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# The Effect of an Additional Alternative on Measured Risk Preferences in a Laboratory Experiment in Peru*

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**Résumé / *Abstract***

Une étude expérimentale a été menée dans le but de vérifier l'incidence qu'un choix supplémentaire peut avoir sur les préférences mesurées des fermiers des zones rurales du Pérou à l'égard du risque. Au cours de notre expérience, les sujets étaient appelés à exprimer leurs préférences face au risque en fonction d'une série de choix entre deux loteries. Nous avons ajouté une troisième loterie, laquelle était toujours dominée par une des deux loteries existantes. Nous avons pu constater que, le quart du temps, les sujets choisissaient cette nouvelle loterie, de sorte que, dans certains cas, les sujets semblaient être plus enclins au risque. Nous avons constaté, dans un environnement de laboratoire traditionnel, que les sujets ne choisissaient pas la loterie dominée, mais que leurs choix étaient influencés par sa présence.

**Mots clés** : choix de la technologie, développement rural, économie expérimentale, instruments de mesure du risque, préférences à l'égard du risque.

*We experimentally test for the effect of an additional alternative on the measured risk preferences of farmers in rural Peru. In our experiment, subjects revealed their risk preferences with a series of choices between two gambles. We added a third gamble, which was always dominated by one of the two existing gambles. We found that subjects chose this gamble nearly one quarter of the time, in some cases causing the subjects to appear to be more risk loving. We found that subjects in a traditional laboratory environment did not choose the dominated gamble, but their choices were affected by its presence.*

***Keywords:*** *rural development, technology choice; risk preferences, risk measurement instruments, experimental economics*

**Codes JEL** : O33, O18, C91

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# 1 Introduction

This paper provides a new twist on decision-making under risk among farmers in a developing country. We run an economics experiment to obtain a behaviorally-based measure of risk preferences of farmers in cotton producing areas of Peru before and after the addition of a new alternative. The main contribution of our paper is the investigation of the effect of the additional alternative.

Choosing among an existing set of options forms the basis of conventional analyses of decision-making under risk. However, few studies consider the effect of adding new alternatives to a set of options, despite their potentially important effects on real world decisions. From new medicines or new varieties of consumption goods to new political parties or new residential neighborhoods, individuals frequently encounter new alternatives in their daily lives.[1]

One way in which the mere existence of new alternatives might alter decision-making is by affecting peoples' attitudes toward risk. If this turned out to be the case, some important high-stakes decisions could be affected. Imagine that the availability of a new form of birth control induces a change in sexual behavior. This could have implications for fertility and the spread of contagious diseases such as HIV/AIDS. Similarly, what if the availability of a new high yield variety of seed causes subsistence farmers to become more risk averse? The farmers could become reluctant to deviate from traditionally safe but low yield varieties, and this could slow technology adoption in rural areas (Feder, 1980; Feder et al., 1985 and Kurosaki and Fafchamps, 2002).

Indeed, the risk attitudes of farmers are a particularly important and widely studied component of decision-making in developing countries. Since Binswanger (1980, 1981) first used experimental methods to measure risk preferences of farmers in India, researchers have

[1] The article "Choice is Good. Yes, No or Maybe" in the New York Times' "Ideas & Trends" section of March 27, 2005 by Eduardo Porter offers several examples of the possibly negative effect of choice on decision-making.

repeated the exercise in many countries (e.g., Barr, 2003 and Miyata, 2003). We build on these methods to study the effect of an additional alternative on measured risk preferences.

At the heart of our experiment is a well-known instrument used to measure risk preferences. The instrument consists of a series of incentivized binary decisions between a relatively safe and a relatively risky gamble. A subject's choices reveal her attitude toward risk in this individual decision-making problem. We add a third gamble, dominated in payoff by one of the existing two gambles, and measure risk preferences again, this time with the new alternative.

We show that adding an alternative to a set of options can cause people to make more risky decisions, despite the fact that the new alternative is dominated by an existing option. While it is true that new alternatives are rarely dominated in the real world, our design is not meant to mimic precisely a decision in the field. Rather, our design provides a particularly clean test of the notion that an additional alternative fundamentally alters preferences: the third alternative should be irrelevant and simply should not have an effect on subjects' measured risk preferences. Since the third alternative is not irrelevant to our subjects, we show that the frame within which the decision is made can affect the risk that people are willing to take. We suggest that this kind of behavior should be taken into account when considering programs for developing countries such as technical assistance programs.[2]

One feature of our results is surprising: the Peruvian subjects select the dominated third option nearly 25% of the time when it is available. When the dominated option is similar to the risky gamble, subjects switch out of the safe gamble and into the dominated risky gamble. In other words, the third option causes subjects to appear to be more risk loving.

We also ran our experiment in a traditional laboratory setting with university undergraduates, and find that these subjects do not choose the dominated gamble. Even so,

[2] As another example, Bertrand et al. (2005) varied four dimensions of loan terms (amount, term, monthly repayment, interest rate) in a study of loan offers. They found that the amount of information presented affected the types of loans chosen by borrowers.

their measured risk preferences change in response to being presented with a new gamble: the dominated gamble increases the number of times the subjects choose the similar gamble. This result is consistent with past related experimental results, and thereby provides a degree of validation for our experimental design, and provides us with a window into the differences between the two very different subject pools.

# 2 Risk Measurement and Dominated Alternatives

## 2.1 Measuring Risk

In incentivized experiments, risk attitudes are typically measured by presenting subjects with choices between gambles of differing risk. Differing risk levels are achieved by varying either the expected value or the variance of the payoffs in the gambles faced by subjects. The subjects' resulting choices reveal their attitudes towards risk. To ensure that they treat their decisions seriously, subjects play one of their selected gambles and are paid according to the outcome.

Holt and Laury (2002) designed an instrument that is commonly used in experiments in which subjects are asked to make ten decisions. Each decision consists of a binary decision between a relatively safe gamble (gamble A) and a relatively risky gamble (gamble B). Each gamble has two possible outcomes: a high payoff and a low payoff. The payoffs in each gamble are fixed across decisions; gamble B pays more than gamble A if the high payoff occurs and less if the low payoff occurs. Thus, with a small probability of a high payoff occurring, most individuals would prefer gamble A because the low payoff is higher than in gamble B. As the probability of the high payoff increases, a subject should switch from choosing gamble A to choosing gamble B. This switch point provides an interval estimate of the subject's risk preference.

Eckel and Grossman (2003) provide a different instrument in which subjects make only

one choice from a larger set of gambles. Our instrument, derived from Eckel and Grossman and similar to the one Binswanger (1980) used in his pioneering study, is illustrated in Figure 1. Rather than altering the probabilities of the gamble payoffs as in Holt and Laury (2002), this instrument varies the gamble payoffs. An advantage of this method is the ease of its description: all gambles involve an equal probability of the high or low payoff and can thus be represented by a coin toss. We will use this variant of the Eckel-Grossman instrument, and our design will enable us to directly compare it to the Holt-Laury approach.[3]

## 2.2 Additional Alternatives and Choice

How should additional alternatives affect decision-making? Regularity, a weak assumption in most choice models (e.g., Luce, 1959 and Tversky, 1972), implies that the probability of choosing an existing option cannot increase when more alternatives are added to the choice set (Becker, Degroot, and Marschak (1963) found experimental evidence for regularity). A standard prediction regarding the magnitude of the effect of an additional alternative is that it lowers the probability of choosing existing options in proportion to their shares (Luce, 1959). However, a new alternative could take disproportionately from (or cannibalize) options that are most similar to it; this is called the similarity effect, and the elimination by aspects model in Tversky (1972) makes such a prediction.

The similarity effect sparked research into the effect of "decoys" on choices. Decoys are alternatives that are dominated by other alternatives in some aspect important to decision making. If a decoy is dominated in some aspects but not others, it is called "asymmetrically dominated". Imagine a choice between two alternatives, where one alternative is superior in price while the other is superior in quality. A third alternative, asymmetrically dominated

[3] More specifically, our design enables the comparison between a series of binary decisions and a single decision from among all options. The systematic altering of expected values of the gambles vs. the altering of the variance of the gambles is a second difference between the two instruments that could contribute to further differences in behavior.

by the quality-superior alternative on the dimension of price, extends the range of prices available making the quality-superior alternative more attractive than it was (this is called a "range" decoy). A third alternative, asymmetrically dominated by the quality-superior alternative on the quality dimension, increases the difference in ranks between the original two alternatives on this dimension (i.e., the rankings on the quality dimension were 1 and 2, but with the addition of the third alternative they are now 1 and 3), making the quality-superior alternative more attractive than it was (this is called a "frequency" decoy). Note that in no case is the dominated alternative predicted to be chosen.

Consistent with this analysis, Huber, Payne, and Puto (1982) show that asymmetrically dominated alternatives can increase the probability that a similar alternative is chosen. This result was in contrast with the Tversky's (1972) similarity effect. Wedell and Pettibone (1996) show that decision models that shift the values of the existing alternative when the third alternative is added to the choice set predict decisions better than a model that alters the relative weights assigned to them by the decision maker. The bottom line is that the dominated alternative affects choices between the original two alternatives.

Strictly dominated alternative are handled in different ways by different theories. Luce (1959) restricted the choice set to non-dominated alternatives. Tversky (1972) handled dominated alternatives by assigning them zero probability because they have no unique aspects. That is, since such an alternative is dominated in all dimensions important for discriminating between alternatives, it cannot satisfy the decision maker in some way that is uniquely different from the other alternatives. Psychological theories of non-expected utility typically have an editing phase, in which the decision maker eliminates dominated alternatives from consideration before evaluating the remaining alternatives (Kahneman and Tversky, 1979).[4]

[4] Starmer (1999) tests and finds evidence that the editing phase in Prospect Theory can cause a certain type of transitivity to fail. And Buschena and Zilberman (1999) present a test of similarity in choices between a pair of lotteries, where their measure of similarity is a Euclidean distance. They find that the more similar two gambles are, the more likely the risky one is chosen.

Stochastically dominated alternatives are also handled in different ways by different theories: choosing particular types of stochastically dominated alternatives is allowed by some theories from psychology, and not others. Birnbaum et al. (1999) present a test for the ability of several theories to describe choices in this context. Gamble $A$ stochastically dominates gamble $B$ if $\Pr(x > t|A) \geq \Pr(x > t|B) \forall t$, where $\Pr(x > t|A)$ is the probability that an outcome of gamble $A$ exceeds $t$. An example from Birnbaum et al. (1999) is the following: gamble $G+$ which pays \$12 with probability 0.05, \$14 with probability 0.05, and \$96 with probability 0.90 dominates gamble $G-$ which pays \$12 with probability 0.10, \$90 with probability 0.05, and \$96 with probability 0.85.

In our study, we add a third alternative to a choice between two gambles, one of which is relatively safer than the other. The third alternative is payoff dominated by one of the two gambles, i.e., in every state of the world it pays less. This alternative is displayed in such a manner that it is easily identified as payoff dominated. Our study thus differs from the work on decoy effects in that it presents subjects with a relatively simple, incentivized choice under uncertainty using an instrument that allows us to measure risk preferences; existing studies use hypothetical choices among alternative product offerings. Our study differs from the work on stochastic dominance in that the dominance we present to the subjects is payoff dominance, i.e., in every state of the world the dominated alternative pays less than another alternative. Our question is whether the mere existence of an additional alternative alters measured preferences. We attempt to get at this question with the simplest design possible.

# 3 Experimental Design

The instrument in Figure 1, which we denote 'five options' (FO hereafter) is inspired by Eckel and Grossman (2003) and is the foundation of our experimental design. Five options are presented and each option shows two payoffs used in the Peruvian experiments, each

with a 50% probability of occurring: in the top option for instance, subjects earn 26 Nuevos Soles (S/.) with certainty, while the option to the left has a low payoff of 20 S/. (with 50% probability) and a high payoff of 35 S/. (with 50% probability).We used different payoffs in the Montreal experiments. Counterclockwise from the top, the payoffs in Montreal are: 13$/13$, 10$/17.50$, 7$/22$, 4$/26.5$ and 1$/31$, all in Canadian Dollars. As we move counter clockwise in this figure, the variance in the payoffs is increasing. A simple way to study the effect of an additional alternative is to decompose this decision of a single choice between five options into four binary decisions. This decomposition, which we denote 'binary options' (BO hereafter) is presented in Figure 2: each row presents a different binary decision consisting of two gambles, which are next to each other in the instrument presented in Figure 1. The decomposition generates a series of decisions as is done in the Holt-Laury instrument, and presents the opportunity to address the methodological question of behavioral differences between the approach in FO and the approach in BO.

Figure 3 presents two examples of the third alternative added to the FO instrument. The top row shows one of the binary decisions. The second row shows a triplet with the center gamble dominated by the gamble to the left. We denote this triplet 'dominated safe', since the third alternative is dominated by the safe gamble. The last row shows the third alternative dominated by the risky gamble, which we denote 'dominated risky'.

Together Figures 1, 2 and 3 provide the features of the entire experimental design. There are thirteen choices in the experiment: one choice between five gambles to elicit subjects' risk preferences (Figure 1); four binary choices designed to elicit the same information (Figure 2); and eight triplet choices with a third alternative, where four times the alternative is a dominated safe gamble (second row of Figure 3), and four times it is a dominated risky gamble (third row of Figure 3).

The goal of our design is to fashion a particularly clean test of the effect of a third alternative. According to expected utility theory, a dominated alternative should not be

chosen and should thus not affect decision-making. We made the dominance as easy to spot as possible so that the editing phase in psychological alternatives to expected utility theory would rule out selection of the dominated alternative; according to these theories, once the dominance is noticed, the alternative is no longer considered. We avoided the complexity of the study of stochastically dominated alternatives. Our choice problem is largely context free compared with many studies of asymmetric dominance, providing relatively strong control for studying the effect of the third alternative. For example, many studies of dominance use hypothetical goods such as beverages or music, making it possible that subjects select on a dimension important to them but unobserved to the experimenter. If we can assume that subjects prefer more income to less when playing our gambles, then our design provides a cleaner measure of the effect of the new alternative.

With our previous discussion of additional, dominated, and asymmetrically dominated options in mind, we can test the following conjectures with our design.

*Conjecture 1*: The dominated options will have no effect.

We base this conjecture on the fact that decision theories tend to rule out choosing dominated alternatives. If this conjecture is false, then the dominated alternative matters and we must turn our attention to the following two conjectures.

*Conjecture 2*: The dominated alternative will remove choice from the similar alternative in greater proportion than from the dissimilar alternative.

We base this conjecture on the similarity effect. Subjects may see the dominated alternative as similar to the original gamble in terms of risk, and nearly identical in terms of payoff, but *superior* in a unique aspect uncontrolled by the experimenters. For example, subjects may see the dominated alternative as desirable because choosing it it makes them feel less greedy. This would reduce the probability of choosing the similar gamble disproportionately

more than reducing the probability of choosing the dissimilar alternative.

*Conjecture 3*: The dominated alternative will attract subjects to the similar alternative.

We base this conjecture on the effect of asymmetric dominance. Subjects may see the dominated alternative as similar to the original gamble in terms of the high payoff, but *inferior* in terms of the low payoff.[5] If they code the gambles in this manner, they may come to see the additional alternative as asymmetrically dominated in the worse outcome. Based on past experimental evidence, we would expect this to increase the probability of choosing the similar gamble disproportionately more than increasing the probability of choosing the dissimilar alternative.

# 4 Experimental Procedures

## 4.1 Peruvian Lab Experiment in the Field

### 4.1.1 Subject Pool

In the spring of 2005, we held our sessions in Cañete, a district 150 km south of the Peruvian capital, Lima. This district is in the central Costa region and is an arid area predominantly specializing in cotton production. We held one session in each of three different communities: Imperial, Cinco Esquinas, and Rinconada. We visited each of the three communities one week in advance to recruit subjects and the community leaders arranged for a locale in which to run the session.

We added a short questionnaire to collect basic individual and household demographic characteristics of the Peruvian subject pool. The questionnaire was administered by two

[5] Indeed, some of our subjects mentioned the avoidance of a loss as driving their choice. They cannot actually lose anything in our experiment, but if they are fixated on the low payoff in the gambles, they can interpret the realization of the lower payoff as a loss if another gamble had a better lower payoff than the one they chose.

experienced surveyors after the session but before subjects were paid. As is customary in rural Peru, where illiteracy may be a problem, surveyors read the question to the surveyed individual who responded orally. The oral responses were then recorded on the questionnaire sheets by the surveyors. Although we were prepared for illiterate subjects, we only had one subject in all sessions to have problems writing.

To control for wealth, the survey included questions about the dwelling that are used by the Peruvian statistical agency, Instituto Nacional de Estadística e Información (INEI), to construct an Unmet Basic Needs Index. For example, we asked about the materials used for the construction of the dwelling (e.g. adobe, concrete...), and access to water, sanitation and electricity. We constructed our Unmet Basic Needs Index with the standard used by the INEI. The means suggest that about one third of our subjects have at least one unmet basic need.

The three communities are quite heterogeneous: Imperial being semi-urban and the most developed and Rinconada the most isolated (rural) and least developed. Average education levels in these areas, despite being rural and agricultural, are relatively high. As shown in appendix 1, 26% our subjects completed secondary schooling, while 33% have some tertiary schooling, significantly higher than the national average of 22% (Barro and Lee, 2000). Most of our subjects are involved in some form of agriculture, mostly cotton farming and at the time of the survey, agricultural activity was at a low as the cotton flowers had only just bloomed. Men are over-represented in our subject pool (they account for 72% of the sample), and mean age is almost 46.

#### 4.1.2 Sessions

Subjects were given a show up fee of 10 S/. (approx. $3 US) upon arrival to cover their transportation and opportunity cost, which is roughly what an agricultural laborer earns in a day. Our research assistant, a native Spanish speaker, gave the instructions in all three

sessions.[6] The subjects were given a booklet comprising of the thirteen decisions. In each decision, they indicated their choice by pen. The order of the thirteen decisions as well as the left/right presentation of the gambles was randomly determined. The third alternative was always placed in the center so that it would always be apparent that it was similar to and dominated by one of the other two alternatives. Forty three subjects participated in the experiments, with session sizes of 11, 15, and 17.[7] Subjects earned an average of 25 S/. in addition to the 10 S/. show up fee. The experiments lasted approximately thirty minutes, and the entire time spent on the experiments and the survey was approximately 2 hours per session.

## 4.2 Montreal Laboratory Experiment

### 4.2.1 Subject Pool

We held each of our sessions at the Bell Laboratory for Experimental Economics at the Centre for Interuniversity Research and Analysis on Organizations (CIRANO) in the spring of 2005. We recruited from an English speaking subject pool (there is also a French speaking pool) consisting primarily of university undergraduates in Montreal. We did not ask the same post-experiment questions as in Peru because of the difference between the subject pools. Most notably, we asked the subjects to report their postal code (the equivalent to the zip code in the U.S.) so that we could use the average property value to control for their wealth.[8] Unlike in Peru, subjects filled out their questionnaires individually.

[6] The English instructions are provided in appendix 2. The instructions in Peru were given in Spanish and are a translation of the English instructions. The Spanish instructions are available upon request from the authors.

[7] Sample sizes in experimental studies of risk preferences in developing countries tend to be quite small. Our study compares in sample size with Grisley and Kellogg (1987) who had 39 farmers and Henrich and McElreath (2002) who had 51 farmers.

[8] We matched subjects by Forward Sortation Area (first three characters of the postal code) to the average value of dwelling in the 20% sample of the 2001 Canadian Census (Statistics Canada). To approximate parental wealth, we also asked subjects for the postal code where they grew up. Unfortunately, many of our subjects are international students, for which we have no comparable measure of dwelling value.

#### 4.2.2 Sessions

To the extent possible, we followed identical experimental procedures as in Peru. We conducted three sessions, subjects were paid a $10 CAD show up fee before making their decisions, the same research assistant conducted the sessions and read the script to the subjects, the experiments were conducted with pencil and paper, we used the identical realizations of random orderings of decisions that we used in Peru, and the third alternative was always placed in the centre. Forty four subjects participated in the experiments, with session sizes of 12, 15, and 17. Subjects earned an average of $19 CAD in addition to the $10 CAD show up fee. The experiments lasted approximately thirty minutes, and the entire time spent on the experiments and the survey was approximately 1 hour per session.

# 5 Results

## 5.1 Risk Preference Measures

Figure 4 shows the distribution of choices in the FO instrument (depicted in Figure 1) for the Peruvian sessions. This distribution is skewed towards the safest of the five options. Conversely, Figure 5 depicts the distribution of choices made in the Montreal sessions. This distribution is bi-modal and shows that Montreal subjects generally choose riskier options; roughly a quarter of all subjects choose the riskiest of the five. Our results suggest that the Peruvian farmers tend to be relatively more risk averse than the Montreal subjects.[9]

To investigate the possible determinants of risk aversion, we analyze the effect of socio-economic characteristics (age, gender, marital status, wealth, education) on measured risk aversion (Table 1). Columns (1) reports the results for the Peruvian sample and column (2)

[9] We cannot rule out that this difference is due, at least in part, to different stakes in the different locations. Camerer and Hogarth (1999) in a survey note that the effect of stakes on decisions in experiments is context dependent, where increasing stakes in gambles increases risk levels of risk aversion. Holt and Laury (2002) report that higher stakes led to more risk averse behavior.

for the Montreal samples. We convert the FO choice into a discrete number to create the dependent variable, increasing in risk from 0 (the safest choice) to 4 (the riskiest choice). Thus, the dependent variable is increasing in risk loving attitudes. The experimental literature, with particular reference to farmers in developing countries, does not however provide firm predictions.

Age has no effect on risk preferences among the Peruvian farmers and a negative effect among the Montreal subjects. Thus, our Montreal (but not Peru) results are consistent with Miyata (2003) who finds that older Indonesian farmers are more risk averse. Single individuals are more risk loving than married individuals, relative to being divorced or widowed. Men are not discernibly more risk loving than women in Peru, though they are in Montreal, consistent with Eckel et al. (2004) and Wik et al. (2004). Education has a negative effect on measured risk preferences in the Peruvian sample; an effect that is increasing with educational attainment. This effect is consistent with Grisley and Kellog's (1987) study of Thai farmers, but contrary to Miyata's (2003) results. Education has little effect on risk postures in Montreal, which might be explained by little variation in educational attainment. Wealth matters in both samples, but with opposing directions. The household's poverty status, measured by the Unmet Basic Needs Index, is inversely related to risk preferences in Peru indicating that wealthier individuals are less risk averse. Average value of dwellings in forward sortation area of current residence, the measure of wealth for the Montreal sample, suggests instead that wealthier subjects are more risk averse. Our inconclusive wealth effects are however consistent with existing empirical evidence: Binswanger (1980), Miyata (2003) and Kebede et al. (2004) find that risk aversion is decreasing in wealth, while Shahabuddhin et al. (1986) and Grisley and Kellog (1987) find the reverse.[10]

[10] We present the results from a Poisson regression. One may argue that such a dependent variable may be better estimated with an ordered probit or an ordered logit. The ordered probit and logit produce similar results to the Poisson with the following exceptions: marital status and unmet basic needs index is no longer significant in Peru, while father's education becomes weakly significant in the Montreal sample suggesting that family background is correlated with risk-aversion. Results are available upon request.

## 5.2 Comparison of the FO instrument with the BO Instrument

We are interested in whether the two methods yield similar results in terms of measured risk posture. In BO, we count the number of risky choices to approximate the degree of risk loving, and the number of safe choices to approximate the degree of risk aversion (this measure was used by Holt and Laury). As there are four binary decisions, an individual who makes 4 risky choices is considered more risk loving than an individual making only 3, 2, 1 or no risky choices. Similarly, we can also approximate risk preferences from either of the two sets of triplet decisions in a parallel fashion.[11] Since the payoffs in our BO instrument come directly from our FO instrument, individuals who chose a risky option in one should also tend to choose a risky option in the other. Thus one would expect to see a high correlation between the choice in FO and the number of risky choices in BO and the triplet decisions.

Table 2 provides the correlation matrix of subjects' choices in the FO, the BO and the two sets of triplet decisions. We immediately observe that the correlation between the number of risky BO choices and the choice in the FO instrument is statistically significant and positive, but less than one. The correlation coefficient from the Peruvian sample is half that from the Montreal sample. The correlations between the risky BO choices and the risky triplet choices are stronger than those between BO and FO for both samples. Also, the correlation is higher for the triplet with the dominated risky than the triplet with dominated safe. We conclude that while both instruments measure similar risk preferences, these measures are nonetheless different.

[11] Note that the number of choices acts as an ordered variable and that associated with each binary decision, for instance, is a parameter range for the coefficient of relative risk aversion.

## 5.3 Effect of the Additional Alternative

### 5.3.1 Are Dominated Options Irrelevant?

Conjecture 1 has two testable implications. First, the dominated alternative should never be chosen. Thus, the number of dominated safe choices in the triplets with dominated safe ($n_{ds}^{ts}$) should be equal to the number of dominated risky choices in the dominated risky triplets ($n_{dr}^{tr}$). Second, the dominated alternative should have no effect. Thus, the number of safe BO choices ($n_s^b$) should be the same as the number of safe choices in the triplets with dominated safe ($n_s^{ts}$) and the triplets with dominated risky options ($n_s^{tr}$). Similarly, the number of risky BO choices ($n_r^b$) should be the same as the number of risky choices in the triplet with dominated safe ($n_r^{ts}$) and the triplets with dominated risky ($n_r^{tr}$).

This conjecture is resoundingly rejected. In the Peruvian sample, the first part of the conjecture is easily rejected: in the triplets with dominated safe options, 26% selected the dominated safe gamble while 23% selected the dominated risky gamble in the triplets with dominated risky options.[12] In unreported regressions, we found that none of the socio-economic characteristics predicted whether subjects made a dominated choice. However, we also found that making dominated choices (as well as the number of dominated choices) was positively associated with a riskier choice in the FO instrument. Given such a high rate of dominated option selection in Peru, our surveyors were asked to investigate this further by asking subjects why they chose the strategies they chose. That some subjects chose the dominated option is not random. One admitted to choosing based on their lucky numbers, which happened frequently in the dominated payoffs. Many others however were attracted to the dominated gamble because it made them feel less greedy. A common response was along the lines that 'God rewards modesty but punishes greediness'. In the Montreal sample, only 2% of triplet decisions were dominated ones; the first part of the conjecture thus holds

[12] In Binswanger (1980), 33% of the subjects chose a stochastically dominated gamble at least once. These subjects chose a gamble with a higher variance but the same mean as another available gamble. Risk averse subjects should not make this choice. In our experiment, no subject should choose the dominated alternative.

for this sample.

At this point we check the data for evidence for a naive diversification strategy in case subjects are randomly choosing the dominated alternative. When presented with '$m$' alternatives, a diversification strategy would have subjects choose each alternative with frequency '$1/m$'. Such strategies have been observed among investors (Benartzi and Thaler, 2001) and trick-or-treating children (Read and Lownstein, 1995).[13] We do not believe that our subjects are employing a diversification strategy. If they were, they would be choosing the safe, dominated and risky options with equal frequency (1/3 of the time). In Peru, only 3 subjects are observed with such choices. In Montreal, meanwhile, such choices are never observed.

The second part of conjecture 1 is however rejected in both samples. Table 2 showed that the number of risky BO choices is positively correlated with the number of risky choices in both triplets. However, this correlation is significantly less than one, more so for the Peruvian sample than for the Montreal sample. Moreover, Table 3 provides some regression results where we present the correlation between a risky BO choice and a risky choice in each of the two associated triplets, controlling for socio-economic characteristics. If conjecture 1 were true, then the coefficient of the number of risky BO choices on the number of risky triplet choices should be close to or equal to one. This is clearly not so in either the Peruvian or the Montreal samples: the further away the coefficients are from one, the more the dominated option mattered. Since the Peruvian sample estimates are significantly lower than in the Montreal sample, we conclude that the dominated alternative matters most among our Peruvian subjects.

Additionally, we test the equality of the distributions between the BO and each of the triplet decisions (Table 4) using mean comparison tests. In nearly all cases, especially in the Peruvian sample, we reject that the number of safe (risky) BO choices equals the number of

[13] Read and Lowenstein (1995) noted that this behavior occurred more often when subjects made their choices simulataneously than when they chose sequentially. Our BO design involved sequential choices to mitigate this possible effect.

safe (risky) triplet choices, rejecting conjecture 1 in this sample. Conjecture 1 is only weakly rejected in the Montreal sample in half of the cases: we reject equality of means between BO and triplet decisions at the 10% level, and only once at the 5% level. Since subjects chose dominated options in the Peru sessions but not in Montreal, then conjecture 2 is relevant in Peru while conjecture 3 is relevant in Montreal.

### 5.3.2 Does the Additional Alternative Make the Similar One More Attractive?

Conjecture 2 implies that the dominated alternative removes disproportionately from the similar option compared to the dissimilar one. Thus, the number of safe BO choices minus half of the number of dominated safe choices must be greater than the number of safe choices in the triplets with dominated safe option ($n_s^b - \frac{n_{ds}^{ts}}{2} > n_s^{ts}$) and the number of risky BO choices less the number of dominated risky choices must be greater than the number of risky choices in the triplets with dominated risky option ($n_r^b - \frac{n_{dr}^{tr}}{2} > n_r^{tr}$). In this conjecture, subjects might make some dominated choices. Thus $n_{ds}^{ts} \neq 0$ and $n_{dr}^{tr} \neq 0$.

Rows (5) and (6) of Table 4 test this conjecture. Our results here are surprising. In the case of triplets with dominated safe options, the dominated option appears to have taken away proportionately from the safe and risky choices. However, in the case of the triplets with dominated risky options, there seems to be a shift towards the risky option, while the conjecture would imply the opposite. These results are supported by Table 3: comparing the coefficients in Panels A and B for the Peruvian sample, we see that the estimates are significantly larger in Panel A than in Panel B. Thus, a risky choice in the triplet with dominated risky is more highly correlated with a risky choice in the BO compared with the risky choice in the triplet with dominated safe. In these triplets, subjects appeared to become more risk-loving when faced with the third, dominated risky, alternative.

### 5.3.3 Does Asymmetric Dominance Hold?

Conjecture 3 implies that the dominated alternative attracts subjects to the similar alternative. Thus, the number of safe BO choices must be less than the number of safe choices in the triplets with dominated safe option ($n_s^b < n_s^{ts}$) and the number of risky BO choices must be less than the number of risky choices in the triplets with dominated risky option ($n_r^b < n_r^{tr}$). In this conjecture, subjects should not make dominated choices.

Rows (7) and (10) of Table 4 tests this conjecture for the Montreal sample. Our results suggest that $n_s^b = n_s^{ts}$ and weakly that $n_r^b < n_r^{tr}$. Since this conjecture implies that $n_s^b < n_s^{ts}$ and $n_r^b < n_r^{tr}$, our results reject the former but is weakly consistent with the latter at a 10% confidence level. We conclude that the dominated option did not affect the Montreal sample. To the extent that the dominated option did matter, our results weakly support the asymmetric dominance effect. In such a conventional subject pool, these results are not surprising and tend to validate our experimental design: the asymmetric dominance effect has been found in marketing studies.

# 6 Discussion

This study is the first to document the effect of an additional alternative on measured risk preferences. In a lab experiment in the field, we modeled the decision-making process as a choice between a safe and a risky gamble. We then presented subjects with a third gamble that is dominated in payoffs by one of the other two. This is a simple test of how subjects react to being faced with a new alternative: we should not observe subjects choosing the new alternative if it is dominated by one of the original ones. We can use the accepted instrument of risk preference measurement to measure the effect of the third choice.

We ran our lab experiments in Peruvian cotton producing communities. Our results strongly indicated that the third, additional, alternative did indeed matter in subjects'

decision-making. We found two surprising results. First, we observed that subjects chose the dominated gamble a quarter of the times in which these were presented to them. Second, when the dominated alternative was similar to the risky gamble, we found that the dominated alternative removed choice from the similar alternative in lesser proportion than from the dissimilar alternative. Thus, subjects appeared to become more risk-loving. To our knowledge, this is the first time that these two effects have been documented.

We ran these experiments with a more conventional subject pool (university students) in Montreal. We conclude that the Peruvian subjects react quite differently from the Montreal subjects when faced with an additional alternative: their measured risk preferences change more when presented with a third dominated alternative. Meanwhile, the effect in the Montreal sample appeared like asymmetric dominance.

The results of our experiments suggest that the availability of new alternatives, be it new farming technologies, new contraceptive methods or new credit contracts, may influence risk taking behavior. Policy makers and non-governmental organizations may want to take this into consideration when devising technical assistance, training or educational programs.

Finally, we contributed methodologically by being the first to compare behavior with an instrument with a single choice between many alternatives (FO) with one that poses a series of binary choices (BO). This methodological contribution is useful because both types of instruments are currently in use (e.g., Holt and Laury, 2002 and Eckel and Grossman, 2003). While the subjects' elicited risk preferences are correlated across both instruments, the correlation is far from being one. This is particularly the case in the Peruvian sample. Thus, our results suggest that researchers exercise caution in the interpretation of their risk preference elicitation mechanisms, particularly when doing field work in a developing country.

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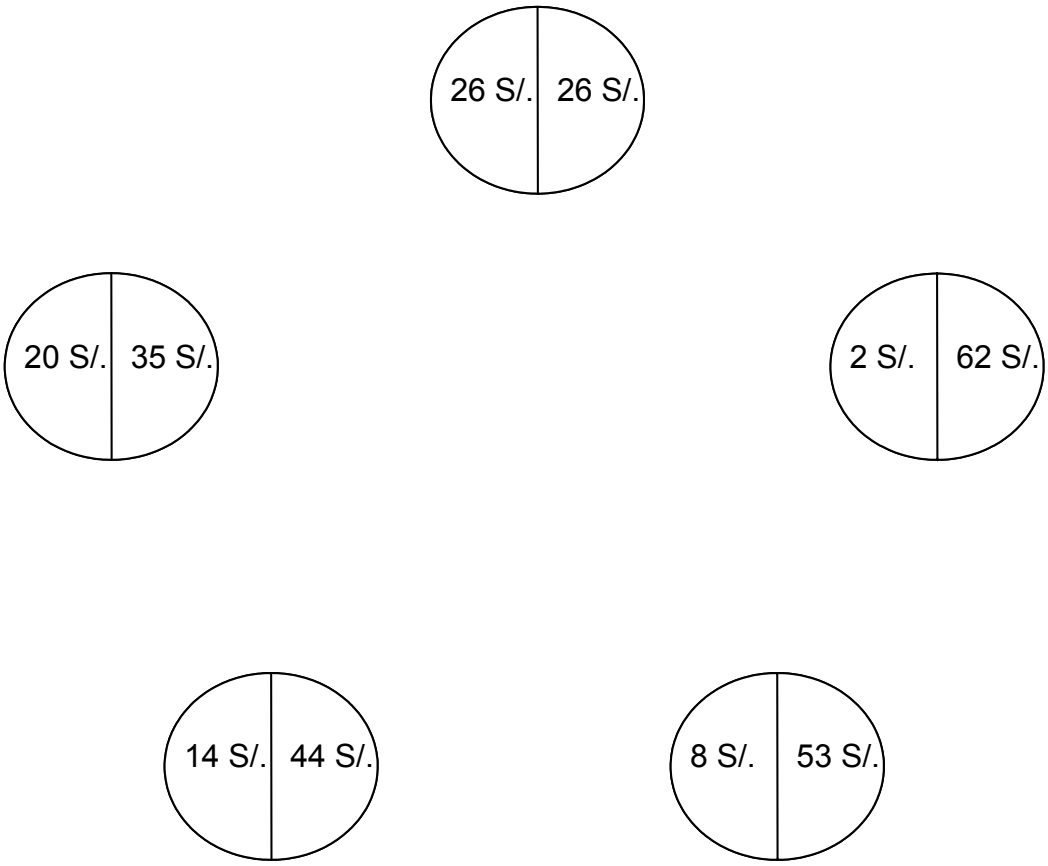
## Figure 1: 'Five Options' Risk Preference Measurement Instrument

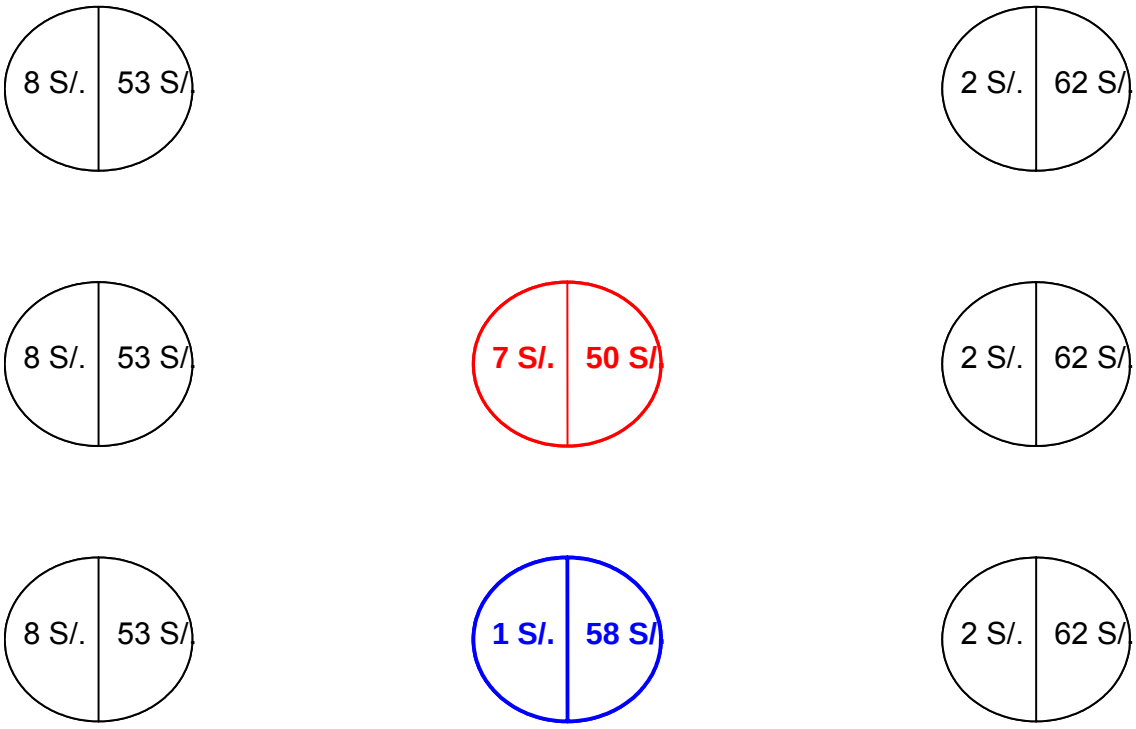



**Note:** In this instrument, subjects are presented with a single decision between these five options. Each option is associated with a high payoff and a low payoff, with 50% probability that either will occur. The payoffs depicted here are the ones from the Peruvian experiments, and so are denominated in Peruvian Nuevos Soles (S/.). In the Montreal experiments, we used different payoffs. Counterclockwise from the top, the payoffs in Montreal are: 13$/13$, 10$/17.50$, 7$/22$, 4$/26.5$ and 1$/31$, all in Canadian Dollars.

**Figure 2: Decomposing the 'Five Options' Instrument into a Series of 'Binary Options' Instruments**


**Note:** This figure shows how the one decision presented in Figure 1 can be decomposed into four different decisions. The payoffs are also depicted in Peruvian Nuevos Soles (S/.). See the note to figure 1 for the corresponding payoffs in Montreal.

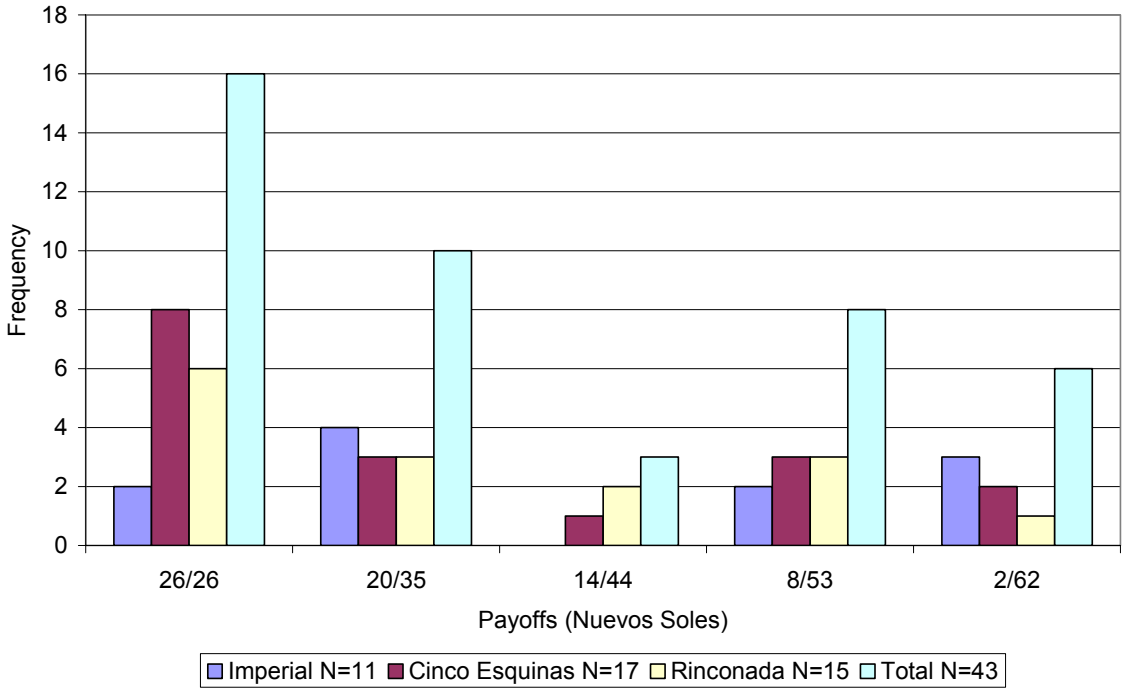
## Figure 3: Adding the Dominated Third Alternative




**Note:** For each binary decision in Figure 2 (for example the top row in this table), we added two other decisions, one with a dominated safe alternative (second row) and one with a dominated risky alternative (third row). Payoffs depicted in this figure are from the Peruvian experiments and denominated in Peruvian Nuevos Soles (S/.)

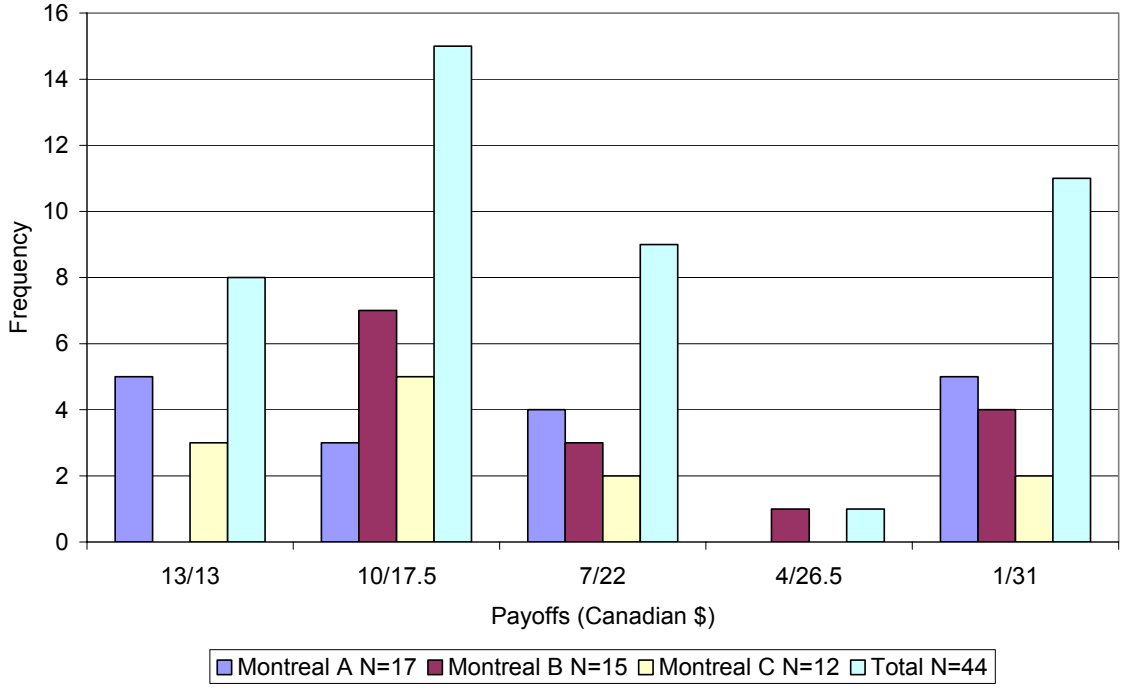
# Figure 4

Distribution of Choices in the 'Five Options' Instrument(Peru)




# Figure 5

Distribution of Choices in the 'Five Options' Instrument (Montreal)



## Table 1 – Socio-Economic Determinants of Risk Preferences Measured by the 'Five Options' Instrument (Poisson Estimates)

| | Peru (N=43) | Montreal (N=44) |
|---|---|---|
| *Demographics* | | |
| Age | 0.016 | -0.081*** |
| | (0.018) | (0.027) |
| Male | 0.272 | 0.663*** |
| | (0.514) | (0.213) |
| Married[a/] | 0.871* | -0.004 |
| | (0.500) | (0.419) |
| Single[a/] | 1.116*** | -- |
| | (0.412) | -- |
| Household Head | -0.603 | -- |
| | (0.495) | -- |
| Working | -- | -0.600** |
| | -- | (0.293) |
| *Education* | | |
| Primary completed or secondary incomplete[b/] | -1.362** | -- |
| | (0.671) | -- |
| Secondary completed[b/] | -1.505** | -- |
| | (0.671) | -- |
| Post secondary[b/] | -2.105*** | -- |
| | (0.630) | -- |
| Incompleted post-secondary[c/] | -- | 0.189 |
| | -- | (0.353) |
| Graduate school [c/] | -- | 0.329 |
| | -- | (0.447) |
| *Wealth* | | |
| Unmet basic needs index | -2.787* | -- |
| | (1.457) | -- |
| Average value of dwelling in Forward Sortation | -- | -2.397** |
| Area of current residence (log, Cdn $)[d/] | -- | (0.964) |
| Mother's educational level [e/] | -- | 0.186 |
| | -- | (0.144) |
| Father's educational level [e/] | -- | -0.218 |
| | -- | (0.138) |
| Wald Chi-Squared (11) | 48.33*** | 49.50*** |
| Pseudo R Squared | 0.1664 | 0.1436 |

***, ** and * statistically significant at the 1%, 5% and 10% level, respectively. Results robust to specification (ologit, oprobit and tobit yield similar results). All regressions include session controls. [a/] Omitted category is separated, divorced or widowed. [b/] Omitted category is less than primary completed. [c/] Omitted category is completed primary. [d/]Source: 20% sample of the 2001 Canadian Census (Forward Sortation Area corresponds to the first 3 characters of the posal code). [e/] Categorical variable: 0=less than secondary school; 1=secondary school completed; 2=University undergraduate; 3=University graduate.

## Table 2 – Correlation Matrix of Risky choices in the 'Five Options', 'Binary Options' and Triplets Instruments

| | Number of Risky Choices | | |
|---|---|---|---|
| | Peru (N=43) | | |
| | Binary | Triplet (with dominated safe) | Triplet (with dominated risky) |
| Triplet (with dominated safe) | 0.606*** (0.000) | 1 | |
| Triplet (with dominated risky) | 0.647*** (0.000) | 0.525*** (0.000) | 1 |
| Eckel/Grossman choice | 0.306** (0.046) | 0.218 (0.160) | 0.550** (0.000) |
| | Montreal (N=44) | | |
| | Binary | Triplet (with dominated safe) | Triplet (with dominated risky) |
| Triplet (with dominated safe) | 0.713*** (0.000) | 1 | |
| Triplet (with dominated risky) | 0.726*** (0.000) | 0.726*** (0.000) | 1 |
| Eckel/Grossman choice | 0.627*** (0.000) | 0.626*** (0.000) | 0.607*** (0.000) |

*** and ** statistically significant at the 1%, 5% and 10% level, respectively.

# Table 3 – Marginal Effects from Logit Estimation

| *Panel A - Risky Choice in triplet with dominated risky* | | | | |
|---|---|---|---|---|
| | Peru (N=172) | | Montreal (N=176) | |
| Risky choice in binary | 0.288*** | 0.278*** | 0.640*** | 0.603*** |
| | (0.080) | (0.088) | (0.064) | (0.069) |
| Wald Chi-Squared | 13.53*** | 41.41*** | 47.66*** | 50.55*** |
| Pseudo R-Squared | 0.0730 | 0.1312 | 0.3368 | 0.3629 |
| Individual and Household Covariates | No | Yes | No | Yes |
| N | 172 | 172 | 176 | 176 |

| *Panel B - Risky Choice in triplet with dominated safe* | | | | |
|---|---|---|---|---|
| | Peru (N=172) | | Montreal (N=176) | |
| Risky choice in binary | 0.206*** | 0.156*** | 0.618*** | 0.598*** |
| | (0.073) | (0.073) | (0.069) | (0.078) |
| Wald Chi-Squared | 10.21** | 30.15*** | 47.41*** | 54.22*** |
| Pseudo R-Squared | 0.0722 | 0.1421 | 0.3023 | 0.3205 |
| Individual and Household Covariates | No | Yes | No | Yes |
| N | 172 | 172 | 176 | 176 |
| Difference | 0.082*** | 0.122*** | 0.022 | 0.005 |
| | (0.016) | (0.017) | (0.014) | (0.016) |
| p-value | [0.000] | [0.000] | [0.1247] | [0.7509] |

***, ** and * statistically significant at the 1%, 5% and 10% level, respectively. All regressions are clustered by subject and include session controls. Same covariates as in Table 1.

## Table 4 – Non-Parametric Tests
## (P-Values in brackets; Ho: Mean(Diff)=0)

| | | Peru (N=43) | | |
|---|---|---|---|---|
| Test | Diff= | $H_a$: Mean(Diff)<0 | $H_a$: Mean(Diff)≠0 | $H_a$: Mean(Diff)>0 |
| (1) | $n_s^b - n_s^{ts}$ | [0.9984] | [0.0032] | [0.0016] |
| (2) | $n_s^b - n_s^{tr}$ | [1.0000] | [0.0001] | [0.0000] |
| (3) | $n_r^b - n_r^{ts}$ | [0.9986] | [0.0028] | [0.0014] |
| (4) | $n_r^b - n_r^{tr}$ | [0.9086] | [0.1828] | [0.0914] |
| (5) | $n_s^b - \frac{n_{ds}^{ts}}{2} - n_s^{ts}$ | [0.6243] | [0.7513] | [0.3757] |
| (6) | $n_r^b - \frac{n_{dr}^{tr}}{2} - n_r^{tr}$ | [0.0370] | [0.0739] | [0.9630] |
| | | Montreal (N=44) | | |
| Test | Diff= | $H_a$: Mean(Diff)<0 | $H_a$: Mean(Diff)≠0 | $H_a$: Mean(Diff)>0 |
| (7) | $n_s^b - n_s^{ts}$ | [0.1336] | [0.2671] | [0.8664] |
| (8) | $n_s^b - n_s^{tr}$ | [0.9334] | [0.1332] | [0.0666] |
| (9) | $n_r^b - n_r^{ts}$ | [0.9531] | [0.0937] | [0.0469] |
| (10) | $n_r^b - n_r^{tr}$ | [0.0914] | [0.1827] | [0.9086] |

**Notes:** $n_s^b$ =Number of safe choices in the binary decisions; $n_s^{ts}$ = number of safe choices in the triplets with dominated safe; $n_s^{tr}$ =number of safe choices in the triplets with dominated risky; $n_r^b$ =number of risky choices in the binary decisions; $n_r^{ts}$ =number of risky choices in the triplets with dominated safe; and $n_r^{tr}$ = number of risky choices in the triplets with dominated risky.

# Appendix 1 – Descriptive Statistics of Subject Pools

| | Peru (N=43) | | | | Montreal (N=44) | | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **Std. Dev.** | **Min** | **Max** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| *Demographics* | | | | | | | | |
| Age | 45.953 | 13.603 | 20 | 74 | 25.045 | 6.833 | 19 | 53 |
| Household Head | 0.279 | 0.454 | 1 | 0 | | | | |
| Sex (Male=1) | 0.721 | 0.454 | 0 | 1 | 0.545 | 0.504 | 0 | 1 |
| Married | 0.767 | 0.427 | 0 | 1 | 0.136 | 0.347 | 0 | 1 |
| Separated | 0.070 | 0.258 | 0 | 1 | 0.000 | | | |
| Single | 0.163 | 0.374 | 0 | 1 | 0.864 | 0.347 | 0 | 1 |
| Working | 0.837 | 0.373 | 0 | 1 | 0.364 | 0.487 | 0 | 1 |
| *Education* | | | | | | | | |
| Student | | | | | 0.818 | 0.390 | 0 | 1 |
| Less than Primary schooling | 0.232 | 0.427 | 0 | 1 | | | | |
| Some Primary schooling | 0.186 | 0.394 | 0 | 1 | | | | |
| Completed secondary schooling | 0.256 | 0.441 | 0 | 1 | | | | |
| Post secondary schooling | 0.326 | 0.474 | 0 | 1 | | | | |
| Post secondary schooling incomplete | | | | | 0.023 | 0.151 | 0 | 1 |
| Post secondary schooling complete | | | | | 0.727 | 0.451 | 0 | 1 |
| Graduate school | | | | | 0.250 | 0.438 | 0 | 1 |
| *Wealth* | | | | | | | | |
| Unmet basic needs index | 0.318 | 0.216 | 0 | 0.83333 | | | | |
| Average dwelling value in FSA (in $CDN)[a/] | | | | | 217,771 | 72,591 | 110,553 | 346,586 |

[a/]Source: 20% sample of the 2001 Canadian Census (Forward Sortation Area corresponds to the first 3 characters of the posal code).