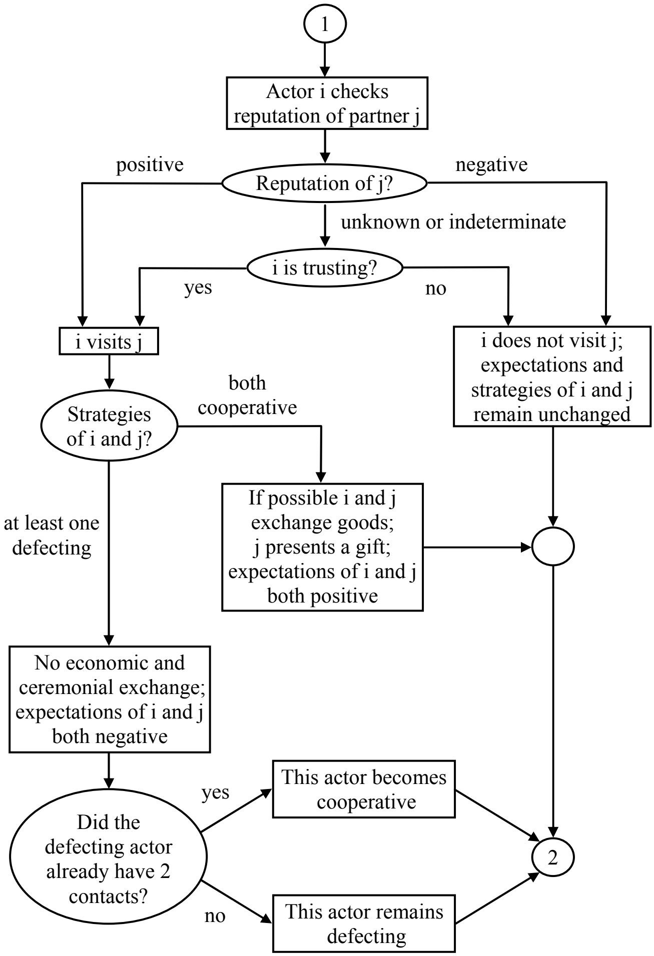

Figure 9b: Flow Diagram of Visiting Module
(double-framed part in Figure 9a)

Note to Figure 9a: definition of priority classes

Class A in Ur-Kula: (a) reciprocal Kula-partnerships
(b) if actual search radius ≥ 4, Tubetube and Woodlark visit each other and get linked, if economic exchange is possible

Class A in total Kula: i and j have been partners in the Ur-Kula

Class B in Ur- and total Kula: distance from actor i to (potential) partner j is within actual search radius r

As far as the empirical boundary conditions are concerned, we assume that only two valuables are being exchanged, which are produced or imported at the four places already mentioned. We will first treat it as an "observed" boundary condition, but will later discuss some reasons presented in literature and run a "counterfactual" simulation experiment with three valuables.

The "observed" trading and ceremonial network structure – with the opposite flow of the two Kula gifts – among the 18 communities is the explanandum; the geographic distances, the supply and demand of 25 goods and the four places at which the two valuables are produced or imported provide the empirical boundary conditions of our simulation model.

9.2 Results of the Baseline Simulation Model

First, *mean results* of 1000 iteration runs will be presented (see Baseline Model, Mean Values in column 1 of Table 3). Without exception all communities always acted cooperatively at the end of every iteration run and everybody could always satisfy his consumptive needs. In 945 out of 1000 iteration runs a coherent trading network was formed, but in 25,2% of the cases it contained bridges. On the average, only 52,7% of all simulated trading relations were symmetric, i.e. both communities visited each other. However, every community could satisfy its consumptive needs within the trading network of symmetric relations. Mean density is .222 (observed density equals .235), mean similarity is .539. A fixed point in the gift exchange was reached in all 945 trading networks after an average of 21.6 rounds. It should be stressed that it is neither obvious nor trivial that the iterative process always converges, as it may be that the simulation process sometimes leads to endless loops or fluctuations. However, almost all fixed points differed and very few duplicates existed. This result may not be surprising if one realizes that there are over 34 billion different networks possible with 36 links among the 18 communities, and an opposite flow of valuables within each dyadic transaction. To be sure, not all of these possible configurations will be fixed points.

	Mean values	Aggregate Network
General Characteristics		
(mean) number of strong components (1) minimum maximum	1.05 1 3	1 1 1
(mean) number of cooperative actors (18) minimum maximum	18.0 18 18	18 18 18
(mean) number of satisfied communities (18) minimum maximum	18.0 18 18	18 18 18
Economic Exchange		
mean percentage of symmetric trading relations (100)	52,7	–
number of trading networks forming one strong component (yes) with positive fixed points (yes) with negative fixed points (yes)	 945 574 371	yes
(mean percentage of) trading networks with bridges (no)	25,2	yes
(mean) density of symmetric trading network(s) (.235)	.222	.222
(mean) similarity of symmetric trading network(s)	.539	.628
(mean) percentage of links in cycles of length 3 or 4 (94,4)	89,3	91,2
Ceremonial Exchange		
mean percentage of fixed points reached in trading networks	100,0	–
mean number of rounds until fixed point is reached	21.6	–
(mean) ceremonial reciprocity in trading relations (1.0)	1.000	1.000
(mean) complementarity of gift exchange (1.0)	1.000	1.000
(mean) degree of clockwise circulation (1.0)	.064	.647
(mean) reachability of gift exchange (1.0)	.483	.039
(mean) number of triads (21)	20.3	23
(mean) transitive closure of gift exchange (1.0)	.635	.913

Table 3: Simulation Results of Baseline Model
(Mean Values of Fixed Points and Aggregate Network; 1000 Iterations)
Note: Observed values in brackets; – no comparable value

Three further positive results should be mentioned. At the end of an iteration, all trading relations were accompanied by ceremonial exchange and in all dyadic transactions the two different valuables were always exchanged complementarily. The degree of local clustering was slightly less than in the observed network: 89,3% of all links were contained in cycles of length 3 or 4.

Nevertheless, the overall result is not satisfactory. As column 1 of Table 3 shows, on the average the measure of clockwise circulation[35] hardly differs from zero and shows a large range: mean = .064; minimum = –.476; maximum = +.647. Two other properties of the observed Kula network were badly reproduced. First, while in the observed network of gift exchanges every two communities may directly or indirectly exchange both armshells and necklaces, on the average, only 48,3% of all 153 pairs of communities are mutually reachable in the baseline model. Second, the number of "transitively closed triads" is, on the average, only 12.9 out of the 20.3 simulated triads, while in the observed network all 21 triads are transitively closed.

Besides mean statistics, we analyzed the *"aggregate" Kula network* (see page 29). The comparable measures of goodness of fit in column 2 of Table 3 – i.e., number of cooperative actors, density, similarity, number of satisfied communities, local clustering, reciprocity, complementarity, number of triads and transitive closure – are very similar or slightly better for the aggregate network with two exceptions: degree of clockwise circulation is much better predicted by the aggregate network (.647 vs. .064), while it performs much worse as far as the reachability is concerned (.039 vs. .483).

Figure 10 depicts a graphical representation of the aggregate baseline model. The pattern of solid and dashed arrows, indicating the rightly and wrongly predicted direction of the flow of armshells and necklaces, and especially the dotted-dashed thin lines, showing the missed links, give the optical impression of an unsatisfactory fit. The western part is too densely connected, while almost no links exist with the eastern part of the Kula ring. In the eastern part of the aggregate simulated network the Kula

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[35] Mean scores of armshells and necklaces are identical.

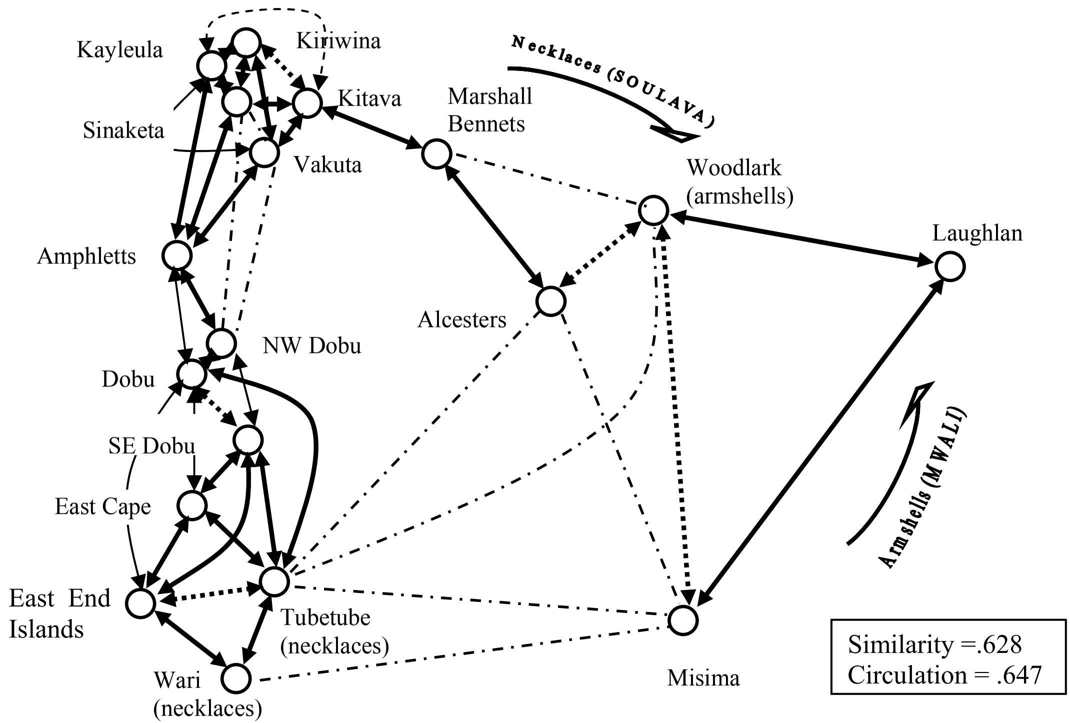

Figure 10: The Aggregate Kula Ring of the Baseline Model

Note: Solid arrows indicate correctly, dashed arrows wrongly predicted circulation of armshells and necklaces; bold arrows indicate ceremonial exchange within, thin arrows outside the observed Kula ring; dotted-dashed thin lines show missing links.

valuables flowed opposite to the observed direction in 2 out of 5 simulated links. In the western part the direction of flow failed to coincide with the observed/inferred one in only 4 out of 29 simulated links.

As these results were unsatisfactory, we tested whether a change in behavioral strategies would lead to an improvement. Two modifications of assumption (C3) on page 62 about behavioral strategies were added.

(C3b*) If a host does not possess a complementary valuable, but only the same kind of *vaygu'a*, he will not present it, but instead will offer an intermediary gift (*basi*). This "*complementary strategy*" is preferred if the probability π of confusion in Figure 8 is sufficiently high, i.e. $\pi > (B–C)/(B–D)$.

(C3e) As noted above, all 21 observed triads were transitively closed. This is not necessarily an unintentional by-product, but may be the result of a deliberate "*transitive strategy*". If A, who uses a certain kind of gift with B, observes that B is using the same kind of gift in his contacts with C, he may think this kind of valuable to be more "appropriate" when acting as host to C.

However, these two modifications did not improve the goodness-of-fit. The differences, in fact, are very slight and inconsistent. Despite the explicit transitive strategy it raised the mean number of transitively closed triads only from .639 to .864 and the aggregate values from .826 to .950, but it also took much longer, on the average 97.3 rounds, until the process converged at a fixed point.

One may ask why a deliberate complementary strategy was introduced, as the complementarity of gift exchange is already perfect (1.0) in the baseline model. However, if only the transitive strategy was added, two counterintuitive results occurred. Average complementarity of gift exchange turned even negative (−.500) and mean transitive closure was almost zero (.066)! A closer look at the interplay of strategies will solve this puzzle. Without a deliberate complementary strategy both the relationship between actor A and B and the link between B and C may lack complementarity (the same valuables are always exchanged). The transitive strategy will then induce actors A and C to exchange the same valuables too. This should happen less frequently if both strategies are used because in effect they reinforce each other.

9.3 Distinguishing Among Historical Phases of the Development

While the modifications of individual strategies did not improve the goodness-of-fit, distinguishing between "different historical phases" during the emergence of the Kula did. Malinowski himself put some conjectures forward. In chapter XII of his book on the "Argonauts of the Western Pacific", he describes several myths about the Kula and its related magical practices. It is important to note that these myths only refer to certain Kula communities and were handed down only in Woodlark, Marshall Bennetts, Kitava, Vakuta, Amphletts and the three Dobu-communities (Malinowski 1966a: 306-7). Malinowski conjectured that other communities joined the Kula at a later time.

Based on this conjecture[36], the anthropologist Per Hage constructed a "primordial Kula", which also included Tubetube (Hage 1977: 33; Hage and Harary 1991: 172-3). It forms an exact ring and is shown by the thick lines in Figure 2.

In addition Malinowski pointed to an "anomaly" in the observed circulation of valuables: "... the Tubetube people import armshells into Murua (this is Woodlark – RZ), thus bringing coals to Newcastle, while the Muruans bring the necklaces to Tubetube and Wari, that is, to the points at which the necklaces flow into the ring from the outside." And he adds: "These considerations are important for anyone who would like to reflect on the origins, or history of the Kula, since the natural movement of valuables was no doubt the original one, and the Western half of the Kula from this point of view appears to be the older." (Malinowski 1966a: 508)

[36] Lacking direct historical evidence common myths or other common cultural elements among neighboring societies are often used as an indication of more intense and/or more longstanding relationships between them.

Applying these ideas, we distinguished among three phases in the development of the network:

(C6) In phase 1, the process is restricted to the 9 communities Woodlark, Marshall Bennetts, Kitava, Vakuta, Amphletts, NW Dobu, Dobu, SE Dobu and Tubetube[37]. After the maximal search radius reached a certain level, the link between Tubetube and Woodlark – the two island communities farthest apart – is "exogenously" established.[38] In phase 2 the process is iterated until the exchange of valuables among the Ur-Kula communities stabilizes or the maximal search radius 8 is reached. In phase 3, the process continues until all 18 communities are incorporated.

Of course the three historical phases distinguished are highly stylized. To treat them as empirically well-founded boundary conditions would ask for more historical evidence than is available. However, the main purpose of these test variants is to show the implications of varying assumptions. As said above intuitive reasoning may lead to conjectures, but it is unable to prove what follows logically from certain assumptions about the dynamic behavior of an interdependent multi-agent, multi-level system.

(C7) We further assume that the nine members of the Ur-Kula ring stick to their patterns of exchanging armshells and necklaces *among themselves* in the same directions during phase 3, as they established at the end of phase 2.[39] We thereby assume that ritualized patterns of behavior developed and became evolutionary stable within subsystems and that actors adhered to their "tradition" even under changed circumstances, i.e. when the network is enlarged. While our game-theoretic reasoning is "forward-

[37] Without including Tubetube in this phase, there would not exist any source of necklaces.

[38] We choose a threshold value of 4 to prevent a "premature" exogenous closure of the link between Tubetube and Woodlark. With 9 actors the largest search radius is 8; the median search radius in the Ur-Kula without the exogenously produced link is 4.3. One should add that this link was only established if the two communities could successfully trade with each other. It should be noted that people of Tubetube are reported to be excellent sailors.

[39] This does improve the goodness-of-fit, especially all measures of the degree of bi-furcation.

looking" these "learned patterns of behavior" are "backward-looking" (Heath 1976: 59-60).

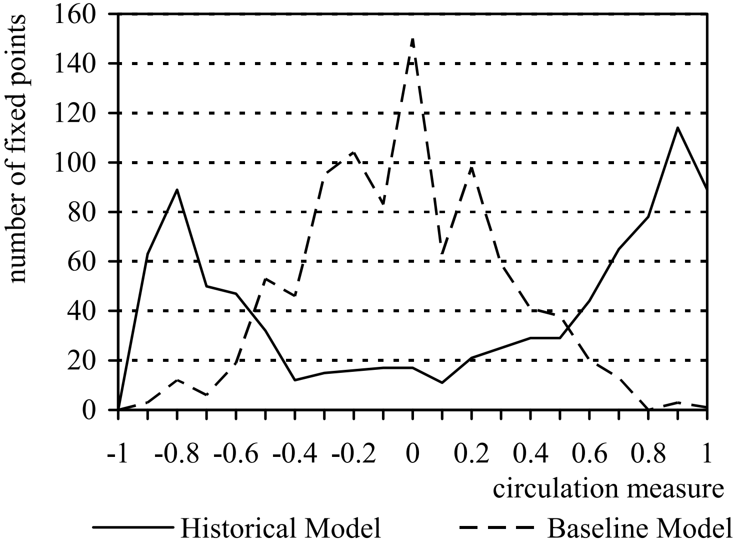

Figure 11: Distribution of Circulation Measures in the Ur-Kula of Baseline Model and of Model with Historical Phases

If one restricts the baseline simulation model to the 9 communities of the primordial Kula network and adds assumption (C6) of an exogenously induced link between Tubetube and Woodlark, the two behavioral strategies produce a striking difference. Without complementary and transitive strategies a unimodal distribution of circulation measures appears, while the modified behavioral strategies and the exogenously induced link between Tubetube and Woodlark lead to a bimodal distribution (see Figure 11). Extreme positive and negative circulation measures become much more frequent, i.e. the process converges to fixed points, which are either closer to the observed/inferred direction of the flow of *vaygu'a* or to its mirror image. However, the former occurs in the majority of runs, resulting in a aggregate primordial Kula ring where the direction of circulation (1.0) is in perfect accordance with the observed/inferred one, i.e. necklaces circulate clockwise and armshells counterclockwise.

9.4 Co-evolution of the Kula Ring: Bi-Furcation and Path-Dependence

This "bi-furcation phenomenon" in the Ur-Kula has important consequences for the whole development. When these changes are made, the simulation model produces quite different results, which will become apparent if we compare networks produced after an Ur-Kula with positive circulation measures and an Ur-Kula where the circulation measure is negative, i.e. the valuables circulate predominantly against the observed/inferred direction.

Before presenting and discussing the results it may be helpful to enumerate – in abbreviated form – the assumptions of this *model with historical phases*, which have been discussed in previous chapters.

(T1) In each round all actors decide – in random order – whether to sail and whom to visit. Each actor will first visit his nearest neighbor and try to barter with him.

(T2) The potential traders can supply goods, which they have either produced themselves or stored from previous exchanges if acting as middlemen.

(T3) A successful exchange takes place if the "double coincidence of wants" is fulfilled, i.e. if both actors have something to offer, which the other asks for.

(T4) If at the end of a round an actor's total consumptive needs are not satisfied he will search for trading partners at successively larger distances in successive rounds.

(T5) There are two stopping rules. Each actor will stop searching for new partners farther away if his total consumptive demand is satisfied and if he has at least two partners with whom he exchanges reciprocally.

(T6) The whole process will stop either if all actors' consumptive needs are satisfied or if the unsatisfied actors have (unsuccessfully) contacted all (i.e. 17) potential partners.

(T7) To simulate the impact of food shortages on the economic exchange process, the food supply of a producer was interrupted with probability .25 in each round.

(T8) With probability .05 the store of middlemen was empty and they were unable to provide the goods in demand.

(P1) The actors use one of two exit-strategies: TFTe or ALL-De. It is assumed that in the beginning all players use the uncooperative strategy ALL-De except the first pair of communities, which are able to trade successfully.

(P2) All actors have expectations regarding the strategies and the state of knowledge of all the others. In the beginning nobody knows anything about the other players.

(P3) If an actor has to decide whether to visit another player and has no personal positive experience about him, he will investigate his reputation. If the majority opinion is positive, A will contact B, if it is negative he will not. If the majority opinion is split or undecided and he himself has no opinion, he will visit B if he is trusting and will not contact him if he is mistrusting.

(P4) A conditionally cooperative host (TFTe) will react cooperatively if he is trusting or – despite his own initial negative expectations – if the reputation of the visitor is positive.

(P5) The outcome of an encounter is the result of the strategies actually used by the two players. After a contact both actors will update their expectations depending on whether they have been treated in a friendly manner or not.

(P6) Only if both actors cooperate can an economic exchange take place – based on the double coincidence of wants.

(P7) After an encounter an ALL-De player will eventually change his strategy and become TFTe, if the number of his contacts passes a certain threshold, because he fears being ostrasized.

(C1) Kula valuables are only exchanged if a peaceful contact is made and if there is an opportunity for successful trading.

(C2) If the hosts do have *vaygu'a*, they present it to their visitors. With probability .8 the four producing or importing islands – Kayleula, Woodlark, Tubetube and Wari – always have enough valuables available. The other communities possess Kula gifts if they have previously received them and have not already given them away.

(C3b*) If a host does not possess a complementary valuable, but only the same kind of *vaygu'a*, he will not present it, but instead will offer an intermediary gift (*basi*).

(C3e) Besides this "complementary" the actors use a "transitive strategy".

(C4) Independently of the geographic distance, an actor will always first visit those communities with which he has reciprocal Kula partnerships.

(C5) If all consumptive needs of all actors are satisfied and everybody has at least two partners with whom he exchanges goods reciprocally, the symmetric trading network which forms one strong component is fixed and the Kula exchange goes on within this network until a fixed point in ceremonial exchange has been reached. Then the simulation run is finished.

(C6) Three phases in the "historical" development are distinguished. In phase 1, the process is restricted to 9 western communities. After the maximal search radius reaches a certain level, the link between Tubetube and Woodlark – the two island communities farthest apart – is "exogenously" established; in phase 2 the process is iterated until the exchange of valuables among the Ur-Kula communities stabilizes. Then phase 3 begins, in which the process continues to include all 18 communities.

(C7) The nine members of the Ur-Kula ring stick to their patterns of exchanging armshells and necklaces among themselves in the same direction during phase 3, as they established at the end of phase 2.

Table 4 presents the results of this model with historical phases, which should be compared with Table 3. In general the *total* mean and aggregate measures produces a comparable or better overall fit. There are more trading networks forming a strong component (991 vs. 945 in 1000 iterations) and on the average they contain fewer bridges (2,5% vs. 25,2%). The percentage of symmetric trading relations is also higher (64,0% vs. 52,7%). As one might expect, the amount of transitive closure is almost perfect (.990 vs. .635 mean values; .917 vs. .913 in the aggregate networks), which is of course due to the postulated transitive strategy. But it comes at a cost. It takes much longer, on the average 50.6 (vs. 21.6) rounds, until the process converges at a fixed point.

	Mean Values	Aggre-gate Network
General Characteristics		
(mean) number of strong components (1)	1.003	1
minimum	1	1
maximum	2	1
(mean) number of cooperative actors (18)	18.0	18
minimum	18	18
maximum	18	18
(mean) number of satisfied communities (18)	18.0	18
minimum	18	18
maximum	18	18
Economic Exchange		
mean percentage of symmetric trading relations (100)	64,0	−
(number of) trading networks forming one strong component (yes)	991	yes
after positive Ur-Kula	597	yes
after negative Ur-Kula	385	yes
(mean percentage of) trading networks with bridges (no)	2,5	no
(mean) density of symmetric trading network(s) (.235)	.230	.242
(mean) similarity of symmetric trading network(s)	.556	.659
(mean) percentage of links in cycles of length 3 or 4 (94,4)	95,6	89,2
Ceremonial Exchange		
mean percentage of fixed points reached in trading networks	99.1	−
mean number of rounds until fixed point is reached	50.6	−
(mean) ceremonial reciprocity in trading relations (1.0)	.980	1.000
(mean) complementarity of gift exchange (1.0)	1.000	1.000
(mean) degree of clockwise circulation (1.0)	.092	.514
after positive Ur-Kula	.395	.622
after negative Ur-Kula	−.340	−.676
correlation between circulation in Ur-Kula and final Kula	.919	−
(mean) reachability of gift exchange (1.0)	.690	.039
after positive Ur-Kula	.657	1.000
after negative Ur-Kula	.758	.595
(mean) number of triads (21)	18.2	24
(mean) transitive closure of gift exchange (1.0)	.990	.917

Table 4: Simulation Model With Historical Phases
(Mean Values of Fixed Points and Aggregate Network; 1000 Iterations)
Note: Observed values in brackets; − no comparable value
Figures for networks after positive/negative Ur-Kula are only presented, if they significantly differ from total values.

The other measures of goodness-of-fit are pretty much the same whether mean values or aggregate measures are considered: number of cooperative actors and of satisfied communities is perfect in both models as well as complementarity of gift exchange. Density of trading networks, percentage of links in cycles of length 3 and 4 and ceremonial reciprocity in trading relations are close to the observed one and similarity measures of the symmetric trading networks are very similar (.556 vs. .539 mean values; .659 vs. .628 in the aggregate networks).

Again the degree of clockwise circulation is predicted much better by the aggregate network than by mean values (.514 vs. .092), while the former performs much worse as far as the reachability is concerned (.039 vs. .690).

The most interesting result appears if one looks at the networks produced after an Ur-Kula with positive circulation measures and an Ur-Kula where the circulation measures are negative. The goodness-of-fit measures for these two types of networks are reported in the second and third line of a cell in Table 4 if they differ significantly from the total values.

First, many more pairs of communities are mutually reachable at the end of the simulation – i.e., armshells and necklaces may be transported from one community to all others and vice versa – which is an important property of a ringlike structure. Mean value of baseline model in Table 3 is .483 as compared with .690 of the model with historical phases in Table 4. With regard to this property, the improvement is even more noticeable as far as the aggregate Kula ring is concerned. After an Ur-Kula with positive circulation measures the index indicates a perfect fit (1.000), i.e., every community can reach all others.

Second, the direction of circulation established in the Ur-Kula is strongly related to the way the valuables circulate at the end of an iteration run (mean value after positive Ur-Kula is +.395, after negative Ur-Kula −.340). Again this effect is more pronounced in the aggregate Kula ring (.622 vs. −.676). Actually the correlation between the circulation measure in the Ur-Kula and the final Kula ring is .919 as Figure 12 shows.

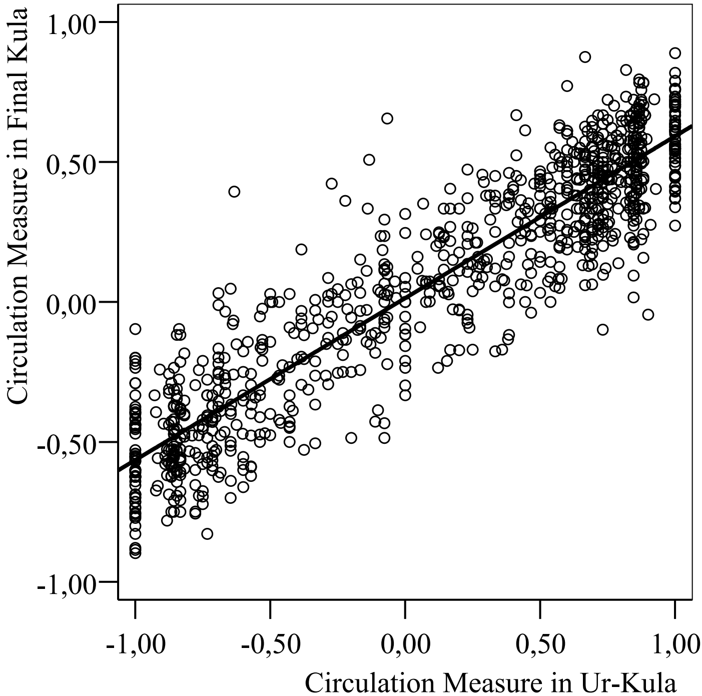

Figure 12: Correlation Between Direction of Circulation in Ur-Kula and Final Kula (R = .919)

If one looks at the distribution of the similarity scores over the 982 fixed points, a bimodal pattern emerges (see Figure 13). Actually a "bi-furcation phenomenon" is observed, which strikingly contrasts the unimodal distribution of the basic model with complementary and transitive strategies (dotted line). If, at the end of phase 2, the process tends towards the observed exchange pattern in the primordial Kula (solid line) – this occurs in 60,8% of the fixed points -, their mean similarity at the end of phase 3 is +.395, and the similarity score of the aggregate Kula ring is +.622. If, on the other hand, the simulated primordial Kula is the mirror image of the observed one (dashed line), the mean similarity of the fixed points at the end of phase 3 is –.340 and the similarity score of the aggregate Kula ring is –.676.

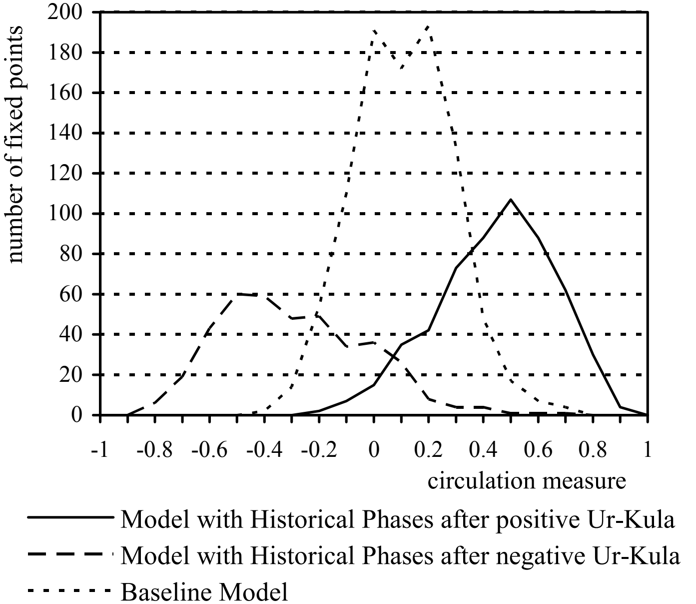

Figure 13: Distribution of Circulation Measures of Model with Historical Phases and of Baseline Model.

Note: Circulation measures of Baseline Model (945 fixed points) and of Model with Historical Phases (982 fixed points) at the end of phase 3, after Ur-Kula was predominantly positively or negatively oriented

Figures 14a and b show the aggregate Kula ring of the model with historical phases after the simulated Ur-Kula was predominantly positively or negatively oriented. It should be compared with the aggregate Kula ring of the baseline model in Figure 10. The western and eastern part are now better connected, though seven of the observed links are still missing in the aggregate simulated network (compare the dotted-dashed thin lines): the links among Misima, Tubetube and Alcesters; between Misima and Woodlark; in the western part between SE Dobu and East End Islands and between Amphletts and NW Dobu on the one hand and Sinaketa on the other. Table 5 summarizes the types of links in the aggregate Kula ring of the three models

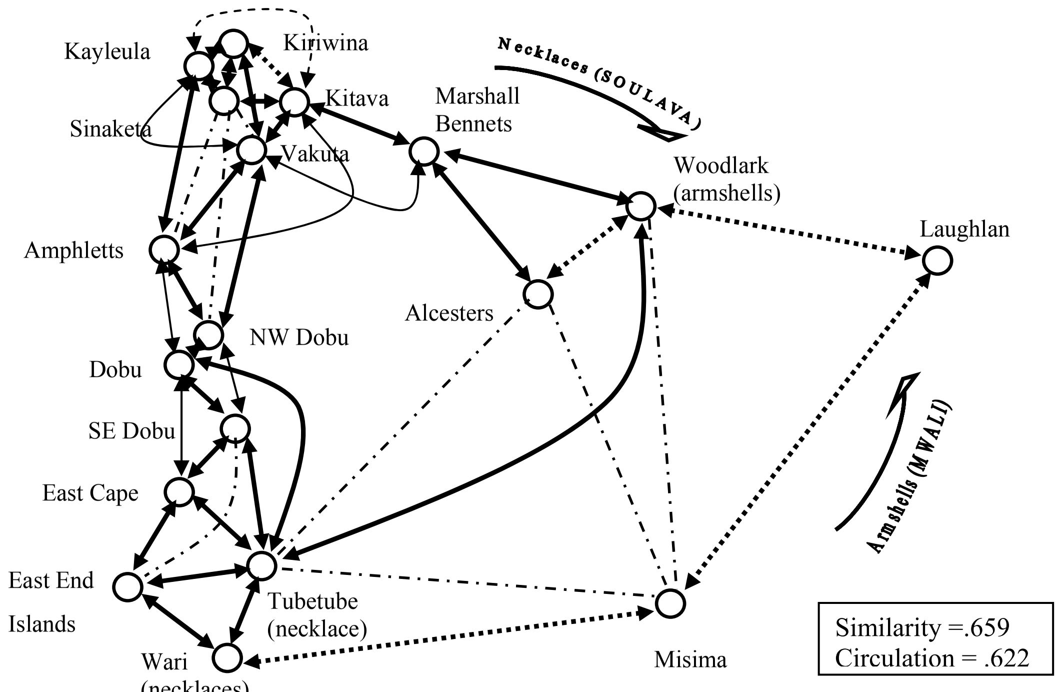

Figure 14a: The Aggregate Kula Ring of the Model With Historical Phases After Circulation in the Ur-Kula was Predominantly in the Observed/Inferred (Positive) Direction

Note: Solid arrows indicate correctly, dashed arrows wrongly predicted circulation of armshells and necklaces; bold arrows indicate ceremonial exchange within, thin arrows outside the observed Kula ring; dotted-dashed thin lines show missing links.

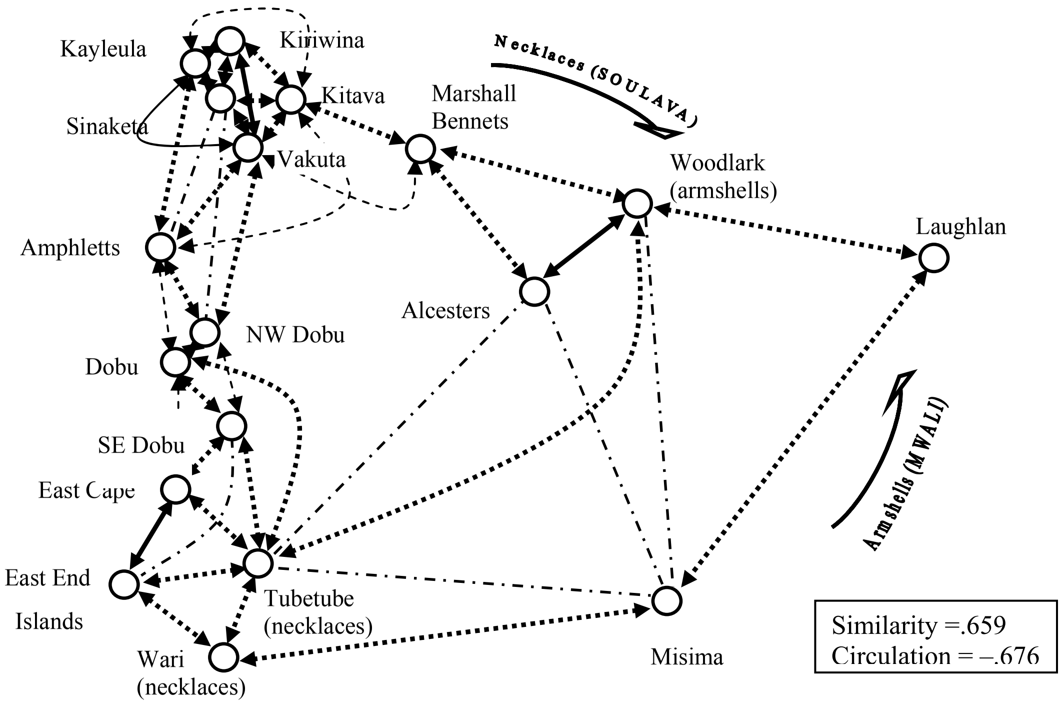

Figure 14b: The Aggregate Kula Ring of the Model With Historical Phases
After Circulation in the Ur-Kula was Predominantly Against the Observed/Inferred (Negative) Direction

Note: Solid arrows indicate correctly, dashed arrows wrongly predicted circulation of armshells and necklaces; bold arrows indicate ceremonial exchange within, thin arrows outside the observed Kula ring; dotted-dashed thin lines show missing links.

	valuables circulate	Baseline Model	Model with Historical Phases after Ur-Kula with circulation predominantly	
			positive	negative
simulated links coinciding with observed ring	as observed/ inferred	22	23	4
	in opposite direction	5	6	25
simulated links outside observed ring	as observed/ inferred	6	7	2
	in opposite direction	1	1	6
observed but not simulated links		9	7	7
similarity of observed and simulated trading network		.628	.659	.659
direction of circulation		.647	.622	–.676

Table 5: Types of Links in the Aggregate Kula of the Baseline Model and the Model with Historical Phases

If in the Ur-Kula the circulation was predominantly positive, in 30 out of 37 links of the final aggregate ring the simulated direction of circulation was the same as the observed/inferred one. If on the other hand the circulation in the Ur-Kula was predominantly negative, i.e. against the observed/inferred direction, in 31 of the 37 links of the final aggregate ring necklaces were moving counterclockwise and armshells clockwise.

A look at Figures 14a and b shows that the two aggregate networks are almost perfect mirror images. These simulation results indicate that the observed circulation of exchange – necklaces clockwise and armshells counterclockwise – is to a very large extent a *historically contingent* development, but the emergence of a network-wide system of gift exchange itself, where in each dyadic transaction armshells and necklaces are exchanged reciprocally and complementarily, is not.[40]

9.5 The Stability of Fixed Points

The iterative process stops if the exchange of gifts is identical in two consecutive rounds. As there are inbuilt stochastic mechanisms, the question arises as to whether randomly caused deviations occur from the fixed points once they are reached, and whether the process returns to the same fixed points afterwards. To test the stability of the fixed points thus far reported, we continued the process for another 250 rounds after the first fixed point was reached at the end of phase 3, which happened in 982 out of 1000 iteration runs. The general conditions of the model with historical phases remained the same and the members of the primordial Kula ring stuck to traditions they developed at the end of phase 2.

The fixed points reached at the end of phase 3 are not a perfectly stable phenomenon (see Figure 15). However, the process in the following 250 rounds is not erratic, but – after an initial small decline – shows an improvement towards a rather high level of stability of about .94. The degree of reachability – i.e. the percentage of pairs of communities which are mutually reachable in the two asymmetric networks of gift exchange – also raises to a level of about .81. Though the similarity with the first fixed point decreases, the similarity with the observed ceremonial network remains pretty much the same: about .09 total average; .41 after

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[40] Based on Coleman's argument (1990: 181-2) about the trust-generating function of an intermediary advisor, Wittek (1997) postulates a strong tendency towards closed triads in the symmetric trading network. The triad census (Holland and Leinhardt 1970, 1976) corroborates this hypothesis: the expected number of connected triads in our "observed" trading network (which slightly differs from Wittek's one) is 9.95 as compared with 21 observed closed triads, resulting in a highly significant tau-value of 3.93. However, our reputation mechanism seems to produce the same outcome. The tau-value for the aggregate network is 4.52 (expected number of closed triads = 10.83; observed number = 24).

"positive" Ur-Kula; –.35 after "negative" Ur-Kula. Reciprocity of ceremonial exchange remains almost perfect at an average level of .97 and complementarity stays even higher at a mean value of .999.[41] These results increase confidence in the robustness of the simulation results.

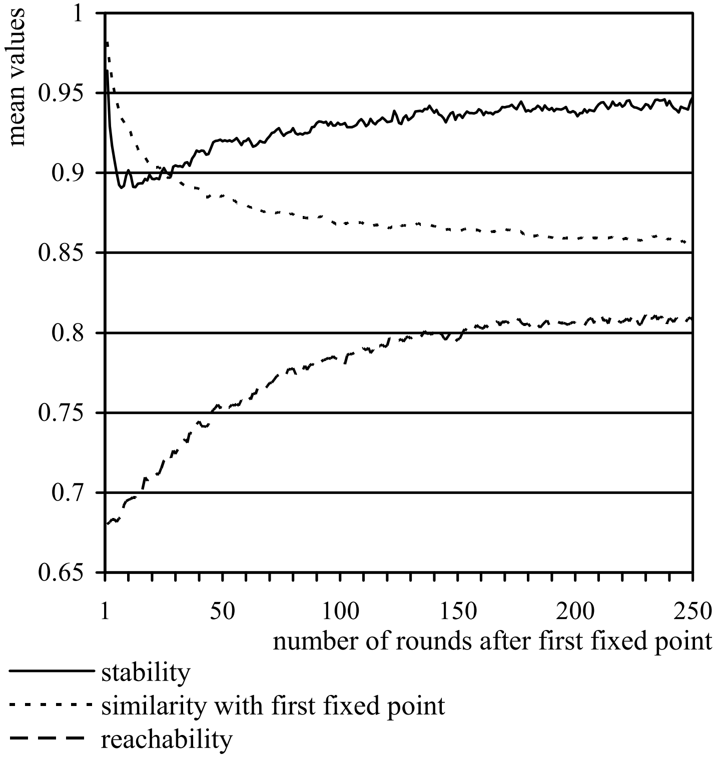

Figure 15: Stability and Reachability of Ceremonial Exchange after and Similarity with First Fixed Point

[41] The lines of reciprocity and complementarity of ceremonial exchange and of similarity with the observed network are not shown in Figure 15.

9.6 Some Remarks on the Status-Enhancing Function of Kula Exchange

In an interesting paper, Camerer (1988) has given a game-theoretic explanation of why gifts, which function as reliable signals of the willingness to invest in a relationship, are "inefficient". A gift is "inefficient" if its marginal utility is less than the marginal utility of its monetary value. Thereby unwilling partners are discouraged from playing the signaling game merely to collect gifts. It seems plausible to assume that in the beginning, the utility of the Kula gifts (besides acting as signals of peaceful intentions) was minimal. This changed after the Kula gifts acquired status value in the prestige-seeking game. It is obvious that at the time when the Kula ring was studied by European ethnographers, a Kula valuable conferred an enormous prestige on its holder. We will not try to develop a model of the emergence of this status-enhancing function[42], but present some game-theoretic speculations about the effect it has on two problems: (1) what makes two partners *alternately* visit each other and (2) why does the host present a gift and not the guest?

Matrix 16a shows the situation without ceremonial exchange. If both alternately sail, in one year they would get twice the economic reward minus the costs of one sailing. It is obviously a "chicken game": each would prefer the other to bear the hazards of sailing twice a year, but if neither sail, neither receive anything i.e. the worst (neutral) outcome X.

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[42] This would require modeling the internal dynamics of Kula communities and the micro-meso link, as e.g. Uberoi has pointed out: "The *kula* is not remarkable only in that it provides the inhabitants of an insular district with friendly and beneficent links oversea. The function which it fulfils has a more dynamic aspect. For recurring and competitive *kula* expeditions act as a channel whereby the quarrels which arise within one district, from the divisions between different lineage groups or villages, are turned outward, and made to renew the district's foreign relations. *Quarrels*, which arise out of the ever-bubbling enmities at home, are turned into *rivalries*, which go to maintain important alliances abroad." (1962: 108)

Matrix a

without ceremonial exchange		B sail	B do not sail
A	sail	2 R – C , 2 R – C	2 R – 2 C , 2 R
	do not sail	2 R , 2 R – 2 C	X , X

Matrix b

host presents gift		B sail	B do not sail
A	sail	2 R – C + V , 2 R – C + V	2 R – 2 C + 2 V , 2 R
	do not sail	2 R , 2 R – 2 C + 2 V	X , X

Matrix c

visitor presents gift		B sail	B do not sail
A	sail	2 R – C + V , 2 R – C + V	2 R – 2 C , 2 R + 2 V
	do not sail	2 R + 2 V , 2 R – 2 C	X , X

Figure 16: Strategic Forms of the „Visiting Game"

Note: R = utility of economic exchange
C = costs of sailing
X = neutral outcome
V = value of *vaygu'a*
Order of preference: R > R – C > X and V > C

If the host presents a gift whose prestige value outweighs the costs of sailing (V > C), the game changes to Matrix 16b, which has a stable Pareto-superior Nash equilibrium: both actors prefer to sail alternately.

If on the other hand the gift is presented by the visitor, the dilemma of the "chicken game" is sharpened (Matrix 16c): the higher the prestige value, the stronger the incentive to wait, let the visitor donate and bear the costs of sailing, but still barter with him successfully.

10. Some Counterfactual Scenarios

So far variations of the simulation model have been restricted to the assumed behavioral strategies and the dynamics of the simulated interaction process. The empirical boundary conditions – geographic distances, production and demand of goods, number and sources of Kula valuables – have been kept constant. We now use simulation as a computer-assisted thought experiment and ask how sensitive the main results are to – admittedly counter-factual – variations of these boundary conditions. Of course, the question immediately arises: which variations should be considered? We have decided in favor of some kind of "randomized null-hypotheses". At the beginning of each of the 1000 iterations one of the empirical boundary conditions is randomly changed, but then kept constant during all rounds of that iteration run. The structure of the simulation model itself is unchanged, i.e. the model with historical phases is always used.

10.1 Randomization of Boundary Conditions

With regard to *geographic distances* we used two kinds of randomization. The first is called *randomized distance matrix* and was constructed in the following way: 153 random numbers were generated and distributed in the upper triangle part of the 18 x 18-distance matrix, which was then symmetrized. This sounds somewhat strange and rather fictional. However, it is not distance in kilometers per se which matters, but the rank order of distances from the point of view of a community which has to decide whether to sail or not. Therefore each row of the randomized symmetric matrix was converted into a rank order from 1 to 17. The second kind of randomization is called *randomized row distances*. Here each row was independently assigned a sequence of 17 random numbers. While both scenarios randomize the effect of distance from the point of view of a potential guest, the first equalizes the (randomized) rank orders from the point of view of (potential) guest *and* host (though the latter should be irrelevant).

One should stress that the randomization differentiates only between the iteration runs, while during an iteration the (randomized) rank orders were kept constant in all rounds.

The randomization of *supply and demand* was also done in two different ways. The first so-called *marginal-dependent* randomization allocated the places of production and demand randomly in the two 18 x 25-matrices subject to the following restrictions: the marginal distributions of both matrices should be identical with the observed ones and both matrices should be disjoint. The first restriction requires (1) that each community produces and demands the same *number* of goods as actually observed, and (2) that the *number* of goods produced and asked for corresponds with the actually observed figures. The second restriction has also been applied to the construction of the tables A.2 and A.3 in the Appendix: a good is demanded only if it is not produced by the potential customer himself. The second variant, so-called *sumtotal-dependent* randomization, had to conform with the second restriction too, but the allocation of random numbers to the two matrices had only to equal the observed sum totals.

Three kinds of randomization were applied to the distribution of sources of *vaygu'a*. Empirically, two sources of valuables existed inside the Ur-Kula (armshells in Woodlark and necklaces in Tubetube) and two further outside (armshells in Kayleula and necklaces in Wari). The first variant, called *2-2 distribution*, randomized the distribution, but required that in- and outside the Ur-Kula there existed exactly one source of armshells and one of necklaces. In the second variant, called *all-one distribution*, all 18 communities possessed either armshells or necklaces, but the random distribution required that there were 9 sources of armshells and 9 of necklaces. The third variant, called *all-both distribution*, implied no randomization at all, but made each community a source of both armshells and necklaces.

Table 6 reports the simulation results of the seven counterfactual scenarios and, for comparison purposes, the fitness measures of the historical model (see Table 4). We will not go into details but only point out the main outcomes. First, the overall deviations from fitness measures of the model with historical phases and observed boundary conditions are amazingly

	Histo-rical Model	distance		prod/demand		vaygu'a		
		matrix	row	margi-nal	sum total	2-2	all one	all both
General Characteristics								
mean number of strong components (1) minimum maximum	1.003 1 2	1.000 1 1	1.003 1 2	1.010 1 2	1.008 1 2	1.005 1 2	1.002 1 2	.1.004 1 2
mean number of cooperative actors (18) minimum maximum	18.0 18 18	18.0 18 18	18.0 18 18	18.0 18 18	18.0 18 18	18.0 18 18	18.0 18 18	18.0 18 18
mean number of satis-fied communities (18) minimum maximum	18.0 18 18	18.0 18 18	18.0 18 18	17.8 9 18	17.6 6 18	18.0 18 18	18.0 18 18	18.0 18 18
Economic Exchange								
mean percentage of symmetric trading relations (100)	64,0	63,9	47,4	63,7	67,1	64,4	64,1	64,3
number of trading networks forming one strong component (yes) with positive fixed points (yes) with negative fixed points (yes)	991 587 395	979 547 432	933 432 501	940 588 348	924 570 350	993 489 474	991 432 516	987 465 487
mean percentage of trading networks with bridges (no)	2,5	0,1	3,0	2,6	1,9	3,0	3,1	2,9
mean density of symmetric trading networks (.235)	.230	.229	.182	.261	.268	.229	.229	.229
mean similarity of symmetric trading networks	.556	.149	.137	.529	.539	.555	.557	.557
mean percentage of links in cycles of length 3 or 4 (94,4)	95,6	87,5	65,7	97,5	98,1	95,7	95,6	95,5

	Historical Model	distance		prod/consum		vaygu'a		
		matrix	row	marginal	sum total	2-2	all one	all both
Ceremonial Exchange								
mean percentage of fixed points reached in trading networks (100)	99.1	100,0	100,0	99,6	99,6	97,0	95,7	96,5
mean number of rounds until fixed point is reached	50.6	20.9	34.1	50.3	42.2	78.1	77.1	71.0
(mean) ceremonial reciprocity in trading relations (1.0)	.980	.994	.990	.981	1.000	1.000	.972	.972
mean complementarity of gift exchange (1.0)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
mean degree of clockwise circulation	.092	.017	.010	.116	.115	.023	−.012	.011
after positive Ur-Kula	.395	.150	.170	.440	.434	.409	.394	.390
after negative Ur-Kula	−.381	−.124	−.134	−.425	−.405	−.391	−.377	−.367
correlation between direction of circulation in Urkula and in final Kula	.919	.621	.627	.937	.940	.906	.890	.892
mean reachability of gift exchange (1.0)	.690	.890	.797	.716	.731	.774	.748	.762
mean number of triads (21)	18.2	8.6	3.2	28.5	30.8	17.6	17.7	17.4
mean transitive closure of gift exchange (1.0)	.990	.927	.576	.976	.970	.932	.939	.931

Table 6: Simulation Results of Counterfactual Scenarios
(Mean Values of Fixed Points; 1000 Iterations)
Note: Observed values in brackets; description of 7 scenarios see text

small. Second, the general, theoretically interesting properties of the simulated network hardly differ: networks forming one strong component; number of cooperative actors; degree of need satisfaction; absence of bridges; percentage of links in cycles of length 3 or 4; percentage of fixed points reached in trading networks;

ceremonial reciprocity in trading relations; complementarity and reachability of gift exchanges; transitive closure of triads. Third, only randomization of distances results in larger deviations, especially when the rank order of search radius varies completely at random between communities acting as guests or as hosts (see third column "distance-row" of Table 6). But even these deviations have less to do with the degree to which general, theoretically interesting properties deteriorate than with measures of correspondence with specific peculiarities of the observed Kula ring: similarity of symmetric trading network; bi-furcation and circulation of valuables as measured by the correlation between direction of circulation in the Ur-Kula and the final Kula.

These results support the following conclusion: The spreading of peaceful relations, the emergence of a coherent network fulfilling the consumptive needs of the communities and the establishment of a circular system of gift exchange among them seem to depend on the interaction dynamics generated by the postulated behavioral assumptions and are rather independent of the specific boundary conditions. The clockwise and counterclockwise circulation of the two valuables seem to be the result of the geographic shape and the historical phasing of the development. Even this effect could be interpreted as the outcome of a different behavioral strategy: search behavior is independent of geographical distance and purely random.

10.2 Why only Two Valuables?

A simplifying assumption of our simulation models has been that only two valuables[43] are being exchanged. In the ethnographic literature it is pointed out that the two kinds of *vaygu'a* are culturally associated with the male-female distinction (Malinowski 1966a: 356). Though this certainly is a factor explaining the

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[43] It is of course historically contingent, which objects will become *vaygu'a*. Besides armshells (*mwali*) and necklaces (*soulava*) two other objects are mentioned in the ethnographic literature as being highly valued: stone axe blades and boar's tusks. But they were not considered to be *vaygu'a*.

continued use of only two valuables, it seems unlikely that it played a decisive role in the early starting phase.

Ekeh (1974) presents an interesting argument in favor of exactly two kinds of valuables: The Kula "combines *direct exchange* between any two partners with what Malinowski [1922: 93] calls *circular exchange* among a large number of exchange actors. With respect to any two Kula partners, say A_1 and A_2, in a unit of time and space exchanging Necklace for Armshell, the exchange is direct and emphasizes the psychological needs of the Kula partners. With respect to any one of the Kula exchange items, the exchange is spread out in time and space and moves among a large number of exchange actors in a form of *circular exchange* to forge, in an incipient form, an organic solidarity in an otherwise mechanically solidary society [Malinowski, 1922: 510]. The use of two items in the Kula exchange is thus not fortuitous. The use of only one item would rob the Kula of the here-and-now psychological satisfaction to be derived by individuals from mutual and *direct exchange*. The two items insure that the needs of social integration of society and the psychological needs of the individuals in the Trobriands could be met simultaneously. The use of three items in the Kula would upset the equality that is assumed to exist between the exchange partners. Thus the two items represent the minimum and maximum needed to work out a correspondence between the needs of the individuals and of society." (1974: 30)

However, this functionalist account does not specify (1) the mechanisms of the generating process, which "spreads out in time and space and moves among a large number of exchange actors in a form of *circular exchange*", and it does not demonstrate (2) why "three items in the Kula would upset the equality that is assumed to exist between the exchange partners" thereby preventing the emergence of a circular exchange. The first problem, i.e. the starting mechanism, we have tried to solve by our simulation model. The second problem we will explore by a kind of counter-factual scenario with three kinds of valuables.

The assumptions are the same as with our baseline model but we allow for three valuables: armshells, necklaces and polished axe blades. The latter were highly valued objects, which usually were not used for practical purposes, but which did not have the symbolic function of Kula gifts (Malinowski 1966a: 507). They were made out of raw greenstone manufactured in Woodlark and polished in the inland Kuboma district of Kiriwina island (Brookfield and Hart 1971: 325; Brunton 1975: 346; Seligman 1910: 520, 531). We therefore use two production places: Woodlark and Kiriwina. No deliberate complementary strategy is assumed, i.e. a different kind of valuable is preferred as counter-gift, but if only the same kind is available it will be presented. If more than one kind of valuable is available the actor will choose at random.

We used a similar stopping rule as previously: The iterative process stops if, in two consecutive rounds, the exchange of gifts is identical in every transaction. If a fixed point can not be reached the iteration run stops after 250 rounds.

The results of this simulation scenario were strikingly different. While in 95% of all iteration runs with two valuables the process converged on a fixed point, not a single iteration run of the simulation model with three valuables stabilized at a fixed point. As Figure 17 shows, the three stabilization measures[44] fluctuate, without any observable trend during 250 rounds. The negative mean values of all three valuables indicate that on the average there was more change than stability in the ceremonial exchange between consecutive rounds.

For comparison purposes we have added the "stabilization curve" for the baseline model with two valuables (dashed line).[45] It shows a rapid and continuous increase in the stability of the exchange of valuables. After 20 rounds a level of .80 has been

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[44] For each valuable the stabilization index between two consecutive rounds was defined as follows: (a-b)/(a+b) where a = number of identical exchanges; b = number of discontinued or newly established exchanges. If (a+b) = 0 the index would have been defined as zero, however, this never happened. As mentioned above, the first round refers to the round after establishment of a coherent trading network, which occurred in the baseline model with two *vaygu'a* in 945 of 1000 iteration runs and in the model with three valuables in 955 of 1000 iterations.

[45] As the stability indices of armshells and necklaces are almost identical, the stabilization curve refers to their mean value.

reached and after 160 rounds the exchange has stabilized at a level of .93.[46]

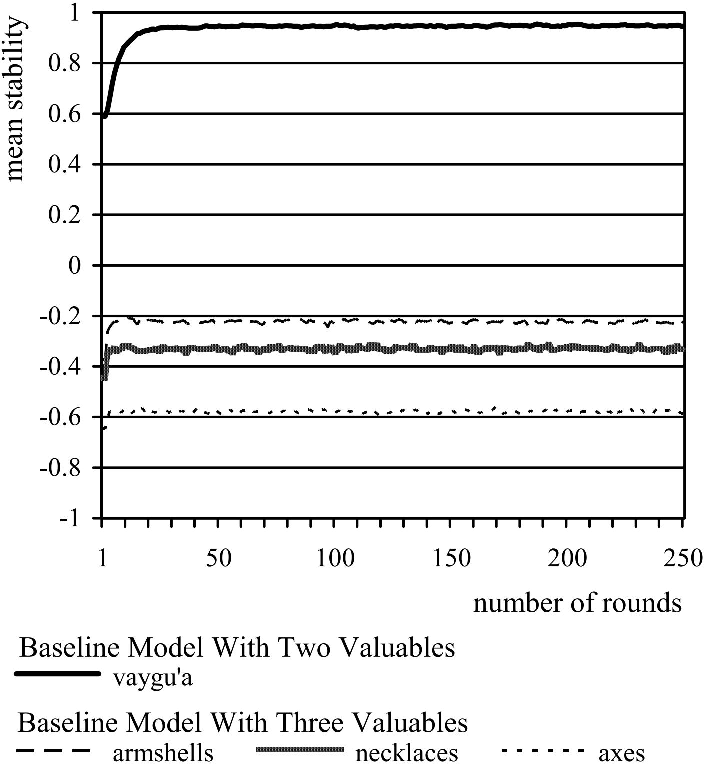

Figure 17: Stabilization of Ceremonial Exchange in Baseline Model With Two and With Three Valuables
Note: Mean stability measures for 250 rounds after establishment of trading network (1000 iteration runs)

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[46] It is interesting to note that the general characteristics and the goodness-of-fit measures of the economic transaction network were hardly affected by the introduction of a third valuable. All actors became cooperative, could satisfy their consumptive needs and there were 955 coherent trading networks with a mean density of .227 and an average similarity coefficient of .539. Even the average complementarity, i.e. exchanging different valuables, was very high (.892).

Of course these simulations do not tell us anything about the actual historical development. However, they demonstrate that the behavioral assumptions and boundary conditions of our model with two *vaygu'a* are compatible with a stable configuration of ceremonial exchange while the same model with three valuables is not.

11. What Happened to the Kula Ring?

One could presume that after the peace-keeping Leviathan of the colonial powers appeared, after the Christian missionaries indoctrinated a new value system and after the importance of the inter-insular barter declined, an efficient signaling system would have become obsolete and that the Kula ring would therefore have broken down. However, the stocktaking at the international conference of Kula experts in 1978 (Leach and Leach 1983; Macintyre and Young 1982) showed that the Kula still existed at that time, though to the great regret of older clan members some of the young men would not go on expeditions with traditional canoes, but instead with motorized fishing boats.

But the geographical shape had changed. A comparison of Map 1 (Leach and Leach 1983: 20-21) and the historical Kula of Figure 2 shows that five communities had left the Kula ring: East Cape, East End Islands, Wari, Misima and Laughlan[47]. Several other links had been cut as well (compare Figure 2 and 18).

To explain the persistence and change of the Kula ring, one has to rely on interpretation P – prestige competition. Being a member in the Kula is still relevant for status enhancement and the fulfillment of internal functions.[48] Therefore, it is to be expected that if communities leave the Kula, it will be those, which have a lower chance of acquiring Kula valuables due to their structural position in the network. To test this hypothesis we use the Markov chain model developed by Hage and Harary (1991: 161-62). The model assumes that each community keeps

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[47] In Map 1, Laughlan is shown to be still connected by "minor routes" with Woodlark in the 1970’s. However, it is impossible that alternating gift exchanges could occur in this single link. Laughlan would quickly run out of complementary valuables, which it would be "obliged" to present to Muruan guests.

[48] In his "Introduction" to the Kula and Massim Exchange Conference Proceedings Jerry W. Leach (1983) summarizes the evidence for the change and continued importance of Kula exchange. A sound Kula reputation was even of major importance for national candidates in parliamentary elections (see also Belshaw 1955; Macintyre and Young 1982; Munn 1983; Uberoi 1962; Weiner 1976).

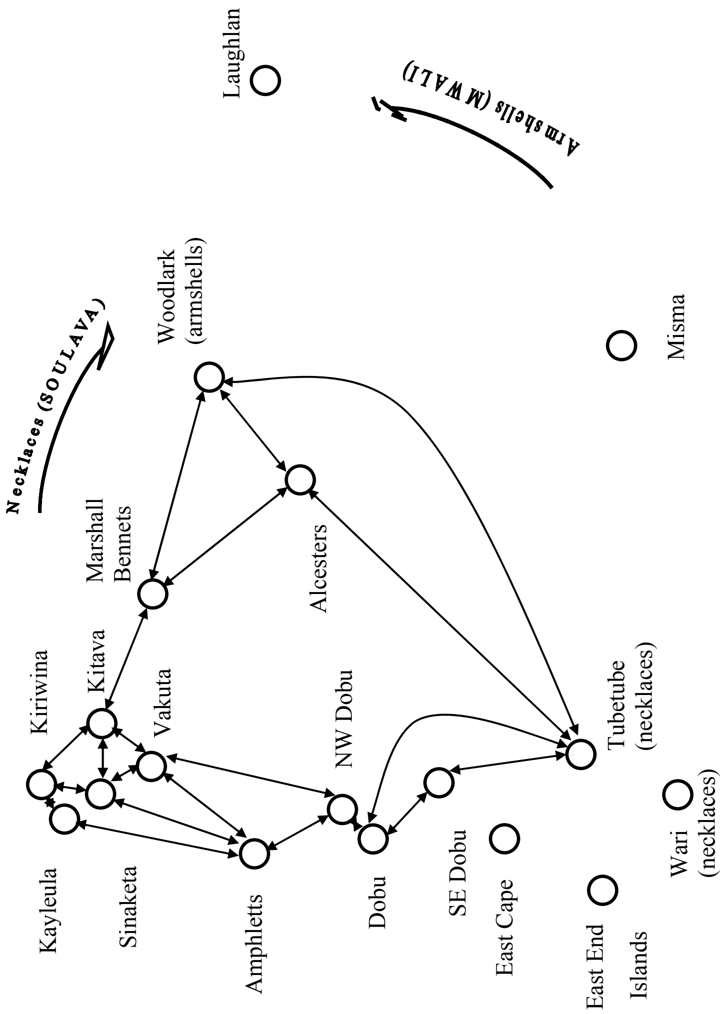

Figure 18: The Kula Ring in the 1970's

20% of its stock of valuables in every round and distributes the other 80% with equal probability among its neighbors. As the Markov chain is regular[49], it converges towards a limit (Hage and Harary 1991: 164). This may be interpreted as the (stable) proportion of the total stock of valuables available to each community in the long run.

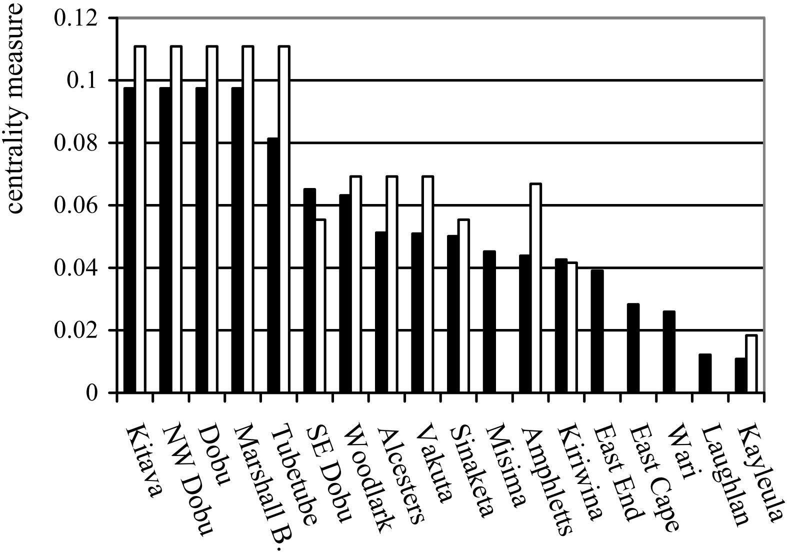

Figure 19: "Centrality" of Communities in the Historical Kula Ring (Black Bars) and in the Kula of the 1970's (White Bars)

Figure 19 shows this limit distribution, both of the historical Kula (Figure 2) and the Kula observed in the seventies of the past century (Figure 18). The five communities that left the Kula were much less able to accumulate *vaygu'a* in the historical Kula ring. The one definite exception, Kayleula, is said to be linked to Kiriwina and the Amphletts only by "minor routes" in more recent times (Leach 1983: 20f).[50]

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[49] This is because the observed network forms one strong component, where each pair of points is mutually reachable, i.e. each point is a source and a sink (Harary, Norman and Cartwright 1965: 99).

[50] Misima is only very slightly more central than the Amphletts and Kiriwina in the early Kula ring.

12. Concluding Remarks

The ceremonial exchange of Kula gifts is a classical example of a "phénomène social total" as Marcel Mauss (1969: 1) called it. It pervades all spheres of traditional life in the stateless tribal societies. We concentrated on one problem so far neglected: explaining the emergence and stability of its peculiar geographical structure among the 18 Kula communities, i.e. the development of a trading network, the spread of peaceful relationships and the circulation of necklaces clockwise and armshells counterclockwise, i.e. in the opposite direction. The behavioral assumptions of the starting mechanism should only refer to dyadic contacts and should not presuppose from the very beginning the existence of a universal norm of reciprocity among potentially hostile foreign communities.

12.1 Summary and Discussion of Results

The basic aim of this treatise was twofold: (1) to theoretically derive the behavioral assumptions of a starting mechanism for the emergence and co-evolution of a peaceful system of economic and ceremonial exchange and (2) to use simulation as a methodological device in order to demonstrate the macro-social consequences of a multi-level, multi-agent, dynamic system.

A game-theoretic interpretation of the external function of the Kula exchange as a signaling system of peaceful intentions with reputation and trust as protective devices against cheating was elaborated. The reciprocal exchange of gifts helps to reduce uncertainty in a game of incomplete information. The creation of social order by establishing a network of stable, peaceful social relationships enables and fosters economic trade.

The simulation model distinguished three processes, which were interlinked. First, a module for the development of a trading network among the 18 communities was presented. The empirical boundary conditions were the geographical distances between them and the places where 25 goods were produced or demanded.

A first model using only producer supply, consumer demand and geographic distances as the determinants of barter was completely unable to reproduce the observed structure. However, when trading by middlemen was added as an additional exchange incentive, a quite good fit was observed. Demand and supply by middlemen are an endogenous result of ongoing trade. If someone observes that his potential partner asks for a good X, which he does not possess, and he himself wants something, but can not offer anything in return, he will search for good X in his other contacts and may become a middleman.

The second process analyzed was the spread of peaceful relationships among potentially hostile tribal societies. Diffusion of reputation, fear of ostracism and trusting strangers if no negative evidence is available turned out to be the decisive factors in creating universal peace.

For the main part, a model that simulates the development of the gift exchange was described. The interest in establishing a gift exchange among neighbors and the behavioral strategies were derived from a game-theoretic analysis. It was demonstrated that under conditions of incomplete information there exists a common interest in establishing a reliable signaling system of peaceful intentions. Its misuse through cheating is again prevented by a functioning reputation mechanism.

Then the three processes were coupled. Though in the beginning the gains from economic exchange are considered to be the driving force of the development, establishment of peace is a necessary condition for barter to take place. In turn the reputation mechanism induces uncooperative actors to change their strategy because of fear of being ostracized. Both reputation and trust are necessary in order that ceremonial exchange of gifts fulfills its signaling function. However, signals are only sent if successful trading creates a lasting interest. Once Kula partnerships are established, they will be given priority irrespectively of geographic distance, when exploring possibilities of trading.

In its baseline form, the model does not reproduce the observed circulation of the two Kula gifts satisfactorily and accounts only for part of its main theoretically interesting features. Distinguishing among different phases in the "historical" development leads to a decisive improvement in the goodness-of-fit. Taking up an idea put forward by Malinowski himself, the process is first restricted to a subset of nine Kula communities in the western part of the region. After the search radius has reached half of its maximum value, the missing link between the two islands farthest apart (Tubetube and Woodlark) is "exogenously" closed and the process is iterated in this "primordial Kula ring" until it converges at a fixed point. In a third phase, the remaining communities are included and the process goes on until a fixed point is reached in the total network. During this phase 3, the members of the Ur-Kula stick to their traditional way of exchanging Kula gifts among themselves, which they established at the end of phase 2. This version of the simulation model produces a reasonably good fit: 29 out of the 36 observed trading relationships are predicted by the simulated aggregate Kula, which is constructed by dichotomizing the sum of all links so that its density equals the mean density of all fixed points. In 28 out of the 37 simulated trading relationships the direction of circulation of armshells and necklaces is correctly predicted.

Actually the process is path-dependent. If, at the end of phase 2, the process tends toward the observed exchange pattern in the Ur-Kula, at the end of phase 3 the direction of circulation in the simulated aggregate Kula ring comes rather close to the observed one. If, on the other hand, the simulated Ur-Kula tends towards the mirror image of the observed, the direction of circulation in the final aggregate Kula ring is approaching its opposite. These simulation results indicate that the observed circulation of the exchange – necklaces clockwise and armshells counterclockwise – is to a very large extent a *historically contingent* phenomenon, but not the emergence of a network-wide system of gift exchange itself, where in each dyadic transaction armshells and necklaces are exchanged reciprocally and complementarily.

An extension of the iterative process for another 250 rounds, after the first fixed point was reached, did not show complete stability, but the structure changed very gradually and the goodness-of-fit did not deteriorate significantly.

To test the impact of the observed boundary conditions on the outcomes of the simulation, seven ways of randomizing geographic distance, distribution of supply and demand of goods and the source of the valuables were analyzed. The differences in goodness-of-fit were amazingly small. The structural features of the simulated network therefore seem to depend more on the behavioral dynamics than on the specific empirical boundary conditions: the geographical distribution of the island communities and the ecological diversity in productive facilities.

A comparison of the historical Kula ring with the Kula in the 1970's shows a change of its geographical shape. It was argued that prestige competition was the decisive factor explaining the persistence and change of the Kula ring after its peace-keeping and economic functions had declined. It turned out that the five communities which had left were less favorably placed in the historical Kula ring. Their peripheral position had lowered their chances of acquiring Kula valuables.

12.2 Limits and Future Directions

Though we have stressed the signaling function of the ceremonial exchange this is of course not to deny the obligatory character, the great symbolic importance and the status-enhancing function of the Kula, which have been well documented by the ethnographers. We only argue that the signaling function is part of the starting mechanism and that the other functions presumably develop later after the exchange of valuables as signals of peaceful and lasting relationships among former strangers has come into being. It is another and interesting task to explain the emergence of a "norm of reciprocity" – beyond the mere convention of reciprocally signaling one's peaceful intentions –, of "universal against parochial solidarity" (Macy and Skvoretz 1998), the status-enhancing character of "prestige goods" (Persson 1983), the emergence of rank orders among the Kula valuables (Gregory 1983), the "inalienable"[51] possession of Kula

[51] Annette Weiner stresses the paradox of Keeping-While-Giving: "Only when certain armshells and necklaces meet the highest standard are they eligible for the top named category and only then is each shell given an individual name. These are the shells that carry the history of

valuables and the recognizable routes (*keda*), along which they are exchanged (Campbell 1983; Munn 1983), as well as their symbolic importance for other ceremonial activities, for marriages and mortuary rites. To model some of these processes would certainly require modules for the dynamics of the (hitherto neglected) micro-meso connection and its coupling with the inter-insular exchange processes.

But even within the narrow focus on the starting phase, our simulation model rests on simplifying restrictions, which ask for further research. It takes the 18 Kula communities as the set of potential partners as given and simulates the emergence and stability of a circular ceremonial exchange of the two Kula gifts within this set. It leaves the question open, how the boundaries of the system were circumscribed. However, this would require much more encompassing and detailed empirical data, which will only doubtfully ever become available.[52]

We argued that the driving force of the emergence of the Kula ring was the economic incentive of interinsular trade, and that the ceremonial exchange helped to establish and stabilize a peaceful order, which is a necessary condition for economic trade to take place. The continued existence and change of the Kula ring in the last century after these incentives had disappeared was attributed to the status enhancing function of the Kula exchange. It would be a challenging task to include this process into the simulation model and to compare its predictions regarding stability and change of the Kula ring in more recent times with the available empirical data.

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their former owners' eminence creating their own specific identities through time." (1992: 134)

[52] Archeological methods might be helpful in collecting data about the prehistorical exchange systems (Earle and Ericson 1977).

Appendix: Empirical Boundary Conditions

	1 Kitava	2 Kiriwina	3 Sinaketa	4 Kayleula	5 Vakuta	6 Amphletts	7 NW Dobu	8 Dobu	9 SE Dobu	10 East Cape	11 East End	12 Wari	13 Tubetube	14 Misima	15 Laughlan	16 Alcesters	17 Woodlark	18 Marshall B
1 Kitava	0	34	30	46	27	84	97	133	148	184	226	258	217	272	264	129	162	55
2 Kiriwina	34	0	21	15	42	86	124	143	167	200	241	274	236	304	298	163	196	89
3 Sinaketa	30	21	0	23	24	65	101	122	146	196	220	255	217	287	293	150	190	84
4 Kayleula	46	15	23	0	46	82	122	139	165	196	238	274	236	312	313	173	209	103
5 Vakuta	27	42	24	46	0	55	87	106	125	163	203	236	196	266	277	148	192	68
6 Amphletts	84	86	65	82	55	0	42	57	89	133	158	194	156	257	306	144	203	110
7 NW Dobu	97	124	101	122	87	42	0	23	48	72	118	152	114	224	295	133	203	124
8 Dobu	133	143	122	139	106	57	23	0	44	55	101	137	103	230	314	148	219	146
9 SE Dobu	148	167	146	165	125	89	48	44	0	51	80	110	70	200	279	122	194	143
10 East Cape	184	200	196	196	163	133	72	55	51	0	44	84	55	211	329	171	241	190
11 East End	226	241	220	238	203	158	118	101	80	44	0	40	32	200	342	192	264	224
12 Wari	258	274	255	274	236	194	152	137	110	84	40	0	42	184	344	207	276	249
13 Tubetube	217	236	217	236	196	156	114	103	70	55	32	42	0	167	308	167	236	207
14 Misima	272	304	287	312	266	257	224	230	200	211	200	184	167	0	188	148	175	228
15 Laughlan	264	298	293	313	277	306	295	314	279	329	342	344	308	188	0	165	105	211
16 Alcesters	129	163	150	173	148	144	133	148	122	171	192	207	167	148	165	0	72	80
17 Woodlark	162	196	190	209	192	203	203	219	194	241	264	276	236	175	105	72	0	106
18 Marshall B	55	89	84	103	68	110	124	146	143	190	224	249	207	228	211	80	106	0

Table A.1: Geographic Distances Among the 18 Kula Communities (in km)
Measures are taken from enlarged Massim Name-Locator Map (Leach and Leach 1983: X-XI)

	1 Bananas	2 Betel nuts	3 Coconuts	4 Fish (dried)	5 Pigs	6 Sago	7 Taro	8 Yam	9Axes (greenstone)	10 Baskets	11 Bowls	12 Canoes L. (nagega)	13 Canoes S. (waga)	14 Clay vessels	15 Lime spatulae, pots	16 Mats	17 Obsidian	18 Sand	19 Wooden dishes	20 Combs	21 Drums	22 Mussel shells	23 Ornaments	24 Skirts	25 Wooden swords
1 Kitava								1		2		3	4			5							6	7	
2 Kiriwina	8	9	10		11		12	13		14*	15				16*				17*	18*	19	20	21*	22	23
3 Sinaketa	24	25	26	27	28		29	30		31*	32		33		34*				35*	36*	37	38	39*		40
4 Kayleula						41*				42			43						44	45			46*		
5 Vakuta	47	48	49	50			51	52		53*	54		55		56*				57*	58*	59	60	61*		62
6 Amphletts													63	64			65	66*					67*		
7 NW Dobu			68			69							70				71	72							
8 Dobu	73		74			75	76	77					78				79	80					81*		
9 SE Dobu			82		83	84	85	86					87	88			89						90		
10 East Cape								91						92											
11 East End				93	94																				
12 Wari				95										96											
13 Tubetube				97										98									99		
14 Misima		100	101		102	103	104	105				106		107											
15 Laughlan			108		109									110		111								112	
16 Alcesters										113		114													
17 Woodlark						115	116	117	118			119													
18 Marshall B		120			121							122	123			124	125								

Table A.2: Location of Production of Goods

Notes to Table A.2: Location of Production of Goods

[*] Goods imported at these places from outside the Kula ring

[1] Malinowki (1966a: 79, 472; 1966b: 72); Scoditti/Leach (1983: 249)
[2] Malinowski (1966a: 481)
[3] Landa (1983:145); Malinowki (1966a: 145); Scoditti/Leach (1983: 264)
[4] Malinowki (1966a: 121ff, 144f)
[5] Malinowki (1966a: 481)
[6] Malinowski (1966a: 481)
[7] Malinowski (1966a: 480f)
[8] Landa (1983: 144)
[9] Malinowki (1966b: 408)
[10] Brookfield/Hart (1971: 325f); Landa (1983: 144) Malinowski (1966a: 213)
[11] Malinowki (1966b: 408)
[12] Brookfield/Hart (1971: 325f); Landa (1983: 144); Malinowki (1966a: 213; 1966b: 426); Weiner (1976: 35)
[13] Brookfield/Hart (1971: 98f); Landa (1983: 144); Malinowki (1966b: 392ff); Weiner (1976: 15, 34f)
[14*] Brookfield/Hart (1971: 325f); Landa (1983: 144); Malinowski (1966a: 189); Seligman (1910: 530ff)
[15] Brookfield/Hart (1971: 325f); Landa (1983: 144); Seligman (1910: 530ff)
[16*] Landa (1983: 144); Malinowski (1966a: 189,480); Seligman (1910: 530ff)
[17*] Fortune (1989: 208); Malinowski (1966a: 189); Seligman (1910: 530ff)
[18*] Landa (1983: 144); Malinowki (1966a: 189, 480); Seligman (1910: 530ff)
[19] Seligman (1910: 530ff)
[20] Malinowki (1966a: 480); Seligman (1910: 530ff)
[21*] Malinowki (1966a: 189, 480f); Seligman (1910: 529)
[22] Seligman (1910: 530)
[23] Seligman (1910: 536)
[24] Malinowki (1966a: 213)
[25] Malinowki (1966b: 300f)
[26] Malinowki (1966b: 300f)
[27] Malinowki (1966a: 390)
[28] Malinowki (1966a: 212)

[29] Malinowki (1966b: 295)
[30] Malinowki (1966a: 195, 213)
[31*] Landa (1983: 144); Malinowki (1966a: 165, 189, 390)
[32] Landa (1983: 144); Malinowki (1966a: 165, 189)
[33] Malinowki (1966a: 121ff, 144f)
[34*] Malinowki (1966a: 189, 390)
[35*] Malinowki (1966a: 189, 390)
[36*] Malinowki (1966a: 363)
[37] Malinowki (1966a: 189, 390)
[38] Malinowki (1966a: 189, 390)
[39*] Malinowki (1966a: 189; 1966b: 17)
[40] Malinowki (1966a: 189, 390)
[41*] Brookfield/Hart (1971: 325f)
[42] Lauer (1970: 173)
[43] Brookfield/Hart (1971: 325f); Malinowki (1966a: 121ff, 144f, 500)
[44] Lauer (1970: 173)
[45] Lauer (1970: 173)
[46*] Brookfield/Hart (1971: 325f)
[47] Malinowki (1966b: 425)
[48] Malinowki (1966b: 300f)
[49] Malinowki (1966b: 300f)
[50] Malinowki (1966a: 390)
[51] Malinowki (1966b: 295, 425)
[52] Malinowki (1966b: 425)
[53*] Landa (1983: 144); Malinowki (1966a: 189, 390)
[54] Landa (1983: 144); Malinowki (1966a: 189, 390)
[55] Brunton (1975: 552); Malinowki (1966a: 121ff, 144f)
[56*] Malinowki (1966a: 189, 390)
[57*] Malinowki (1966a: 189, 390)
[58*] Malinowki (1966a: 363)
[59] Landa (1983: 144); Malinowki (1966a: 189, 390)
[60] Malinowki (1966a: 189, 390)
[61*] Malinowki (1966a: 363)
[62] Malinowki (1966a: 189, 390)
[63] Malinowki (1966a: 144f, 288)
[64] Brookfield/Hart (1971: 325f); Fortune (1989: 202ff); Irwin (1983: 57, 68); Landa (1983: 144); Lauer (1970: 170f); Lauer (1971: 200ff); Malinowki (1966a: 282ff); Seligman (1910: 15, 531); Thune (1983: 353)
[65] Malinowki (1966a: 287)
[66*] Brookfield/Hart (1971: 325f)

[67*] Brookfield/Hart (1971: 325f)
[68] Malinowki (1966a: 282)
[69] Fortune (1989: 207); Landa (1983: 144); Malinowski (1966a: 375,381)
[70] Malinowki (1966a: 144f, 288)
[71] Malinowki (1966a: 366)
[72] Malinowki (1966a: 367)
[73] Brookfield/Hart (1971: 98f); Fortune (1989: 105); Thune (1983: 353)
[74] Brookfield/Hart (1971: 325f)
[75] Austen (1945: 26); Brookfield/Hart (1971: 98f, 325f); Fortune (1989: 207); Malinowski (1966a: 375)
[76] Brookfield/Hart (1971: 98f)
[77] Brookfield/Hart (1971: 98f); Fortune (1989: 105f); Thune (1983: 353)
[78] Malinowki (1966a: 144f, 288)
[79] Malinowki (1966a: 366); Thune (1983: 353)
[80] Brookfield/Hart (1971: 325f)
[81*] Brookfield/Hart (1971: 325f)
[82] Brookfield/Hart (1971: 325f)
[83] Thune (1983: 351)
[84] Brookfield/Hart (1971: 325f)
[85] Brookfield/Hart (1971: 325f)
[86] Brookfield/Hart (1971: 325f); Macintyre (1983b: 370); Malinowki (1966b: 73); Thune (1983: 347)
[87] Malinowki (1966a: 144f)
[88] Brookfield/Hart (1971: 325f); Fortune (1989: 207); Lauer (1970: 170f)
[89] Seligman (1910: 536)
[90] Brookfield/Hart (1971: 325f)
[91] Thune (1983: 347)
[92] Lauer (1970: 170f)
[93] Thune (1983: 347)
[94] Seligman (1910: 535)
[95] Thune (1983: 347)
[96] Belshaw (1955: 5); Brookfield/Hart (1971: 325f); Irwin (1983: 68); Lauer (1970: 170f); Lepowsky (1983:475); Macintyre (1983b: 370); Seligman (1910: 15)
[97] Thune (1983: 347)
[98] Brookfield/Hart (1971: 325f); Fortune (1989: 202); Irwin (1983: 68); Landa (1983: 145); Lauer (1970: 170f); Macintyre (1983b: 370); Seligman (1910: 15, 526, 536); Seligman/Strong (1906: 239)

[99] Brookfield/Hart (1971: 327); Fortune (1989: 208); Landa (1983: 145); Lauer (1970: 170f); Seligman (1910: 526, 536)
[100] Malinowki (1966a: 80; 1966b: 73)
[101] Brookfield/Hart (1971: 325f)
[102] Lepowsky (1983: 475); Seligman (1910: 531)
[103] Berde (1983: 433); Brookfield/Hart (1971: 325f); Lepowsky (1983: 475)
[104] Berde (1983: 433); Brookfield/Hart (1971: 325f)
[105] Berde (1983: 433); Brookfield/Hart (1971: 325f)
[106] Belshaw (1955: 25); Brookfield/Hart (1971: 325f); Malinowki (1966a: 38, 144f, 499); Seligman/Strong (1906: 238)
[107] Irwin (1983: 68)
[108] Damon (1983: 42); Damon (1990: 231); Malinowki (1966b: 73); Seligman (1910: 531)
[109] Damon (1983: 42); Damon (1990: 231); Seligman (1910: 532)
[110] Damon (1990: 231)
[111] Damon (1983: 42); Damon (1990: 231)
[112] Damon (1983: 42); Damon (1990: 231)
[113] Seligman (1910: 536)
[114] Seligman (1910: 526)
[115] Damon (1983: 42); Damon (1990: 231)
[116] Damon (1990: 232)
[117] Damon (1990: 232)
[118] Brookfield/Hart (1971: 325f); Damon (1983: 42); Fortune (1989: 202, 207); Malinowki (1966a: 481); Seligman (1910: 15, 530ff); Seligman/Strong (1906: 353); Thune(1983: 353)
[119] Belshaw (1955: 25); Brookfield/Hart (1971: 325f); Fortune (1989: 207); Landa (1983: 144); Malinowki (1966a: 144f); Seligman (1910: 526, 534); Seligman/Strong (1906: 238)
[120] Scoditti/Leach (1983:263)
[121] Seligman (1910: 531)
[122] Fortune (1989: 202); Landa (1983: 144); Malinowki (1966a: 144f, 499); Seligman/Strong (1906: 238)
[123] Malinowki (1966a: 145)
[124] Scoditti/Leach (1983:263)
[125] Scoditti/Leach (1983:263)

	1 Bananas	2 Betel nuts	3 Coconuts	4 Fish (dried)	5 Pigs	6 Sago	7 Taro	8 Yam	9Axes (greenstone)	10 Baskets	11 Bowls	12 Canoes L. (nagega)	13 Canoes S. (waga)	14 Clay vessels	15 Lime spatulae, pots	16 Mats	17 Obsidian	18 Sand	19 Wooden dishes	20 Combs	21 Drums	22 Mussel shells	23 Ornaments	24 Skirts	25 Wooden swords
1 Kitava		1				2			3						4		5			6		7			
2 Kiriwina						8			9				10	11		12	13	14							
3 Sinaketa						15								16			17								
4 Kayleula		18	19											20			21	22							
5 Vakuta						23								24			25								
6 Amphletts	26	27	28		29	30	31	32	33	34	35				36				37		38	39			
7 NW Dobu	40			41			42	43		44				45	46				47	48				49	
8 Dobu									50	51				52	53				54	55		56		57	
9 SE Dobu	58			59						60									61	62		63		64	
10 East Cape				65									66												
11 East End							67	68				69		70											
12 Wari			71		72	73	74	75				76							77						
13 Tubetube	78		79		80	81	82	83	84	85	86	87			88		89		90		91				92
14 Misima									93	94	95					96			97						
15 Laughlan						98	99	100	101			102													
16 Alcesters					103				104			105													
17 Woodlark			106		107								108	109		110							111	112	
18 Marshall B								113	114					115									116		

Table A.3: Location of Demand for Goods

Notes to Table A.3: Location of Demand for Goods

[1] Scoditti/Leach (1983:263)
[2] Austen (1945: 26); Brookfield/Hart (1971: 325f)
[3] Seligman (1910: 531f)
[4] Malinowki (1966a: 480f)
[5] Scoditti/Leach (1983:263)
[6] Malinowki (1966a: 480f)
[7] Malinowki (1966a: 480f)
[8] Brookfield/Hart (1971: 325f); Fortune (1989: 207); Landa (1983: 144); Malinowki (1966b: 7)
[9] Brookfield/Hart (1971: 325f); Malinowki (1966a: 481); Uberoi (1962: 155)
[10] Malinowki (1966a: 121ff, 145)
[11] Brookfield/Hart (1971: 325f); Irwin (1983: 57); Lauer (1970: 171); Lauer (1971: 200ff)
[12] Malinowski (1966a: 481)
[13] Malinowki (1966a: 287, 366)
[14] Brookfield/Hart (1971: 325f); Fortune (1989: 207)
[15] Fortune (1989: 207); Malinowki (1966a: 206, 375; 1966b: 7)
[16] Brookfield/Hart (1971: 325f); Irwin (1983: 57); Lauer (1970: 171); Lauer (1971: 200ff)
[17] Malinowki (1966a: 287, 366)
[18] Lauer (1970: 173); Malinowki (1966a: 69)
[19] Lauer (1970: 173)
[20] Brookfield/Hart (1971: 325f); Irwin (1983: 57); Lauer (1970: 171); Lauer (1971: 200ff); Malinowki (1966a: 69)
[21] Malinowki (1966a: 287, 366)
[22] Brookfield/Hart (1971: 325f)
[23] Austen (1945: 26); Fortune (1989: 207); Malinowki (1966b: 7)
[24] Brookfield/Hart (1971: 325f); Irwin (1983: 57); Lauer (1970: 171); Lauer (1971: 200ff)
[25] Malinowki (1966a: 287, 366)
[26] Fortune 1983: 208); Landa (1983: 144)
[27] Malinowki (1966a: 287)
[28] Brookfield/Hart (1971: 325f); Landa (1983: 144); Malinowki (1966a: 287)
[29] Malinowki (1966a: 287)
[30] Austen (1945: 26); Landa (1983: 144); Malinowki (1966a: 287)
[31] Landa (1983: 144); Malinowki (1966a: 287)

[32] Fortune (1983: 208); Landa (1983: 144); Malinowki (1966a: 287)
[33] Fortune (1983: 208)
[34] Malinowki (1966a: 47, 287)
[35] Fortune (1989: 208)
[36] Fortune (1989: 208); Malinowki (1966a: 287)
[37] Malinowki (1966a: 287)
[38] Fortune (1989: 208)
[39] Malinowki (1966a: 287)
[40] Landa (1983: 144)
[41] Malinowki (1966a: 390)
[42] Landa (1983: 144)
[43] Landa (1983: 144)
[44] Malinowki (1966a: 390); Seligman (1910: 530)
[45] Fortune (1989: 207); Irwin (1983: 57); Landa (1983: 144)
[46] Malinowki (1966a: 390)
[47] Seligman (1910: 530)
[48] Seligman (1910: 530)
[49] Seligman (1910: 530)
[50] Thune (1983: 353)
[51] Seligman (1910: 530)
[52] Brookfield/Hart (1971: 325f); Fortune (1989: 207); Landa (1983: 144); Macintyre (1983b: 370); Malinowki (1966a: 282f)
[53] Malinowki (1966a: 390)
[54] Lauer (1970: 173); Seligman (1910: 530)
[55] Lauer (1970: 173); Seligman (1910: 530)
[56] Seligman (1910: 530)
[57] Seligman (1910: 530)
[58] Thune (1983: 353)
[59] Thune (1983: 347)
[60] Belshaw (1955: 82); Lauer (1970: 173); Seligman (1910: 530)
[61] Lauer (1970: 173); Seligman (1910: 530)
[62] Lauer (1970: 173); Seligman (1910: 530)
[63] Seligman (1910: 530)
[64] Seligman (1910: 530); Thune (1983: 353)
[65] Thune (1983: 347)
[66] Malinowki (1966a: 144f)
[67] Belshaw (1955: 82)
[68] Thune (1983: 347)
[69] Malinowki (1966a: 38)
[70] Malinowki (1966a: 282f); Seligman (1910: 531ff)
[71] Brookfield/Hart (1971: 325f)

[72] Lepowsky (1983: 475)
[73] Belshaw (1955: 28); Brookfield/Hart (1971: 325f); Lepowsky (1983: 475)
[74] Brookfield/Hart (1971: 325f)
[75] Brookfield/Hart (1971: 325f); Thune (1983: 347)
[76] Malinowki (1966a: 144f)
[77] Belshaw (1955: 28)
[78] Belshaw (1955: 82)
[79] Brookfield/Hart (1971: 325f)
[80] Seligman (1910: 536)
[81] Brookfield/Hart (1971: 325f)
[82] Brookfield/Hart (1971: 325f)
[83] Belshaw (1955: 82); Brookfield/Hart (1971: 325f); Macintyre (1983b: 370); Thune (1983: 347)
[84] Macintyre (1983c: 11)
[85] Seligman (1910: 536)
[86] Seligman (1910: 536)
[87] Fortune (1989: 208); Landa (1983: 145); Macintyre (1983b: 374); Malinowki (1966a: 144f); Seligman/Strong (1906: 238); Seligman (1910: 526, 534)
[88] Seligman (1910: 536)
[89] Seligman (1910: 536)
[90] Seligman (1910: 536)
[91] Seligman (1910: 536)
[92] Seligman (1910: 536)
[93] Malinowki (1966a: 507)
[94] Brookfield/Hart (1971: 325f)
[95] Brookfield/Hart (1971: 325f)
[96] Belshaw (1955: 81)
[97] Belshaw (1955: 81)
[98] Damon (1983: 42); Damon (1990: 231)
[99] Damon (1990: 232)
[100] Damon (1990: 232)
[101] Seligman (1910: 531f)
[102] Malinowki (1966a: 144)
[103] Seligman (1910: 730)
[104] Seligman (1910: 531f)
[105] Malinowki (1966a: 144); Seligman (1910: 534)
[106] Damon (1990: 231)
[107] Damon (1990: 231); Macintyre (1983b: 374)
[108] Damon (1990: 231)

[109] Brookfield/Hart (1971: 325f); Fortune (1989: 207); Irwin (1983: 57); Landa (1983: 144)
[110] Damon (1983: 42)
[111] Brookfield/Hart (1971: 325f)
[112] Damon (1983: 42)
[113] Scoditti/Leach (1983: 264f)
[114] Seligman/Strong (1906: 353); Seligman (1910: 531f)
[115] Fortune (1989: 207); Irwin (1983: 57); Landa (1983: 144)
[116] Seligman (1910: 528)

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