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# Peasants are *not* risk averse

## (In fact, they are risk prone)

by

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## Abstract

The goal of this paper is to bring experimental and ethnographic evidence to bear upon the common assumption that peasants are risk-averse. I show experimentally that two groups of small, subsistence-oriented farmers (the Mapuche and Sangu) are actually risk-prone decision makers in monetary gambles in both absolute terms (relative to expected value theory), and in comparison to non-Mapuche Chilean townspeople and UCLA undergraduates. Further analysis reveals that these experimentally-derived risk-preferences cannot be explained by differences in household economic/demographic variables. My work agrees with the common claim that many peasant practices, observed throughout the world, do in fact manage risk, but I argue that they are unlikely to be a product of risk-averse decision making. I suggest, instead, that these practices are likely to be culturally-evolved products of biased cultural transmission. Using data from the Mapuche, I demonstrate that risky or risk-managing practices vary, not as a consequence of wealth, land or family size, but by social/ethnic group or locale. This kind of distribution argues against risk-averse cost/benefit decision-making, and in favor of some form of biased cultural transmission. Taken together, these findings bring into question the standard conceptions of risk and risk-aversion that have many social scientists have applied to understand peasant behavior (and human behavior more generally).

"[T]he literature of risk aversion and risk preference [is] one of the richest sources of *ad hoc* assumptions concerning tastes...[N]o significant behavior has been illuminated by assumptions of differences in tastes. ... [Such theories] have been a convenient crutch to lean on when the analysis has bogged down...They give the appearance of considered judgement, yet really have only been ad hoc arguments that disguise analytical failures."—George Stigler & Gary Becker in *De Gustibus Non Est Disputandum* (1977: 89)

For decades, researchers studying small-scale, subsistence-oriented farmers, who comprise one-quarter of the world's population (Ellis 1988), have sought to explain why these 'peasants' seem slow to acquire new technologies and novel agricultural practices—not to mention a host of other behavioral practices, beliefs and ideas—from larger societies that have engulfed them. The early work on this question suggested that this cultural conservatism results from things like a rigid adherence to tradition or custom, a cognitive orientation towards a 'limited good,' or simply from ignorance and lack of education. In response, much of the subsequent debate on this issue has focused on showing how this seeming 'conservatism' actually results from quite sophisticated cost-benefit analysis in which rational individuals make "risk-averse" decisions because of their economically uncertain and precarious positions (e.g. Johnson 1971; Schluter & Mount 1976; Norman 1974; Gladwin 1979; Ortiz 1979; Netting 1993; Turner 1996). To build on this work, I have synthesized experimental field studies with standard economically-oriented ethnography to argue three things: (1) peasants are not risk-averse in any standard economic sense, (2) risk preferences and actual practices are uncorrelated with wealth, land and labor availability, and (3) therefore risk aversion cannot be used to explain 'peasant conservatism,' or any of the behavioral patterns often attributed to 'rational risk aversion.' Further, I have tentatively proposed that the actual distributions of both risky and risk-managing practices suggests that they result from some form of biased cultural transmission, rather than the standard, risk-averse, cost-benefit decision-making assumed by most peasant researchers.

My discussion proceeds as follows: I'll first present two analytical models of risk preferences that seek to more precisely capture what many peasant researchers mean when they describe behavior as "risk-averse." Second, I introduce the ethnographic field sites where the experimental and ethnographic research was performed, and I describe the methods used. Third, I present the basic experimental results. Fourth, I connect these results to the ways peasant researchers have used risk and risk aversion in order to clarify their implications. In doing this, I argue that local cultural transmission (i.e. socially learned beliefs, ideas and behaviors) matters much more than wealth—in fact wealth does not seem to matter much at all—in understanding both experimentally-derived risk preferences, and actual economic practices. In making these connections, I'll broaden, bolster and further contextualize these experimental results with field observations and ethnographic interview data. Finally, I suggest some preliminary explanations and future lines of research.

## *What researchers might mean by "risk aversion"*

In this paper, I bring evidence to bear against the common claim that peasants are "risk averse." Unfortunately, many economic anthropologists have used this term without definition, in imprecise ways, or in ways that may deviate from its standard usage in economics textbooks (Chibnik 1990). Consequently, in order to clarify exactly how my evidence addresses previous work on risk and peasants, I have delineated two categories that seek to capture, and define more precisely, the ways in which anthropologists, and peasant researchers more generally, have employed 'risk aversion.'[1] Later in the paper, I connect these conceptualizations of risk and risk aversion to my empirical findings and discuss their relevance.

### *What economists mean by 'risk aversion': decreasing marginal utility functions*

Many economic anthropologists deal with risk and risk aversion in the same way as economists. Economists have attempted to capture the concept of 'risk aversion' by formalizing the idea that as an individual gets more and more of something, she values each additional increment less and less. If I'm

[1] I have delineated these two ways because they are the most prevalent in the literature on peasants and decision-making. Elsewhere I have described two other possibilities. In the first, I present an individual learning model which incorporates a variable that captures risk-averse learning through experimentation. Researchers who conceptualize peasants as experimentalists who maintain a 'high threshold of evidence' against switching to novel practices (but still sometimes switch when the evidence is solid), might investigate this paper. In the second, I

giving you eggs, you might value the first two or three eggs quite highly (especially if you are planning breakfast), the 6th and 7th a bit less, and the 49th and 50th eggs hardly at all. Mathematically, economists describe such individuals as having concave utility functions—see Figure 1. In this approach, individuals select among alternative practices or options by computing the expected utility (the y-axis on Figure 1) associated with each option, and then picking the choice with the higher expected utility. On Figure 1, the x-axis is a quantity of wealth: like cash, sacks of grain or M & M's. The curve allows us to convert from wealth to utility, which is measured on the y-axis and represents the quantity we want to maximize. For example, suppose a farmer knows his current cropping strategy will produce a yield of 30 sacks of wheat, but he is considering an alternative 'green revolution' technology that produces 60 sacks of wheat half the time, and entirely fails the other half of the time (it yields just enough to replace the seed). What does he choose? Looking at Figure 1, we can compute the farmer's expected utility from option 1—30 sacks for sure. Starting at a wealth of 30, one can trace up to the curve and over to the corresponding Utility value, which is also about 30. Because this is a sure thing, with no chance of failure, the utility of 30 sacks equals the expected utility from this decision. Computing the *EU* (expected utility) for option 2, the green technology, is a bit more complex. The farmer determines the expected utility (*EU*) of this option in the following manner:

$$EU = U_1 \bullet PROB + U_2 \bullet (1 - PROB)$$

Where $U_1$ is the utility the farmer gets from 60 sacks of wheat, $U_2$ is the utility from zero sacks of wheat, and *PROB* is the chances of getting 60 sacks instead of zero sacks. In this example, *PROB* equals 0.50. To get $U_1$ we trace up from 60 sacks of wheat on the x-axis to the curve, and over to the corresponding Utility (*U*), which is about 50. $U_2$, the Utility of zero sacks of wheat, is zero. Substituting into the above equation gives an expected utility of 25, which is less than option 1's Utility of 30, so our farmer prefers option 1—the sure thing.

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discuss the experimental phenomena of ambiguity aversion, in which typical western subjects are *irrationally* afraid of uncertain or ambiguous choices.

This farmer is 'risk averse' because of the concave shape of his utility curve. In contrast, if he was 'risk neutral,' he would be indifferent between the two options described above, because they both produce the same expected yield (of 30 sacks). Risk neutral utility curves are straight lines. A risk prone farmer would have a convex utility curves, in which the line accelerates upward, instead of decelerating downward—so he would prefer the risky option that yields 60 sacks half the time.

*Theoretical Note about Risk Aversion and Wealth*

The common intuition that wealthier people should be *less* risk averse than poorer people *cannot* be derived from this standard economic conception of absolute risk aversion. Depending of the slope and acceleration of the concave utility function, wealthier people could be either less risk averse or *more* risk averse than poorer people. In Western populations for example, some empirical work shows that a negative exponential function may best describe people's utility functions. This implies that an individual's degree of risk aversion will remain *constant* with increasing wealth. Do peasants have a different, more concave, utility functions than westerners? Does the form of their utility function, unlike westerners, cause risk aversion to decrease as wealth increases?

The binary lottery experiments described below directly address the question of whether peasants (specifically the Mapuche and Sangu) are risk averse in the sense just described. As I'll show, these peasants cannot be described as having concave utility functions with regards to substantial sums of real money. Further, the common intuition about wealth and risk aversion seems to be wrong. In contrast to wealth, what does seem to predict risk preferences in monetary gambles is where you were raised (i.e. whether you are Mapuche, Huinca, Sangu or American). Because these experiments used cash, it is possible to escape their implications by reformulating a 'utilities theory,' in which individuals have compartmentalized utility functions for money and subsistence goods. This could allow researchers to account for this data. However, from the standard economics perspective, it's difficult to see why such compartmentalizations would exist, given that money is directly convertible into subsistence goods in these economies, and that such dis-integration would certainly be maladaptive, sub-optimal and irrational.

This gambit also begs the question of where individuals get their utility functions for money, and why they are so different from subsistence utility curves.

*Risk and Uncertainty*

Many economists (e.g. Knight 1921) and anthropologists (e.g. Chibnik 1990; Cancian 1989) have worried about the difference between risk and uncertainty (or ambiguity). Traditionally, risk involves known probabilities, like the chances of flipping a coin and getting 'heads.' Uncertainty involves situations or choices with unknown probabilities attached, like what are you chances of finding a book entitled *The Internet's Swan Song* in the library today. In the real world, even in the casinos, pure risk and absolute uncertainty are two poles of a continuum, and we are almost always somewhere in the middle of that continuum. Even in coin flipping, there's always some unknown chance that it's a trick coin, or is unbalanced due to random variation in minting quality. At the other end of the continuum, in sowing a novel seed, for example, farmers at least know how similar seeds usually perform, and what the upper and lower bounds of production are; so they are never completely uncertain. This risk-uncertainty continuum can be incorporated in the expected utility framework described above, as long as individuals compute subjective probabilities, or subjective probability distributions based on what they do know, and then use these to maximize their expected utility (Hirshliefer & Riley 1992). As you will see, my data indicate that Mapuche farmers treat risky and uncertain bets in similar ways.

*Satisficing or Safety-first: minimizing the chances of falling below a subsistence threshold*

Another way researchers use the concept of 'risk aversion' is to suggest or hypothesize that farmers, very small birds, horticulturalists and/or foragers make decisions (i.e. select among alternative actions) in order to minimize their chances of falling below some subsistence minimum—which may be culturally or biologically defined, depending on the researcher. With some plausible assumptions, we can formalize and clarify this often intuitive approach. On Figure 2, curves 1 and 2 represent the normal distributions of crop yields for two kinds of wheat (say winter and spring wheat). The symbols $\mu_1$ and $\mu_2$ stand for the average yields of these two varieties, while *R* represents the minimum amount of wheat harvest needed to avoid catastrophic consequences like starvation, the death of a child, the loss of land, etc. Rather than maximizing their average yield, which would cause them to sow crop 2, risk-averse farmers would prefer crop 1, because, although its average yield is less than crop 2 ($\mu_1 < (_2$), the probability that one falls below the catastrophic threshold—*R*—is less for crop 1 than crop 2. To see this graphically, look at the area under each curve to the left side of *R*. That area equals the probability of falling below *R*, and suffering the catastrophic consequences.[2]

This conceptualization may capture what many researchers mean when they say peasant farmers are 'risk averse.' That is, they mean peasant farmers cannot adopt a new type of seed, planting practice or fertilizer (for example) which they know may raise their average yields (and perhaps their profits) because new practices have, either objectively or subjectively, a substantial variance in performance. Any new technique or practice, even if its long-term variance is small, will often have a high variance at start-up because such novelties often require experience and/or experimentation. During this period the farmer must refine his skills and understanding of the new practice in adapting it to the particulars of the local situation. From this perspective, given the economically precarious situation of many peasants, farmers might, quite sensibly, prefer tried-and-true practices—that consistently keep them above their minimum threshold—over new practices with greater variation. This all makes sense, but is it a good model for peasant behavior?

The experimental and ethnographic evidence that I present here does address this approach, but not as directly as the previous approach. We can derive the following predictions from the above safety-first model. The above model predicts that all households above *R* (i.e. families that expect to meet their 'subsistence minimum') should be risk-averse, while household below *R* should be risk prone. Individuals should apply this same reasoning to land sharing and exchanges of land-for-labor. Appendix A derives the variances for three land-for-labor exchanges: fixed rents, sharecropping and wage labor. This model assumes that market forces have equalized the expected returns for each arrangement, so the only thing

[2] This conceptualization is common in both behavioral ecology in the analysis of risk-sensitive foraging (see Stephens & Krebs 1986) and in economics for the analysis of capital asset markets and portfolio composition (see Nicholson 1995) Also see Roumasset (1976) for a discussion directly related to farming risk. Note that this

that matters is the variance. Land-poor individuals (who want to work another's land) who expect to fall below their basic subsistence needs (*R*) should prefer fixed tenancy/rent agreements (the risky option), while those who expect to surpass their basic subsistence threshold should prefer either wage labor situations or sharecropping (the risk averse options). Land-rich individuals (those with land who need labor) who expect to surpass their threshold should prefer tenancy/renting—by renting their land at a fixed cost they can entirely avert the inherent production risk in farming[3]. Therefore, in most situations when most households expect to exceed their minimum threshold, land-rich and land-poor farmers will have conflicting objectives. The economically-minded might then propose that a series of different land-for-labor contractual arrangements will emerge that depend on the relative bargaining power of the two households involved (Ellis 1988). As you will see, this speckled pattern clearly does not fit the Mapuche data, nor the data from farmers in Illinois (Young & Burke 1998).

### Ethnographic context: the Mapuche, Huinca and Sangu

Before digging into the research methodology and results, I provide a brief ethnographic sketch of three of the cultural groups discussed. Although this inquiry focuses primarily on the Mapuche of southern Chile, I feel it is also important to briefly describe two other groups that are used as points of comparison. One of the groups, the Huinca, are non-Mapuche townspeople who inhabit the small town adjacent to the farming communities in which the Mapuche research was performed—so they provide a controlled comparison for the Mapuche data. The other group, the Sangu, are corn farmers and cattle herders in southern Tanzania. It is assumed that the reader is sufficiently familiar with the lifeways of the fourth group, UCLA undergraduates, that no ethnographic description is warranted.

approach can be made formally identical to the utility maximization approach, but doing this would dilute my effort to clarify typical approaches to risk among peasants.

[3] Of course, this assumes both a world where wages are usually paid and contracts are mostly enforced, and a world in which market forces have acted on the price of labor and land-rent to equalize the expected net returns from all three forms of land-for-labor exchanges.

*The Mapuche of Southern Chile*

This description of the Mapuche derives from my work in the farming communities of Carrarreñi, Cautinche and Huentelar, around the rural town of Chol-Chol.[4] In this cool, wet Mediterranean climate (similar to San Francisco), the Mapuche live in widely scattered farming households that range in size from two to 38 hectares, with an average size of around nine hectares. All households practice a form of 3-field cereal agriculture using steel plows and 2-oxen teams. Most harvest and subsist primarily on wheat (consumed in the form of bread), but many also produce oats—which are used only as animal feed. Households supplement their diets with seasonably-available vegetables (e.g. tomatoes, onions, garlic and chilies), legumes (e.g. peas, lentils and beans) and livestock (chickens, cows, horses, sheep and pigs), as well as some store-bought foods (e.g. salt, sugar, rice, noodles). Cash income to buy these foods and other goods such as cooking oil, chemical fertilizers and school supplies derives from a number of other sources, including (listed in decreasing degree of importance): selling livestock (mostly cows and pigs), selling lumber (fast-growing pines and eucalyptus trees), performing part-time wage labor and selling cottage crafts (often traditional Mapuche clothing).

These Mapuche households are quite socially and economically independent. Although goods are still frequently exchanged between neighboring households (who are almost always recognized as kin in some fashion), these are usually straight cash-for-goods transactions, though 'interest-free credit' is readily extended (one can pay later). People buy meat, vegetable seeds and homemade wine (*pulco*) from one-another. Labor is most commonly exchanged in reciprocal fashion between friends and relatives (*mano vuelto*). Group labor parties or *mingacos*, traditionally used during planting and harvesting, have become quite rare, except among elderly households. Land is rarely bought or sold (and it's now illegal for a Mapuche to sell his land to a non-Mapuche). However, many land-poor households sharecrop on the land of neighboring Mapuches—land is never rented. Sharecroppers receive access to one or two hectares

[4] More generally, the Mapuche are a growing ethnic/indigenous group of approximately 1,000,000 people (about 10% of the Chilean population). In the last 50 years, this population has been increasingly expanding out of the rural regions of central Chile into urban centers throughout Chile (Bengoa 1997: 11).

of land for one year in exchange for 50% of the yield. If chemical fertilizers or other inputs are employed, their costs are split 50/50.[5]

Just as they are in many places, productive activities are governed by the yearly agricultural cycle. Mapuche plant wheat at the end of fall (late May, early June), just after the rains begin. Winters are wet and cold. Mud and rain makes travel difficult and most families remain indoors during much of June, July and August. As the rain slows at the end of August and early September, agricultural work re-commences as thinning oxen are yoked and hitched to steel plows in order to turn pasture into fallow—in preparation for sowing during the following May. The Mapuche traditionally call spring (late October and November) the "hunger season," because it is during this time when supplies of wheat run short and animals are too thin to be of much value. In late spring (late November and December), vegetables and potatoes are planted in small garden patches located in wetter low-lying areas, near wells. By January, the long, dry summer has arrived, and everyone looks forward to the harvest, relaxation and lots of fresh foods (the end of January, and February). After the harvest, in March and April, many folks burn the wheat's stubble and plow it under in preparation for sowing oats, pasture grasses or the natural processes of field succession.

[5] It turns out that both the sharecropper and landowner must agree on the inputs to be used. During my fieldwork I encountered two cases in which one of the sharecropping pair refused to put up the money for fertilizer (one time it was the landowner, and the other time it was the sharecropper). The decision to use or not use fertilizer was not made prior to the informal exchange contract, so by the time the disagreement about fertilizer use arose, the sharecropper had already put substantial amounts of labor into preparing the land. These disagreements caused both bad feelings between the sharecroppers, and much community gossip.

*The Huinca of Southern Chile*

The Mapuche commonly use the term Huinca (pronounced "Winka") to refer to the non-Mapuche Chileans who inhabit the lands and towns that surround them. I have adopted this term to distinguish the Mapuche from the non-Mapuche inhabitants of the town of Chol-Chol. I used the Huinca as a comparative group to control for the influences of the regional economy and local environment. All the Huinca used in this study grew up in the small, rural town of Chol-Chol. Most work in low or minimum wage labor jobs, often in temporary construction jobs, on road crews, or as well-diggers and painters. A few were older high school students or "pre-university" students (although no one was younger than 17 years). Although the Huinca and Mapuche have intermixed, interacted, inter-married and interbred for hundreds of years, the Huinca/Mapuche distinction remains quite salient throughout this region. Everyone knows and agrees on who is a Huinca and who is a Mapuche.[6]

*The Sangu of Tanzania*

The Sangu are polygamous, patriarchal, patrilocal, agropastorists in southern Tanzania. In small, sedentary agricultural communities Sangu farmers grow corn (some rice) and raise cattle and chickens on an average parcel size of one acre for an average family of six people. Cattle are the primary measure of wealth, though some farmers do sell rice (which they then use to buy corn). Until recently, the Sangu have had little market contact, but now Sangu use the market to sell grain and buy most living and farming supplies. In many ways Sangu herders appear quite similar to their farmer brethren, though wealthy herders maintain a transhumanent settlement pattern, and all herders have more restricted market access than farmers do.

## Experimental Methodology

In this section I present the methodology for two different binary-choice lottery experiments that were performed among Mapuche farmers, Huinca townspeople, Sangu farmers and UCLA undergraduates. Each of these experiments were designed to measure risk aversion in the standard

[6] Individuals with mixed parents are, somewhat pejoratively, called *champoria*—a Mapuche word meaning 'mixed,' though this context best translated as 'half-breed.'

economic sense that I described above. I administered the first experiment, hereafter called the *Titration experiment*, to both Mapuche farmers and Huinca townspeople. I performed the second experiment, called the *Variance experiment*, with Mapuche farmers and UCLA undergraduates. Richard McElreath replicated my V*ariance Experiment* with the Sangu of Tanzania.

*The Titration Experiment*

The Titration Experiment is designed to compute the certainty equivalent or the indifference point for a risky option. By asking participants to chose between a series of binary choices involving some sure amount of money (option A) and a fixed risky bet (option B), one can home in on the approximate point at which the participant becomes indifferent between a fixed amount of money and a risky bet—thereby assigning a value to the risky option. Risk-neutral expected value theory predicts (or recommends) that this certainty equivalent will be the expected value of the risky bet. So, if the risky bet is 50% chance at 2000 pesos (and 50% at zero pesos), then people should be indifferent between 1000 pesos with certainty and the risky 2000 peso gamble. From this perspective, risk averse individuals will prefer the 1000 pesos option over the 2000 pesos gamble, and will not become indifferent between the options until the guaranteed amount is less than 1000. Their degree of risk aversion depends on how far below 1000 they will go until they switch to preferring the 2000 pesos gamble. In contrast, risk prone people will prefer the risky bet and do not become indifferent until the sure-bet reaches above 1000 pesos (higher than the expected value of the risky bet). The point above 1000 pesos at which they switch to preferring the sure thing determines their indifference point—and their risk preference. Economists and psychologists have performed many experiments of this type among typical western participants (i.e. university undergraduates) and generally found them to be moderately risk averse.

I performed the *Titration Experiment* with 26 Mapuche farmers and 25 Huinca townspeople. For standardization purposes, I used a Spanish-language version of the form shown in Figure 3.[7] In all these experiments, I followed the same basic script. First, if I had not previously worked with the person, I was introduced by a friend or neighbor of the participant. I explained that I was administering an "economics experiment." Because I had been working with, interviewing and/or interacting with all of the Mapuche participants for several months prior to administering this experiment, introductions were mostly unnecessary, and few people asked much about the experiment. For many of the Huinca participants, this brief introduction was necessary because I did not know them, or had only a passing familiarity with them. Second, I explained the game using the form (Figure 3) as a visual aid. I emphasized that all the rounds are independent: what happens in the first round does not affect the second round; what happens in the second round does not influence the third round. I further explained that participants would first make all their choices in the three rounds, and then at the end, we would 'play' any risky choices (i.e. flip the coin) and I would pay them the total amount earned in all three rounds. I also showed the participants an envelope full of cash and coins, and assured them that all winnings would be paid in full right after the game.

I explained round 1 as follows (this is translated nearly verbatim):

> In round 1 you have to choose between option A and option B [I pointed to each]. Option A is 1000 *pesos* for sure. I simply pay you 1000 *pesos* in option A. In option B, you have a 50% chance at 2000 *pesos*, but you may lose and receive nothing. If you pick option B, you will flip a coin. If the coin comes up "heads" you get 2000 *pesos*, but if tails comes up you get nothing. If you pick option A, you get 1000 *pesos*—no coin flipping. If you pick option B, you flip the coin—'heads' you get 2000 *pesos* and 'tails' you get zero *pesos*.

Then, I asked if the participant had any questions. If they did not, I would then ask them three test questions: (1) "if you pick option A, how many *pesos* do you get?" (2) "if you pick option B and tails comes up, how many *pesos* do you receive?" and (3) "if you pick option B and heads comes up, how many *pesos* do you receive?" If the participant answered all three questions correctly, I would then ask them which option they pick, A or B. If they did not answer correctly, I re-explained the game, and we would try again. Most people understood the game fairly easily and got all the questions right the first time. A few older Mapuche never got the correct answers, and I eventually had to give up.

[7] Although I used a written version of the game, it did not matter if subjects could read Spanish. I explained the entire game verbally and used the sheets only to remind subjects of the numerical values involved—all participants seemed to understand the numbers.

If the participant picked the risky bet (option B) in the first round, I would 'sweeten' option A by increasing it from the 1000 *pesos* in round 1 to 1500—which I would write down in the blank next to round 2 (see Figure 3). If the participant picked the safe bet (option A) in round 1, I would 'sour' option A and put "500" in the blank space in round 2. The idea being to either sweeten or sour the safe bet until the participant switches from the risky to the safe bet, or from the safe to the risky bet. Round 2 was administered much like round 1. If the participant picked the risky bet on round 2, I would increase the value of the safe bet by 300 *pesos* in round 3, by writing down either "1800" or "800," depending on the participants previously choices. If the participant picked the safe bet on round 2, I would decrease the value of option A to either 1500 or 300 *pesos*—again depending on their previous choices.[8]

Indifference points were recorded as the amount halfway between the sure bet in round 3 and the nearest known decision point. For example, if a participant picked "A" in round 1, round 2 becomes a choice between 500 *pesos* for sure and 2000 with a 50% chance. If the participant then picks "B," round 3 becomes a choice between 800 *pesos* for sure or 2000 *pesos* with a 50% chance. If the participant then picks "B" again, the indifference point is recorded as 900 *pesos* (he picked "A" when it was 1000 and "B" when it was 800 *pesos*). Also note that participants who picked BBB were recorded as 1900, and participants who picked AAA were recorded as 150. After round 3 was complete, the participant flipped the coin for any risky bets and I paid them the total amount owed. After this, I interviewed each participant about why they made particular choices.

*The Variance Experiment*

The basic structure of the *Variance Experiment* is very similar to the *Titration Experiment*. My goal was to gather data on how changing the variation in outcomes affects people's economic decisions, when the expected value of the options remains the same. Figure 4 depicts one of the two forms used to play the game, which I administered to both Mapuche (41 participants) and UCLA undergraduates (20

[8] If subjects could have foreseen what I was doing with the bets, they might have calculated that the best strategy is to pick BAA (which gives the highest expected payoff). However, it's very difficult to see how subjects could have deduced this apriori, even if they had talked among themselves. It was also clear from the subject's actual behavior that no one figured this out.

participants). The expected value (average return) of both options in all four rounds is the same (1000 *pesos* for Mapuche and $15 for UCLA undergraduates), except in round 4b, where the chances of winning were unknown. What does change from round to round is the probability of winning and the amount won in option B (i.e. the variance), not the expected return.

I administered round 1 of this game in the same way as round 1 of the *Titration Experiment*, except that we played risky bets right away (rather than waiting until the end) and I paid players after each round. For the 50% bet, I used the same coin-flipping method as in the titration experiment, but for the other gambles participants had to pick a white card out of a hat. For the 20% and 80% gambles, I used the same five cards, four with 'X's' and one with a 'Z'. In the 20% case, if the participant picked the 'Z' out of the hat, she received 5000 *pesos* (or $75 for UCLA students). If she chose an 'X,' she got zero *pesos*. In the 80% case, if the player chose one of the four 'Xs,' he received the 1,250 *pesos* (or $18.75), but if she chose the 'Z,' she received nothing. For the 5% gamble, 19 blank cards were counted out, one 'X card' was mixed in, and the whole pile was put into the hat. If the player chose a blank card she receive no money. If she picked the 'X,' she got 20,000 *pesos* (or $300).

In some versions of the game, instead of being 1000 *pesos* or 20,000 with a 5% chance, round 4 was 1000 or 5000 with an *unknown* chance. For this game, I removed small stack of cards from my knapsack and told the participant that the stack contains some blank cards and some "Xs." I would explain that: "if you pick an 'X' you get 5,000 *pesos*; if you pick a 'blank,' you receive zero *pesos*; but, you do not known how many 'X's there are nor how many 'blanks' there are in this stack." Players would then pick either option A or B. I did not perform this round (4b) at UCLA.

As a method of controlling for the order of presentation of the different gambles, I also performed a number of games among the Mapuche using another form in which the first three gambles were presented 80%, 50%, 20%, instead of the 50%, 20%, 80% shown in Figure 4. Round 4 or 4b was always presented last. I administered only the version shown in Figure 4 to UCLA undergraduates.

In the UCLA control experiment, I calculated the stake size or the expected value of the gambles by comparing the marginal value of Mapuche wage labor to that of UCLA undergraduates. 1000 pesos is one-third of a days pay for a Mapuche (farmers sometimes work on local, large-scale plantations), and $15 is about one-third of a days pay for a typical undergraduate job (working at the University, for example), after social security and taxes are accounted for. To give you a feel for the buying power of 1000 *pesos*, one large beer costs 250 *pesos*, one sack of nitrogen fertilizer costs 12,000 *pesos* (and covers about one-half hectare), and a bus ride to Temuco (the closest urban center) costs 200 *pesos*.

In McElreath's work among the Sangu of Tanzania, he used the same procedure, except for two things. One, he did not use forms, he simply explained the game verbally, though he always presented the gambles in the order shown in Figure 4. And two, he used two cards to generate probabilities in the 50/50 gambles rather than flipping a coin.[9] He also matched the stake size I used, using the same means of calculation that I described above.

### *Experiments show that Mapuche farmers are not risk averse*

Figure 5 shows a histogram of the results for the *Titration Experiments*. The horizontal axis gives the eight possible indifference points between zero and 2000 *pesos*. The vertical axis is the frequency of individuals who arrived at each indifference point. Comparing Mapuche farmers and their Huinca neighbors clearly shows that Mapuche are substantially more risk-prone than the risk-averse Huinca. The expected value of a 50% chance at 2000 *pesos* (and a 50% chance at zero pesos) is 1000 *pesos*—that is risk neutral. Most Mapuche indifference points are well above this point, although a few Mapuche are quite risk averse. The mean indifference point for the Mapuche is 1400 *pesos* (with standard deviation of 474). This means that, on average, Mapuche farmers are indifferent between 1400 *pesos* and a 50% chance at 2000 *pesos*. In contrast, over 80% of Huinca indifference points are below 1000 *pesos* and therefore risk-averse. The mean indifference point for the Huinca is 790 *pesos* (with standard deviation of 354)—comparable data from economics suggests this is about what we'd get from U.S. populations. Comparing the Mapuche and Huinca data using the Mann-Whitney non-parametric test yields a *p*-value less than 0.0001 (t-tests yield similar results).

For the *Variance Experiment*, Figure 6 shows the frequency of risky bets (option B) for each of the five possible gambles in three different groups: the Mapuche, UCLA undergraduates and the Sangu of Tanzania. The graph reveals substantial behavioral differences for the highest variance gambles: 20% and 5%. Given a choice between 1000 *pesos* for sure or 5,000 *pesos* with a 20% chances, 78% of Mapuche prefer the risky option, while only 20% of Americans take the risky gamble ($p$ = 5.07E-08). For the highest variance gamble, 67% of Mapuche prefer the risky bet, while only 20% of Americans went for the big money ($p$ = 6.22E-06). For the lowest variance bet, with an 80% chance of winning, Mapuche were still significantly more risk prone than Americans, who are approximately risk neutral. Over 80% of Mapuche prefer the risky bet on this one, while only 55% of Americans go for it ($p$ = 0.076) [10]. Sangu risk preferences are generally quite similar to the Mapuche.

The most puzzling outcome of these experiments is the UCLA students' strong preference for the risky bet, when the chances are 50/50. This preference strongly deviates from their preferences on both sides of the 50/50 gamble (80% and 20%) and parallels the preferences shown by the otherwise risk-prone Mapuche and Sangu. Eighty percent of Americans, 73% of Mapuche, and 75% of Sangu took the risky bet on this one. This strong preference of Americans for the 50/50 gamble replicates previous findings in similar laboratory research. Among American University students, both Edwards (1953) and Coombs & Pruitt (1960) found that 50/50 gambles were selected much more frequently than similar gambles on both sides of 50/50. Coombs & Pruitt (p.273) suggest that perhaps subjects preferred the 50/50 bets more because, "they are regarded as 'fair bets,' and perhaps because they are simpler bets, more easily comprehended than some of the others." My post-game interviews and observations concur, in part, with their suggestion. When I asked why they picked the risky bet on the 50/50 gamble, UCLA subjects often responded with something like, "50/50 is a good chance" or in some cases that they preferred coin

[9] I plan to run an experiment with UCLA students to see if this coin vs. cards makes any significant difference in their responses.

[10] These $p$-values are cumulative binomial probabilities that give the chances of picking the UCLA sample (or one with fewer risky picks) via a random draw from a distribution matching the combined Mapuche and UCLA samples.

flipping to card picking, which indicates that there was something that they particularly liked about this gamble. In contrast to the suggestion of Coombs & Pruitt, understanding the bets did not seem to be a problem, and this supposed lack of understanding certainly could not explain the general pattern of the Sangu or Mapuche. Non-Americans don't seem to show this particular obsession with 50/50 chances. For example, an analysis of only round 1 (the 50/50 gamble) from the Huinca's Titration data reveals that only 16% of the Huinca (4/25) picked the risky bet. This is quite consistent with the Huinca's generally risk-averse behavior in the *Titration Game*, but is also consistent with the pattern of risk aversion shown by Americans in the *Variance Game* for the gambles of 20% and 5%. Similarly, Mapuche and Sangu do not show any particular favoritism toward the 50/50 gamble, although any particular preference would be difficult to detect, given that they favor all of the risky gambles.

The Sangu results also provide a number of interesting puzzles,[11] but for our purposes what they confirm is that another group of small scale, partially market-integrated, culturally-distinct people (living on another continent) behave quite similarly to the Mapuche, and quite differently from UCLA students. Later in this section, I will break-out the male farmers from the rest of the Sangu data (which includes male and female farmers and herders) to show that this does not substantially alter the basic results, though it does add some interesting nuances.

The final bar on the far right of the Figure 6 shows the frequency of Mapuche farmers picking the risky bet when they faced a choice between 1000 *pesos* for certain, or 5000 pesos with an unknown chance of winning. As I mentioned earlier, I always played this game last, after the other three games were complete. The result, in contrast to the ambiguity aversion found among typical western subjects (Camerer & Weber 1992) indicates that the Mapuche prefer this uncertain option over the certain option with about the same frequency as they preferred the other risky gambles. Perhaps westerners learn to fear both uncertainty and risk in dealing with money more than the Mapuche.

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If the UCLA samples are compared to the distribution matching the Mapuche only, then the *p*-values for the 80%, 20% and 5% bets are 0.0084, 5.78E-08, and 6.22E-05, respectively.

For the remainder of this section, I address five questions about this experimental data: 1) Can the observed difference in risk preferences between the groups be explained by the different proportions of males and females found in the samples? 2) Does the order of presentation of the different gambles matter in the Variance Experiment? 3) Do people look further down the form and adjust their choices according to what they see? 4) Do people change their answers in the later rounds because of wins or losses in the earlier rounds (i.e. are the rounds independent)? And, 5) Did people understand the games? In the next section, I focus on the implications of these results for understanding peasant behavior in terms of the different ways researchers have used 'risk aversion'.

***1) Can the difference in risk preferences between the groups be explained by the different proportions of males and females found in the samples?*** No. Because my research among the Mapuche focused primarily on household economic behavior, I administered the V*ariance Experiment* to heads-of-household. There were 36 male heads-of-household and only five female heads. These five females performed quite similarly to the males, but of course, there are only five. Compiling all the choices from all four possible bets, Mapuche males (36 people and 144 choices) picked the risky bet 73% of the time, while Mapuche females (5 people and 20 choices) took the risky bet 90% of the time. The addition of the females to the males sample moves the average from 73% to 75%. Males and females are not significantly different, although females tended to be more *risk-prone* than males.

Among UCLA students, 14 males and 6 females revealed quite similar behavior in the *Variance Game*. Table 1 summarizes the results for males and females across the different gambles. I do this for the UCLA sample and not the Mapuche sample because, unlike Mapuche, the behavior of UCLA students varied greatly with the amount of risk or variance in a gamble. Table 1 shows that UCLA males and females, like Mapuche males and females, behave quite similarly. In both samples the females make the group average slightly more risk-prone. This means that if the difference between the groups was driven by the differences in female/male ratio, then the group with more females should be more risk-prone. In

[11] For example, Sangu herders are more risk-prone than Sangu farmers because herder females are much more risk-prone than risk-neutral female farmers (males in both groups possess nearly the same degree of risk proneness). See

contrast, the UCLA sample, which has a higher female/male ratio than the Mapuche sample, is much more risk-averse. Consequently, if the difference in sex ratio between the samples affects the results at all, it makes the two groups seem more similar.

The within-group analysis of the Mapuche and Huinca titration data further indicates that the small differences in the sex ratio used in the two samples does not seriously influence the large differences observed between the Mapuche and the Huinca. Table 2 summarizes the breakdown. The Mapuche *Titration Experiment* used 22 males and 4 females. There was no significant difference between them, though the females tended to be more risk-prone than males (again). Similarly, the Huinca sample consisted of 18 males and 7 females, and also shows no significant difference—although here females tend to be more risk-averse than the Huinca males. Removing the females entirely from both samples still reveals a substantial difference in the mean indifference points for each group. The point here is not to argue that the sex of the participant is unimportant, but only to claim that the differences in the sex ratios used in the experiments cannot explain the observed differences between the groups. This analysis further indicates that cultural differences between groups with regards to risk preferences can be much larger than differences between the sexes within a group.

Experimental work done by Binswanger (1980) using similar monetary gambles among peasant farmers in India further confirms that sex is not an important explanatory variable. In this work, participants have to pick a gamble to 'play' from a series of possibilities that differ in their expected returns and variances. Essentially, participants had to trade-off higher variance outcomes against gambles with higher expected returns. Participants were paid in real money, and the stakes ranged from one-seventh of a days wage to 14 days wage. Using this approach, Binswanger found that males and females have quite similar risk preferences, once educational level is controlled for.

The Sangu show some interesting sex differences. Among Sangu farmers, females were significantly more risk-averse than male farmers. Yet among Sangu herders, both males and females remain risk-prone. If we extract only the male farmers from the Sangu data, and compare them against the

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Henrich & McElreath (1998).

Mapuche and UCLA data (where I have already shown that females do not significantly alter the results), we get Figure 7, which is quite similar to Figure 4. Male Sangu farmers are slightly more risk prone than the overall Sangu result, except in the low variance bet (80% chance of winning), where they drop down to the nearly risk-neutral position of UCLA students. More details on this sex difference among Sangu can be found in Henrich & McElreath (1998).

***(2) Does the order of presentation of the differentgambles matter in the Variance Experiment?*** No. In the Mapuche *Variance Experiment,* I performed two versions of the game. With 28 participants I administered a version with the following sequence of winning chances 50, 20, 80 on the first three rounds. Of these 28 games, 17 ended with the unknown gamble ('4b' in Figure 2), while the rest ended with the 20,000 gamble ('4' in Figure 2). With the other 12 participants, I did a different version in which the order of the first three gambles was 80, 50, 20. All 12 of these ended with the unknown bet. Table 3, below, shows the frequencies and *p*-values of $X^2$ comparisons in which individuals took the risky bets on each of the versions. All of the means appear quite close and none approach typical significance levels—although a power analysis indicates that with sample sizes of only 12 and 28 statistical analysis won't become weakly significant ($p < 0.10$) until the difference between the two samples exceeds approximately 0.21. That is, the order may matter, but it's effect is less than 0.21, which is small relative to the cultural differences observed between groups (which is about 0.6).

***(3) Do people look further down the form and adjust their choices according to what they see?*** Not much. Both the *Titration Experiment* and *Variance Experiment* (50-20-80 version) began with the 50/50 bet for 2000 *pesos* or a certain 1000 *pesos*. In the *Variance Game*, participants may have glanced down the form, saw the other gambles, and altered their behavior with some inferences about what was to come. In contrast, Titration participants might have also looked down the form, but all they saw would have been incomplete gambles with blank lines (see the methodology section). If this 'glancing down' is important, we should expect the choices made in the first 50/50 bet in the *Titration* and *Variance Games* to be different. Instead, the frequency of risky bets is quite similar in the two games: *Variance Game* participants selected the risky option 73% of time ($n = 41$), while titrators picked it 80% of the time ($n = 26$; $p = 0.38$[12]).

***(4) Do people change their answers in the later rounds because of wins or losses in the earlier rounds (i.e. are the rounds independent)?*** Table 4 addresses this question with a series of conditional probabilities calculated from the *Variance Game* data for both the Mapuche and UCLA experiments. Each frequency represents the fraction of times a participant took the risky bet given the following three (all-encompassing) conditions: (1) they had picked the safe bet on the previous round (obviously the first round was not included in this analysis), (2) they had picked the risky bet and won the gamble on the previous round, and (3) they had picked the risky gamble and lost on the previous round.

Looking at the Mapuche, it's clear that what happened on the previous round did not affect their decisions on the current round. The chances of picking the risky bet are quite similar in all three conditionals. If a Mapuche lost the previous gamble, his chance of picking the risky option is 75%, while if he won his chance is 78%. At UCLA, having won or lost the previous gamble also does not significantly influence one's chance of taking the risky bet, although having taken the safe bet in the previous round doubles one's chances of taking the risky bet on the current round ($p = 0.04$). UCLA choices are independent of winning and losing on the previous round, but students seem to like to 'mix' things up in choosing A or B.

***(5) Did people understand the games?*** Both hypothetical test questions and interviews indicate that the Mapuche, Huinca and UCLA students all understood the games. As I mentioned earlier, everyone had to answer the three test questions before playing each round. Most people got these correct right away. The few people who were never able to answer correctly were not permitted to participate. In the post-game interviews, for the both the Mapuche and Huinca, I asked questions such as "in which round would you have the best chance of winning if you picked option B" or "in round 2, are you more likely to win or lose if you pick option B." Participants answers were mostly correct, and indicated that everyone had a

[12] This $p$-value is based on comparing the titration sample to the overall cumulative binomial probability created by combining the samples.

qualitatively accurate understanding of the game. People, for example, definitely knew that the chances of picking one card out of five were less than the chances of getting 'heads' with the coin.

## Discussion

In this section, I discuss how these results affect standard conceptions of risk aversion among peasants (and everyone else). To accomplish this, I will refer back to my earlier efforts to clarify what scholars mean when they say some group of individuals are 'risk averse.' According to the standard economics conception of risk aversion as decreasing marginal utility, neither the Mapuche, nor the Sangu, are risk averse—in fact they are both quite risk prone. Concave utility functions predict that an individual's indifference point should be below the expected value of the gamble, while convex utility functions produce indifference points above the expected value of the gamble. In the Chilean *Titration Experiments*, the expected value of the gambles was always 1000 pesos. Town-dwelling Huinca revealed an average indifference point of 790 *pesos*—risk aversion and just where economists would expect to find typical western subjects. In contrast, Mapuche participants have a mean indifference point of 1400 *pesos*—quite risk prone, and well above the Huinca's point. Once again, the Huinca, a market-dependent group like UCLA students, behave in ways at least consistent with concave utility, while Mapuche and Sangu behave in a manner that is clearly inconsistent with concave utility functions.

In the *Variance Game*, Mapuche farmers consistently preferred the risky options for all levels of risk or outcomes variance. This behavior contrasts with UCLA students, who showed a distinct movement from risk neutral or somewhat risk prone preference in the low variance gambles to high levels of risk aversion in high variance gambles—with the exception of their strong risk proneness in the 50/50 gamble. Accepting this, UCLA students reveal the general trend predicted by concave utility functions, whereas both Mapuche and Sangu reveal no risk aversion and no systematic response to gamble variance. Even if we assume Mapuche and Sangu have convex—risk prone—utility curves, we would still be unable to explain the *irrelevance* of outcome variation to individual choices in these groups. Thus, the standard economic approach to risk cannot account for these data.

*Does wealth affect risk preferences?*

Although utility maximization under concave utility functions does not make any predictions about the effect of wealth on risk preferences without further specification of the shape of the utility curve, many economists and anthropologists have the intuition that wealthier individuals should be more risk-prone. If wealth were an important variable, then one might endeavor to explain the risk-preference differences between these groups as a consequence of their average differences in wealth. Without any further analysis, the intuition that wealthier groups should be more risk prone is clearly not supported. To the contrary, if we compare the Mapuche and the Sangu with UCLA students, the poorer groups are substantially more risk prone than richer American university students. Additionally, UCLA students and Huinca townspeople are both risk-averse, but the Huinca are much poorer than UCLA students. Comparing the relative wealth of the Huinca and Mapuche is difficult because the Mapuche have lower social status and less cash on hand than the Huinca, but the Mapuche have more total wealth stored in land an animals than the wage-laboring Huinca. If land and animals can be converted into cash (which they can, but not that easily or quickly), the Mapuche are wealthier than the Huinca. Emically, the Mapuche and Huinca both consider the Mapuche to be poorer and of lower social status.

Analyzing the explanatory power of different wealth measures within the different groups further demonstrates that wealth, in any form, does not substantially influence risk-preferences (in these games). Using the Titration data, Table 5 shows correlations (and *p*-values) between a series of demographic/economic variables and indifferences points. None of the variables show any significant correlation with indifference, except the number of oxen a farmer owns. Mapuche farmers own between zero and four oxen, but most own exactly two. This may be important, as oxen are the primary work animal (pulling both plows and carts), but an analysis of the *Variance Game* data in Table 6 shows this may be a statistical fluke, as this data does not replicate the oxen effect. Note specifically for the Huinca, that neither income nor family size has any impact on risk preferences. I also made several efforts to generate composite wealth variables, in which the total *peso*-value of land and animals is summed up, however none of these produced a strong (i.e. significant) correlation with indifference points. In the final row of Table 5, aggregate animal wealth is the total *pesos*-value of wealth held in cows, oxen, pigs and sheep (based on the market value of each animal during the research).

Table 6 divides all the Mapuche's *Variance Game* data, regardless of the chances of winning the gamble, into risk-averse choices (A) and risk-prone choices (B) in order to show that average economic/demographic variables remain nearly identical for these two categories. None of the variables reveal any significant effects. Note that the average number of oxen owned by farmers is not different between choosers of option A and B.

Several other experimental studies of risk among peasants confirms the finding that wealth does *not* influence risk preferences in any fashion. In summarizing work done by five different researchers in India (Binswanger 1980), the Philippines (Sillers 1980), El Salvador (Walker 1980) and Thailand (Grisley 1980), Binswanger & Sillers (1983:9) write:

> In each of the cases where regression analysis was applied to determine the impact of household characteristics on risk aversion, neither wealth nor income had a significant effect on observed choices, despite large differences in the household wealth of respondents.

Binswanger (1980) also found that tenant farmers were more risk-prone than land-owners—not vice-versa as some might intuit.

Because these experiments were designed to specifically address the standard economic conceptualization of risk, they do not confront the satisficing or safety-first approach (described earlier) as directly. However, I argue the general predictions of the satisficing model are not supported. This model predicts that individuals above some minimum 'subsistence' threshold *R* (see Figure 2) should behave risk aversely. If *R* is some biologically defined minimum level of subsistence, then all four groups described in this paper are well above *R*. No one was starving, or seemed concerned that they would not be able to obtain sufficient food in the coming year. Many Mapuche, for example, maintain a healthy store of body fat throughout the year. If this is the case, then the Mapuche and Sangu violate the risk-averse prediction of the safety-first model, while the Huinca and UCLA students remain consistent with it. If any group runs the risk of falling beneath *R*, its the risk-averse Huinca. If instead, *R* is defined by some mean wealth level that cross-cuts the local population (perhaps learned through experience or acquired culturally), then risk preferences within groups should be predicted by some measure of individual wealth. However, as we just saw in Tables 6 and 7, wealth does not predict risk behavior at all. It's difficult to see how either of these two approaches to risk make any sense out of these robust results.

*Explanations and Ethnographic Support*

These experiments clearly indicate that the Mapuche, Sangu, and probably peasants more generally, are not risk-averse in any general economic sense. But how can we interpret these data, given that so much research has argued that peasant practices effectively reduce risk? At least three possible explanations for these data remain. *Possibility 1*: peasant economic practices, like their experimental risk preferences, are actually not risk averse. *Possibility 2*: peasants are risk-averse decision-makers in most economic/agricultural domains, but for some unknown reason they are risk-prone in these gambles (gambles which involve substantial sums of money that could be used for food, fertilizer and seed). *Possibility 3*: their practices do effectively manage risk and are well-adapted to their economic situation, but do not result from individuals doing risk-averse cost-benefit analysis, nor cost-benefit decision-making of any kind. Instead, such peasant practices and farming rules-of-thumb may have evolved culturally through a gradual process of *prestige-biased cultural transmission* or some other form of biased cultural transmission.

I won't spend much time on *Possibility 1*, because my own experience with the Mapuche and the work of many other researchers indicates that a great deal of peasant economic behavior is adaptive and does manage risk. Practices such as intercropping, crop diversification (relying on several different types of crops), planting in multiple eco-zones, sharecropping, etc. have all been shown to effectively manage risk and reduce the possibility of disastrous outcomes (Johnson 1971; Norman 1974, 1977; Wolgin 1975; Ellis 1988; Ortiz 1979; Roumasset 1976; Netting 1993). However, just because a practice effectively manages risk does not means that it *results* from risk-averse decision-making.

*Possibility 2*: Some peasant researchers have proposed that, perhaps, peasants do not behave in these gambles in ways that reflect their actual economic decision-making behavior (Ellis 1988). These researchers are pinned down by the twin facts that peasants often do not take the risk-averse choices in high-stakes monetary gambles, but seem to possess risk-averse agricultural and economic practices. Unfortunately, no one has a solid theoretical reason for why these two domains (both of which involve real costs and benefits) would be different. In various kinds of experimental risk games (in addition to the data presented above see Binswanger & Siller 1983 for review of previous work), peasants from very different places all behave in remarkably similar ways which all involve risking substantial sums of real money. What 'turns off' their supposed economizing cognitive machinery? It's difficult to imagine that when faced with a 'game,' peasants suddenly give up their rational risk-aversion, and suddenly start behaving in risk prone ways, which totally deviate from their usual behavioral patterns. Why isn't this true of university students? Are the experiments accurate for university students, but suddenly useless for peasants?

*Possibility 3*: Elsewhere I have argued at length, using data from psychology, experimental economics and anthropology, that humans (whether peasants or corporate CEOs) do very little cost/benefit analysis, and that much of human behavioral variation result from cultural transmission or biased imitation (Henrich 1999). If, instead of cost-benefit decision-making, people rely on *prestige-biased cultural transmission* (see Gil-White & Henrich 1999), in which individuals preferentially copy the behaviors, ideas and beliefs of prestigious or 'successful' people, then quite sensible and adaptive behaviors that would effectively manage risk in the economically-precarious context of peasants would spread without anyone applying risk-averse decision analysis (see Weibull 1995 for formal evolutionary model). In the usual peasant economic context, farmers who persistently deployed risky practices would eventually experience catastrophic losses (of lands, crops, animals or children) that would create a severe drop in their prestige (or their apparent degree of 'success') if they managed to survive. Such results would stifle the spread of these risk-prone practices, and any other transmittable traits possessed by these unsuccessful farmers. In contrast, farmers whose practices effectively manage risk and consistently avoid disastrous or catastrophic consequences would gradually accumulate wealth (e.g. land and animals), wives and children. This success would lead to prestige, which would cause their practices and cultural traits to spread more vigorously than those of more average farmers In cultural evolutionary time, this process would diffuse risk-managing practices throughout the population, without anyone being risk-averse in the usual economic sense. Once spread through a population, another weaker cultural transmission mechanism, *conformist transmission*, will maintain such practices at high frequency in the face of migration and cultural drift (see Henrich & Boyd 1998).

From this perspective, given that in many peasant economies cash transactions, banking credit, and money management is either relatively new or has never been a crucial feature of one's economic success (this is certainly true for the Mapuche and Sangu), we should not expect cultural selection processes, like *prestige-biased transmission*, to have evolved adaptive rules or preferences for dealing with such matters. In contrast, Huinca townspeople and UCLA students come from cultures where cash transactions, banking, credit, and money management have long been the key to economic prosperity and prestige. Consequently, we should expect them to have acquired culturally-evolved rules and preference about how to deal with money in risky situations. Further, given that gambling games are prevalent and popular in many foraging groups throughout the world, that big-money lotteries have rapidly spread to most nations, and that people can become addicted to gambling, just as they can to food, drugs and sex, it could very well be that humans have some innate predisposition (probably an evolutionary artifact) towards taking risky monetary gambles (experimental or otherwise). Consequently, Westerners or any cultural groups, which have long and intensely participated in monetary economies, are risk-averse in monetary gambles because they have acquired, via social learning, culturally-evolved rules and preferences for how to deal with all kinds of risky monetary situations. UCLA students, for example, seemed clearly tempted by the higher pay-off risky bets, but they *believed* the "smart thing" to do was to take the sure money. Neither the Mapuche nor the Sangu possess such a belief.

I have dismissed *Possibility 1* (peasant practices do not actually manage risk) on empirical grounds. *Possibility* 2, although it lacks any supporting theoretical structure, could still be true. Fortunately, *Possibilities* 2 and *3* make quite different predictions about the distribution of risky and risk managing practices, and about their locus of variation. Possibility 2, that peasant farmers are actually risk-averse decision makers, suggests that demographic and economic household variables should explain substantial portions of the variation in actual practices, and that the mean differences in these variables between groups should explain the variation in the distribution of risky practices observed between groups. *Possibility 3* predicts that individuals within the same social group should tend to behave more similarly (because they've grown up in similar cultural environments), regardless of demographic/economic variables, and that most of the variation will occur, not between individuals within groups, but between groups. This prediction goes for both their performance in experimental games, and their actual economic practices. *Possibility 2* just leaves the experimental results in the category of inexplicable artifact.

Above, I showed that the best predictor of one's experimental risk preferences is whether one is a Mapuche, UCLA student, Sangu or Huinca, which confirms one aspect of *Possibility 3*. I have also already shown that wealth measures and demographic factors do not explain any significant portion of the variation in experimental risk measures (and previous work from six different researchers supports this claim). But, can economic and demographic variables account for variation in the use of actual risk-managing practices, as predicted by *Possibility 2*? Below, I show that they do not. Further, if cultural transmission mechanisms generate the diffusion, or lack of diffusion, of actual risk-management practices, then much of the variation in these practices should be observed between groups or communities. To address this, I will analyze my own Mapuche data on four risky or risk-managing practices: sharecropping (land-for-labor exchanges), herbicide use, sowing spring wheat and selling cilantro. These examples demonstrate that risky practices do *not* vary with economic variables, but do vary greatly by group or locale (depending of the relevant scale)—i.e. community or locale explains much more of the variation in practices than economic/demographic variables.

Mapuche households vary quite a bit in their animal wealth, land and labor, yet they do not vary at all in their labor-for-land exchange practices. Mapuches own an average of 9 hectares, but this ranges from 2 to 38 hectares; household size varies from 2 to 7 with an average of 4.3 people; and the number of cows plus oxen ranges from zero to eight, with an average of 3.5. Of the 63 different Mapuche households I worked with, 29 participated, at least occasionally, in a sharecropping arrangement. Nine of these 29 were landowners who allowed associates to cultivate on their land in exchange for 50% of the yield (and paid 50% of any inputs). Twenty were sharecroppers who used the land of a neighboring Mapuche household. The sharecropping 'contract' was always the same, regardless of the locale's soil quality, micro-climate, expected crop yield or yield variance. The irrelevance of sharecropping contracts to the environmental details of the land involved has also been observed among farmers in Illinois (Young & Burke 1998). I asked if each farmer had ever rented a piece of land for a fixed fee, either as a land owner, or a renter. No one seemed to have ever even considered this arrangement. I asked if they have ever been hired as a wage laborer to work on the land of another Mapuche, or if they had ever hired anyone for wages instead of sharecropping with them. I also asked if they knew any other Mapuche farmers (anywhere) who had ever used either of these alternatives to sharecropping (renting or hiring labor). So despite the clear differences in wealth and available labor among Mapuche farmers, no Mapuche in this region ever exchanges land-for-labor in any arrangement other than sharecropping, even though Mapuches sometimes work as wage laborers on nearby Huinca plantations, which reportedly employ both sharecropping and wage labor arrangements. Consequently, given that a pair of individuals is involved in an exchange of land and labor, the best predictor of whether the arrangement is sharecropping is whether the two are both Mapuches. *Possibility 2's* prediction about the effect of economic and demographic variables is not supported, but *Possibility 3's* prediction that most of the variation will occur between groups does seem to be supported.

Furthermore, as I noted earlier, this sharecropping pattern does not match the predictions of the safety-first model at all. Assuming both land-rich and land-poor farmers expect to be above $R$, land-rich individuals should prefer a fixed rent and land-poor should prefer either wage labor or sharecropping. This creates a bargaining situation in which the relative bargaining power of each pair will determine the type of arrangement. It's difficult to believe, given that some Mapuches have only 2 hectares, that land-poor farmers always get their way, and always pick sharecropping instead of wage work. Moreover, if any land-poor farmers expect to fall below $R$, then land-rich and land-poor farmers would agree and we would see fixed rents, but there are no fixed rents anywhere. Finally, land-rich Huinca should also prefer fixed rents, but they use wage labor and sharecropping.

My general claim of a lack of association between risk and land-for-labor exchanges is further supported by data from North American and Indian farmers. In fact, economists (Allen & Lueck 1995; 1992) provide extensive data from four studies which show an *inverse* relationship between apparent riskiness (crop yield variances) and the presence of risk managing share contracts. That is, areas that produce crops with lower yield variances have greater proportions of risk managing share contracts. Rao (1971) provide similar supporting data for Indian famers in his early refutation of Cheung's original risk-sharing theory of contracts (1969).

Below, I have analyzed three other 'risky' behavioral practices employed by some Mapuche farmers (but not by others). So, unlike sharecropping, there is variation within my sample of farmers. These practices are: using herbicides, planting spring wheat, and selling cilantro in Temuco. Applying chemical herbicides carries some risk because farmers must pay for the chemicals up-front, and these applications may or may not increase their total wheat yield, depending on a whole variety of human and environmental factors. The outcome variance of herbicide use effectiveness depends on the rain patterns around the time of application, the type of weeds that may arise, the skill/knowledge of the applier, and the amount of damage to the harvest that these weeds would do if they went untreated. Next, few farmers have ever planted spring wheat (traditionally most farmers plant winter wheat), so no one has much experience with it. Reports of its yields are both positive and negative. Sowing cereals in late August also violates the traditional pattern of planting before the bulk of the winter rains (mid-June and July) arrive, so as to make the best use of this seasonal water. The third practice, selling cilantro, is also risky business. Want-to-be sellers must use scarce wet areas to plant substantial amounts of cilantro. They then must collect it, strap it in bunches (straps cost money) and transport it by bus to Temuco (which also costs), where they'll battle fierce market competition in cilantro. After all this, farmers may or may not earn enough to cover their expenses, let alone make a profit—but some people do make a nice profit.

Neither aggregate animal wealth, total land, household size nor any multivariate combination of these variables (e.g. land per household member, animal wealth per household member) predicts any significant portion of the variance in these risky practices. For sowing spring wheat, selling cilantro and using herbicides, Table 7 shows the logistic regression coefficients (ß), their standard error, the statistical significance of these and the proportion of the variance accounted for by each variable ($R^2$). Only two cases in Table 7 even approach significance. Total animal wealth, with a significance of 0.08, accounts for 2.2% of the variation in spring wheat use, while land wealth, with a significance of 0.051, account for 2.2% of the variation in herbicide use.

If these economic variables do not account for the variation in risky practices, then what does: the community in which the farmer lives. Table 8 shows the frequency of each of these risky practices in three Mapuche communities. For herbicide use, most farmers in Carrarreñi and Huentelar apply herbicides to their wheat fields, while no one in Cautinche does. In analyzing the distribution of spring wheat, we should only compare the data from Carrarreñi and Cautinche (which are located in quite similar soils and environments) because several Huentelar households possess only floodplain land, and so they cannot plant anything other than spring wheat (the winter seed would rot in water). In Carrareñi, 30% of the farms sampled currently plant spring wheat, while in Cautinche only one farmer (6%) plants spring wheat ($p = 0.019$ using the cumulative binomial distribution)—and he told me that he plans to discontinue this practice. If *prestige-biased transmission*, and not risk-averse cost-benefit decision-making, is the key to spreading novel practices (risky or otherwise), then spring wheat should continue to spread, and accelerate, in Carrareñi because some locally prestigious community leaders have recently adopted it (they are part of the 30%). Finally, cilantro selling is common is Carrarreñi, but rare in Cautinche and Huentelar (pairwise Carrarreñi vs. Cautinche and Huentelar yields $p = 0.004$ and 0.02, respectively). As I mentioned, economic factors cannot account for this distribution of cilantro sellers in any simple way, but neither can ecological factors. Cilantro requires either naturally wet garden patches or irrigation, so one might suggest that communities with more available water might plant more cilantro. This, however, does not seem to be the case. Of the three communities, Carrarreñi, by agreement of people in both communities, and by my own observations, is the same as, or perhaps drier than Cautinche. Huentelar is by far the wettest place, and many folks there live on or near the river Chol-Chol, but their frequency of cilantro selling is not much higher than Cautinche. Further, an analysis of farmers' answers to questions about why they use, or don't use, each of these practices shows little agreement on the costs and benefits of each, suggesting that cost-benefit analysis, risk-averse or otherwise, is not responsible for the observed distribution of behavioral practices (see Henrich 1999). The best predictor of whether a farmer will use one of these risky practices is which community he lives in, irrespective of economic and demographic variables. This further supports *Possibility 3.*

Norman (1974), in his extensive study of mixed cropping practices in Northern Nigeria, describes patterns similar to what I found with the Mapuche in Chile. He argues that farmers' reliance on mixed cropping effectively manages security and production risks, and is thus quite economically sensible (i.e. adaptive) given the socioeconomic conditions that these farmers confront. However, he also reveals three things of interest: 1) mixed cropping is universal throughout this region; 2) the extent of reliance on mixed cropping is independent of wealth (measured in land) and available household labor (i.e. family size); and 3) interviews with farmers produced no agreement on why this practice is used (despite the fact that everyone uses it).

## Conclusion

The goal of this paper is to bring experimental and ethnographic evidence to bear upon the common assumption that peasants are risk-averse. I've shown experimentally that two groups of small, subsistence-oriented farmers are actually risk-prone decision makers in monetary gambles in comparison to both the theoretical expected value, and to Huinca and UCLA students. I've also shown that these experimentally-derived risk-preferences cannot be explained by differences in household economic/demographic variables. I've further agreed that many of the peasant practices observed throughout the peasant world do in fact manage risk, but are unlikely to be a product of risk-averse decision making. I suggested that, instead, these practices and beliefs are likely to be evolved products of biased cultural transmission. Using data from the Mapuche, I demonstrated that risky or risk-managing practices vary, not as a consequence of wealth, land or family size, but by social/ethnic group or locale. This kind of distribution argues against risk-averse cost/benefit decision-making, and in favor of some form of biased cultural transmission (like conformist transmission, see Henrich & Boyd 1998). Vast amounts of evidence from the diffusion of innovation literature suggest similar distributional patterns of innovations (see Rogers 1995; Roger & Kincaid 1981).[13] Taken together, these finding bring into serious question the standard conceptions of risk used by many social scientists, and particularly the notion that 'peasant conservatism' results from cost/benefit decision-making under uncertainty and risk. From this perspective, researchers should begin to model the dynamics of cultural transmission, and the evolutionary processes to which they give rise, in order to understand and predict the conditions under which novel ideas, beliefs, values, behaviors and 'innovations' (whether useful or silly) will spread slowly, rapidly or fail to spread at all. We should then test these models, head-to-head, with standard risk-averse, cost-benefit, decision-making models (see Henrich 1999).

Similarly, just as risk-averse farming practices among peasants may be a product of cultural transmission, risk-averse decisions in monetary gambling games are also likely to be a product of cultural evolutionary processes operating in social groups with long histories of fully-monetized economies and markets with banking, foreclosures, credit and horse-racing. Consequently, I make a simple prediction with regards to experimental work on risk: among groups with long histories of market dependence, credit and monetary dependence, people will have more risk averse preferences in monetary gambles (like the ones I have used), than people from groups with little or no history of market dependence, credit or monetization.

[13] For example, work done by Roger & Kincaid (1981) on the diffusion of contraceptive practices in Korean peasant farming communities suggests that, when exposed to the same national campaign which pushed all forms of family planning equally, villages containing individuals at a variety of wealth levels became dominated by one form of contraception or another. There are "pill" villages, "IUD" villages, and even vasectomy villages.

## Appendix A: ANALYSIS OF VARIANCE FOR LAND-RICH AND LAND-POOR FARMERS

The goal of this model is to derive predictions about the land-for-labor exchanges preferred by land-rich and land-poor farmers in the simplest and starkest way possible. Much more complex rational-actor models, which make similar and equally inaccurate empirical predictions, can be found in Newbery & Stiglitz (1982), Binswanger & Rosenzweig (1986), Bliss & Stern (1982), and Ellis (1988). Because we are interested in the effect of variance (which equals risk when distributions are assumed approximately normal ) on land-for-labor exchanges, this model assumes the expected returns from sharecropping, fixed rents and wage labor have all been equalized by market forces (or the differences in returns made sufficiently small). Consequently, only the variance of an option affects an individual's preference.

$U$ = the utility; risk-averse individuals will pick options that minimize the variance in $U$, while risk-prone individuals prefer options that maximize the variance in $U$ (assuming the expected value of $U$ remains constant).

$Y$ = is a normally distributed random variable representing the yield of the crop planted on the land in question. $Y$ is in utility units and has a mean $\mu$ and a variance $v$.

From the perspective of the land-poor sharecropper we find the following.

*Fixed rent:*

$U = Y - C$; so the variance in $U$ is: $VAR(U) = VAR(Y) - 0 = v$

Where $C$ = the fixed cost of renting a piece of land to plant a crop that produces $Y$ yield.

*Sharecropping:*

$U = \delta Y$; the variance in U is: $VAR(U) = \delta v$

Where $\delta$ = the proportion of $Y$ yield that goes to the land-poor sharecropper (usually 50%).

*Wage labor:*

$U = \kappa Y$; the variance in U is: $VAR(U) = \kappa v$

The larger the harvest the more wage labor is needed, so $U$ rises in proportion to Y, by an amount $\kappa$.

As I said, it is assumed that market forces have equalized the expected utilities of the three options. Using this assumption, we find that $\delta = \kappa$, and that $C = \mu(1-\delta)$. This makes the variance derived for sharecropping and wage labor equal, but does not affect the fixed rent derivation. Because $\delta$ (or $\kappa$) is between 0 and 1, the variance of both wage labor and sharecropping is always less than fixed-rent tenancy. Consequently, risk-prone, land-poor farmers should prefer fixed rent arrangements, while risk-averse farmers will want to avoid such situations, and instead prefer wage labor or sharecropping (and they should be indifferent between these two).

Applying the same analysis to land-rich farmers yields the following.

*Fixed rent:*

$U = C;\ VAR(U) = VAR(C) = 0$

*Sharecropping:*

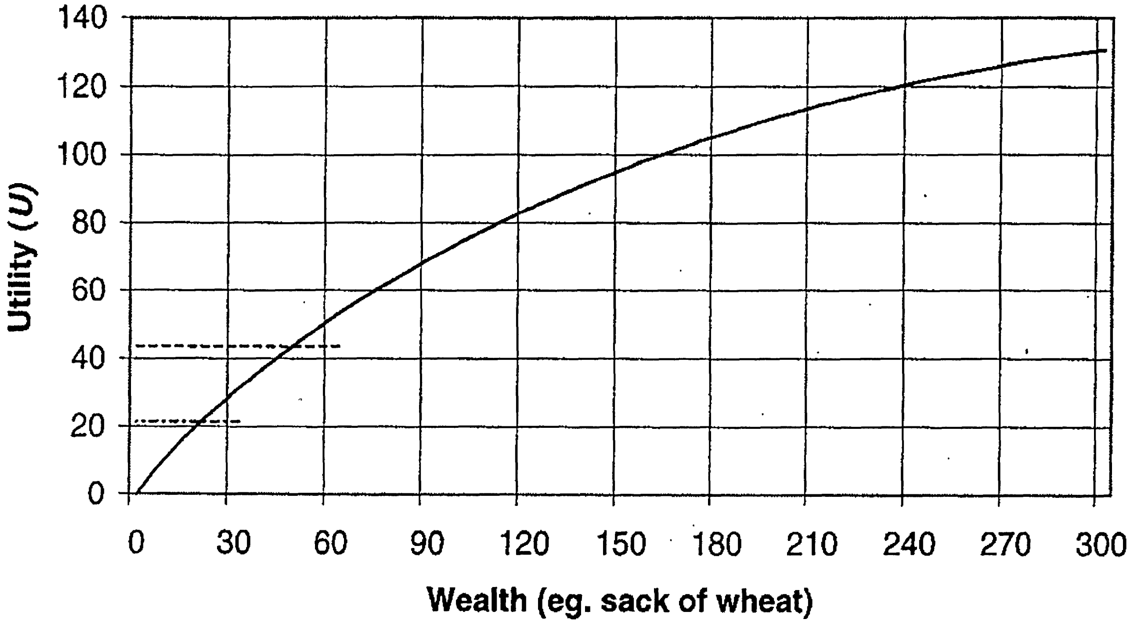
$U = (1-\delta)Y$ ; the variance in $U$ is: $VAR(U) = (1-\delta)v$

*Wage labor:*

$U = (1-\kappa)Y$ ; the variance in U is: $VAR(U) = (1-\kappa)v = (1-\delta)v$

Similarly, risk-averse owners should prefer fixed rent situations, while risk-prone land owners should prefer either sharecropping or wage labor. Assuming everyone is risk averse, owners of land should bargain with labor over which arrangement arises. Where land is scarce and people are not, most arrangements should be fixed rent tenancy because land-rich owners have the more valuable resource, and thus more bargaining power.

**Figure 1.** Decreasing marginal utility curve (risk aversion)



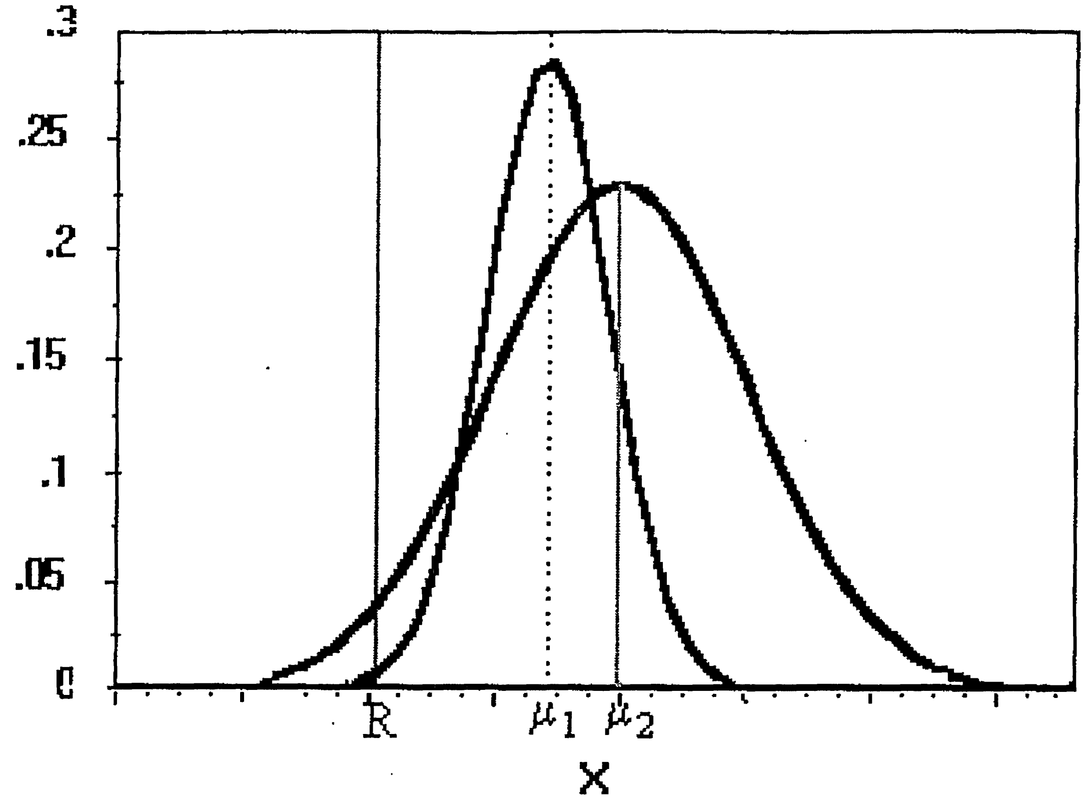



**Figure 2.** Normally-distributed crop yields for the satisficing or safety-first risk model. $R$ is the minimum threshold. $\mu_1$ and $\mu_2$ are the mean yields of crop 1 and crop 2.

**Figure 3.** The Titration Experiment

**The Preference Game**

The are 3 rounds in this game and individuals play alone. In each round, you have to pick between 2 possibilities.

Do you prefer:

| A | | B |
|---|---|---|
| 1. 1000 *pesos* (100%) | or | 2000 *pesos* (50% chance) |
| 2. _____*pesos* (100%) | or | 2000 *pesos* (50% chance) |
| 3. _____*pesos* (100%) | or | 2000 *pesos* (50% chance) |

***The money is real and you will be paid.**

**There are no correct or incorrect answers. Pick whatever you prefer.

**Figure 4.** The Variance Experiment

**The Risk Game**

The are 4 rounds in this game and individuals play alone. In each round, you have to pick between 2 possibilities.

Do you prefer:

| | A | | B |
|---|---|---|---|
| 1. | 1000 *pesos* (100%) | or | 2000 *pesos* (50% chance) |
| 2. | 1000 *pesos* (100%) | or | 5000 *pesos* (20% chance) |
| 3. | 1000 *pesos* (100%) | or | 1250 *pesos* (80% chance) |
| 4. | 1000 *pesos* (100%) | or | 20,000 *pesos* (5% chance) |
| 4b. | 1000 *pesos* (100%) | or | 20,000 *pesos* (unknown chance) |

***The money is real and you will be paid.**

**There are no correct or incorrect answers. Pick whatever you prefer.

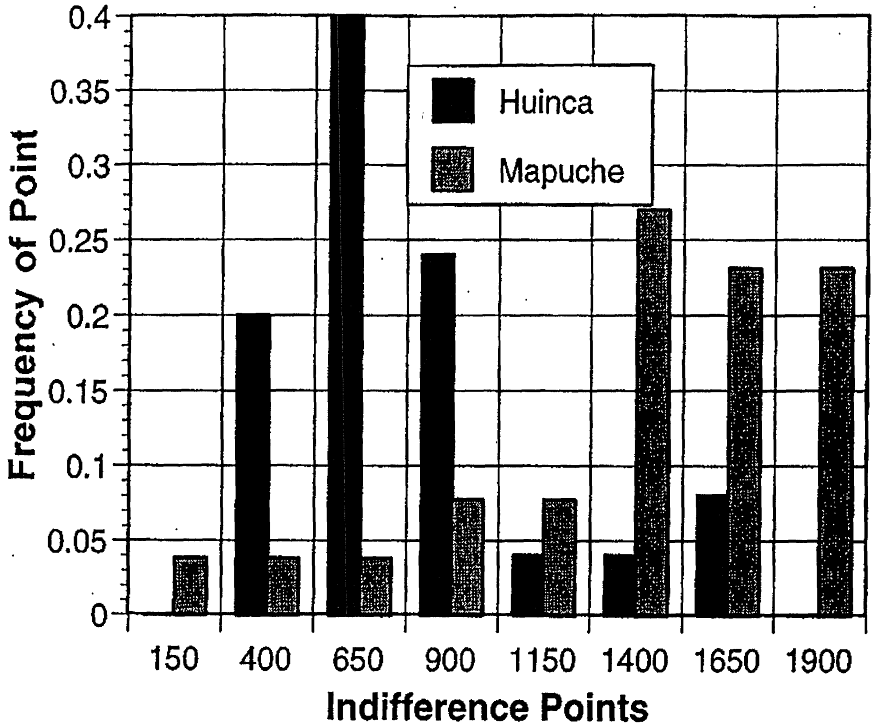



**Figure 5.** Titration experimental results for the Huinca and Mapuche. $N = 25$ for the Huinca and 26 for the Mapuche.

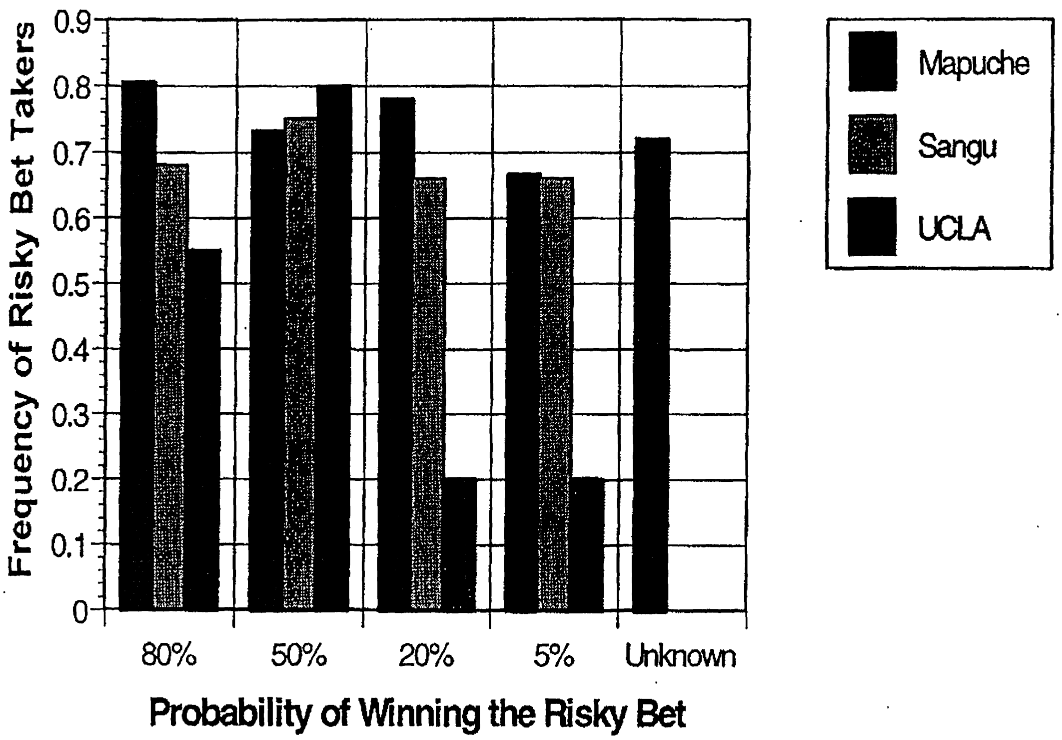



**Figure 6.** Frequency of risky gambles with difference amounts of outcome variance. Sample sizes are n=41 for all Mapuche at 80%, 50%, and 20%; n = 12 for 5% and n=29 for unknown bet. For Sangu n = 76 for 50% and n = 38 for other Sangu bets.

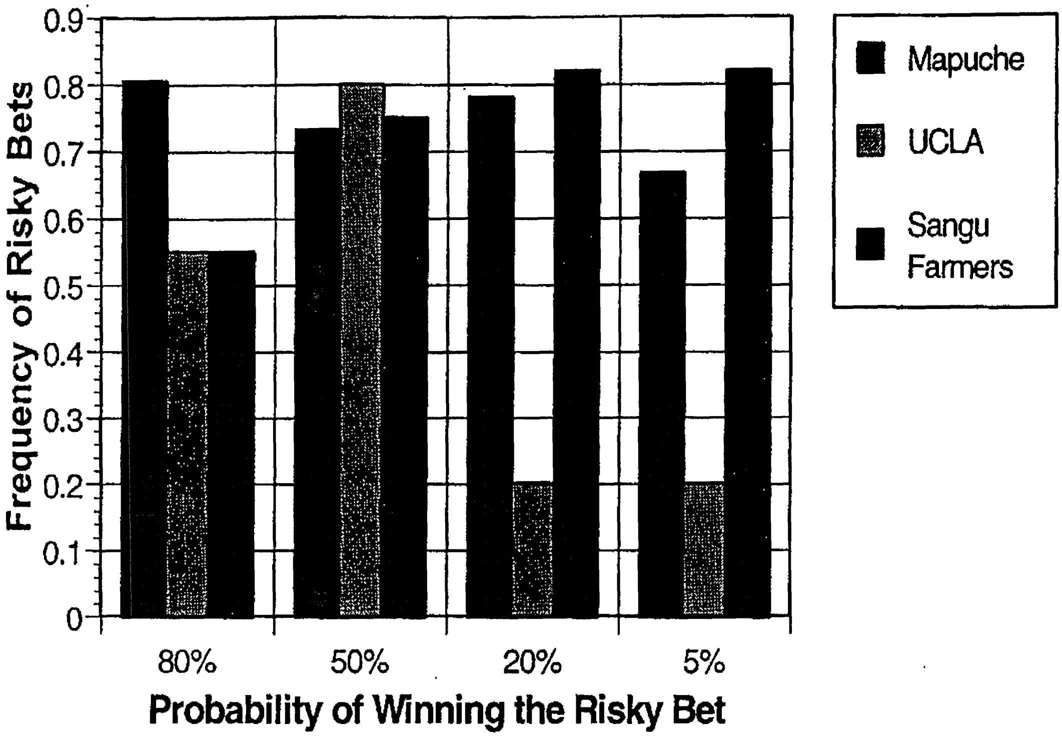



**Figure 7.** Variance results for Mapuche, UCLA and Sangu male farmers. The Sangu sample of male farmers has $n = 11$ for 80%, 20% and 5% gambles, and $n = 20$ for 50% gamble. The Mapuche and UCLA data is the same as in Figure 4.

**Table 1.** Frequency of Risky Gambles for UCLA, split by sex

| UCLA | 50 Gamble | 20 Gamble | 80 Gamble | 5% Gamble | Avg. of Gambles |
|---|---|---|---|---|---|
| Males | 0.79 | 0.14 | 0.50 | 0.21 | 0.41 |
| Females | 0.83 | 0.33 | 0.67 | 0.17 | 0.50 |

**Table 2.** Indifference Points for Mapuche and Huinca males and females

| Group/Sex | No. of Participants | Indifference Point* |
|---|---|---|
| Mapuche females | 4 | 1525 |
| Mapuche males | 22 | 1377 |
| Huinca females | 7 | 721 |
| Huinca males | 18 | 816 |

*$p$-values for both for male-female, within-group, comparisons are about 0.57

**Table 3.** Variance Game Data from 2 different bet orderings

| Variance Bet | Risky Bet Freq. 50-20-80 version (n) | Risky Bet Freq. 80-50-20 version (n) | Comparison *p*-values | Freq. risky bet overall |
|---|---|---|---|---|
| 80% | 0.82 (28) | 0.83 (12) | 0.93 | 0.82 |
| 50% | 0.79 (28) | 0.67 (12) | 0.44 | 0.75 |
| 20% | 0.71 (28) | 0.92 (12) | 0.17 | 0.77 |
| Unknown | 0.88 (17) | 0.67 (12) | 0.17 | 0.79 |
| Total* | 0.79 (101) | 0.77 (48) | 0.73 | 0.78 |

*this calculation assumes each *round* is independent. Analysis presented in the next two sections justify this assumption.

**Table 4.** Conditional Frequencies of Risky Bets

| **Freq. risky bet given previous:** | **Mapuche** | **UCLA** |
|---|---|---|
| Picked safe bet on previous | 21/28 (75%) | 13/29 (45%) |
| Picked risky bet and won | 36/46 (78%) | 4/20 (20%) |
| Picked risky bet and lost | 36/48 (75%) | 2/11 (18%) |

**Table 5**. Correlation of Economic Variables with Indifference Points

| **Economic Variable** | **Mapuche (p-value)** | **Huinca (*p*-value)** |
|---|---|---|
| Family Size | 0.072 (0.74) | 0.016 (0.94) |
| House Head | -0.025 (0.91) | 0.15 (0.48) |
| Age | -0.071 (0.75) | 0.047 (0.83) |
| Wages/income | ------ | 0.026 (0.91) |
| Land owned | 0.091 (0.68) | ---- |
| Cows | 0.25 (0.25) | ---- |
| Horses | 0.006 (0.98) | ---- |
| Oxen | 0.59 (0.002) | ---- |
| Total Animal Wealth | 0.30 (0.15) | |

**Table 6.** Comparison of Mean Values of Economic Variables for Mapuches who picked the safe bet (A) and the risky bet (B)

| Economic Factor | Risk Averse (A) | Risk Prone (B) | *p*-value |
|---|---|---|---|
| Age (years) | 48.7 | 49.7 | 0.73 |
| Family Size | 4.66 | 4.50 | 0.61 |
| Land (hect.) | 10.8 | 9.6 | 0.28 |
| Oxen (No.) | 1.97 | 1.92 | 0.67 |
| Cows (No.) | 1.51 | 1.48 | 0.89 |
| Horses (No.) | 0.33 | 0.46 | 0.16 |
| Pigs (No.) | 4.1 | 3.6 | 0.46 |
| Tot. Animal Wealth | 801K | 827K | 0.69 |

**Table 7.** Logistic Regression for Land, Household Size & Aggregate Animal Wealth

| **Spring Wheat*** | **ß** | **Stand. Error** | **Signif** | $R^2$ |
|---|---|---|---|---|
| Land | -0.028 | 0.055 | 0.61 | 0.0000 |
| Tot. animal Wealth | 0.0028 | 0.0011 | 0.080 | 0.022 |
| Household Size | -0.360 | 0.23 | 0.12 | 0.008 |
| **Selling Cilantro** | **ß** | **Stand. Error** | **Signif** | $R^2$ |
| Land | 0.063 | 0.91 | .21 | 0.0045 |
| Tot. animal Wealth | -0.0006 | 0.0008 | 0.41 | 0.0000 |
| Household Size | 0.058 | 0.15 | 0.70 | 0.0000 |
| **Herbicide Use** | **ß** | **Stand. Error** | **Signif** | $R^2$ |
| Land | 0.092 | 0.047 | 0.051 | 0.022 |
| Tot. animal Wealth | -0.0005 | 0.0008 | 0.50 | 0.0000 |
| Household Size | 0.081 | 0.16 | 0.61 | 0.0000 |

*Six families in Huentelar were removed from the analysis because they have to plant spring wheat, as their fields are in a flood plain.

**Table 8.** Frequency of risky practices users in 3 communities

| Community | Herbicide users | Spring wheat planters | Cilantro sellers |
|---|---|---|---|
| Carrarreñi | 88% (21/24) | 30% (6/20) | 52% (12/23) |
| Cautinche | 0% (0/17) | 6% (1/17) | 13% (2/16) |
| Huentelar | 77% (10/13) | 46% (7/13)* | 18% (2/11) |

*Some Huentelar farms are entirely in a flood plain, so they cannot plant anything other than spring wheat (the fields flood all winter).

**Reference List**

1. Allen, Douglas W., and Dean Lueck. "Contract Choice in Modern Agriculture." *Journal of Law and Economics* 35, no. 2 (1992): 397-426.

2. ———. "Risk Preferences and the Economics of Contracts." *American Economic Review* 85, no. 2 (1995): 447-51.

3. Bengoa, Jose. *Los Mapuches: Comunidades y Localidades En Chile.* Coleccion Estudios Sociales. Chile: Instituto Nacional de Estadisticas, 1997.

4. Binswanger, H. P., and M. R. Rosenzweig. "Behavioural and Material Determinants of Production Relations in Agriculture." *Journal of Development Studies* 22, no. 3 (1986).

5. Binswanger, Hans P. "Attitudes Toward Risk: Experimental Measurement in Rural India." *American Journal of Agricultural Economics* 62, no. 3 (1980): 395-407.

6. Binswanger, Hans P. "The Impact of Attitudes Toward Risk on Agricultural Decisions in Rural India.", 25 leaves 29 cm . Economics Program. Progress Report ; 42. Patancheru, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 1982.

7. Binswanger, Hans P., and D. A. Sillers. "Risk Aversion and Credit Constraints in Farmers' Decision-Making: a Reinterpretation." *Journal of Development Studies* 20, no. 1 (1983): 5-21.

8. Bliss, C. J., and Stern N. H. *Palanpur: The Economy of an Indian Village.* Oxford: Clarendon Press, 1982.

9. Borgerhoff Mulder, Monique. "Kipsigis Bridewealth Payments." *Human Reproductive Behaviour.* Eds. Laura Betzig, and Paul W. Turke, 65-82. Cambridge: Cambridge University Press, 1988.

10. Camerer, Colin, and Martin Weber. "Recent Developments in Modeling Preferences: Uncertainty and Ambiguity." *Journal of Risk and Uncertainty* 5 (1992): 325-70.

11. Cancian, Frank. "Economic Behavior in Peasant Communities." *Economic Anthropology.* ed. Stuart Plattner, 127-70. Stanford: Stanford University Press, 1989.

12. Cheung, Steven N. S. "Transaction Costs, Risk Aversion and the Choice of Contractual Arrangements." *Journal of Law and Economics* 12, no. 1 (1969): 23-42.

13. Chibnik, Michael. "Double-Edged Risks and Uncertainties: Choices About Rice Loans in the Peruvian Amazon." *Risk and Uncertainty in Tribal and Peasant Economies.* ed Elizabeth CashdanBoulder, CO: Westview Press, 1990.

14. Coombs, C. H, and D. G Pruitt. "Components of Risk in Decision Making: Probability and Variance Preferences." *Journal of Experimental Psychology* 60 (1960): 265-77.

15. Crissman, Charles Clinton. "Production Risk, Risk Attitudes and the Adoption of Modern Rice Varieties in the Philippines." 1986.

16. Edwards, W. "Probability Preferences in Gambling." *American Journal of Psychology* 66 (1953): 349-64.

17. Ellis, Frank. *Peasant Economics: Farm Households and Agrarian Development*. New York: Cambridge University Press, 1988.

18. Gil-White, Francisco, and Joe Henrich. "The Evolution of Prestige."1999.

19. Gladwin, Christina. "Cognitive Strategies and Adoption Decisions: A Case Study of Nonadoption of an Agronomic Recommendations." *Economic Development and Culture Change* 28, no. 1 (1979): 155-73.

20. Grisley, William. "Effect of Risk and Risk Aversion on Farm Decision-Making: Farmers in Northern Thailand." Ph.D. Dissertation, University of Illinois, 1980.

21. Henrich, Joe. "Rationality, Cultural Transmission and Adaptation: the Problem of Culture and Decision-Making in Anthropology."1999.

22. Henrich, Joe, and Robert Boyd. "The Evolution of Conformist Transmission and the Emergence of Between-Group Differences." *Evolution and Human Behavior* 19 (1998): 215-42.

23. Johnson, Allen W. "Sharecroppers of the Sertao; Economics and Dependence on a Brazilian Plantation.", 153 p illus., maps, group ports. 23 cm . Stanford, Calif: Stanford University Press, 1971.

24. Knight, Frank. *Risk, Uncertainty and Profit*. Boston: Houghton Mifflin, 1921.

25. Miller, Louis, David E Meyer, and John T Lanzetta. "Choice Among Equal Expected Value Alternatives: Sequential Effects of Winning Probability Level on Risk Preferences." *Journal of Experimental Psychology* 79, no. 3, Pt. 1 (1969): 419-23.

26. Netting, Robert McC. "Smallholders, Householders : Farm Families and the Ecology of Intensive, Sustainable Agriculture.". Stanford: Stanford University Press, 1993.

27. Newbery, D. M. G., and J. E. Stiglitz. "Sharecropping, Risk Sharing and the Importance of Imperfect Information." *Risk, Uncertainty and Agricultural Development.* eds J. A. et. al. RoumassettNew York: Agricultural Development Council.

28. Nicholson, Walter. *Microeconomic Theory*. Fort Worth, TX: The Dryden Press, 1995.

29. Norman, D. W. "Rationalizing Mixed Cropping Under Indigenous Conditions: the Example of Northern Nigeria." *Journal of Development Studies* 11 (1974).

30. Oren, Shmuel S., and Rick G. Schwartz. "Diffusion of New Products in Risk-Sensitive Markets." *Journal of Forecasting* 7 (1988): 273-87.

31. Ortiz, Sutti. "The Effect of Risk Aversion Strategies on Subsistence and Cash Crop Decisions." *Risk, Uncertainty, and Agricultural Development.* eds J. Roumasset, J. Boussard, and I. Singh, 231-46. New York: Agricultural Development Council, 1979.

32. Payne, John W. "Relation of Perceived Risk to Preferences Among Gambles." *Journal of Experimental Psychology: Human Perception & Performance* 1, no. 1 (1975): 86-94.

33. Rao, C. H. Hanumatha. "Uncertainty, Entrepreneurship, and Sharecropping in India." *Journal of Political Economy* 83, no. 3 (1971): 578-95.

34. Roger, Everett M., and D. Lawrence Kincaid. *Communication Networks: Toward a New Paradigm for Research.* New York: The Free Press, 1981.

35. Rogers, Everett M. "Diffusion of Innovations.". New York: Free Press, 1995.

36. Roumasset, James A. *Rice and Risk: Decision Making Among Low-Income Farmers.* New York: North-Holland Publishing Company, 1976.

37. Schluter, M. G. G., and T. D. Mount. "Some Management Objectives of the Peasant Farmer: an Analysis of Risk Aversion in the Choice of Cropping Patterns, Surat District, India." *Journal of Development Studies* 12, no. 3 (1976): 246-61.

38. Sillers, Donald. "Measuring Risk Preferences of Rice Farmers in Nueva Ecija, Philippines: An Experimental Approach." Ph.D. Thesis, Yale University.

39. Stephens, David W., and John R. Krebs. *Foraging Theory.* Princeton: Princeton University Press, 1986.

40. Stigler, George J., and Gary S. Becker. "De Gustibus Non Est Disputandum." *American Economic Review* 67, no. 1 (1977): 76-90.

41. Stiglitz, Joseph E. "Incentive and Risk Sharing in Sharecropping." *Review of Economic Studies* 41, no. 2 (1974): 219-56.

42. Tait, E. J. "Measuring Attitudes to Risk : Farmers' Attitudes to the Financial, Personal and Environmental Risks Associated With Pesticide Usage.", 34 p 28 cm . Toronto: Publications and Information, Institute for Environmental Studies, University of Toronto, 1979.

43. Turner, Christina Bolke. "Historical Perspectives on Long Term Change: Compadrazgo Choice Patterns in Rural Paraguay." *Economic Analysis Beyond the Local System: Monographs in Economic Anthropology.* eds Richard E. Blanton, Peter N. Peregrine, Deborah Winslow, and Thomas D. Hall, 171-93. Vol. 13. University Press of America, London.

44. Walker, Thomas S. "Decision Making by Farmers and by the National Agricultural Research Program on the Adoption and Development of Maize Varieties in El Salvador." Ph.D. Dissertation, Standard Food Research Institute, 1980.

45. Weibull, Jorgen W. "Evolutionary Game Theory.". Cambridge, Mass: MIT Press, 1995.

46. Wolgin, J. M. "Resource Allocation and Risk: a Case Study of Smallholder Agriculture in Kenya." *American Journal of Agricultural Economics* 57, no. 5 (1975).

47. Young, H. Peyton, and Mary A. Burke. "Competition and Custom in Economic Contracts: A Case Study of Illnois Agriculture."1998.