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Does Education Increase Risk Aversion in Households? Some Evidence Using Artefactual Experiments in Peru

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Abstract

We provide empirical evidence supporting a causal link between education and risk attitudes when using representative data from representative surveys and artefactual or lab-on-the-field experiments in Lima, Peru. We employ three standard experimental measures of risk attitudes and find that each is positively correlated with years of education. Furthermore, we suggest that this relationship may be causal as we take advantage of an identification strategy that exploits an exogenous boom in the construction of new schools in Lima, providing evidence that more education may increase risk attitudes. Our findings are further confirmed when applying a broad set of robustness tests.

JEL Classification Code: D01, O12,

Key Words: Experiments, Surveys, Risk Attitudes, Education, Latin America

Introduction

Education is usually at the forefront of policymaking in most developing countries as it is firmly believed that it can be welfare-enhancing for it helps individuals make better decisions in an expanded set of choices. Uninformed, uneducated individuals may be less able to distinguish between the costs and benefits of alternative options, producing equivocal, welfare

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decreasing choices. This may range from simple, everyday household decisions, such as comparing the nutritional content of foods, to more substantial ones, such as deciding on the optimal business credit line.

While, on average, there is little doubt that more education will translate into better decisions and thus better choices in households, it is not uncommon to find cases where more education will not translate into improved choices, but on somewhat puzzling ones, which are not consistent with the paradigm described above. For instance, it is unclear why rural households in developing countries frequently prefer to stick with highly inefficient farming methods, even after being taught and demonstrated that simple, modern improvements in their agricultural methods can result in vastly more productive and efficient harvests. Similarly, it is unclear why incipient home-based entrepreneurs in developing countries are so wary about opening formal banking accounts and prefer to keep the cash "under the mattress," regardless of the demonstrable benefits and convenience of being part of a commercial banking system[1].

Whereas there may be different explanations for these behaviors, in this research, we focus on risk attitudes, which are perhaps as significant as other more commonly discussed factors, such as culture and tradition, but are often overlooked in policy considerations. In particular, we study education's role on risk attitudes and how the former impacts the latter if any. We argue that this link may help understand why individuals and heads of households may be reluctant to make choices consistent with their seemingly best interests, regardless of their education. In the context of the examples described above, for instance, rural households that learn modern agricultural techniques may also learn that the use of pesticides and other chemicals can put their health at risk and can contaminate their soil and water if they are not careful enough, which may produce the unintended effect of increasing an aversion to the new technique instead of embracing it, especially when compared to their inefficient, but generations-tested agricultural methods. Similarly, in the case of home-based entrepreneurs, when learning about the benefits and convenience of the formal banking system, they may also learn that these benefits may also mean losing physical track of their money, something they may perceive as risky and thus may be averse to doing.

In this paper, we empirically explore the extent to which education may increase risk attitudes, as shown by the examples above. This is not a new question, but it is not well understood, which is illustrated by the fact that while some studies show a positive correlation between education and risk, other studies find a negative correlation between these two variables. Furthermore, some other empirical studies do not find any link between them. Unlike previous work, we offer three specific contributions to the literature, which we believe are significant to understanding the relationship between education and risk. First, we use new and representative data at the city level, which was explicitly considered and is relatively uncommon in this empirical work. Second, we employ risk measures based on artefactual or laboratory-on-the-field experiments, which are viewed as more reliable than measures based on standard household surveys. We use three "tried and true" artefactual measures that have been broadly employed and accepted in the literature as reasonable proxies for risk attitudes. Third, we make a reasonable attempt to test for the causal association between education and risk attitudes. This is done by exploiting an exogenous school infrastructure construction shock in Lima, Peru. We believe that the contributions of our paper are significant to both the literature on risk attitudes in households and may be of use to policymakers, which may be able to assess better the effectiveness of educational promotion as a policy tool.

1 This type of example is not circumscribed to developing countries. For example, about the 2016 presidential democratic primaries in the United States, Blow (2016) argues that the strong preference of black voters towards Hillary Clinton instead of Bernie Sanders, even though the latter better represents their interests, has endured for decades despite "education, a vast, all-purpose term, conjuring up visions of sunlit housing projects, stacks of copybooks and a race of well-soaped, dark-skinned people who never slur their R's…" (Baldwin, 1955).

Overall, our findings are consistent with previous studies that show a positive link between education and risk attitudes. To the extent that our identification strategy may be credible, we also provide suggestive causal evidence when testing from education to risk. This implies that the extent to which education can shape risk attitudes can help provide a better understanding to policymakers who, while clearly understanding the importance of education, tend to discount the importance of risk in policy design significantly.

Our paper is organized as follows. The next section provides a brief review of the literature. Section 3 describes the data as well as the experimental design, including the specific risk games applied. Section 4 presents our identification strategy. Section 5 presents our main findings. Section 6 offers robustness tests. Finally, in section 7, we present a summary and conclude.

Brief Review of the Literature

As mentioned above, there is little consensus on the nature of the link between education and risk aversion, if any. Theoretically, some researchers have argued that the link between education and risk attitudes may be negative. For instance, Breen, et al (2014) develop a rational choice model of educational decision-making in which the utility of educational choices depends on the risk aversion individuals and their time discounting preferences. While individuals from advantaged socioeconomic backgrounds may not be affected by risk aversion, those with lower time discounting preferences and low-risk aversion may be more likely to opt for more education, which in their model may likely result in higher long-term payoffs. Thus, these researchers find that risk aversion and time discounting preferences may mediate the effect of socioeconomic background on educational choices, and the effect of these factors on educational decision-making may vary across socioeconomic groups.

On the other hand, Brodaty et al. (2014) have argued that the link between education and risk aversion may be optimistic. They propose a model in which an individual's investment in education maximizes expected utility conditional on public and private information. Their model considers future wage risk and treats the direct and opportunity costs of education as additional sources of risk. They argue for significant and substantial effects of expected returns on individual education choices. The risk affecting education costs and, in particular, the randomness of time-to-degree plays an important role in explaining enrollment in higher education. They claim that more educated individuals bear more risk and are more risk-averse than other groups. Yet, they will study more because of higher returns and markedly lower expected investment costs. As Outreville (2015) described, the relationship between risk aversion and the level of education is even more ambiguous. This researcher explains that from a causality point of view, it may be argued that investors with a high level of education are less risk-averse. Still, it may also be argued that less risk-averse individuals choose to pursue a higher level of education.

The ambiguity existing in theory is also reflected empirically. For instance, Harrison et al. (2007) provides experimental evidence that shows a positive and statistically significant link between higher education and risk aversion. This effect appears to be monotonic, given that the sign and significance of the effect remain regardless of the magnitude of the prize of lottery employed. Similarly, Dohmen et al. (2010) use data from a German survey and experimental data to study the intergenerational links related to risk-taking and show a positive causal effect between the education level of parents and the risk aversion of the children. Finally, additional studies that find a positive link between education and risk aversion are Hardeweg et al. (2013) and Jung (2014). However, while plenty of research shows a positive link between education and different measures of risk aversion, there is also plenty of evidence that shows that such a link may be negative. For instance, Riley and Chow (1992) use data from investment decisions of a sample of US households. They show that risk aversion tends to decrease significantly as the years of education increase. Similarly, Caliendo et al. (2009) apply different risk aversion

measures and find a negative and statistically significant effect with higher education, albeit with a shallow marginal effect. Other studies that find a negative link between education and risk aversion are Donkers et al. (2001), Hartog et al. (2002), and Hryshko et al. (2011).

Furthermore, other studies, such as Halek and Eisenhauer (2001), provide evidence showing ambiguous effects between the educational level of individuals and risk aversion measures. For example, Hartlaub and Schenider (2012) find that students with a higher social background are not only less sensitive to their school performance, and individual risk aversion is irrelevant to their educational plans. But, on the other hand, they find that students with a lower social background are more risk-averse and, thus, more likely to opt for further education. Similarly, Belzil and Leonardi (2007) find that such a link may be non-linear by showing evidence that schooling continuation probabilities decrease with risk aversion at low grade levels, but increase with risk aversion at the time when the decision to enter higher education is made, where differences in attitudes toward risk account for a modest portion of the probability of entering higher education and differences in parental human capital and abilities are more important.

Data and Experimental Design[2]

The individuals who participated in this study throughout 2007 were recruited to fulfill strata quotas for Metropolitan Lima and were selected based on education, gender, age, and average family income in either quartiles or quintiles, depending on data availability. They were invited to the study so that the empirical distributions of individuals within these combinations of characteristics resembled those of the population in Lima. That is, the sample collected is representative of the observable characteristics that make the strata. The individuals recruited were living in the different districts of Lima at the moment of the interview. This recruitment process was done to ensure that they were not transient individuals but people who actually lived in the districts from which they were recruited. The recruitment methods in the city included phone calls, door-to-door visits, e-mail invitations, and calls in public workplaces. Once recruited, the people were invited a few days before the experimental session to receive information about the expected gains from participating in the experiments, including a show-up fee and potential gains resulting from their decisions.

At that stage, we gathered participants' socioeconomic background information, which was used as input in the experimental sessions. The day before the experimental sessions, participants received a phone call or a visit to be reminded about the invitation and to coordinate transportation arrangements. On the day of the sessions, which were 20 in total, the participants were welcomed, and at the accorded time, the sessions began. Approximately 30 individuals were invited for each session, assuming that around one-third would not show up, thus allowing each experimental session to have between 20 to 25 participants. The sessions were arranged so that at least three included individuals from high-income strata only, and at least three included individuals from low-income strata only. The rest combined individuals from all strata. The participants met throughout the session in one room where they could see each other, although they were not allowed to communicate during the session. Thus, we avoided having two people who knew each other during the recruitment process within the same session. However, as the sessions progressed, participants received information about their peers. In particular, social heterogeneity on individuals' decisions in each particular session was made as salient and straightforward as possible using the information collected on the socioeconomic composition

2 The experimental data employed in this paper, which are publicly available, come from a broader research effort funded by the Inter-American Development Bank, of which Chong was a co-principal investigator. It is essential to mention that this section draws very heavily from previous research that also describes both this same experimental design and the application on the field, in particular, Cardenas, Chong, and Nopo (2013). We do this for the sake of completeness so that the paper can remain self-explanatory. In addition, Candelo et al. (2008) provide a technical note with a detailed account of the complete experimental design and implementation of the exercises employed in this paper. The complete data collection resulting from the project also includes information for the other five cities in Latin America and additional artefactual experiments.

of the groups. In general, each experimental session followed the same protocol, which included the same sequence of activities to guarantee consistency. Following the batteries of experiments, participants completed a post-session survey. To reduce idiosyncratic measurement error, the surveys were administered by the coordinators of the experiments and supported by a group of pollsters especially trained for these purposes. Our full final sample size is 540 individuals in the city of Metropolitan Lima.

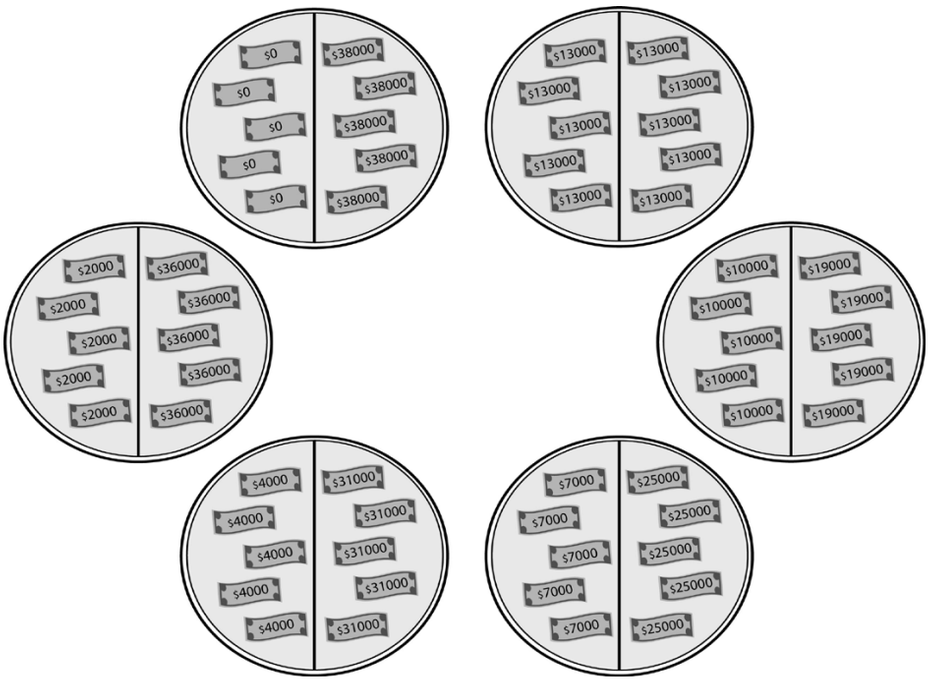
The three experimental risk games applied in this research are all "tried and true" activities. The aim was not to create a new risk measure or refine existing ones but to employ broadly accepted experimental risk measures that are believed to capture risk attitudes in individuals adequately. In this regard, we follow the well-known tripartite concept by Kahneman and Tversky (2000) and later consolidated in experimental measures using gambling approaches by Binswanger (1980) and, more recently, Barr (2003).

These experiments are clearly described in Cardenas et al. (2009): "*The first stage, measuring risk aversion, offered the participants known probabilities and known outcomes for six fifty-fifty lotteries that went from a sure low payoff to an all-or-nothing higher payoff. The lotteries in between gradually increased in expected value and in the spread of the low and high payoffs, but all of them were fifty-fifty. The second stage, measuring ambiguity aversion, offered the same payoffs for the six lotteries, but the participants did not know the exact probabilities, as they did in the first stage. They only knew that at least 30 percent of the chances were for the low pay- off and at least 30 percent were for the high payoff. The third stage, measuring loss aversion, used the same six lotteries with fifty-fifty probabilities, but including the possibility of negative payoffs in some cases. The individual risk games were based on three components of risk behavior. They thus allow us to distinguish risk attitudes in terms of risk aversion, ambiguity aversion, and loss aversion. The first stage measures risk aversion, based on known probabilities and known outcomes for six fifty-fifty lotteries. Choosing lotteries with lower payoffs can be interpreted as greater risk aversion. The second stage measures risk ambiguity, and the third stage centers on loss aversion*".

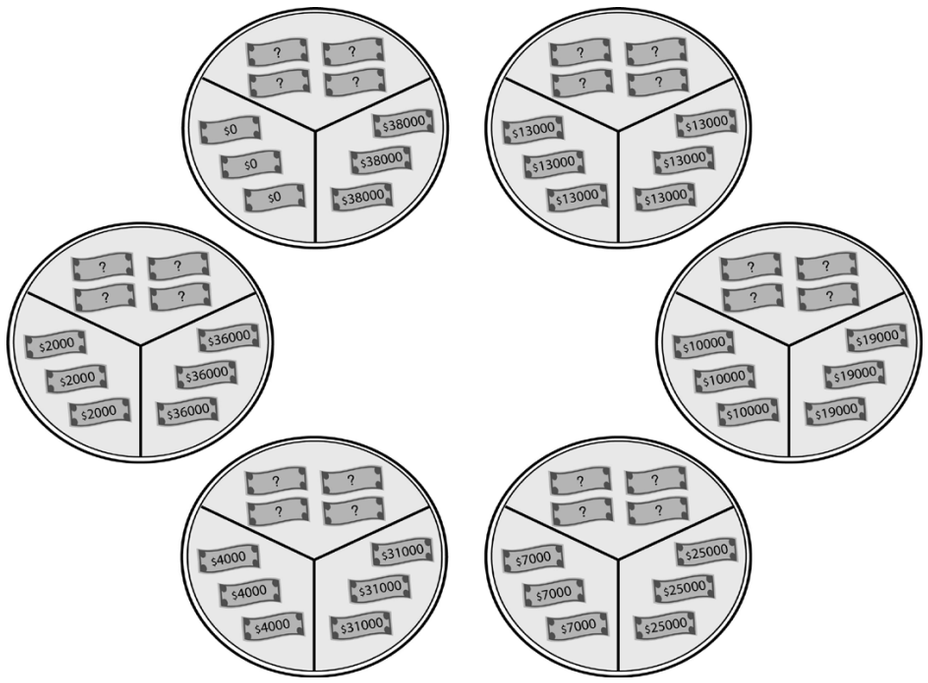
Thus, each player makes three individual decisions that measure attitudes towards risk aversion, ambiguity, and losses. In the first activity, which measures risk aversion, there is a distribution of ten tokens within each of six envelopes, so five of the tokens represent low payoffs, and the other five represent high payoffs in each envelope. The game consists of six gambles with 50/50 payoffs that go from low to high-expected amounts of money, which is informed to the participants during the session. An illustration of the gambles that were presented to the participants of the sessions are staged in Panel A, Figure 1. Here, the envelopes are represented as circles and the tokens as bills. Note that the high and low values marked in the tokens are different in each envelope. As we observe envelopes to the right in a clockwise sense, notice that the risk level of the gambles is higher —the gap between high and low payoffs and the overall expected gain increases. This arrangement holds in the three risk activities (Cárdenas et al., 2009, 2013). The player has to decide between these six lotteries, ranging from a sure low payoff, a gamble with a relative percentage of 0.33/0.33, to an all-or-nothing higher expected payoff with 0/0.95, accompanied with four intermediary combinations. Recall that in this first risk activity, the participants know the exact probabilities of the payoffs. The second activity measures risk ambiguity by offering the same payoffs for the previous six lotteries. Still, unlike in the first activity, individuals ignore the exact probabilities for each token to show up. Instead, participants know, for certain, that three out of ten tokens correspond to the low payoff, and the other three correspond to the high payoff. The remaining four tokens were included without telling the participants whether they had low or high payoffs. A representation of this set of gambles is shown in Panel B, Figure 1.

Figure 1. Experiments for measuring risk aversion, ambiguity and loss aversion

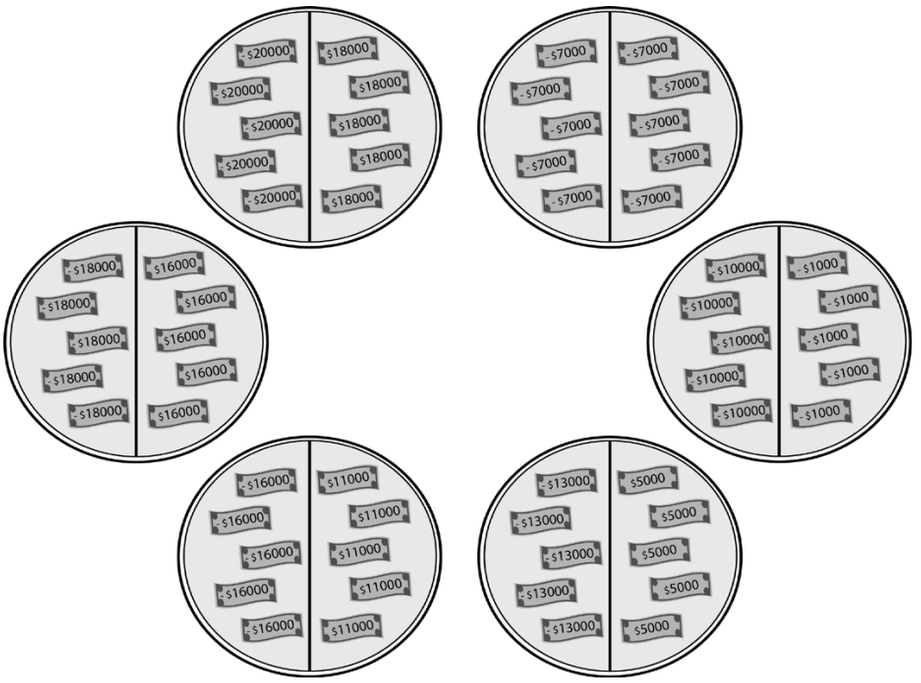
Panel A: Risk Aversion



Panel B: Risk Ambiguity



Panel C: Loss Aversion



Notes: This figure presents a schematic representation of the payoffs available to participants in the three experiments conducted to measure risk aversion, risk ambiguity, and loss aversion, as presented in Candelo et al. (2009). Panel A displays the payoffs offered in the risk aversion experiment, which comprises six gambles represented by a different circle. Each gamble has five tokens with a low payoff and five tokens with a high payoff. The gambles' risk level increases as the difference between the high and low payoffs increase clockwise. Panel B displays the gambles and payoffs of the risk ambiguity experiment. Here, a third of the payoffs are high, low, and uncertain, respectively. Again, the gambles are represented with increasing risk clockwise. Finally, Panel C displays the loss aversion experiment where the lower payoffs are negative.

Finally, the third activity measures loss aversion. It also uses six lotteries with 50/50 probabilities but includes the possibility of negative payoffs. In order to avoid negative payments, players are endowed with a fixed amount that is equal to the maximum value he or she could lose in the maximum-risk envelope. This amount was given regardless of the participant's gains or losses. Participants who opt for the safer possible choice (low-payoff token in the first enveloped) would have zero gains. The decision scheme for the loss aversion activity is shown in Panel C, Figure 1. In order to ensure that the participants clearly understand the activities, the session coordinator simulates each of the games before the participant's decision process, making sure not to bias the election of the participants during the actual game and keeping written records of these events.

Complementary information on the participants is drawn from the pre, and post-game surveys gathered from everyone who attended. Table 1 presents a description and sources of all the employed variables, whereas Table 2 reports their corresponding summary statistics. We observe that half of the sample is female. Similarly, married participants represent about fifty percent of the sample, and those who formally own a house, also reach about fifty percent of the sample. In addition, the average number of years of education is nearly 11, which is the total for an individual who has completed primary and secondary levels in the mandatory six years and five years, respectively. Interestingly, the share of participants employed at the time of the survey accounts for around sixty percent. National Census values do not differ for 2007 significantly from the values obtained from the expanded sample of participants of the experiment in Lima, as seen in the last column of this table.

Table 1. Variables Definitions

Variable	Definition
Individual Characteristics	
Schooling	Years of education of the individual. *Source: Survey and experiments.*
Age	Age of the individual.
Female	Dummy variable that takes the value of 1 when the individual is female, and 0 otherwise.
Married	A dummy variable that takes the value of 1 when the individual is married or cohabitating and 0 otherwise. The base omitted variable was being single.
Homeowner	A dummy variable that takes the value of 1 when the individual is a homeowner, and 0 otherwise.
Employed	A categorical variable that takes the value of 1 when the individual is employed, and 0 otherwise.
Session Characteristics	
Percent women	Share of women per session
Mean age	Mean of the age of individuals per session.
Standard deviation, women	Standard deviation of females per session
Standard deviation, age	Standard deviation of age per session
Participants	Number of participants per session
District Characteristics	
Robbery Victims	Share of district residents of the participant who report being a victim of a robbery in the district
Residents belonging to educational organization	Share of residents who live in the district of the respondent and who report belonging to an educational organization, such as parents' association, educational, artistic, musical, or cultural associations.

Note: This table shows the definition of the variables used in the empirical analysis. The first panel shows the participants' characteristics; the second panel reports the characteristics of the experiment session. The third panel shows residence district characteristics. In the case of district characteristics, the source is the Study of Perceptions in Metropolitan Lima (2010).

The outcome values associated with the three risk activities described above were employed as dependent variables in our empirical estimations. These are considered objective measures of risk-averse attitudes. At the end of the sessions, the envelopes were numbered from 1 to 6. In the first activity, choosing an envelope with a higher number —and therefore, lower risk— points out that the participant had very low-risk aversion attitudes. During the second activity, with the presence of ambiguity, risk aversion attitudes are more strictly tested. Similar to the first activity, a higher envelope's number stands for a low-risk adverse participant. Lastly, the less risk-averse individuals are utterly tested in the third activity with the possibility of losses. We can check the consistency of these three increasingly strict measures in Table 3, presenting simple pairwise correlations between risk attitudes and educational attainments.

Table 2. Summary statistics

	Experiment sample, weighted					Census
	N	Mean	S.D.	Min	Max	
	(1)	(2)	(3)	(4)	(5)	(6)
Individual characteristics						
Schooling (years)	540	10.72	3.82	0.00	21.00	10.94

Table 2 (continued). Summary statistics

	Experiment sample, weighted					Census
	N	Mean	S.D.	Min	Max	
	(1)	(2)	(3)	(4)	(5)	(6)
Age (years)	540	36.61	13.36	17.00	76.00	30.21
Female (%)	540	0.52	0.50	0.00	1.00	0.51
Married (%)	540	0.51	0.50	0.00	1.00	0.51
Homeowner (%)	540	0.54	0.50	0.00	1.00	0.42
Employed (%)	540	0.64	0.48	0.00	1.00	0.70
Risk attitudes						
Risk aversion	540	4.12	1.64	1.00	6.00	-
Risk ambiguity	540	4.30	1.62	1.00	6.00	-
Loss Aversion	540	3.58	1.86	1.00	6.00	-
Session characteristics						
Participants per session	540	22.60	4.64	14.00	32.00	-
Percentage of women	540	0.54	0.12	0.23	0.83	-
Standard deviation, women	540	0.49	0.03	0.38	0.52	-
Mean of age per session	540	35.11	3.44	25.93	41.30	-
Standard deviation, age	540	12.56	2.74	6.78	16.35	-

Notes: This table reports the summary statistics of the sample of experiment participants. Columns (1) to (5) reports sample statistics using weights for Metropolitan Lima city (N1=540). Columns (6) reports means calculated using the National Census from 2007 reports (N2=8,482,619). The census figures were collected with the same question in the experimental survey as in the census.

We also employed secondary data sources. In particular, a 2010 perceptions data set gathered by a local university, which contains data on violence and public security and is representative at the district level[3]. We also employed data from the national Census (INEI, 1993, 2007) and data from the National Registry of District Municipalities (RENAMU, 2016)[4].

Table 3. Correlation matrix

	Years of School	Risk Aversion	Risk ambiguity
	(1)	(2)	(3)
Risk Aversion	0.184		
	(0.000)		
Risk ambiguity	0.113	0.550	
	(0.008)	(0.000)	
Loss aversion	0.205	0.440	0.390
	(0.000)	(0.000)	(0.000)

Notes: The table reports pairwise correlations between the risk measures and educational attainment of experiment participants. P-values are in parenthesis.

3 The data comes from the Catholic University of Peru (2010). The scope of the survey is Metropolitan Lima only.

4 Each district in the city is governed by a District Municipality, whose highest authority is the mayor. The registry is administrative data reported by Municipal authorities about the services provided, planning, and other related attributes.

Empirical Approach

As described above, one of this research's objectives is to understand better whether there is a statistically significant correlation between education and risk aversion and the nature of such a link, if any. In order to do this, we employ risk measures from experimental sessions in which agents face risky prospects by making decisions involving money payoffs. Our baseline reduced linear regression form follows the specification:

$$RiskAversion_i = \alpha + \beta_1 Schooling_i + \boldsymbol{X}_i'\beta_2 + \beta_3 W_i + \boldsymbol{S}_i'\beta_4 + \varepsilon_i \quad (1)$$

where $RiskAversion_i$ is the dependent variable i obtained from one of the three risk activities described above, namely risk aversion, risk ambiguity, and loss aversion. The values of the dependent variable range from one to six where a higher value stands for a higher risk attitude. Our key variable of interest, $Schooling_i$ represents the years of schooling of the participant and it is obtained directly from surveys applied to the individuals that participated in the experimental games. In addition, the vector $\boldsymbol{X}_i$ reflects a set of household and individual characteristics, such as age, gender, marital status, and type of ownership of the home. W_i is a variable that states the employment status of participant i as an approximate measure of his or her socio-economic status. Vector $\boldsymbol{S}_i$ contains data collected throughout the experimental sessions, in particular, the percentage of women in the session, average age of participants in the session, the standard deviation of females per session, and the standard deviation of the age of participants. We also control for the number of participants who attended to each session, and non-observed factors are clustered at the session level. In addition, all the regressions include fixed effects at the district level. A complete description of every covariate included is shown in Table 1. Finally, e_i is the error term.

As it is well known, a weakness of our empirical approach above is that the relationship between education and risk aversion may be endogenous due to unobservable factors that may be biasing our relationship of interest. Coefficient β_1 in the specification (1) may be biased if there is any correlation between education levels and an omitted variable included in the error term. As such, the causal inference may be challenging to establish. In order to deal with this issue, we take advantage of an exogenous government policy in Peru that promoted the construction of new schools. This law was issued in 1996 to increase the quality of education in the country by promoting the participation of the private sector in education. It reduces entrance barriers of for-profit schools via tax credits, tax exemptions, and others. As a result, school enrollment rates rose from 23 percent to 32.6 percent between 2000 and 2007, according to the National School Census collected by the Ministry of Education. We employ the net change in the number of private schools in Metropolitan Lima after the policy law was enacted as an exogenous source of variation for educational attainment. As discussed below, this variable is highly correlated with education; we argue that it is not linked with risk aversion attitudes.

Findings

We present basic results in Table 4, which include fixed effects at the district level and standard errors clustered at the session level to account for session-specific error components. We find a positive and statistically significant link between the schooling variable and our three risk aversion measures when controlling for a broad set of individual and session-related characteristics. An additional year of education is associated with an increase in the risk aversion index of about eleven percentage points, an increase in the ambiguity index of about nine percentage points, and an increase in the index of loss aversion of around twelve percentage points.

Table 4. Education and Risk Attitudes, Ordinary Least Squares

	Risk Aversion		Risk Ambiguity		Loss Aversion	
	(1)	(2)	(3)	(4)	(5)	(6)
			Individual characteristics			
Years of education	0.104***	0.114***	0.080***	0.097***	0.126***	0.118***
	(0.024)	(0.022)	(0.021)	(0.024)	(0.021)	(0.018)
Age (years)	-0.011	-0.012	-0.005	-0.006	-0.009	-0.010
	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)
Female	0.128	0.160	0.328*	0.317	0.225	0.348**
	(0.184)	(0.173)	(0.188)	(0.187)	(0.170)	(0.147)
Married	0.163	0.223	0.008	0.026	0.183	0.208
	(0.170)	(0.157)	(0.195)	(0.192)	(0.182)	(0.181)
Homeowner	0.021	-0.036	-0.078	-0.074	0.413**	0.331*
	(0.207)	(0.182)	(0.202)	(0.181)	(0.186)	(0.173)
Employed	-0.177	-0.082	-0.177	-0.125	-0.151	-0.059
	(0.157)	(0.156)	(0.172)	(0.186)	(0.167)	(0.190)
		Session characteristics:				
Percent women		1.434**		1.507**		-1.292***
		(0.657)		(0.589)		(0.444)
Mean age		-0.068*		-0.022		-0.002
		(0.033)		(0.038)		(0.036)
Standard deviation, women		-0.875		4.129		2.374
		(2.280)		(2.425)		(1.811)
Standard deviation, age		0.127***		0.071		0.056
		(0.043)		(0.047)		(0.052)
Num. participants per		0.034**		0.008		0.046**
session		(0.016)		(0.023)		(0.020)
Constant	3.350***	2.892	3.606***	0.267	2.221***	0.075
	(0.399)	(1.709)	(0.414)	(1.993)	(0.457)	(1.581)
Observations	540	540	540	540	540	540
R-squared	0.0775	0.1207	0.0518	0.0719	0.1029	0.1380

Notes: This table reports estimated effects of the educational attainment on risk aversion, risk ambiguity and loss aversion. Coefficients are estimated using ordinary least squares. Observations are at the participant level. All variables are indicator variables unless otherwise indicated. All regressions include fixed effects at the district level as well as clustered robust standard errors at session level, which are reported in parenthesis. Coefficients which are significantly different from zero are denoted by the following nomenclature * = 10%; ** = 5%; *** = 1%.

In addition, in an attempt to deal with endogeneity, we take advantage of an exogenous policy measure issued by the Peruvian government in 1996, in particular, a law to promote the opening of private schools aimed at increasing the access to high-quality education by reducing barriers to for-profit education enterprises via tax credits, tariff exemptions, and others[5]. We employ the net change in the number of private schools in the districts of Metropolitan Lima after the policy law was enacted as an exogenous source of variation for educational attainment. We limit our proposed instrument to primary schools as enrollment in this education level better

5 Whereas this law prompted school's private enrollment rates to rise from 23 percent to 32.6 percent between 2000 and 2007, it is somewhat unclear whether the educational quality also increased (Ministry of Education of Peru, 2016).

captures the school expansion trend in Lima (Balarin, 2015)[6]. Our proposed instrument is the accumulated variation of the number of new private primary schools across districts in Lima between the years 2000 and 2007. We define this variable $\boldsymbol{Z_c}$ as the change between the number of schools in 2007 located in district c ($school_{c,2007}$) and the number of schools in 2000 ($school_{c,2000}$) as follows:

$$Z_c = \left(school_{c,2007} - school_{c,2000}\right)/school_{c,2000} \quad (2)$$

We argue that this is a purely exogenous policy that is uncorrelated to risk attitudes. As stipulated in the law, its applicability is nationwide. The data come from the National School Registry at the Ministry of Education of Peru[7]. Also, policy implementation, because its execution could have launched activities of 'de facto' prioritization. Interestingly, we do not find any discernable pattern that may be linked to any observable, as several overlapping factors were at play in the process, such as educational demand, district purchasing power, entrepreneurship, vacant infrastructure, and several others[8]. These data were matched with information from the National School Census —also gathered by the Ministry of Education. We calculate the net change in private primary schools in 2007 compared to 2000 from each of the 43 Metropolitan Lima districts. The expansion is consistent with the process of deregulation in the provision of basic educational services in the country (Balarín 2015, Arregui 2000, Du Bois 2004).

We classify the variations in school construction categories by quintiles and use this variable as an instrument to test for the relationship between years of education and risk attitudes. Table 5 provides our findings. Overall, we find a positive and statistically significant link between education and our risk indexes, which supports the idea that additional years of education increase risk attitudes, on average. In every specification, the Anderson-Rubin F-statistic largely passes the Staiger and Stock's (1997) threshold as defined by the rule of thumb by Stock and Yogo (2005). We can reject that the maximum IV size distortion is larger than ten percent, which appears to render our instrument a reasonably strong one. Notice that once corrected for endogeneity in schooling, our coefficients become substantially larger, as it reflects LATE findings[9].

Table 5. Education and Risk Attitudes, Instrumental Variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Risk Aversion		Risk Ambiguity		Loss Aversion	
	Individual characteristics					
Years of education	0.253***	0.285***	0.323***	0.391***	0.223**	0.251*
	(0.094)	(0.106)	(0.112)	(0.121)	(0.103)	(0.145)
Age (years)	0.003	0.001	0.017	0.016	-0.000	0.000
	(0.015)	(0.014)	(0.014)	(0.014)	(0.010)	(0.010)
Female	0.134	0.110	0.337	0.231	0.228	0.310*
	(0.194)	(0.178)	(0.225)	(0.229)	(0.174)	(0.160)
Married	0.214	0.262	0.091	0.093	0.216	0.238
	(0.183)	(0.169)	(0.228)	(0.235)	(0.198)	(0.197)
Homeowner	-0.250	-0.272	-0.519**	-0.480**	0.238	0.148
	(0.237)	(0.234)	(0.250)	(0.245)	(0.278)	(0.291)

6 Results do not change if we also include secondary schools.

7 This provides basic information regarding the schools' principal (i.e., name, genre, and contact phone number), its district location, and the availability of essential services within the school (i.e., water, electricity, sanitation).

8 In particular, there is no clear pattern along the lines that relatively wealthy districts opened more schools after the law was enacted (Balarin, 2015).

9 First-stage regressions are available upon request. We also employed ordered probits and IV ordered probits as an alternative method. Our findings are analogous (basic probits are shown in the Appendix).

Table 5 (continued). Education and Risk Attitudes, Instrumental Variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Risk Aversion		Risk Ambiguity		Loss Aversion	
Individual characteristics						
Employed	-0.255	-0.153	-0.304*	-0.247	-0.202	-0.114
	(0.159)	(0.149)	(0.177)	(0.196)	(0.167)	(0.180)
Session characteristics						
Percent of women		3.086**		4.354***		0.013
		(1.262)		(1.497)		(1.467)
Age mean		-0.061**		-0.010		0.004
		(0.028)		(0.039)		(0.034)
Standard deviation, women		2.470		9.893***		4.964
		(2.860)		(3.807)		(3.365)
Standard deviation, age		0.143***		0.099		0.069
		(0.049)		(0.061)		(0.057)
Num. participants per		0.0317**		0.013		0.048**
session		(0.015)		(0.023)		(0.020)
Constant	1.409	-2.272	0.455	-8.633**	0.968	-3.924
	(1.389)	(3.582)	(1.565)	(4.051)	(1.237)	(4.845)
Observations	540	540	540	540	540	540
Wald Test, F-Stat	8.73	7.16	13.04	12.67	4.6	2.88
P-Value	0.0069	0.132	0.0014	0.160	0.0423	0.1024

Notes: This table reports estimated effects of the educational attainment on risk aversion, risk ambiguity and loss aversion where the endogenous variable is instrumented by the accumulated variation in the number of primary schools across districts in Lima between 2000 and 2007 according to Equation (2). Coefficients are estimated by two-stage least squares. The observations are at the participant level, but instrument is at the district level. All variables are indicator variables unless otherwise indicated. All regressions include fixed effects at district level and clusters at session level. Instrument is the accumulated growth (%) of number of private primary schools 2007-2000, by participant's district of residence. Coefficients that are significantly different from zero are denoted by the following nomenclature * = 10%; ** = 5%; *** = 1%.

Robustness

Our identification strategy assumes that any variation in the number of schools in the district where the participant lives have a systematic effect on their risk-averse attitudes only through their educational attainments. While we believe that this is a reasonable assumption as we simply exploit an exogenous policy shock, it may be true that households whose risk aversion preferences may be linked to unobservable factors may attempt to systematically move to districts with new schools resulting of the new law. Thus, we need to examine whether households systematically move to districts with lower risks, as reflected by having more schools. It is reasonable to expect that other analogous "pull factors" would also significantly attract households to other districts. Households may not only seek to live in areas with more schools, but they may also be more likely to move to districts that offered more health services, more public safety, more public sanitation services, more road conditioning, and overall increased urban development. We employ data from the Peruvian National Registry of District Municipalities to test this idea. When using ordinary least squares, we find that there is no statistically significant correlation between risk attitudes and any measure of the quality of life indicators in the case of health services, which includes hospitals, health establishments, health centers and doctors' offices; public safety services, which includes civil urban organizations, neighborhood committee and

self-defense committees against crime; sanitation services, which include centers of growth and development of children, control of acute respiratory infections and diarrheal diseases; roads conditioning, which includes repair and construction of roadways and pavement roads, as well as the presence of strategic local economic strategic development plan in the district. All regressions control for schooling, population, gender, age, type of household, and a household index of assets.

Table 6. Risk Attitudes and Pull Factors, robustness

Dependent variable	Health Services	Public Safety	Sanitation	Road Maintenance	Urban Planning
			Risk aversion		
Coefficient	0.1814	0.1005	-0.0107	0.2382	-0.0991
Standard Error	(0.4020)	(0.2495)	(0.2776)	(0.2767)	(0.2899)
			Risk ambiguity		
Coefficient	-0.0618	0.1586	-0.1293	0.0989	-0.0988
Standard Error	(0.2818)	(0.1761)	(0.2098)	(0.2010)	(0.2022)
			Loss aversion		
Coefficient	0.3135	0.2234	-0.1642	-0.2357	0.0885
Standard Error	(0.4559)	(0.3387)	(0.3426)	(0.3241)	(0.3175)

Notes: This table reports estimated effects of the educational attainment on life quality variables, i.e., pull factors. Coefficients are estimated by ordinary least squares. Robust standard errors are reported in parenthesis. All regressions include district fixed effects and clusters as well as a set of district-level controls including schooling, population, gender, age, type of household, and index of assets. The Municipality District services are listed as follows. (i) Health services: hospitals, health establishments, health centers and doctors' offices. (ii) Public safety services: civil urban organizations, neighborhood committee and self-defense committee against crime. (iii) Sanitation services: centers of growth and development of children, control of acute respiratory infections and diarrheal diseases. (iv) Road maintenance: repair and construction of roadways and pavement roads. (v) Has strategic local economic strategic development plan. All regressions control for schooling years, population, age, type of household and household index of assets. Coefficients that are significantly different from zero are denoted by the following nomenclature: * = 10%; ** = 5%; *** = 1%.

Just like "pull factors" may play a significant role in any potential relocation of households, there are also "push factors" that are important to consider. As the literature points out, community-related factors, such as crime and social cohesion, appear to be relevant determinants of risky attitudes (Gould et al., 2002; Lochner & Moretti, 2001; Huang et al., 2009; Huang et al., 2012; others). We augment the instrumental variables version of our main risk attitudes specification of Table 5 and now include both crime and social capital proxies. When controlling for the rate of street robbery victims in the district of residence and the share of participants in organizations with educational purposes in the district, we find that the coefficient of years of education keeps the expected sign and remains statistically significant at conventional levels. These findings are shown in Table 7[10].

Table 7. Risk Attitudes and Push Factors

Dependent Variable	Risk Aversion	Risk Ambiguity	Loss Aversion
	(1)	(2)	(3)
Years of education	0.314**	0.434***	0.271*

10 A complementary approach is to look at mobility among adult citizens. When using census data from 2007 (www.inei.gob.pe), which is the year of the experimental sessions, we find that the share of adults who had moved from out of the city into Lima during the previous five years is less than ten percent of the total number of adults, which equals to less than two percent of total households. Focusing only on within-city movements, we find that this is even less common, as just 1.3 percent of total households moved within districts in the previous five years. Finally, when focusing on school-aged children instead of adults, we find comparable results. Detailed findings are available upon request.

Table 7 (continued). Risk Attitudes and Push Factors

Dependent Variable	Risk Aversion	Risk Ambiguity	Loss Aversion
	(1)	(2)	(3)
	(0.136)	(0.152)	(0.153)
Street robbery victims that reside in district, percent	-0.007	0.007	0.008
	(0.014)	(0.016)	(0.019)
District residents in organizations with educational aims, percent	-0.023	-0.021	-0.007
	(0.029)	(0.025)	(0.028)
Constant	-2.440	-9.842**	-4.720
	(4.179)	(4.860)	(5.789)
Observations	540	540	540
Anderson-Rubin Wald test, F statistic	4.85	9.22	2.39
Anderson-Rubin Wald test p-value	0.1375	0.157	0.1352

Notes: This table reports estimated effects of the educational attainment using as an instrument the accumulated variation in schools controlling for push factors. Coefficients are estimated by two-stage least squares. The observations are at the participant level. Robust standard errors clustered by session are reported in parenthesis. Regressions include the same controls as in the most complete specifications in Table 5 namely, age, female, married, homeowner, employed, share of women in session, mean age in session, female standard deviation of session, age standard deviation of session, participants per session. Similar to Table 5, the instrument is the accumulated growth (%) of number of private primary schools 2000-2007, by participant's district of residence. Coefficients that are significantly different from zero are denoted by the following nomenclature: * = 10%; ** = 5%; *** = 1%.

We also conduct a set of falsification tests using instruments based on upcoming schools' variations and not before the experiments were conducted. In theory, doing this should result in findings that do not affect risk attitudes as the latter have been reported in a prior year to such schools' openings, which occurred in 2007 as described above. In particular, we use the school variation between 2008 and 2009 and the school variation between 2008 and 2014. When regressing the years of education on our three risk measures by using a two stage least squares method analogous to the one employed above with the alternative instruments, we find results fully consistent with our expectations as the corresponding coefficient of our years of education variable is not statistically significant at conventional levels in any case considered. Findings are shown in Table 8.

Table 8. Falsified Instrumental Variables

	Risk Aversion			Risk Ambiguity			Loss Aversion		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Variation 2008/2009								
Years of Education	0.073	0.105	0.101	0.158	0.235	0.231	0.053	0.038	0.011
	(0.086)	(0.105)	(0.127)	(0.114)	(0.159)	(0.178)	(0.118)	(0.144)	(0.157)
Constant	3.747***	3.159	3.781	2.591*	-3.895	-3.905	3.172**	2.506	2.889
	(1.128)	(3.705)	(3.928)	(1.450)	(4.532)	(5.070)	(1.569)	(4.342)	(4.769)
R-squared	0.0733	0.1203	0.1223	0.1234	0.0163	0.0126	0.0842	0.1179	0.1044
	Variation 2008/2014								
Years of Education	0.133	0.217	0.203	0.084	0.147	0.138	-0.061	-0.121	-0.148
	(0.131)	(0.154)	(0.161)	(0.102)	(0.119)	(0.134)	(0.119)	(0.142)	(0.151)
Constant	3.747***	3.159	3.781	2.591*	-3.895	-3.905	3.172**	2.506	2.889
	(1.128)	(3.705)	(3.928)	(1.450)	(4.532)	(5.070)	(1.569)	(4.342)	

Table 8 (continued). Falsified Instrumental Variables

	Risk Aversion			Risk Ambiguity			Loss Aversion		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Variation 2008/2014								
R-squared	0.074	0.0785	0.091	0.152	0.0162	0.066	0.021	0.041	
Observations	540	540	540	540	540	540	540	540	

Notes: All regressions include the same controls as in Table 4 and Table 5. The method of estimation is two-stage least squares. The observations are at the participant level. Regressions include fixed effects at the district level and standard errors are clustered at the session level. Instrument is the accumulated change (%) in the number of private primary schools from 2000 to 2009 and from 2000 to 2014 by participant's district of residence. Coefficients that are significantly different from zero are denoted by the following nomenclature: * = 10%; ** = 5%; *** = 1%.

Summary and Conclusions

This paper provides empirical evidence on the link between risk aversion and education using representative data from surveys and artefactual experiments in Lima, Peru. We find that the relationship between years of education and measures of risk attitudes is positive and statistically significant at conventional levels when employing ordinary least squares. In addition, we take advantage of an exogenous government policy to deal with endogeneity issues, as this policy is orthogonal to the dependent variable. Our evidence appears to be reasonably consistent with the presence of a causal link. We apply a broad number of robustness tests, which further confirm our results. Thus, to the extent that our identification strategy and robustness tests may be credible, our research appears to help provide suggestive causal evidence from years of education to risk attitudes.

In general, our results align with the studies that show a positive link rather than a negative or non-monotonic one. This means that from a policy perspective, our findings support the idea that more education may sometimes end up translating into unexpected decisions by individuals, which may help explain the apparent paradox of people failing to take advantage of new learned technologies, methods, or processes, regardless of capital or related resources. The fact that these unexpected behaviors are more prominent in more traditional, rural areas in developing countries is consistent with an increase in risk aversion due to more education. In future research, we expect to study these issues further.

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Appendix

Table A. Education and Risk Attitudes

Ordered Probits

	Risk aversion	Risk ambiguity	Loss aversion
Individual characteristics			
Years of education	0.110***	0.112***	0.118***
	(0.0268)	(0.0383)	(0.0236)
Age	-0.0136*	-0.00615	-0.0119***
	(0.00825)	(0.00865)	(0.00457)
Female	0.185	0.392**	0.425***
	(0.226)	(0.177)	(0.161)
Married	0.227	-0.0733	0.151
	(0.168)	(0.246)	(0.159)
Homeowner	-0.235	-0.0182	0.320
	(0.229)	(0.273)	(0.237)
Employed	0.0249	-0.0279	0.105
	(0.192)	(0.177)	(0.134)
Session characteristics:			
Percent women	-0.0431	-0.0544	-0.0785
	(0.101)	(0.0700)	(0.0537)
Mean age	-0.0194	-0.167*	0.0105
	(0.134)	(0.0955)	(0.119)
Standard deviation, women	-16.54	-21.26	-14.11
	(28.63)	(21.25)	(17.29)
Standard deviation, age	-0.0256	0.000998	-0.124
	(0.195)	(0.136)	(0.113)
Constant	-13.12	-20.23	-12.64
	(25.05)	(17.66)	(15.51)
Observations	540	540	540
Pseudo R-squared	0.0921	0.1321	0.1321
Wald chi2	20.66	43.52	179.5
Prob > chi2	5.48e-06	4.01e-06	0

All regressions include session fixed effects, district fixed effects and the standard errors are clustered at the district level. The method of estimation is maximum likelihood. The observations are at the participant level. Robust standard errors are reported in parenthesis. Coefficients that are significantly different from zero are denoted by the following nomenclature: * = 10%; ** = 5%; *** =