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Bounded Rationality of Economic Man: Decision Making under Ecological, Social, and Institutional Constraints

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Synopsis: Neoclassical economic theory is implicitly based on the assumption of atomistic individuals living in anonymous societies, unconnected to other individuals by kinship, ethnic, friendship or other social ties. Furthermore, neoclassical economic theory is based on a model of rational, omniscient individuals operating in a zero transaction costs world of perfect markets without institutions. In the last forty years or so, New Institutional Economics (NIE) have criticized Neoclassical economics and have incorporated concepts of bounded rationality, transaction costs, and uncertainty. Neoclassical economic theory has also been challenged by behavioral studies of decision-making showing that cognitive constraints lead to various decisional biases and judgmental errors. However, similar to neoclassical economic theory, behavioral models of risky choice have largely ignored environmental variables such as social structure (group size, group composition, etc.) and institutional infrastructure (the formal and informal 'rules of the game'). In this paper, we show how social structure and institutions serve as important constraints influencing rational choice in risky situations. Wang's experimental work shows that a famous 'cognitive illusion' called framing effects disappear when kinship relations, the smallness of group size, and group homogeneity are taken into account. These empirical findings are explained in a framework of 'Bounded Risk Distribution'. Landa's NIE theory of the ethnically homogeneous Chinese middleman group, based on fielwork, shows that in an environment characterized by contract uncertainty, hence positive transaction costs traders choose their trading partners along kinship and other particularistic basis, a phenomenon not predicted by Neoclassical theory of exchange. Our paper shows that economic and descriptive psychological risky choice theories of decision-making need to take into account the social and institutional environment: the boundly rationality of economic man is influenced by the social contexts in which he makes decisions.

Key words: risky choice, contract uncertainty, cognition, framing effects, heuristics, social structure, kinship, ethnicity, institutions, transaction costs

JEL classification: D23, K12, 017, C91, C93, Z13

Introduction

Neoclassical economics implicitly assumes atomistic individuals unconnected to others by ties of kinship, ethnic or other social ties. Furthermore, neoclassical economics assumes a rational, omniscient 'economic man' (*Homo economicus*) operating in a zero transactions costs world without institutions. The concept of rationality is defined by a

small set of axioms: dominance, independence, transitivity, and invariance (for reviews, see Luce 1992, Luce & Raiffa 1957, Savage 1954, Simon 1987, Tversky & Kahneman 1986). A rational individual making decisions under risk is assumed to behave according to the von Neumann-Morgenstern (1947) axioms, i.e. the person selects the option that maximizes expected utility. Rational choice theory is a normative theory of the average or representative individual making choices; it is not a descriptive theory of actual behavior in specific environments.

The rational choice paradigm has been criticized by Herbert Simon (1957) who developed a 'bounded rationality' theory of 'satisficing'—in contrast to maximization—by the actor who is constrained by cognitive limitations and the structures of task environment. George Miller's (1956) work on limited capacity of short-term memory is a classic example of cognitive constraints on information processing. The rational choice paradigm underlying neoclassical theory has also been criticized by New Institutional economists for its abstraction of real-world institutions in a world of positive transaction costs (see Landa 1994, chap. 1). New institutional economists, in the last forty years or so, have incorporated concepts of bounded rationality, transaction costs and uncertainty in their theories.

More recent work by psychologists (e.g., Tversky & Kahneman 1981, 1986) and some economists, using empirical evidence drawn from behavioral decision-making experiments, offer even more disturbing challenges to the theory of rational choice by demonstrating that individuals make choices in violation of expected-utility theory. Many examples of irrational or anomalies in individual behavior have been identified (see Kahneman et al. 1982). A classic example of cognitive anomaly is the so-called 'framing effects' (Tversky & Kahneman 1981, 1986) that is, a risk preference reversal of the decision maker induced by mere 'framing' or re-description of the choice outcomes. The irrational reversal is in violation of the axiom of invariance of rational choice, which requires that individual's risk preference or choice order should be invariant as to how choice outcomes are framed. When faced with anomalous, irrational individual behavior, some economists attempt to explain these anomalies, for example, by introducing new environmental or contextual variables, such as the role of institutions, which emerge to deal with these anomalies (Frey & Eichenberger 1989).

In this paper, we go further. We argue that a rational choice model capable of accounting for individual decision anomalies such as framing effects need to take account of relevant environmental or contextual variables affecting individual rational choice. Institutions—the 'rules of the game'—or the institutional environment—is an important part of the environment or context. Other important environmental or contextual variables, such as kinship structure, group size, and group composition (group heterogeneity or group homogeneity) are also important in influencing individual choice in specific cultures.

The important role of the environment/context in rational decision-making has been emphasized by Simon (1990). Taking a bounded rationality approach, Simon views decision-making as a process of problem solving under constraints. According to Simon (1990, p. 7) bounded rationality is shaped by a pair of scissors whose two blades are 'the structure of task environments and the computational capacities of the actor.'

Although a great deal of attention has been paid to the cognitive constraints in the studies of human behavioral decision, the other blade of the bounded rationality scissors—the role of the environment in shaping rational choice behavior—is largely ignored in the literature of many economic and psychological models of decision-making under risk (see also Dudey & Todd paper in this issue).

From this perspective, new research questions and agendas arise: To what extent is the observed judgmental errors and decision biases that give rise to individual irrational behavior due to cognitive constraints and to what extent is due to the constraints of the 'task environments'? Is it possible that some of the observed decision-biases, such as framing effects, are special cases occurring in context-free environments? What would happen if normatively the same decision tasks were viewed under evolutionary, ecological, social, cultural, and institutional constraints? Would these decision biases appear and disappear depending on the task environments in which the decision problem occurs?

This paper is an inter-disciplinary collaborative effort by an economist and a psychologist to answer the questions posed above. In order to demonstrate the impact of contextual variables such as group size and kinship on decision making under uncertainty, we first present Wang's (e.g. 1996a, b) laboratory experiments of how people prioritize group size and kinship cues embedded in a life-death decision problem and the subjective scope of small 'we-groups' for Chinese and American subjects. Within the same bounded rationality framework, we then present Landa's (1981, 1988) empirical findings based on field studies of how Chinese middlemen in Southeast Asia chose trading partners under conditions of contract uncertainty where the legal framework for contract enforcement was not well-developed. Chinese middlemen used a cognitive device, the 'calculus of relations', to classify all potential trading partners on the basis of the degree of kinship/genetic relatedness or social distance, resulting in two major classifications, 'we, the insiders' vs. 'them, the outsiders'. The empirical findings presented in this paper by Wang & Landa are not new. What is new and significant, however, is how two independent empirical studies on Chinese participants/interviewees undertaken by Wang and Landa converge to show the significance of cognitive limitations and contexts/environment in influencing bounded rational decision-making under uncertainty. By taking into account of cognitive and environmental constraints, we demonstrate that human decisions are, indeed, boundedly rational.

The paper is divided into two main parts. Part 1 focuses on X.T. Wang's empirical tests using framing effects as an experimental probe of decision rationality to examine how the universal features of group living–kinship, group size, and group composition affect human decision making under risk. Wang's experimental work shows that a famous 'cognitive illusion' called framing effects disappear when kinship relations, the smallness of group size, and group homogeneity are taken into account. Risky choice is then analyzed in a framework of 'Bounded Risk Distribution' where expected values of choice outcomes, the minimum requirement, and outcome distributions (variance) are taken into consideration. This model of risky choice is also tested in a computer simulation using a genetic algorithm. Part 2 focuses on Landa's (1978, 1981) fieldwork

and theory on the Chinese merchants in Southeast Asia. The empirical evidence of *particularistic* exchange relations, along kinship and ethnic lines, between Chinese merchants, which contradicts Neoclassical theory of *impersonal* exchange, forms the basis of Landa's new institutional economic theory of the ethnically-homogeneous Chinese middleman group (EHMG). Landa's theory of the EHMG, by focusing on the cognitive foundations of social classification of peoples, establishes links with evolutionary psychology's 'fast and frugal heuristics' research program (Gigerenzer et al. 1999, Todd 2000).

1. Wang's experimental studies and the bounded risk distribution model

1.1. The Asian disease problem and framing effects

Consider a widely cited violation of normative rationality, framing effects, first demonstrated by Tversky & Kahneman (1981) using the Asian disease problem. The cover story of the Asian disease problem involves a hypothetical group context in which 600 anonymous people are infected by a fatal disease. The participants were asked to evaluate two alternative medical plans proposed to rescue the hypothetical patients at risk. One alternative was a sure thing (plan A) whereas the other was a gamble (plan B) of equivalent expected payoff. The outcomes of the two alternatives were presented under either a positive frame or a negative frame. In the positive framing condition, the participants were told that if plan A was adopted one-third of the lives at risk would be saved for certain; and if plan B was adopted, there would be a one-third probability that all 600 lives would be saved and a two-thirds probability that none of them would be saved. In contrast, in the negative framing condition, the same choice outcomes were framed in terms of lives lost. The participants were then told that if plan A was adopted, two-thirds of the 600 lives would die for certain; and if plan B was adopted, there would be a one-third probability that none of them would die and a two-thirds probability that all 600 lives would die.

Under positive framing, given this binary choice, the majority of their participants (72%) were risk averse. They preferred the sure outcome (Plan A) over its gamble equivalent (Plan B). However, when the same outcomes framed in terms of lives lost were presented to another sample of participants, the majority of the participants (78%) were risk taking. They favored the gamble outcome over the sure outcome. This framing effect is often considered to be a cognitive illusion that violates the invariance principle of expected utility theory, hence rationality of the decision-maker. The descriptive invariance axiom requires a rational decision maker to have a consistent preference order among choice prospects independent of the way the prospects are presented or framed. What causes such irrational reversal in risk preference? Would the task environment be a precondition for the presence of framing effects? In the Asian disease problem, it was not identified who the 600 people at risk were. Nevertheless, a domain-general model of decision-making would not bother to ask for such specific information. However, what would happen if the ecological and social environments

of decision problems matter? What would happen if the number of lives at risk was not 6 rather than 600? What would happen if the 6 of the lives at stake were your friends or relatives?

1.2. Kith-and-kin rationality

Humans have always lived in groups (e.g., families, clans, tribes, villages, communities). For over 95% of hominid evolution, humans lived in small-face-to-face groups organized mainly by kinship and reciprocity relationships. The size of primitive human groups rarely exceeded 100 people (see Knauft 1991, Lee & DeVore 1968, Reynolds 1973). The prolonged evolutionary experience in small-face-to-face groups would have shaped human mental mechanisms to be sensitive to the risk distributions in kith-and-kin group living and the decision cues about the relational structure and the size of a group.

The basic working hypothesis is that human decision makers possess a kith-and-kin rationality, which maps the persistent and survival relevant features of environments onto decision-making mechanisms. When making risky choices, specialized risky-choice mechanisms would be instantly triggered by simple and implicit cues inherent in a choice problem and reliably signal the adaptive significance of the problem.

In a series of studies, Wang and his colleagues (1996a, b, Wang et al. 2001) have examined how framing effects wax and wane in response to changing task contexts. Using a life-death problem similar to the Asian disease problem (Tversky & Kahneman 1981), they systematically manipulated three organizational variables: group size, relational structure of the group (i.e., kinship), and the composition of the group at risk.

1.3. Group size effect

The life-death decision problem provides a useful empirical paradigm to manipulate the social group context of the problem in an implicit manner. In Wang's study (Wang 1996a, b), each group of subjects was given only one version of the life-death problem. All the subjects were asked to 'Imagine that X people are infected by a fatal disease'. The number X, however, was different for each group of subjects. Four numbers were used, 6000, 600, 60 and 6. The underlying assumption was that the simple difference among these numbers would be perceived to be qualitatively different (i.e. large group vs. small group) and as a result, activate different risk preferences. The second manipulation was the framing of the choice outcomes, as illustrated in aforementioned example. In all the cases, the expected value was the same for the sure-thing option and the gamble, and the probability of survival was one-third. It was found and replicated that the framing effect (i.e. the irrational reversal in risk preference) was found only when the problem was presented in a large group context with either 6000 or 600 people involved. However, with smaller group sizes of 6 and 60, the framing effect was absent, and the

majority of the subjects favored the risky probabilistic outcome under both framing conditions, suggesting a 'live or die together' small group rationality. These findings suggest that the size of a social group is a reliable cue indicating the degree of interdependence among group members. The smaller the size of a group, the higher the interdependence among its group members. See Table 1 which shows framing effects as a function group size.

1.4. Kinship effect

When the 6 hypothetical patients were described as close relatives, the respondents always unambiguously preferred the gamble option to the sure option, in order to give everybody an equal chance to survive. The respondents became even more risk-taking if the choice outcomes were framed negatively in terms of lives lost. The risk-seeking choice percentage increased from 72% under positive framing to 94% under negative framing in the first study and from 73% to 90% in the second study. Although the shift from 73% to 90% was significant, it was clear that the majority of the respondents were risk taking under both framing conditions. The shift towards risk seeking under negative framing suggests that the higher relatedness among kin elicits a stronger 'we all live or die together' attitude, particularly when tthe choice outcomes are both

Table 1. Framing effects as a function of the size of the group measured by percent (%) of participants making risk-seeking shoice.

American sample 1 (Wang 1996a)				
	Group size = 6000	Group size = 600	Group size = 60	Group size = 6
Positive frame	40.9% (n = 44)	40.0% (n = 50)	67.5% (n = 40)	64.0% (n = 50)
Negative frame	61.4% (n = 44)	68.0% (n = 50)	65.0% (n = 40)	70.0% (n = 50)
Framing effects	Yes	Yes	No	No
American sample 2 (Wang 1996b)				
	Group size = 6000	Group size = 600	Group size = 60	Group size = 6
Positive frame	38.7% (n = 31)	41.9% (n = 31)	57.6% (n = 33)	66.7% (n = 30)
Negative frame	66.7% (n = 30)	76.5% (n = 34)	66.7% (n = 30)	75.8% (n = 33)
Framing effects	Yes	Yes	No	No
Belgian sample (Wang et al. 2001)				
	Group size = 6 billion		Group size = 6	
Positive frame	36.0% (n = 50)		70.0% (n = 50)	
Negative frame	66.0% (n = 50)		70.0% (n = 50)	
Framing effects	Yes		No	

objectively negative and negatively worded. The irrational reversal in risk preference disappears when the formally identical decision problem is presented in either a kinship or small group context. Kinship and the size of a social group appear to be powerful and reliable cues for the interdependence of group members, leading to all-or-none risk seeking decisions.

1.5. Cultural constraints on decision rationality

The same life-death problems (in Chinese) were used in a study (Wang 1996a) with a total of 400 Chinese participants, recruited from universities, research institutes, factories, companies, and government departments in Beijing of the People's Republic of China. The general choice pattern found in this study was similar to that found in the U. S. samples. First, a classical type of framing effect was found in the large group context with 6000 hypothetical patients. Second, the framing effect disappeared when the life-death problem was presented in a kith-and-kin context. Third, the respondents became more risk-taking in kith-and-kin contexts. Finally, at group size of 600 or smaller, however, no framing effect was found. In a word, the results from the Chinese study replicated the US data with the one exception that the group size at which risk preference switched from risk averse to risk taking was larger for Chinese subjects. This finding suggests that the subjective size of the we-group (kith-group) is larger for Chinese participants (i.e., 600 instead of 60).

These results suggest that the decisional sensitivity to task environments (i.e., the kith-kin cues) are cross-cultural. However, the switching point between risk-aversion and risk-taking along the group size dimension is culturally specific. A larger scope of 'we-group' for Chinese can be considered as an adjustment to specific demographic and organizational features inherent in the structure of Chinese social environment: a large overall population, extended family size, more complex kinship structure, larger reciprocal networks and low mobility of social groups.

1.6. Group composition effects

The concept of vicarious functioning proposed by Brunswik (1940) suggests that cues used in decision making are selected with priority and substituted for each other. Individual decision cues with varying validities are collectively used for making accurate judgments and decisions. When making a life-death decision, a kinship cue should be given a much higher priority than a verbal framing cue. When cues about kinship, group size, group composition (group homogeneity) are unambiguously presented, one would pay little attention to verbal framing cues which present the same choice outcomes in terms of either lives-saved or lives-lost. However, when the evolutionarily valid cues are absent or in conflict, the decision-maker becomes sensitive and susceptible to the verbal frames of choice outcome. Thus, in case of cue-conflict or goal-conflict (Simon 1954, 1990), unreliable low-ranking cues may be selected in

making risky choices. Similarly, research on simple heuristics of decision-making by Gigerenzer, Todd & the ABC group (1999) also show that when cue values tie, simple heuristics (e.g., Take The Best and Lexicographic rules) would skip good cues and make decisions based on low validity cues.

In a recent study (Wang et al. 2001) examined how the group cues are used in making risky choice, using a life-death problem. Consistent with the previous findings, no framing effects were found when the endangered group was homogeneous, consisting of either 6 kin or 6 strangers. Compared with the two six-stranger groups (i.e. one under positive framing and one under negative frames), the participants in the two six-kin groups were more risk seeking irrespective of the framing of choice options. The participants in the kinship context were significantly more risk-taking than those in the stranger context. The homogeneity in both kin and stranger conditions overrode the verbal framing and framing effects were absent in both group contexts. However, when the group became heterogeneous, consisting of either 1 kin and 5 strangers or 2 kin and 4 strangers, the effects of verbal framing reappeared. In such heterogeneous groups, the kinship cue and stranger cue coexisted and led to a conflict between risk-seeking preference triggered by the kinship cue and a relatively more risk-averse preference activated by the stranger cue.

In summary, the irrational preference reversal as a result of framing the same choice outcomes differently only occurs when (1) the task environment is novel and lacks valid cues (e.g., large and anonymous groups) or (2) decision cues and goals are in conflict (e.g., heterogeneous groups).

1.7. Bounded risk distribution

The adaptiveness of a kith-and-kin rationality depends on its fit to the structure of task environments. The functional values of a kith-and-kin rationality can be viewed in a framework in which a decision maker is expected to maximize the opportunity of reaching a task-specific goal and minimize the likelihood of falling below a minimum requirement at the same time (see Wang 2002). Under risk, one needs to consider not only a task-specific goal but also a task specific minimum requirement (e.g., to get x amount of y before the deadline z). In contrast to the normative concept of maximizing expected utility, a choice option yielding the highest expected value may not have a risk-variance distribution that satisfies the task constraints as measured by both the goal level and minimum requirement (MR).

Consider the life-death problem again, the goal of the task should be clear to any decision-maker across group conditions. That is to save all the group members at stake. However, the MR varies as a function of task environment. The MR is highest for a kin group and lowest for a large anonymous group (Wang 2002). According to the mean-variance heuristic (Wang 2000), a decision-maker should be risk/variance seeking when the expected mean value of choice outcomes is below a task-relevant MR since a higher variance increases the likelihood of reaching the MR. In contrast, one should be risk/variance averse when the expected mean value is above the MR since a higher

variance may cause a disastrous outcome of falling below the MR. This heuristic assumes that the utility of an increase from value A to value B should be larger when the MR is between the two values than when the MR is either higher than B or lower than A. For instance, if losing two-thirds of kin means the ultimate death of the kin group, the MR for kin group survival would be higher than one-third. This means that saving one-third of the group is not enough. The decision-maker therefore would be forced to choose a gamble option rather than a sure survival of one-third of the group.

1.8. Utilize the statistical features of task environments

This section reports new findings from a recent simulation study conducted by X.T. Wang. The study examined the effects of the setting of MR in large and small group situations. The Appendix illustrates the basic steps taken in this simulation. If the survival probability for each individual group member at risk is Ps, the expected number of survivors in a target group would be Ps (Group Size). Therefore, at a group level, the simulated 'natural selection' should favor any strategies that maximize the likelihood of [Ps (Group Size) – MR $>$ 0].

In making binary choice between a sure option and a gamble of the same expected value, the sure outcome is equal to Ps (Group Size). In case of choosing a gamble option, a stochastic process takes place where the group outcome is the sum total of the surviving individuals.

The fitness for a specific risk strategy (e.g., being risk-seeking for 85% of the time) can be measured against the MR variable.

Assume that the MR for group survival is not a fixed number but a variable reflecting environmental hostility and resource limitation. The MR, in the simulation is thus a random number from 0 to the value of Group Size. Thus, on average, MR = 1/2 (Group Size).

Let the size of the large group = 600, and the size of the small group = 6. When the Ps = 1/3, the number of survivors would be, on average, 200 in the large group situation and 2 in the small group situation. Therefore, on average, the Expected Mean $<$ MR. Since the mean on average is below the MR, the riskiness of the choice strategy should evolve from the 50–50 risk neutral starting point to a more risk seeking point over generations. This evolved riskyness should be seen in both large group and small group conditions. The simulation results confirmed this prediction (see the bottom graph of Figure 1).

A second prediction is that the size of the group at risk would also influence the speed and the extent of evolution towards risk seeking. According to the law of large numbers, there would be a higher variance in survival outcomes of the small group than the large group. This higher variance would be useful when the expected value of survival outcome is below the average MR for group survival. Thus, this statistical feature of small group structure should be reflected in the riskiness of the evolved risk strategy. It can be seen in the bottom graph of Figure 1, the overall evolved riskiness is more risk seeking for the small group survival than that for the large group survival.

In contrast, when we change the Ps from 1/3 to 2/3, the expected value would be greater than the MR for group survival (i.e., Expected Mean > MR). Since the expected mean is above the MR, the overall evolved riskiness would, over generations, become more risk averse in both group size conditions. In addition, a higher variance in outcomes in the small group condition would hinder the effectiveness of a risk-averse strategy. Thus, such an evolved increase in risk averseness (or a decrease in risk proneness) would be more prominent in the large group situation. These predictions were supported by the simulation results (see the graph in Figure 1).

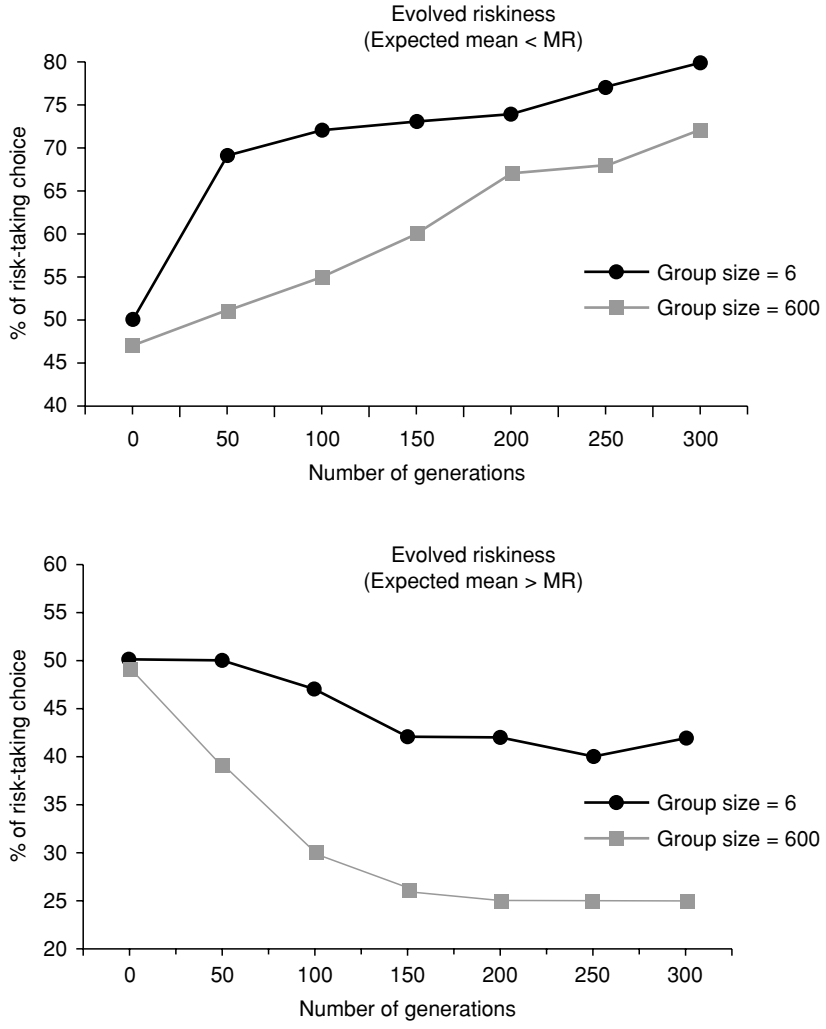

Figure 1.

These simulation results lend further support to the Bounded Risk Distribution model, suggesting that bounded rationality should seek for outcome variance when the expected mean is blow the MR but avoid outcome variance when the expected mean is above the MR. The variance difference associated with the size of a group can be utilized to facilitate decision-making.

2. Landa's fieldwork and theory of the ethnically-homogenous Chinese middlemen group (EHMG)

We now turn to Landa's fieldwork and theory of the ethnically homogeneous middleman group (EHMG). Like Wang's findings presented in section 1, Landa's theory is also a theory of rational choice behavior under uncertainty, in this case contract-uncertainty. Exchange under conditions of contract uncertainty requires a theory that departs from Neoclassical theory of impersonal exchange.

2.1. Theory of impersonal exchange vs.theory of EHMG

Neoclassical theory of exchange assumes a zero transaction costs world in which contracts are enforced costlessly. In such a world without contract-uncertainty, transactions are conducted on an impersonal basis. Landa's field work (Landa 1978, 1988) on Chinese merchants in Southeast Asia found that the marketing of small-holders' rubber was monopolized by a close-knit EHMG: Hokkien-Chinese dominated by five clans—Tan, Lee, Lim, Ng, and Gan—originating from Chuan-chow and Yung-chun counties in Fukien province in China; the phenomenon of EHMG contradicts Neoclassical theory of impersonal exchange.

Interviews with rubber-dealers revealed the importance of trust in Chinese merchants' choice of trading partners under conditions of contract uncertainty. As one rubber merchant puts it: 'Because of the risk involved in advancing money without security, based purely on trust, we tend to trade with those whom we trust; they are often kinsmen, friends, people from the same place in China and those who speak the same dialect. Because of the longer association of Hokkens with each other in the rubber industry, we find it easier to give credit to a fellow-Hokkien because there are ways of finding out the creditworthiness of that person—about his background, his associates, his ethical code, and so on' (Landa 1988, p. 82).

Based on the empirical findings of the EHMG, Landa developed a theory of the EHMG (Landa 1978, 1981, reprinted in Landa 1994) as a low-cost club-like institutional arrangement, alternative to contract law for protecting contracts. Landa's theory of the EHMG draws on two central concepts and ideas in the New Institutional Economics (NIE), not found in neoclassical economics: (1) the important role of institutions (formal and informal rules of the game) in constraining anti-social behavior so as to achieve cooperation and coordination of actions among inter-dependent individuals; and (2) the role of institutions in economizing on 'transaction costs'. (See Landa 1994, chapter 1 for a discussion of the NIE literature).

Under conditions of contract uncertainty a rational Chinese trader, will arm himself with a Confucian 'calculus of relations' which establishes a system of discriminatory rankings by classifying all potential trading partners into seven categories on the basis of degree of kinship/social distance corresponding to different 'grades' of trustworthiness of trading partners, in descending order of trustworthiness: (1) kinsmen in the nuclear family; (2) kinsman in the extended family; (3) clansmen (sharing the same surname); (4) fellow-villagers; (5) fellow Hokkien-Chinese speaking the same dialect if the Chinese trader ('Ego') is Hokkien-speaking; (6) Chinese speaking another dialect; and (7) non-Chinese (Europeans, Indians, indigenous).

In order to economize on contract enforcement costs, a rational trader will choose his network of trading partners from the inner most circle, before moving outwards from the innermost circle. As Ego moves outward from the center, members of his trading network or group will be chosen from ever-widening circles giving rise to a more heterogeneous group membership. As Ego crosses the major ethnic boundary separating Chinese ('insiders') from non-Chinese ('outsiders') trading partners, costs of enforcement of contracts rise abruptly, as trading partners are chosen from a different ethnic group. Because of the sharply rising transaction costs of contract enforcement, Ego, a rational trader, has the incentive to limit his choice of his network of trading partners to those insiders within his own ethnic/racial boundary. The aggregate effects of many middlemen's discriminatory choice of trading partners result in the emergence of Confucian code of ethics embedded within the EHMG. For those middlemen who must cross the major ethnic/racial boundary in order to trade with non-Chinese, cash is used to minimize the transaction costs of breach of contract. Within the EHMG, any trader who violates the Confucian cultural norms of mutual aid will be punished, including ostracism, by members of the group. In this way the EHMG functions as a low-cost club-like organization, alternative to contract law, which economizes on costs of contract enforcement in an environment in which the legal infrastructure was not well-developed (see Landa 1978, 1981; see also Carr & Landa 1983).

2.2. Cognitive and classificatory foundations of a theory of EHMG

So far, we assumed that Chinese traders are able to develop a classificatory system of ranking of traders, in descending order of degree of trustworthiness in honoring contracts. But how does the Chinese merchant establish *seven* categories of trading partners, in descending order of trustworthiness? The discriminatory classification system of all potential trading partners into seven categories reflects the *content* and *limits* of the informal institution, Confucian ethics of mutual aid, adapted to overseas Chinese societies.[1]

Using the prescriptions of Confucian social norms, a Hokkien-Chinese merchant, for example, can classify all Chinese traders into five categories, with the fifth category being 'all Hokkiens'. Beyond the Hokkien-Chinese ethnic boundary, the limits of Confucian ethics form the basis for a Hokkien-Chinese trader's classification of all potential traders into two major categories, the 'insiders' (i.e. Hokkens); and

(2) 'outsiders' (non-Hokkiens, and non-Chinese). The insiders, because of shared Confucian social norms of behavior, are seen as members of a 'moral community' of reliable trading partners.

A Hokkien trader uses information cues or non-market signals such as the degree of kinship relatedness or social distance, in combination with Confucian rules of mutual aid obligation, to assess, infer, or predict the creditworthiness/trustworthiness of a potential trading partner. For Chinese merchants Confucian code of ethics thus serves not only as a tool of action, an adaptive mechanism used in an environment where the legal infrastructure for enforcing contracts is not well developed, but also serves as *cognitive screening and signalling device* for efficiently obtaining information to predict or infer about the degree of trustworthiness of a potential trading partner (Landa 1981). Cognitive foundations of institutions, serving as classification systems, economize on information costs in an environment in which credit-rating institutions are non-existent or poorly developed.

All rational action is preceded by cognitive processes in the individual's mind in which classification plays a fundamental role. NIE, however, has ignored the cognitive and classificatory foundations of social institutions. In order to develop a theory of institutions resting on cognitive and classificatory foundations, Landa (1997/forthcoming in Salter ed.) extended her theory of the EHMG (Landa 1981) to incorporate the work of anthropologist Mary Douglas's cognitive approach to institutions. According to Douglas (1986, p. 55): 'Institutions which promote co-operation and social solidarity, need to be grounded by a cognitive device in order for individuals to be certain about the other person's strategies, and generate the necessary trust in the other individual's behavior. For human discourse and cooperation to be possible, individuals have to agree on basic categories of thought'. And that, according to Douglas (1986, pp. 55, 91), is provided by institutions which 'define sameness', 'confer identity', and 'do the classification'. In what ways 'institutions do the classifying'? The first basis of classification by an individual of different kinds of people is the difference between oneself and the others (Douglas 1986, p. 62). Institutions do the classifying for individuals by providing 'labels': 'persons realize their own identities and classify each other through community affiliation' (p. 102).

The importance of classifying of people into different categories is to allow the person doing the classification to predict behavior which economize on contract enforcement and information costs.

2.3. A bioeconomics theory of EHMG: 'The biology of morality' and inter-group competition

Landa's theory of EHMG establishes links with evolutionary biology, especially with the work of William Hamilton (1964). In Hamilton's 'kinship-selection' theory, he agues that the degree of kin relatedness determines the degree of altruism, hence cooperation among animals. Altruism toward one's kin, in turn, increases the survival of the group; hence altruistic acts toward one's genetic kin is one of the most important

traits of animal behavior. Hamilton's kinship theory implies that animals have the ability to recognize categories of kinship, in effect, to measure degree of kin relatedness. Robert Trivers (1971) argues that another way that individuals can achieve cooperation is through 'reciprocal altruism' in which unrelated individuals exchange altruistic acts. In a paper with Axelrod (Axelrod & Hamilton 1981, reprinted in Axelrod 1984), Hamilton & Axelrod emphasized the importance of superior memory and identification by humans, and hence the ability of humans to form larger cooperative groups, beyond kinship groups, in situations of repeated interactions among specific identified non-related individuals.

Clearly, the EHMG is an excellent example of a larger cooperative group, whose members include kinsmen and non-kinsmen (members of an ethnic group) and are linked by 'reciprocal altruism' (i.e. Confucian code of reciprocity). Members of the EHMG, by economizing on contract-enforcement and information costs can *out-compete* other ethnic groups to appropriate and maintain their middleman roles (Landa 1999). The emergence of the phenomenon of the EHMG and its persistence over time is a manifestation of what evolutionary biologist Richard Alexander (1987) calls the 'biology of moral systems.' According to Alexander (1987, p. 1): 'Moral systems are societies with rules'. Alexander speaks of moral systems as systems of indirect reciprocity and provides a biological theory of moral systems: '. . . the concept of moral and ethical arise because of the conflict of interest, and that—at least up to now—moral systems have been designed to assist group members and explicitly not to assist the members of other competing groups' (Alexander, p. 1). Central to Alexander's perspective on moral systems is his emphasis on inter-group (between group) competition and the conflict of interest between groups that promote *within-group* cooperation. Alexander (p. 79) argues that humans alone play competitive group-against-group on a large and complex scale'. Thus Confucian ethics, seen as promoting in-group loyalty and solidarity plays an important role in an ethnic group's ability to out-compete another ethnic group in appropriating the role of middleman-entrepreneurs.

2.4. An evolutionary psychological theory of EHMG

Landa's bioeconomic theory of EHMG also establishes links with evolutionary cognitive psychology's research program, and the 'fast and frugal heuristics' research program developed by Gigerenzer and his ABC group of researchers (1990); see also Todd (2000). According to Todd (2000, pp. 940–941): 'Individual in challenging situations must often make up their minds—make inferences, choices, and decisions—rapidly and efficiently, using only the information currently available and not spending much time deliberating. If they do not, they may lose their dinner to a competitor, their mate to a rival, or their life to a predator. [O]rganisms can take advantage of the structure inherent in the decision environment itself. By matching the internal structure of simple decision-making mechanisms to the external structure of information in the environment, inferential accuracy can be achieved without computational

complexity . . . We call this view of adaptive, accurate decisions made with simple, fast, information-frugal and environment-exploiting mechanisms 'ecological rationality.'

Clearly, Hokkien traders possess ecological rationality: Hokkien traders, faced with the environment of contract-uncertainty and costly information on the reliability of potential trading partners, must therefore make inferences, using only the information that they can obtain cheaply The Confucian code of ethics—adapted by overseas Chinese to overseas Chinese societies in Singapore and West Malaysia—helped overseas Chinese traders to economize on the costs of contract enforcement and information under conditions of contract uncertainty and scarce information. Chinese middlemen, in fact, use fast and frugal heuristics, which include:

(i) 'Recognition heuristic' (Todd 2000, p. 944): the decision maker chooses between two objects, if one is recognized and the other is not, then select the former. For a Hokkien Chinese trader, if presented with opportunities to trade with two traders, one with a kinsman, and one with a stranger, the Chinese typically prefers to choose his kinsman over the stranger[2];

(ii) 'Categorization heuristic/categorization by elimination' (Todd 2000, p. 947): This heuristic 'makes accurate category judgements by using each successive cue to whittle away the set of possible categories to which the object in question could belong, until only a single possible category remains.' Chinese middleman uses this categorization heuristic by setting up seven categories of different categories of people, in terms of kinship/social distance, and looks for simple cues such as kinship, surname, place of origin, to whittle away the categories until the potential trading partners properly identified and assigned to one single category. Or as in the case of an ethnic/racial cue, the Chinese merchant can immediately recognize or identify a non-Chinese and assign him to the correct category (category 7).[3] Categorization all potential trading partners into seven categories allows a Chinese merchant to infer the degree of trustworthiness of a potential trading partner from signals or cues of identity in a fast and frugal way. 'Simple heuristics may be advantageous for navigating the complexities of social domains (Gigerenzer 1996), an important question for further research concerns how might social norms, cultural strictures, historical proverbs, and the like play a role in enabling fast and frugal social reasoning?' (Todd 2000, p. 953). As can be seen from this section, Landa's field work and theory of EHMG clearly show the importance of an informal institution—Confucian cultural or social norms of reciprocity–in enabling a Chinese trader to employ fast and frugal social reasoning to cope with an environment characterized by contract uncertainty and limited information.

3. Concluding comments

Wang's empirical work demonstrates the behavioral effects of the task environments, which is one of the two blades of Herbert Simon's scissors for shaping bounded rationality. The studies show that people are sensitive to the ecological, social and

cultural features of the task environment and are capable of managing risks adaptively under these constraints. His laboratory experiments demonstrate that once contextual/environment variables are taken into account, framing effects disappear. His Bounded Risk Distribution model integrates the effects of the environmental constraints into a three-way relationship between the setting of the task MR, the variance in payoff distribution, and the expected mean value of a choice option.

Landa's field work and theory of EHMG show how an informal institution such as Confucian social norms of mutual aid played a very important role in economizing on transaction costs of contract enforcement and information costs. Section 2.4 also shows how Landa's NIE and bioeconomic approaches to the EHMG, which emphasize the importance of cognitive foundations of institutions, is consistent with evolutionary psychology's fast and frugal heuristics research program.

Our empircal findings, even if the findings are not new, show the important role that ecological, social, and institutional constraints (i.e. kinship structure, group size, group composition, informal social norms) play in boundly rational decision-making under uncertainty. Thus, boundly rational models of decision-making under uncertainty—both economic and descriptive psychological risky choice theories of decision-making—need to take into account not only cognitive limitations of the mind, but also the adaptive relationship between decision strategies and the ecological, social, and institutional constraints of the environment in which a decision task is presented.

Appendix

Computer simulations of the group size effects using a Genetic Algorithm (GA)

Since it was first developed by John Holland (1975), GAs has become a common research tool in artificial intelligence, human factors studies, and some areas of the social sciences. A GA makes use of the evolutionary principles of natural selection, mutation, and crossover to select the most 'fit' member from a 'population' of choice strategies. The algorithm uses a binary string to code information which allows information exchange when two bit strings 'breed'. During the 'breeding', both a 'crossing over' oprerator (i.e., the exchange of segments between two bit strings) and a 'gene mutation' operator (i.e., a '1' changes to a '0' or vice versa) could occur at specified rate.

In the simulation study, the binary strings were randomly generated to code risk strategies ranging from the extremes of risk seeking to risk aversion. *A 7-bit binary string that was randomly generated at the beginning of the simulation, defined each choice strategy*. The value of each 7-bit string was then translated into a decimal number raging from 0 to 100. *The decimal number 85, for example, would be interpreted as making risk-averse choices 85 percent of the time and risk-seeking choices 15 percent of the time*. In other words, when facing a binary decision between two prospects, say, a sure thing and a gamble of equal expected value, this strategy would be more likely (with a .85 probability) to choose the sure thing.

The implementation procedures involved the following steps:

(a) Generate a population of 100 risk strategies represented by random bit strings called genotypes';
(b) Convert the bit-strings into decimal values. Each risk strategy in the population is then represented as an integer X between 0 and 100, with 0 means absolute risk seeking and 100 means absolute risk averse;
(c) For every 100 trials of binary choice between a sure outcome and its gamble equivalent, each risk strategy is risk averse X times and risk seeking (100 − X) times per generation-time;
(d) The variables in the simulations are the size of the endangered group (600 or 6) and the setting of the MR (either above or below the expected mean of simulated choice outcomes). See the text for detailed descriptions.
(e) The risk strategies are tested one by one in each of the simulated mean-variance (payoff) situations. During the testing, binary choices are made repeatedly (100 times in each generation) between a sure option and its gamble equivalent, in proportion to the riskiness of the risk strategy (e.g., taking the sure option 68% of the time if $X = 68$);
(f) The group survival outcome for each specific risk strategy is measured by the cumulative number of lives saved over the trials with the size of the group as a fixed number in each simulation. If (Group Survival Outcome − MR) > 0 then fitness value for the strategy increases by one unit;
(g) According to the fitness of the strategies, the two best strategies would be selected to 'breed' per generation with a .05 rate of mutation and crossing-over;
(h) The offspring bit-string is tested and enters the population if its fitness value is greater than the population average. The new offspring replaces the one with the lowest fitness value in the population. Overall evolved riskiness in the population of competing strategies is computed for each generation; and
(i) The simulation of the evolutionary process takes a total of 300 generations.

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Notes

1. Confucian ethics prescribes differences in the patterns of mutual aid obligations between people with varying degrees of social distance. Kinship relations, in which social distance is at its minimum, are strong ties that involve the severest degree of mutual aid constraints in dealings among kinsmen; hence kinsmen are the most trustworthy people to trade with.

2. It would be interesting to test the recognition heuristic: For instance, what would the choice be if a trader were presented with a known (recognized) 'stranger' and an unknown (unrecognized) kinsmen, (e.g. because of moving back to the area after growing up somewhere else)? If the trader still chooses the former recognized individual, then he is (probably) using the recognition heuristic –if not, then not. Thanks to Peter Todd for this suggestion.
3. It would also be interesting to test this: Make a decision/categorization tree that shows what cues are considered in what order and what decision can be made at each point (could show this in a figure, for example) and then test this, e.g., to see if really only one cue is used at a time, and if it is non-compensatory (e.g. if you are not close kin but you are Hokkien-Chinese speaking and recognized, then does that outweigh not being close kin? Thanks to Peter Todd for for this suggestion

References cited

Axelrod, Robert & William D. Hamilton. 1981. The evolution of cooperation in biological systems. Science 211:1390–96. Pp. 88–105 in R. Axelrod, The Evolution of Cooperation. Basic Books, Inc., Publishers, New York.

Brunswik, Egon. 1940. Thing constancy as measured by correlation coefficients. Psychological Review 47:69–78.

Carr, Jack L. & Janet T. Landa. 1983. The economics of symbols, clan names and religion. Journal of Legal Studies 12:15–156.

Frey, Bruno S. & Reiner Eichenberger. 1989. Anomalies and institutions. Journal of Institutional and Theoretical Economics 145:423–437.

Gigerenzer, Gerd & Peter Todd & the ABC Research Group. 1999. Simple heuristics that make us smart. Oxford University Press, Oxford.

Hamilton, William D. 1964. The evolution of social behavior. Journal of Theoretical Biology 7:1–52.

Holland, John H. 1975. Adaptation in natural and artificial systems. University of Michigan Press, Ann Arbor.

Kahneman, Daniel, Paul Slovic & Amos Tversky. (ed.) 1982. Judgment under uncertainty: Heuristics and biases. Cambridge University Press, New York.

Kahneman, Daniel & Amos Tversky. 1979. Prospect theory. Econometrica 47:263–292.

Knauft, Bruce M. 1991. Violence and sociality in human evolution. Current Anthropology 32:391–428.

Landa, Janet T. 1978. The economics of the ethnically homogeneous Chinese middleman group: a property rights-public choice approach. Unpublished Ph.D. dissertation, Virginia Polytechnic Institute & State University.

Landa, Janet T. 1981. A theory of the ethnically homogeneous middleman group: an institutional alternative to contract law. Journal of Legal Studies 10(2):349–362.

Landa, Janet T. 1988. Underground economics: generic or *sui generis?* Pp. 76–103 in J. Jenkins (ed.) Beyond the Informal Sector: Including the Excluded in Developing Countries, ICS Press.

Landa, Janet T. 1994. Trust, ethnicity, and identity: beyond the new institutional economics of ethnic trading networks, contract law, and gift-exchange. University of Michigan Press, Ann Abor.

Landa, Janet T. 1997. Cognitive and classificatory foundations of trust and nformal institutions: a new and expanded theory of ethnic trading networks. Conference paper. Forthcoming in F. Salter (ed.) 2002. Risky Transactions: Trust, Kinship, and Ethnicity. Berghahn Books, Oxford.

Lee, Richard B. & Irven DeVore (ed.) 1968. Man the hunter. Aldine, Chicago.

Luce, Duncan R. 1992. Where does subjective expected utility fail descriptively? Journal of Risk and Uncertainty 5:5–27.

Luce, Duncan R. & Howard Raiffa. 1957. Games and decisions. Wiley, New York.

McNamara, John M. 1996. Risk-prone behaviour under rules which have evolved in a changing environment. American Zoologist 36:484–495.

Miller, George A. 1956. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychological Review 63:81–97.

Reynolds, Vernon. 1973. Ethology of social change. Pp. 467–480 in C. Renfrew (ed.) The Explanation of Culture Change: Models in Prehistory, University of Pittsburgh Press, Pittsburgh.
Savage, L.J. 1954. The foundations of statistics. Wiley, New York.
Simon, Herbert A. 1956. Rational choice and the structure of the environment. Psychological Review 63:129–138.
Simon, Herbert. A. 1987. Rationality in psychology and economics. Pp. 25–40 in R.M. Hogarth & M.W. Reder (ed.) Rational Choice: The Contrast between Economics and Psychology. University of Chicago Press.
Simon, Herbert A. 1990. A mechanism for social selection and successful altruism. Science 250:1665–1668.
Todd, Peter. 2000. The ecological rationality of mechanisms evolved to make up minds. American Behavioral Scientist 43:940–956.
Trivers, Robert L. 1971. The evolution of reciprocal altruism. Quarterly Review of Biology 46(4):35–57.
Tversky, Amos. 1969. Intransitivity of preferences. Psychological Review 76:31–48.
Tversky, Amos & Daniel Kahneman. 1981. The framing of decisions and the psychology of choice. Science 211:453–458.
Tversky, Amos & Daniel Kahneman. 1986. Rational choice and the framing of decisions. Journal of Business 59:S251–S278.
Von Neuman, John & Oskar Morgenstern. 1947. Theory of games and economic behaviour. 2nd ed. Princeton University Press, Princeton.
Wang, Xiao Tian (XT). 1996a. Domain-specific rationality in human choices: violations of utility axioms and social contexts. Cognition 60:31–63.
Wang, Xiao Tian (XT). 1996b. Framing effects: dynamics and task domains. Organizational Behavior and Human Decision Processes 68:145–157.
Wang, Xiao Tian (XT). 2002. Risk as reproductive variance. Evolution and Human Behavior 23:35–57.
Wang, Xiao Tian (XT), Frederic Simons & Serge Brédart. 2001. Social cues and verbal framing in risky choice. Journal of Behavioral Decision Making 14:1–15.