THE UNIVERSITY OF CAPE TOWN

FIRE PREVENTION AND RISK AVERSION AMONG INFORMAL URBAN DWELLERS IN CAPE TOWN

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This minor dissertation is submitted in partial fulfilment of the requirements for the award of the degree of Masters of Commerce (MCom) specialising in Economics

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ABSTRACT

This paper attempts to provide experimental evidence on fire prevention and risk aversion among urban informal settlers using lottery choice data with real monetary prizes. The paper estimates the risk attitudes of a sample of 174 individuals from an informal housing development in Cape Town. The empirical analysis is performed within the expected utility theory specification, assuming constant relative risk aversion (CRRA) defined over the lottery prize. We tests the hypothesis that risk averse individuals will take precautionary measures in as far as possible to mitigate the risk of fire to their household. We find that individual-level fire prevention measures that are within the means of the households to effect, such as making sure that matches, lighters and paraffin are kept out of reach of children, is correlated with risk aversion, but measures, such as building of homes at least 3-5 meters from the neighbours, does not seem to be within the choice set of low-income informal dwellers. Our results further indicate that subjects who engage in fire prevention/fire safety strategies that require the "most effort" (that are most effective and costly) are significantly more risk averse relative to subjects engaging in fire safety measures that need "least effort". Contrary to expectation, distance from the main road, informal electricity connection, and the use of paraffin for lighting, heating and cooking are not correlated with risk aversion, indicating that irrespective of the risk profiles of decision makers, low-income households are often forced to make choices that increase their exposure to fire hazards.

Key words: Fire Prevention, Risk Aversion, Risk attitudes, Informal Settlement, South Africa

ACKNOWLEDGEMENTS

I would like to express my most sincere gratitude to my supervisors Professor Dr. Martine Visser and Dr. Kerri Brick, Research Fellow at Environmental-Economics Policy Research Unit (EPRU) of the School of Economics, University of Cape Town (UCT), for providing much guidance both academically and professionally throughout the study and for allowing me undertake my research in their field. Special thanks to the Environmental-Economics Policy Research Unit (EPRU) and the African Climate Development Initiative (ACDI), University of Cape Town for financial support and particularly to Professor Visser for facilitating funding towards my studies and to this research. Additionally, funding from the Centre for Environmental Economics and Policy (CEEPA) is gratefully acknowledged. Many thanks to Glenn Harrison, Elisabet Rutström and Morten Lau for providing the Stata codes. I would also like to extend my profound gratitude to Thomas Slingsby of the Geomatics Department of the University of Cape Town for technical assistance in GIS mapping used in this study. Finally, I am very thankful to my wife, Judith Luwita, for the time endured without me and for being a great source of encouragement during the time of my studies.

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February 2015

COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works of other people has been attributed, and has been cited and referenced.

Signed by candidate

Signature: signature removed Date: 16 February 2015 .

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ABBREVIATIONS

ACDI	African Climate Development Initiative
CCT	City of Cape Town
CEEPA	Centre for Environmental Economics and Policy
CLG	Communities and Local Government
CPT	Cumulative Prospect Theory
CRRA	Constant Relative Risk Aversion
DiMP	Disaster Mitigation for Sustainable Programme
EPRU	Environmental-Economics Policy Research Unit
EU	Expected Utility
EUT	Expected Utility Theory
GIS	Geographic Information System
GPS	Geographic Position System
IAFC	International Association of Fire Chiefs
IRIN	Integrated Regional Information Network
MCom	Masters of Commerce
PT	Prospect Theory
RLP	Random Lottery Pair
SEA	Sustainable Energy Africa
UCT	University of Cape Town

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I. INTRODUCTION

With the growing urban informal settlements in Africa in general and South Africa in particular, the problems and challenges of fire have persisted annually, which have become a disaster, in many of these settlements. Informal settlements are often characterised by both poor infrastructure and high population growth, mainly due to urbanisation. These factors coupled with poverty and inequality in informal settlements is related to sprawling informal settlements which increases the occurrence of fires. Fires in the informal settlements in Cape Town are a particular problem. They destroy dwellings almost on a weekly basis, undermining fragile livelihoods and compounding the conditions of extreme vulnerability of poor households (Pharoah, 2009). Recent statistics shows that over 17,354 fire incidents occurred between 1999 and 2012 in informal settlements in Cape Town[1] although the number of structures affected has reduced[2] from 8,864 in 2003, 3,700 in 2009 to 1586 in 2013 (CCT, 2013).

There are several structural features of informal settlements that increase the spread and severity of fires. Many informal settlements in Cape Town, such as Sweet Home Farm in Philippi, Masphumelele and Imizamo Yethu, are very high density settlements with dwellings constructed with materials that are cheap but rather highly flammable, including plastics, untreated wood and cardboard. The high density nature of informal settlements make it easy for fire to spread between dwellings and difficult for emergency and rescue services to reach affected areas – a situation that is often compounded by a lack of hood extinguishing systems, portable fire extinguishers, home fire sprinklers and water mains. In addition, the spaces between dwellings are narrow and often congested with potential fuel, from flammable household waste to disused cars (Pharoah, 2009). As most people in informal settlements often uses open fires, such as paraffin/candles/fires, as the main source of lighting, heating and cooking, and many are perpetrators of illegal/informal electricity connection or "electricity tapping", the risk of fire is extremely high in these settlements.

Research in several different informal settlements suggest that fires are often linked to behavioural factors such as alcohol abuse, smoking and domestic violence. For instance,

[1] See Figure A.I in the appendix for a trend in fire incidents in informal settlements for the period 1999 to 2012 in Cape Town.

[2] See Figure A.II in the appendix for a trend in the number of structures affected by fire from 2005 to 2013 in informal settlement in Cape Town

Pharoah (2009) notes that in Imizamo Yethu, Cape Town residents report that fires are commonly started when people return from a night of drinking in local *"shebeens"*[3] and either fall asleep with candles or stoves burning or knock them over. Such behaviour is reported to be common among young men living alone, which tend to suggest that both the number of drinking establishments and the demographic profile of settlements may influence fire risk (MacGregor et al, 2005; Morrissey & Taylor, 2006).

In many localities, the local authorities are the custodian of fire fighting services within their jurisdiction. They are usually charged with the responsibility of planning, co-ordinating and regulating of fire services. In Cape Town, the City of Cape Town (CCT) has continued providing fire fighting services within its jurisdiction. However, just like other local authorities in the country, they are faced with operational challenges in fire fighting especially in the growing urban informal settlements. Many of the fire risk management techniques implemented by the authorities of the City of Cape Town are seen in formally planned settlements. For instance, the City of Cape Town recommends keeping a well-maintained fire extinguisher at home, and knowing how to use it, but this is seldom the case in informal settlements. As such, when fires occur, whole areas (and large numbers of people) are affected by fire. Damages include loss of property/possessions and often lives. It is unknown how many people are killed and injured by informal settlement fires, but it is clear that they cause significant damage to and loss of property and assets, placing strain on both communities and local authorities (*See* for example Figure I).

Fires in informal settlements are closely associated to socio-economic conditions. It has been suggested by many development practitioners that a solution to fire problems exist in upgrading of these urban informal settlements through proper housing. The South African government has struggled to keep up with the demand for low-income housing and in cities like Cape Town, many people live in informal settlements for years while they wait for government housing (IRIN News, 2013). Sadly, there is substantial evidence that suggest that some fires are started deliberately in an attempt to jump the queue for government-subsidized low-cost housing (e.g. DiMP, 2002; MacGregor et al, 2005; Morrissey & Taylor, 2006). In the BM Section in Khayelitsha, Cape Town (the area where this risk experiment was conducted), fire has highlighted the need for a more holistic approach to the prevention of

[3] These are places in informal settlements where food, tobacco, beer and other alcoholic beverages are sold i.e. shebeens are local pubs/bars/clubs in informal settlements where excisable alcoholic beverages are sold usually without a licence.

fires that includes better planning of informal settlements and enforcement of legislation that prohibits the so-called land invasions, particularly in high fire-risk areas (IRIN News, 2013).

Figure I: Destruction of Fire in Langa Zone 17, 19 & 20, Cape Town on Monday 05 March 2012 *(Source: City of Cape Town, 2013)*

There is an extensive literature on fire and fire prevention. However, existing literature has treated the subject from the viewpoint of those who through practicable means seek to reduce fire hazards; broadly examining the origin and/or causes of fire, its control and prevention measures[4]. This paper does not however explicitly focus itself on fire and fire prevention but rather relates risk preferences to fire prevention measures among urban informal settlers. We attempt to provide experimental evidence on fire prevention and risk aversion among informal urban dwellers using a field experiment that uses real monetary incentives.

Existing literature on behavioural and experimental economics tends to shows that risk attitudes play a role in decision making across a number of contexts – for example, the adoption of new farming practices (e.g. Binswanger, 1980; Feder, Gerston, Just & Zilberman, 1985; Hodgdon, 1966), compliance with fishing regulation (e.g. Brick, Visser & Burns, 2012; Eggert & Lokina, 2007), and flood mitigation (e.g. Brick & Visser, *forthcoming*). This study

[4]See for example Crosby, 1905; Bayliss, 1955 for a comprehensive review of fire and fire prevention.

contributes to this discussion by illustrating that risk preferences matter in the case of reducing the risk of fires. More so, these studies are showing that risk attitudes can affect decision making even when large stakes are involved (in this case, individuals have a lot to lose in the advent of a fire – so the financial stakes are high).

Indeed, risk attitudes play a role in subjects' use of fire safety measures and as such one would expect *a priori* that many subjects would be risk averse. Specifically, as subjects, who participated in this field experiment, live in the same area and face largely the same probability of fire, risk preferences (along with socio-demographic characteristics that can be controlled for) likely explain heterogeneity in putting into practice fire safety measures by residents. To this effect, we tests the hypothesis that risk averse individuals will take precautionary measures in as far as possible to mitigate the risk of fire to their household. We present estimates of individual risk attitudes within an expected utility theory (EUT) framework that incorporates real monetary incentives, socio-demographic characteristics and subjects' use of fire safety measures.

There is an extensive literature on behavioural and experimental economics in development that utilizes the expected utility theory framework to investigate development problems (e.g. Hey & Orme, 1994; Holt & Laury, 2002; Harrison, Lau & Ruström, 2007; Schechter, 2007). The expected utility theory is a very powerful tool for the analysis of decisions under risk (Quiggin, 1982) and it has widely been utilized in both developed and developing countries (e.g. Harrison, Lau and Ruström (2007) in Denmark; Holt and Laury (2002) in the United States; Brick, Visser and Burns (2012) in South Africa, Binswanger (1980) in India, Galarza (2009) in Peru). The expected utility framework has been used to analyse decision-making under uncertainty in a variety of contexts, namely: the role of risk aversion as a possible behavioral explanation for the lack of technology adoption among the rural poor (e.g. Harrison, Humphrey & Verschoor, 2010), compliance with fishing regulation (e.g. Brick, Visser & Burns, 2012) and the slow down in the adoption of financial or production innovations (e.g. Feder, 1980; Feder, Gerston, Just, & Zilberman, 1985).

There are however other competing theories of choice under uncertainity that have been extensively used in both empirical and theoretical studies. Prospect theory (PT) and its counterpart Cumulative prospect theory (CPT) are leading alternative theories to expected utility theory. In this context, several studies have found subjects' observed behaviour to be inconsistent with expected utility theory (e.g. Tversky & Kahneman 1992, Camerer 1998, Humphrey & Verschoor 2004, Mosley & Verschoor 2005) while other studies find evidence

of heterogeneity in decision making – where subjects' choices are not best represented in one single theory (e.g. Harrison & Rutstrom 2009, Harrison, Humphrey, & Verschoor, 2010). Nothwithstanding this fact, expected utility theory (EUT) remains one of the leading theories of choice under uncertainty (mainly due to the advantage it has on parameterization over other theories)[5]. This paper estimates individuals' risk attitudes using the expected utility theory (EUT) framework, assuming constant relative risk aversion (CRRA). The objective of this study is not to evaluate different theories of choice under uncertainty, but rather to examine how risk preferences are related to subjects' engagement in fire prevention strategies in informal settlements.

This paper contributes to the growing literature on risk aversion[6] and its applications in development and is closely related to a number of recent studies on the subject. Important contributions include Harrison, Lau and Rustrom (2007), who estimate individual risk attitudes using controlled experiments in the field in Denmark on a sample of 253 people aged between 19 and 75 years of age. This study reported that the average Dane is risk averse and that risk attitudes vary significantly with respect to several important socio-demographic variables such as age and education. Using lottery choice data from a field experiment, Binswanger (1980) concluded that most farmers in India exhibit a significant amount of risk aversion that tends to increase as payoffs are increased. Related to this finding, Brick, Visser and Burns (2012), using subjects' choices over lotteries with real monetary prizes estimated the risk attitudes of a large sample of small-scale fishers from various fishing communities along the west coast of South Africa. This study found that participants exhibited moderate risk aversion and that risk attitudes vary with certain socio-demographic variables, that is, females were found to be more risk averse than their male counterparts (Brick, Visser & Burns, 2012). (*See*, Table A.III in the appendix for a summary of selected previous related studies). All these and similar studies presents mounting evidence that suggests variation in

[5]The essence of the expected utility theory (EUT) is to determine a single parameter for assessing risk preferences e.g. in constant relative risk aversion (CRRA) terms, a single parameter, r, is analysed to determine the risk preference of subjects while other theories e.g. the cumulative prospect theory involve estimating more than a single parameter.

[6] The notion of risk aversion, from an empirical analysis perspective, is equivalent to concavity of the utility function under the expected utility theory and thus one would expect that one utility function is "more risk averse" than another if it is "more concave". In empirical studies, risk aversion has been inferred from auctioning i.e. bidding and pricing tasks (e.g. Kachelmeier & Shehata, 1992); field and laboratory experiments (e.g. Brick, Visser & Burns, 2012; Harrison & Rustrom 2008; Harrison, Lau & Rustrom, 2007; Hey & Orme, 1994; Binswanger, 1980); in buying and/or selling prices for simple lotteries (e.g. Holt & Laury, 2002); and behavioural decision-making (e.g. Maguire & Albright, 2005).

risk attitudes across several identifiable socio-demographic and individual characteristics of the samples under investigation.

The experimental design and procedure employed in this study is a replication of Harrison and Rutström (2009, 2008), and Hey and Orme (1994), with extensions to collect socio-demographic characteristics and subjects' fire experience and fire safety measures data. Following Hey and Orme (1994), subjects were asked to make choices over 60 pair of lottery tasks. A total of 174 subjects were recruited from BM section in Khayelitsha, Cape Town. We tests the hypothesis that risk averse individuals will take precautionary measures in as far as possible to mitigate the risk of fire to their household. We finds that individual-level fire prevention measures that are within the means of the households to effect, such as making sure that matches, lighters and paraffin are kept out of reach of children, is correlated with risk aversion, but measures, such as building of homes at least 3-5 meters from the neighbours, does not seem to be within the choice set of low-income informal dwellers[7]. We also grouped the fire prevention measures into two (2) broad categories, namely *"most effort"* and *"least effort"* measures depending on the effort and cost involved in each measure and constructed a binary variable that captures households engaging in these measures. Our results indicate that subjects who engage in fire prevention/fire safety strategies that require the *„most effort"* (that are most effective and costly) are significantly more risk averse relative to subjects engaging in fire safety measures that need *„least effort"*. In terms of demographic variables, there is a significant effect from age, with risk aversion increasing with each year in age of subjects.

The rest of the paper is organised as follows. In Section II, the choice under uncertainty structural model i.e. the expected utility theory specification is discussed while Section III summarizes the experiment design and procedures, with additional details provided in Brick and Visser (*forthcoming*) that share the dataset with the current study. Section IV details the specifics of the sample. In Section V, the paper examines the results and relates them to those found in similar previous studies. Section VI summarizes the main findings of the paper and makes concluding remarks.

[7] The fire prevention strategies investigated in this paper are some of the low-cost individual and local initiatives fire safety measures that the local authorities of the City of Cape Town have recommended. See more on: http://www.capetown.gov.za/en/FireAndRescue/Pages/PreventingFires.aspx and in the next section, where we give a detailed account of these fire safety measures.

II. CHOICE UNDER UNCERTAINTY: EXPECTED UTILITY THEORY

In this section, we will describe the estimation procedure used to measure risk preferences, assuming that the data are entirely generated by the Expected Utility Theory (EUT) following Harrison and Rutström (2008) and Anderson, Harrison, Lau and Rutström (2010), with additional references indicated in text.

Expected Utility Theory (EUT)

The experiment estimation procedure used in this paper assumes a latent structural model under Expected Utility Theory (EUT). EUT is a very powerful and convenient way to represent people's attitudes toward risk. The essence of the EUT approach is that the utility, $U(.)$ of some lottery, say L, can be represented as the probability-weighted average of the utilities of the outcomes associated with L (Jehle & Reny, 2011).

For exposition, assuming that the utility of income is defined by Constant Relative Risk Aversion (CRRA) as:

$$U(x) = \frac{(e+x)^{(1-r)}}{(1-r)} \tag{1}$$

where x is the lottery prize, e is the endowment, and r (for $r \neq 1$)[8] is a parameter to be estimated. The CRRA specification entails that when $r = 0$ (i.e. zero) it implies risk neutrality, $r > 0$ (i.e. positive) indicates risk aversion and $r < 0$ (i.e. negative) indicates risk seeking. For K possible outcomes in a lottery, under EUT, the probabilities for each outcome k, denoted as p_k, are those that are induced by the experimenter. Thus, the expected utility is simply the probability weighted utility of each outcome in each lottery i:

$$EU_i = \sum_{k=1}^{K} (p_k * u_k) \qquad \text{for} \qquad k = 1, 2, 3, 4; i = 1, \dots, 60^{9} \tag{2}$$

The EU for each lottery pair is calculated for a candidate estimate of r, and the index

$$\nabla EU = EU_R - EU_L \tag{3}$$

[8] Harrison and Rutström (2008) note that for r = 1 assume U(x) = ln(x) if needed.

[9] Although in this experiment, the loss frame (treatment) had $i = 1, \dots, 54$ as 6 subjects do not show up on the actual day of the experiment.

calculated, where EU_R is the "left" lottery and EU_L is the "right" lottery. This latent index, based on latent preferences, is then linked to the observed choices using a cumulative normal distribution function (∇EU)[10]. This "probit" function takes any arguments between $\pm\infty$ and transforms it into a number between 0 and 1. The agent chooses lottery R if $\nabla EU + \varepsilon > 0$, where ε is a normally distributed error term with mean zero and variance, σ^2 (i.e. the conventional interpretation of σ is the sampling error). Thus, the probit link function, showing the probability that R is chosen, is:

$$\Pr(choose\ lottery\ R) = \Pr(\nabla EU + \varepsilon > 0) = \Pr\left({}^{\varepsilon}/_{\sigma} > {}^{-\nabla EU}/_{\sigma}\right) = \boldsymbol{\Phi}\left({}^{\nabla EU}/_{\sigma}\right) \quad (4)$$

Anderson, Harrison, Lau and Rutström (2010) notes that the cumulative normal distribution function $\boldsymbol{\Phi}(.)$ forms the critical statistical link between observed binary choices, the latent structure generating the index y^*, and the probability of that index y^* being observed. In this application, y^* refers to some function, such as equation (3), of the EU of two lotteries. The index defined by equation (3) is linked to the observed choices by specifying that the R lottery is chosen when $\nabla EU + \varepsilon > 0$, which is implied by equation (4).

Thus the likelihood of the observed responses, conditional on the EUT and CRRA specifications being true, depends on the estimates of r given the above statistical specification and the observed choices. The "statistical specification" usually assumes some functional form for the cumulative density function (cdf), such as the normal distribution function[11]. Ignoring responses that reflect indifference, Anderson, Harrison, Lau and Rutström (2010) notes that the conditional log-likelihood function would be

$$ln\ L(r; y, \boldsymbol{X}) = \sum_i \left[\left(ln\Phi(\nabla EU) * \boldsymbol{I}(y_i = 1)\right) + \left(ln\left(1 - \Phi(\nabla EU)\right) * \boldsymbol{I}(y_i = -1)\right)\right] \quad (5)$$

where $\boldsymbol{I}(.)$ is the indicator function, $y_i = 1(y_i = -1)$ denotes the choice of the option R(L) lottery in risk aversion task i, and $\boldsymbol{X}$ is a vector of individual and socio-demographic characteristics. The parameter r, as a linear function of the characteristics in vector $\boldsymbol{X}$. Anderson, Harrison, Lau and Rutström (2010) notes that the expected utility model can be

[10] See Figure A.X in the appendix A or Harrison and Rutström (2008); Anderson, Harrison, Lau and Rutström (2010) or any standard advanced econometrics textbook for a display of the normal and logistic cumulative density function (cdf).

[11] See footnote 10

extended to allow the core parameter r to be a linear function of observable characteristics of the individual or task. In this regard, we controls for the following independent variables: subjects' age (in years) and it squared; gender (*female*); household size (*hhsize*); a binary as to whether or not the household has children aged 0-17 years (*children*) i.e. the presence of children; mean educational attainment (*matrics*) i.e. Grade 12 or Standard 10; a binary as to whether or not the household monthly income is less than R2,000 (*hhincome*); employment status (*unemployed*); a binary as to whether or not the household received government grants (*govt. grant*); a binary as to whether or not the household experienced home damaged by fire *(fire_exp);* a binary as to whether or not the household/dwelling is located within a 70 meters radius from the main road *(close_to_road)*; a binary as to whether or not the household has informal electricity connection *(informal_elect)*; a binary as to whether or not the household uses paraffin for lighting, cooking and/or heating *(paraffin)*; a binary as to whether or not the household is engaged in "*most effort*" against "*least effort*" fire prevention strategies[12], referred to as *"fires"* and for the game frames or treatment i.e. mixed frame *"mixed"* and loss frame *"loss"*.

Notice that in order to allow for behavioural errors in the sample[13], an important extension of the model is done by incorporating the Fechner index, μ, following Anderson, Harrison, Lau and Rutström (2010) such that equation (3) becomes:

$$\nabla EU = {(EU_R - EU_L)}/{\mu} \tag{3a}$$

The Fechner index is due to Fechner (1966) and is an important error specification that was popularized by Hey and Orme (1994), among others. Accordingly, if $\mu = 1$ there is no

[12] Essentially, this variable distinguish households as engaged in either *"most effort"* measures i.e. fire prevention strategies that need most effort, are most effective and costly, including building a home at least 3-5 meters from the neighbours and making sure that the home has more than one exits against *"least effort"* measures i.e. fire prevention strategies that are less effective and least cost and pertain to households' exposure to "risk" of fire from most probable causes or origins of fire (*See* Table A.III for the grouped fire prevention strategies categories in the appendices)

[13] It is natural to assume that subjects make errors in their choice, say due to carelessness, hurry, or insufficient motivation in the process of calculating the expected utilities. In fact, as Anderson, Harrison, Lau and Rutström (2010) notes that the notion of error is one that is already encountered in the form of the statistical assumption that the probability of choosing a lottery is not 1 when the EU of that lottery exceeds the EU of the other lottery. This assumption is clear in the use of a link function between the latent index ∇EU and the probability of picking one or other lottery; in the case of the normal CDF, this link function is $\boldsymbol{\Phi}(\nabla EU/\sigma)$ (see Anderson, Harrison, Lau and Rutström, 2010).

behaviour error implying that specification (3a) essentially collapses to specification (3); if $\mu < 1$ ($\mu > 1$) then the difference in the expected utility of the two lotteries is increased (decreased), making the choice that was predicted when $\mu = 1$ more (less) likely (Anderson, Harrison, Lau & Rutström, 2010).

Furthermore, the "contextual error" specification developed by Wilcox, 2008 and advocated by Harrison and Swarthout (2012) is incorporated into the model so that specification (3a) becomes:

$$\nabla EU = ((EU_2 - EU_1)/v)/\mu \quad (3b)$$

where v is a normalizing term which, for each lottery pair, is defined as the difference between the maximum and minimum utility over all lottery prizes in a particular lottery pair. This extension is incorporated into the probit specification equation (4) such that the conditional log-likelihood function specification (5) becomes:

$$ln\ L(r, \mu; y, \boldsymbol{X}) = \sum_i \left[\left(ln\Phi(\nabla EU) * \boldsymbol{I}(y_i = 1) \right) + \left(ln\left(1 - \Phi(\nabla EU)\right) * \boldsymbol{I}(y_i = -1) \right) \right] \quad (5a)$$

where the variables are as defined above. It should be noted that, as v is provided by the data, it is not a parameter that needs to be estimated.

This experimental estimation is done using maximum likelihood method in *Stata* and the codes for which are cordially provided by Harrison (2008). In every case the standard errors are corrected for clustering at the individual level in order to account for the possibility that choices made by the same individual are correlated across decision rows.[14]

[14] As Harrison, Lau, and Rutström (2007) notes that the procedures for allowing for clustering allow heteroskedasticity between and within clusters, as well as autocorrelation within clusters. They are closely related to the "generalized estimating equations" approach to panel estimation in epidemiology and generalize the "robust standard errors" approach popular in econometrics (also see, Harrison & Rutström, 2009).

III. EXPERIMENT DESIGN & PROCEDURE

This section provides an overview of the experiment design and procedure. For more details, the reader is referred to Brick and Visser (*forthcoming*) that share the dataset as the current study. Whereas Brick and Visser focus on flooding and risk attitudes, this paper focuses on fire prevention and risk aversion among the urban informal dwellers in Cape Town.

A. Experiment Design

The experiment design employed in this study follows Harrison and Rutström (2009, 2008), and Hey and Orme (1994). This study employed the Random Lottery Pair design (RLP)[15], which entails giving the subject an ordered array of binary lottery choices to make all at once. The RLP requires the subject to pick one of the lotteries on offer, and then the experimenter plays that lottery. More generally, the RLP instrument is typically used in conjunction with the random lottery payment procedure in which one choice is picked to be played out. The great advantage of the RLP instrument is that it is extremely easy to explain to subjects and the incentive compatibility of truthful responses apparent (Harrison & Rustrom, 2008).

Following Hey and Orme (1994), subjects were asked to make direct preference choices over 60 pair of lottery tasks in which the probabilities varied for four fixed monetary prizes[16]. Subjects could express direct preference for one lottery over the other. One of the pairs was chosen at random at the end of each session for pay-out for each subject, and the subjects' preferences over that pair applied. In each lottery task, subjects choose between two lottery pairs (Option 1 or Option 2).[17, 18] There are three (3) treatments: a gains-only treatment, a mixed treatment and a loss treatment. In the gain frame, there is no endowment and the lottery prizes are R0, R50, R100 and R150. In the loss frame, the lottery prizes are –R150, –R100, –R50 and R0. In addition, experiment participants are provided with an initial per game endowment of R150 so that total payoffs are equalized across the treatments. In the

[15] Harrison and Rutström (2008) provide a comprehensive review of the different elicitation procedures that have been used in empirical and theoretical studies. Readers are thus referred to this paper for a comprehensive review of elicitation procedure.

[16] Just for clarifications, all monetary terms are in South African Rands, denoted as R

[17] This is similar to the Holt and Orme (HO) instrument which provides a simple test for risk aversion using an RLP design. Each subject is presented with a choice between two lotteries; say option A and option B.

[18] Subjects choose either Option 1 or Option 2 (no explicit indifference option was provided).

mixed frame, however, participants are provided with a R75 per game endowment and the payoffs are R75, –R25, R25 and –R75 (*See*, appendix B for an exhibit of the game frame and appendix E for the instructions).

The probabilities of each prize vary with each lottery task (Table I). In the first lottery task of the gain frame[19], if a participant chooses Option 1, s/he has a 13 percent chance of earning nothing, a 25 percent chance of earning R100 and a 62 percent chance of earning R150. Conversely, if he/she chooses Option 2, he/she is guaranteed R100. Thus, the expected payoff incentive to choose option 1 in lottery task 1 is R18[20] (and the expected payoff incentives were equalized across treatments per lottery task). Notice that the expected payoff incentive varies across lottery tasks. For a risk-neutral person, we expect he/she to choose option 1 six times (i.e. lottery task 1, 2, 4, 5, 8, 9) before switching to option 2 (for the first 10 lottery tasks), regardless of the treatment.

B. Procedures

The experimental procedure used to capture data is similar to that reported by (Harrison & Rustrom, 2008; Anderson, Harrison, Lau & Rutström, 2010). The lottery probabilities were depicted as a "pie" (with colour codes) showing the probability of each prize, which were operationalized through the use of a spinning wheel. Given that this experiment was conducted in a sample with low levels of numeracy and education, great care was taken to make the lottery task as cognitively accessible as possible. While the actual probabilities associated with each lottery outcome are provided in the decision sheets, participants were able to supplement this metric by also looking at the "slices of the pie"[21].

[19]The interpretation can be extended to other treatments, that is, the mixed and loss treatment.

[20] Notice that, for example, the expected payoff of option 1 in lottery task 1 is: $EV_1^1 = 0.13(0) + 0.25(100) + 0.62(150) = R118$ and $EV_1^2 = R100$ (guaranteed). Therefore, the expected payoff incentive to choose option 1 over option 2 in lottery task 1 is R18. The expected payoffs were not provided in the instructions to subjects, just like in Holt and Orme (1994) procedure.

[21] See Appendix B

Table I: Lottery-Choice Decisions & Expected Payoff Difference

(Per treatment)

	Option 1				Option 2				Expected Payoff Difference		
Gain	**R 0**	**R 50**	**R 100**	**R 150**	**R 0**	**R 50**	**R 100**	**R 150**			
Mixed	-R75	-R25	R25	R75	-R75	-R25	R25	R75	Treatment		
Loss	-R150	-R100	-R50	R0	-R150	-R100	-R50	R0			
Lottery task	Pr. 1	Pr. 2	Pr. 3	Pr. 4	Pr. 1	Pr. 2	Pr. 3	Pr. 4	Gains	Mixed	Loss
1	**0.13**	**0.00**	**0.25**	**0.62**	**0.00**	**0.00**	**1.00**	**0.00**	**18.0**	18.0	18.0
2	0.13	0.38	0.49	0.00	0.00	1.00	0.00	0.00	18.0	18.0	18.0
3	0.00	0.00	0.62	0.38	0.13	0.00	0.13	0.74	-5.0	-5.0	-5.0
4	0.00	0.87	0.13	0.00	0.13	0.62	0.25	0.00	0.5	0.5	0.5
5	0.87	0.00	0.00	0.13	0.75	0.25	0.00	0.00	7.0	7.0	7.0
6	0.13	0.87	0.00	0.00	0.37	0.37	0.00	0.26	-14.0	-14.0	-14.0
7	0.13	0.87	0.00	0.00	0.25	0.50	0.25	0.00	-6.5	-6.5	-6.5
8	0.38	0.00	0.00	0.62	0.25	0.00	0.75	0.00	18.0	18.0	18.0
9	0.37	0.26	0.37	0.00	0.25	0.62	0.13	0.00	6.0	6.0	6.0
10	0.25	0.75	0.00	0.00	0.38	0.00	0.62	0.00	-24.5	-24.5	-24.5

Adopted from Harrison and Rutström (2009), Hey and Orme (1994)

After all lottery tasks were completed, two were selected at random for payment[22]. The "pies" for Option 1 and Option 2 of the selected lottery tasks were in turn placed on a spinning wheel. One of the participants would spin the wheel, ultimately determining the payoff for both Option 1 and Option 2 in each lottery task. There were three treatments (gain, mixed & loss) and each was conducted on separate days[23].

In addition to participating in the lottery task, each participant completed a survey questionnaire[24] which captured the socio-demographic characteristics of subjects, including a

[22] Lotteries were randomly selected by placing 60 pieces of paper – numbered 1 to 60 – into a bag. Once all decisions sheets were collected, 2 participants each drew a piece of paper out of the bag which determined which lottery tasks were to be played for real money (Brick & Visser, forthcoming).

[23] At each treatment, the same enumerator explained the instructions (see, appendix C for the instructions) in detail. A projector was used to display the lottery tasks while the enumerator went through the instructions (Brick & Visser, forthcoming).

[24] See the survey questionnaire in appendix D

range of questions around their experience of floods and fires and their flood and fire mitigation strategies. In terms of fire, specific questions were asked about subjects' fire risks, fire experience and fire precautions or fire safety measures.

In order to eliminate house money effects (as far as possible), in both the mixed and loss treatments the endowment was expressed as payment for completing a survey questionnaire. However, it was emphasised that any money earned throughout the course of the day would be added (i.e. gain and mixed frame) to this amount and any money lost (i.e. mixed and loss frame) while playing the lottery tasks. In addition to the endowment, participants in all treatments receive a participation fee of R50 (*See*, Brick & Visser, *forthcoming* for details).

IV. SAMPLE

The number of participants that were recruited[25] from BM section in Khayelitsha, Cape Town was 174 (60 for treatment I: gains; 60 for treatment II: mixed; and 54 for treatment III: loss), each representing a household. Khayelitsha is an informal settlement in Cape Town, located on the Cape Flats, and is annually prone to natural disasters (such as floods) and fire[26]. The area is densely populated and according to the City of Cape Town 2011 census, about 55 percent of the households live in informal dwelling.[27] Subjects were randomly chosen from this informal settlement to represent the population that was affected by these disasters.

Table II shows the mean characteristics of the sample – for the sample as a whole and for each treatment (gain, mixed and loss). On average, participants are 32 years old (with standard deviation of 9.88) and there is a considerable variation of age across the three treatments. The average age for treatment I (gain), treatment II (mixed), and treatment III (loss) respectively is about 35 years, 32 years, and 30 years.[28] Approximately 60 percent of the respondents are females, although this varied across treatments. Females constitute about 67 percent, 65 percent, and 48 percent of the sample in the three treatments (gains, mixed, and loss), respectively.

For the entire sample, on average, about 37 percent of the households have children aged 0 to 17 years old. About 58 percent of the households have adults aged 18 to 64 years old while only 5 percent of the households have elderly persons aged 65 years or over. However, the average (mean) household size for the entire sample is 5.20 (with standard deviation of 2.32).

Educational attainment amongst subjects is relatively low. Subjects have, on average, obtained 12 years of education (Grade 12, Standard 10) (for the entire sample), although the mean level of education is higher in treatment III (loss) where participants are younger on average. Approximately, 2 percent of the sample has obtained some primary school education only and nearly 4 percent have completed their primary schooling (Grade 7). Just over 18

[25] See Brick and Visser (forthcoming) for the field setting and recruitment details.

[26] See Figure A.III and A.IV in the Appendices for the map of Khayelitsha, Cape Town and an aerial view of BM Section, the study site.

[27]The City of Cape Town - 2011 Census Suburb for Khayelitsha reported a population of 391 749 people (predominantly Black African (99 percent)); 118 809 households with 55 percent of the households living in informal dwelling (CCT, 2013).

[28] A kernel density distribution of age shows that age is almost normally distributed for the entire sample (*See* Figure A.V, Kernel density of distribution of age in appendix A)

percent have obtained some high school education (Grades 8-10), around 28 percent have passed grade 11 and approximately 39 percent have obtained a Grade 12 qualification.[29]

Table II: Sample Statistics

(Standard deviation in parentheses)

Variables	All (n=174)	Treatment I: Gains (n=60)	Treatment II: Mixed (n=60)	Treatment III: Loss (n=54)[a]
Female *(percent)*	60.34	66.67	65.00	48.15
Age[b]	32.40	35.42	31.87	29.65
	(9.88)	(9.74)	(10.87)	(7.95)
Household Size	5.20	5.30	5.49	4.76
	(2.32)	(2.11)	(2.27)	(2.55)
Household Composition:				
▪ Proportion of children *(0-17 yrs)*	0.37	0.41	0.35	0.36
	(0.26)	(0.27)	(0.25)	(0.26)
▪ Proportion of adults *(18-64 yrs)*	0.58	0.54	0.57	0.62
	(0.26)	(0.27)	(0.24)	(0.26)
▪ Proportion of elderly *(65+ yrs)*	0.05	0.05	0.08	0.02
	(0.11)	(0.11)	(0.15)	(0.05)
Educational attainment[c]	12.37	11.68	12.28	13.24
	(2.44)	(2.44)	(2.40)	(2.24)
Household Monthly Income[d] *(percent) (<R2,000)*	54.02	61.67	45.00	55.56
Unemployed *(percent)*	40.35	46.67	37.93	35.85
Govt. grant recipient status *(percent)*	71.26	73.33	75.00	64.81
Fire experience *(percent)*	34.48	31.67	40.00	31.48
Informal electricity connection *(percent)*	28.16	18.33	26.67	40.74
Use of paraffin *(percent)*	45.40	46.67	38.33	51.85
Location of dwellings *(percent of dwelling located <70 meters from main road)*	51.15	51.14	51.28	51.02

Notes:

(i) [a]Six (6) participants never showed up on the actual day of the experiment

(ii) [b]A kernel density distribution of age shows that age is almost normally distributed for the entire sample (*See* Figure A.V, Kernel density of distribution of age in appendix A)

(iii) [c]See Figure A.VI in the appendix for the distribution of educational attainment

(iv) [d]See Figure A.VII in the appendix for the distribution of household monthly income per income bracket

[29] See Figure A.VI in the appendix for the distribution of subjects' educational attainment.

Household monthly income is relatively low. About 54 percent of the households earn less than R2, 000 per month[30]. This sample statistics is fairly consistent with official statistics. According to the City of Cape Town - 2011 Census Suburb for Khayelitsha, 41 percent of households living in informal settlement earn less than R800 per month. It is worth noting however that the quality of census data on household income is relatively poor as it is derived by adding together the individual incomes of all members of the household (CCT, 2013).

Nearly 40 percent of the subjects in the entire sample are unemployed, and this varied across treatment with participants in treatment I (gains) having the highest unemployment rate at about 47 percent and those in treatment III (loss) the lowest unemployment rate at about 36 percent. This is consistent with the official City of Cape Town – 2011 Census suburb for Khayelitsha, that report about 60 percent of the labour force (aged 15 to 64) being employed (CCT, 2013).

In terms of uptake of government grants, approximately 70 percent of the households receive at least one government grant. Specifically, 16 percent of the households receive a pension, over 61 percent of the households receive a child care grant, and only 6 percent receive a disability grant.

Nearly 35 percent of the participants reported having experienced damage from fires[31, 32]. Additionally, a large proportion of the sample engages in activities that pose fire risks. Specifically, about 29 percent of the sample had illegal/informal electricity connection. These present a serious fire hazards as illegal/informal electricity connection has been cited as the main cause of fires in homes. For instance, due to illegal electricity connection or "electricity tapping", overloading of the electricity power system often leads to wires overheating, short circuits and insulation being ignited resulting in fires that spread rapidly.

There is a considerable variation in the energy sources used for lighting, heating and cooking in South Africa. Most households in informal settlements rely largely on unsafe, unhealthy forms of energy such as candles, paraffin, coal and firewood, when they cannot afford to buy electricity to fulfil basic household energy needs particularly with respect to lighting, heating and cooking (SEA, 2014). Nearly 45 percent of this sample use paraffin for lighting, heating

[30] See Figure A.VII in the appendix for the distribution of household monthly income per income bracket.
[31] See also Figure A.VIII in the appendix for the distribution of household experience with fire, use of paraffin for lighting, heating and cooking, and informal/illegal electricity connection
[32] It is worth noting however that all the subjects knew the risk of fires in the informal settlements

and cooking[33]. Paraffin is highly flammable, and poses serious fire risk when contaminated by water or other fuels (Schwebel & Swart, 2009). It has been cited as the main cause of severe burns, and paraffin stoves that are knocked over or explode are a major cause of injuries and fires in informal settlements.[34] As such, local authorities recommend that households should always have a bucket of sand nearby when using a paraffin appliance and keep their stove on a flat surface, as a fire prevention strategy.

Prevention of fires in view of exposure from possibilities of fires spreading from one dwelling to others due to the influence of street widths and openness (Bayliss, 1955) is the main challenge in fire prevention in informal settlements. Informal settlements are highly dense and often have narrow road, such that in case of emergency, it is difficult for emergency and rescue teams to get to the fire site[35]. This study tries to capture the distributional pattern of dwelling i.e. in terms of the distance of subjects' dwelling from the main road.[36] Almost half (i.e. 50 percent) of the household are located less than 70 meters from the main road and is evenly distributed across treatments.[37, 38]

From what we infer above households may have very limited choice over several high risk factors such as their household's physical location from access roads and may also be forced by necessity to make illegal/informal electricity connections or to use flammable substances, like paraffin for lighting, heating and cooking to meet their basic needs. We borrow Professor Amartya Sen's concepts of *functioning* and *capability*. Sen's concept of functioning relates to the things a person may value *doing* or *being*. Functionings are features of a person's state of existence ranging from relatively elementary states (e.g. being adequately nourished), to

[33] This statistics is consistent with regional statistics for Western Cape Province South Africa. According to the Western Cape Informal Settlements Status 2013 report, formal urban areas almost exclusively use electricity for lighting and cooking (96 percent) while informal urban settlements use candles and paraffin for lighting (25 percent), cooking (26 percent) and heating (39 percent) (CCT, 2013).

[34] Follow the City of Cape Town link for more details: https://www.capetown.gov.za/EN/ENVIRONMENTALRESOURCEMANAGEMENT/TIPS/Pages/ParaffinSafetyTips.aspx

[35] Informal settlements, such as Khayelitsha in Cape Town, are densely populated and the roads are narrow and not tarred in many places. The obvious impact of this is on time it takes the emergency and rescue services to reach the dwelling. See Figure A.IV, an aerial photo of the study site – BM section of Khayelitsha, Cape Town in appendix A.

[36] The distance (in meters) of dwellings from the main road was estimated using GPS coordinates captured during the time of recruitment of subjects, with assistance from the Geomatics department of the University of Cape Town. Note that this is the linear distance approximation of dwellings from the main road. However, we did not consider the distance of dwellings from un-gazetted informal settlement roads. See an aerial photo of the study site – BM section of Khayelitsha, Cape Town in appendix a.

[37] The average distance of dwellings from the main road is about 70 meters with most of the dwellings located within a 100 meters range

[38] See also Figure A.V in the appendix for the distribution of households from the main road, per treatment.

complex personal states and activities (e.g. participation and appearing without shame). The concept of capability relates to the ability of a person to achieve different combinations of functionings – the various combinations of valuable beings and doings that are within a person's reach, reflecting the opportunity or freedom to choose a life that a person values (Sen, 1984). In this regard, we may deduce that households have capabilities that they can engage in to reduce the hazards of fires. Households may be able to engage in a range of fire prevention strategies over which they do have more direct choice or control. These include:

- *Building the home about 3-5 metres away from the neighbours;*
- *Making sure that candles and lamps are extinguished before sleeping or leaving the home;*
- *Making sure that the home has more than one exit;*
- *Keeping matches, lighters and paraffin out of reach of children;*
- *Keeping the stove on a flat surface; and*
- *Keeping a bucket of sand and a bucket of water for fire extinguishing*[39].

These are low-cost local initiatives and individual-level strategies that can be designed to prevent fires or mitigate fires originating from homes over which households have a lot more direct control or choice. It is worth stating that there are other technologies designed to prevent fires or mitigate the risk of fires that include smoke alarms, detection and burner control, hood extinguishing systems, portable fire extinguishers, and home fire sprinklers. However, for the low-income highly dense urban informal settlements, such low-cost local initiatives and individual-level strategies (like the fire safety measures outlined above) can greatly mitigate the risk of fire.

The above outlined fire prevention or fire safety measures are grouped into three (3) broad categories, depending on the level of effort (and/or effectiveness and cost) need to engage in such strategies[40], as:

(i) **Do Nothing:** this category captures all responses to subjects who reported that they do nothing to mitigate themselves from the risk of fire.

(ii) **Least effort measures:** this category captures all responses to subjects who reported that they usually put out all candles and lamps before sleeping or leaving home; keeps matches, lighters and paraffin out of reach of children; keep their stove on flat surface; and, keep a bucket of water and/or a bucket of sand close-by for fire

[39] See footnote 7

[40] See Table A.III in appendix A for a summary of these fire prevention strategies categories.

extinguishing. These are fire prevention strategies for subjects' exposure to "risk" of fire from most probable causes or origins of fire i.e. heating and lighting, house-keeping and habits. It is worth noting that fires beginning with cooking appliances account for the largest shares of home structure fires and associated fire injuries in informal settlements. The leading causes of fires in informal settlements are probably from cooking (e.g. unattended cooking), heating, and human behaviours, such as substance abuse like alcohol and smoking.

(iii) **Most effort measures:** this category captures all responses to subjects who reported that they have built their homes at least 3-5 meters apart from the neighbours; and that they make sure that their homes have more than one exit. Essentially, this fire prevention category captures individual "risk" at which the fire originates via building planning and construction. The occurrences of fire in informal settlements have been compounded by the fact that homes are typically small, low, with small window opening in many areas and frequently separated by narrow avenues. These homes are hurriedly and cheaply built, using vast quantities of wood in floor and roof constructed with materials which are widely available and least expensive, such as plastics, cardboard or iron sheets.

The second column of Table III shows individual and grouped fire prevention strategies engaged in by all households while in the third and fourth column, the sample is sorted so as to show individual and grouped fire prevention strategies engaged in by households with previous fire experience and household without previous fire experience, respectively. The difference in means for the two sub-samples i.e. household with previous fire experience and household without previous fire experience in terms of the individual and grouped fire prevention strategies is shown in the last column[41]. Further, the two-sample *t-test* for difference in means, assuming equal variances for the sub-samples, is performed. Essentially, we test the pairwise hypothesis that the mean difference is zero against its alternative i.e. to show that those with previous fire experience significantly engage in more fire prevention strategies than those without.

Nearly 18 percent of the entire sample has done nothing to mitigate themselves from the risk of fire. About 73 percent of the entire sample is engaged in *"least effort"* fire prevention strategies with nearly 22 percent report putting out candles and lamps before sleeping or

[41] See Table A.II and A.III in the appendix for fire experience and individual fire prevention strategies per treatment (gain, mixed, and loss) and fire experience and grouped fire prevention strategies, respectively.

leaving home, about 15 percent report keeping matches, lighters and paraffin out of reach of children, 26 percent report keeping the stove on a flat surface, while the majority (37.90 percent) report keeping a bucket of sand and a bucket of water for fire extinguishing as fire prevention measures. Approximately, 9 percent of the entire sample is engaged in *"most effort"* fire prevention strategies, of which nearly 45 percent report having built their homes at least 3-5 metres apart from the neighbours and about 55 percent report making sure that their home has more than one exit.

The proportion of households that have done nothing to mitigate themselves from the risk of fire is significantly less for household with previous fire experience as their counterpart. This may not be surprising as households with previous fire experience may undertake more fire precautionary measures to reduce future occurrences of fires. The proportion of households engaged in *"most effort"* fire prevention strategies is significantly more for household with previous fire experience than for households without previous fire experience. Similarly, the proportion of households engaged in *"least effort"* fire prevention strategies is significantly more for household with previous fire experience than for household without previous fire experience[42].

[42] See Table A.II in the appendices for households' fire experience and grouped fire prevention strategies (as described in Table A.III, in the appendices)

Table III: Fire Experience & Fire Prevention Strategies

(Figures are in Percentage)

FIRE PREVENTION STRATEGIES	All households (n=10,440)	Households with fire experience (n=3,600)	Households without fire experience (n=6,840)	Diff[a]
I. Do nothing[b]	**18.39**	**5.00**	**25.44**	**-20.44***
II. Least effort	**72.99**	**85.00**	**66.67**	**18.33***
▪ Put out all candles & lamps before sleeping or leaving home	21.77	16.33	25.33	-9.00*
▪ Keep matches, lighters and paraffin out of reach of children	14.52	8.16	18.67	-10.51*
▪ Keep stove on flat surface	25.81	28.57	24.00	4.57*
▪ Keep a bucket of water and a bucket of sand close-by for fire extinguishing	37.90	46.94	32.00	14.94*
III. Most effort	**8.62**	**10.00**	**7.89**	**2.11***
▪ Built the home at least 3 metres apart from the neighbours	44.64	60.87	33.33	27.54*
▪ Made sure that the house has more than one exit	55.36	39.13	66.67	-27.54*

Notes

(i) [a]Differences in means is computed for the sub-samples: households with and without previous fire experiences.

(ii) [a]The two-sample *t-test* for difference in means, assuming equal variances for the sub-samples, is performed between household with and without fire experience. Essentially, we test the pairwise hypothesis that the mean difference is zero against its alternative i.e. to show that those with previous experience make significantly more effort than those without.

(iii) [b]"*Do nothing*" captures all responses to subjects who reported that they do nothing to mitigate themselves from the risk of fire.

(iv) [*]Significant at 5 percent

V. RESULTS & DISCUSSION

In this section, we presents the maximum likelihood estimates, assuming normal Fechner errors and taking into account the "contextual error" specification developed by Wilcox, 2008 and advocated by Harrison and Swarthout (2012). We also discuss the results in relation to those found in similar previous studies.

Table IV presents the results from the conditional log-likelihood function (equation 5a) of the expected utility specification, assuming constant relative risk aversion (CRRA). Accordingly, if the coefficient of constant relative risk aversion, r, of the expected utility model is equal to zero (i.e. $r = 0$), greater than zero (i.e. $r > 0$) or positive, or less than zero (i.e. $r < 0$) or negative, it corresponds respectively to risk neutrality, to risk aversion, and to risk seeking. Notice that the regression coefficients are interpreted as the marginal effects of each variable as compared to the default case (Harrison, Lau & Rutström, 2007). The first panel (panel A) of Table IV shows the maximum likelihood estimates of the expected utility specification with Fechner index, assuming homogeneous preferences. The coefficient r is estimated to be -0.0698, with a standard error of 0.0906. The coefficient is however not statistically significant different from zero implying risk neutrality.

Figure II (a) displays the distribution of predicted risk attitudes from the EUT model estimated, assuming constant relative risk aversion. As mentioned above, for the CRRA specification, a value of 0 denotes risk neutrality behaviour, negative values indicate risk seeking behaviour, and positive values indicate risk aversion. Thus, it can easily be seen from the chart (*Figure II (a)*) that the average of this distribution is centred around 0 (with the point estimate $r = -0.0698$) implying risk neutrality in CRRA terms. This result is noteworthy because experimental evidence from other studies indicates modest degrees of risk aversion. In particular Anderson, Harrison, Lau and Rutström (2010), who utilized data on experimental procedure reported by Harrison and Rutström (2009, 2008) on 158 students of the University of Central Florida, found a coefficient of constant relative risk aversion of 0.771, indicating risk aversion. Other studies, such as Harrison, Humphrey and Verschoor (2010) in Ethiopia, India and Uganda; Brick, Visser and Burns (2012) in South Africa; Galarza (2009) in Peru; Harrison, Lau and Rutström (2007) in Denmark, also found evidence of moderate risk aversion. There is, however, considerable variation in the distribution of risk

attitudes for the three treatments: gain, mixed and loss. With the exception of the gain frame (*Figure II (b)*), the loss and mixed frame shows risk seeking behaviour of subjects[43].

The second panel (panel B) of Table IV reports the relative risk estimates assuming that choices are explained by the expected utility theory specification (specification 5a) with Fechner index, and making such risk estimate be a linear function of subjects' characteristics and subjects' use of fire safety measures[44]. There are five (5) main results that can be drawn from this panel. First, the results indicate moderate degree of risk seeking, i.e. the predicted r at average values is -0.1334, with standard error of 0.4991. This means that an individual with the average characteristics and fire safety measures (Table IV) will exhibit a moderate degree of risk seeking, however, not statistically significant different from zero. Second, there is evidence of a large degree of randomness in choices, as indicated by the Fechner index, μ = -0.1630 with standard error of 0.0151, for homogeneous preferences and μ = -0.1520 with standard error of 0.0263, for heterogeneous preferences. This result is not surprising as our sample is composed of individuals with typically low levels of schooling and as such a large proportion of them are bound to make mistakes in their lottery choices[45]. Several studies that incorporates the normal Fechner errors in their analysis have found it to be statistically significant, implying evidence of random errors when subjects calculate the values of the lotteries (e.g. Galarza (2009) in Peru; Harrison, Lau & Rutström (2007) in Denmark; Brick, Visser, & Burns (2012) in South Africa).

Third, subjects in the mixed and loss treatments are less risk averse, as shown by the decreasingly negative coefficients of the variables *mixed frame* and *loss frame*, with the effect being statistically significant ($p - value < 0.001$). Clearly, Figures II (c) and II (d) point out the left-ward skewness from zero in the distribution of risk attitudes for the mixed frame and loss frame, respectively. It is striking to note that recent experimental evidence from the laboratory (e.g. Holt & Laury, 2002; Hey & Orme, 1994) and the field (e.g. Galarza, 2009;

[43]See Figures II (b), (c), and (d) below which displays the kernel density of observed risk attitudes per treatment (gain, mixed and loss).

[44] Additional regression results are appended in Table A.VI, where we systematically introduce different covariates to illustrate the effects of socio-demographic characteristics and fire experience & fire prevention strategies on risk attitudes.

[45] The large random errors or mistakes can be attributed to several factors, including the lack of attention to or understanding of game instructions, carelessness, hurry, or insufficient motivation in the process of calculating the expected utilities.

Harrison, Lau, & Rutström, 2007; Bosch-Domenech & Silvestre, 1999) suggests in general that subjects exhibit risk aversion over the gain domain.

Fourthly, risk aversion varies with key demographic variables, namely gender, age, educational attainment, the presence of children, household income, and employment status. We find a significant effect from age, with risk aversion increasing with each year in age of subjects ($r = 0.0824$)[46] and risk aversion increases with educational attainment. This finding is consistent with the findings of Tanaka, Camerer, and Nguyen (2010) who find that subjects who are both older and more educated are more risk averse in Vietnam. Similarly, Harrison, Lau and Rutström (2007) finds the age and education effects on risk attitudes, with subjects who begin or complete vocational training or higher education in Denmark being significantly more risk averse than those with less while risk aversion decreases with age, particularly after age 40. However, we do not statistical significant effects of educational attainment and other demographic variables, including the presence of children[47] in the household, on risk aversion contrary to expectation. For instance, we hypothesized that risk aversion amongst subjects with children at home is more than those without children at home. It is noteworthy however that empirical evidence on the relationship between risk aversion and other characteristics such as gender, age, education level, the presence of children at home, and employment status is mixed.

[46] Interestingly, age remains statistically significant even when subjects' previous experience with fire and distance of dwelling from the main road are not controlled for in regression (2) and (3) of Table A.VI in the appendices (*See* Table A.VI in the appendices).

[47] Interestingly, the presence of children at home indicates less risk aversion, and becomes statistically significant when distance of dwelling from the main road, use of paraffin for lighting, heating and cooking, and informal/illegal electricity connection variables are not controlled for in regression (6) and (7) of Table BVI in the appendices (*See* Table B.VI in the appendices).

Table IV: Maximum Likelihood Estimation - Expected Utility Theory

(Dependent variable: Risk aversion)

		A. Homogeneous Preferences	B. Heterogeneous Preferences
Variable(s)	Description	Constant	Constant
r	**Constant**	**-0.0698**	**-1.7550***
		(0.0906)	**(0.9630)**
Mixed	**Mixed frame**	**.**	**-0.5650*****
		.	**(0.1760)**
Loss	**Loss frame**	**.**	**-1.3080****
		.	**(0.6080)**
Female	Female	**.**	0.3390
		.	(0.2150)
Age	**Age (in years)**	**.**	**0.0842***
		.	**(0.0485)**
Agesq	Age squared	**.**	-0.0009
		.	(0.0006)
Children	Presence of children	**.**	-0.2460
		.	(0.1770)
Matrics	Grade 12 (or Standard 10)	**.**	0.0084
		.	(0.1370)
HHincome	Household monthly income	**.**	0.0049
	(>R2,000)	**.**	(0.1750)
Unemployed	Unemployed	**.**	0.1750
		.	(0.1650)
Fire_exp	Fire experience	**.**	-0.1120
		.	(0.1850)
Fires	**Fire prevention strategies**	**.**	**0.2210****
		.	**(0.1060)**
Close_to_road	Distance of dwelling from main	**.**	-0.0082
	road	**.**	(0.0536)
Informal_elect	Informal electricity connection	**.**	-0.1750
		.	(0.1810)
Paraffin	Use of paraffin for lighting,	**.**	-0.0915
	heating and cooking	**.**	(0.1490)
μ	**Constant**	**-0.1630*****	**-0.1520*****
		(0.0151)	**(0.0263)**
Notes			
(i) Sample size, n		*10,394*	*7,290*
(ii) Log pseudo-likelihood		*-6889.15*	*-4606.94*
(iii) Wald Chi-square (df)		**.**	*30.92 (14)*
(iv) ***Predicted r (at average values)***		**.**	***-0.3167***
*(v) Standard errors in parentheses; ***Significant at 1%, **Significant at 5%, *Significant at 10%*			

Fifth, the results indicates that subjects engaged in fire safety measures that need *„most effort"*(i.e. fire prevention measures that are most effective and costly) are more risk averse as compared to subjects engaged in fire safety measures that need *„least effort"*(i.e. fire prevention measures that are least effective and less cost), as shown by an increasing positive coefficient on the variable *fires*[48] by 0.2210, with standard error of 0.1060. This coefficient is statistically significant at $p - value < 0.05$. The *"most effort"* measures are defined as those fire prevention measures that need more effort, are most effective and costly and are typically aimed at reducing households exposure to fire risks from probable causes[49]. The fire prevention measures included in this category are: building of homes at least 3-5 meters apart from the neighbours, and making sure that subjects' homes have more than one exit. Essentially, this fire prevention category captures individual "risk" at which the fire originates via building planning and construction.

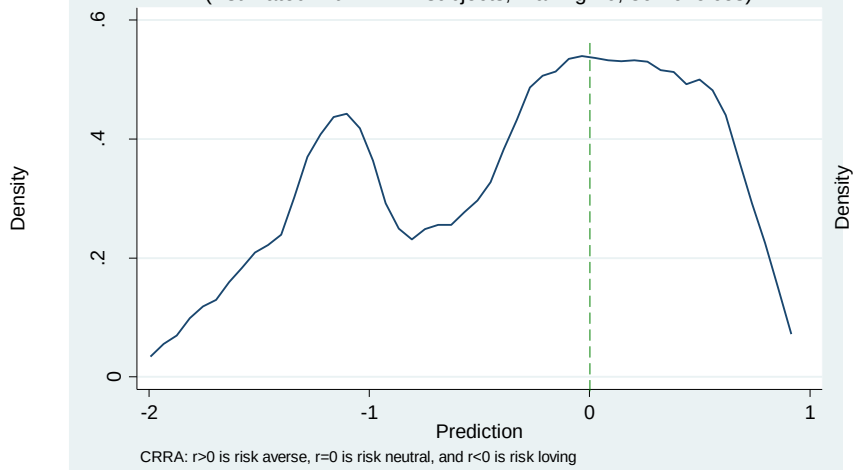
On the other hand, the *"least effort"* measures are those fire prevention measures that need least effort, are least effective and less cost, and include: putting out all candles and lamps before sleeping or leaving home, keeping matches, lighters and paraffin out of reach of children, keeping of stove on the flat surface and keeping a bucket of water and/or a bucket of sand close-by for fire extinguishing. These are fire prevention strategies for subjects' exposure to "risk" of fire from most probable causes or origins of fire i.e. heating and lighting, house-keeping and habits. Most fires in the informal settlement begins with cooking appliances which account for the largest shares of home structure fires and associated fire injuries (IAFC, 2013). It is common knowledge that the leading causes of fires in informal settlements are probably from cooking (e.g. unattended cooking), heating, and human behaviours, such as substance abuse like alcohol and smoking.

[48] Note that a binary variable that assess households engaging in *"most effort"* versus *"least effort"* measures was constructed and used in regression analysis i.e. maximum likelihood estimation reported in Table III and Table A.VI, in the appendices. In essence, subjects who have done nothing to mitigate themselves from the risk of fires are not included in this analysis. This task reduced the sample size from 10,394 choices to 7,290 choices. However, the aim is to test the hypothesis as to whether or not subjects engaged in *"most effort"* are more risk averse as subjects engaged in *"least effort"*.

[49] See Bayliss (1955), Crosby (1905) for a comprehensive review of causes of fires in homes and Raphela (2011) on the thesis of the impact of stack fires on poor households in informal settlements.

Figure II (a): Distribution of risk attitudes under EUT (full sample)

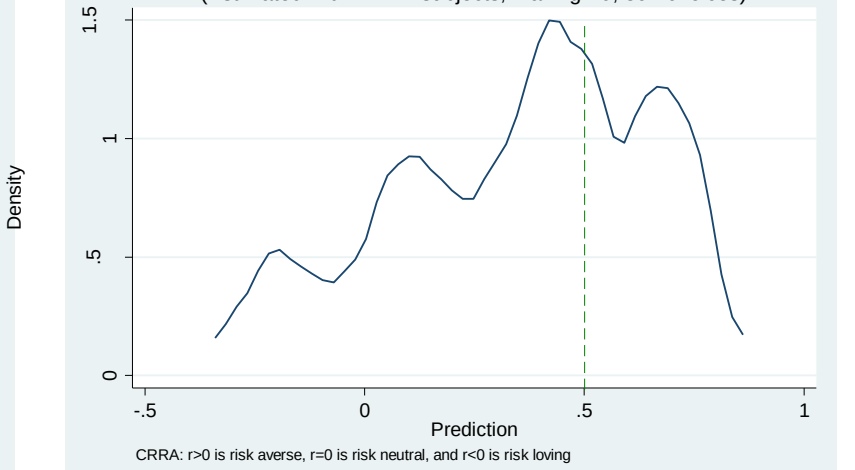
(Estimated with n=174 subjects, making 10, 394 choices)



CRRA: r>0 is risk averse, r=0 is risk neutral, and r<0 is risk loving

Figure II (b): Distribution of risk attitudes under EUT (Gain frame)

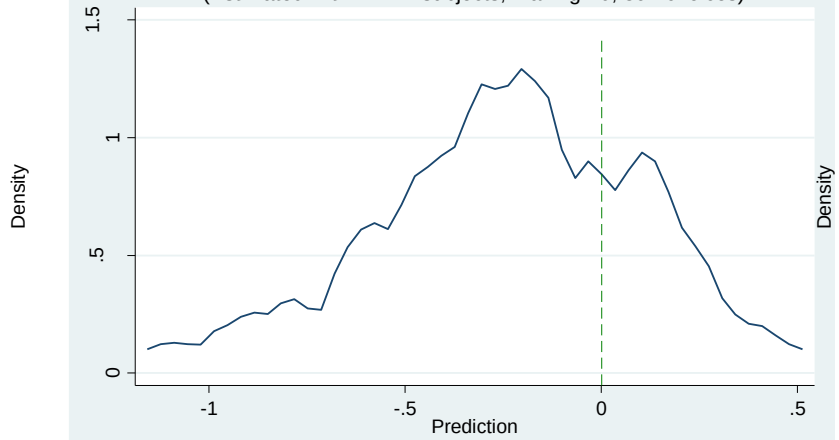
(Estimated with n=174 subjects, making 10, 394 choices)



CRRA: r>0 is risk averse, r=0 is risk neutral, and r<0 is risk loving

Figure II (c): Distribution of risk attitudes under EUT (Mixed frame)

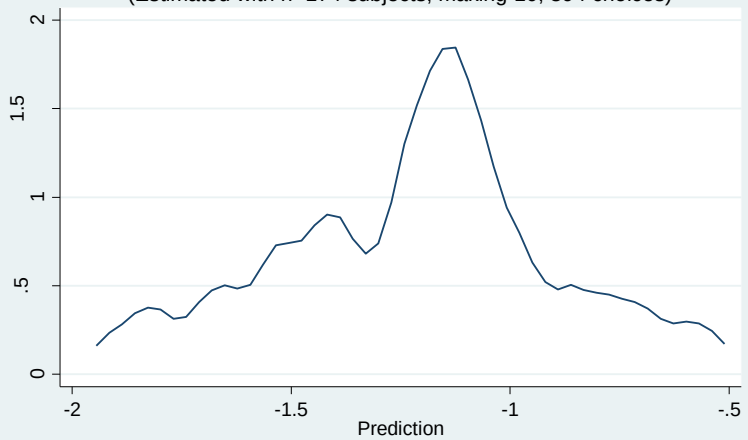
(Estimated with n=174 subjects, making 10, 394 choices)



CRRA: r>0 is risk averse, r=0 is risk neutral, and r<0 is risk loving

Figure II (d): Distribution of risk attitudes under EUT (Loss frame)

(Estimated with n=174 subjects, making 10, 394 choices)



CRRA: r>0 is risk averse, r=0 is risk neutral, and r<0 is risk loving

We also estimated risk preferences using only individual-level fire prevention strategies variables in a separate regression (appended as Table A.V), where we show that certain individual-level fire prevention measures that are within the means of the households to effect, such as keeping matches, lighters and paraffin out of reach of children, is correlated with risk aversion, but measures, such as building of homes at least 3-5 meters from the neighbours, and keeping of stove on the flat surface, does not seem to be within the choice set of low-income informal dwellers due to constraints, such as poverty and inequality.

Contrary to expectation, distance from the main road, informal electricity connection, and the use of paraffin for lighting, heating and cooking are not correlated with risk aversion, indicating that irrespective of the risk profiles of decision makers, low-income households are often forced to make choices that increase their exposure to fire hazards. It is common practice that with no electricity connection (and even with unreliable electricity supply), households are forced to rely on unsafe and unhealthy forms of energy for lighting, heating and cooking, such as the use of flammable substances like paraffin, which poses high fire hazards. It is also worth noting that with informal/illegal electricity connection, which is the common practice especially in informal settlements, households are exposed to high fire hazards as informal electricity connection has been cited as one of the leading causes of fires.

We explore the relationship of informal electricity connection (and the use of paraffin for lighting, heating and cooking) with several socio-demographic and household previous fire experience factors in Table V. The logistic regression analysis is performed at two levels: for the full sample and a sub-sample of subjects with previous fire experience. The aim of this task is to show the extent to which socio-demographic and household previous experience with fires is correlated with informal electricity connection (and the use of paraffin for lighting, heating and cooking)[50].

The literature shows that illegal/informal electricity or "electricity tapping" are mostly explained as the urban shantytown dwellers' (informal settlers') response to non-affordable prices of electricity. Mimmi and Ecer (2010) who studied the incidence and determinants of illegality in the context of low-income urban informal dwellers in Brazil found that the probability of urban

[50] It should be noted here that this is not an explicit study on the determinant of households engagement in the use of paraffin for lighting, heating and cooking or illegal/informal electricity connection but rather we try to assess the extent to which socio-demographic and household previous experience with fires is correlated with these factors.

informal dwellers engaging in such illegal behaviours is explained not only by low income, but by a combination of concurring factors, including sub-standard energy provision and equipment, inefficient or incorrect use of domestic electric appliances and running an informal in-house businesses. Our findings seems to suggests that informal electricity connection is associated with educational attainment, household income, and household previous fire experience, here statistically significant at 1 percent (Table V). Interestingly, low-income households (or poor households) with previous fire experience are more likely to have illegal/informal electricity connection, and also subjects with low educational attainment (i.e. less than Grade 12 or Standard 10) are more likely to have illegal/informal electricity connection. On the other hand, households with previous fire experience and have children at home are less likely to have illegal/informal electricity connection while the probability of female engaging in illegal/informal electricity connection is less than their male counterparts.

Poor households living in informal settlements face a range of chronic everyday risks associated with marginal living conditions and poor service delivery (Pharoah, 2009). Inadequate service delivery increases both people's exposure and vulnerability to hazards, including fire hazards. For instance, with no electricity connection, households are forced to rely on unsafe and unhealthy forms of energy for lighting, heating and cooking, such as the use of flammable substances like paraffin, which poses high fire hazards. However, even with electricity, households may continue to rely on traditional sources of energy for lighting, heating and cooking, such as the use of paraffin stoves. Our results indicates that low-income households with previous fire experience are more likely to use paraffin for lighting, heating and cooking, and that subjects who are unemployed are more likely to use paraffin for lighting, heating and cooking. This result is not surprising as Kehrer, Kuhn, Lemay and Wells (2008) notes that most residents in informal settlement often struggle to obtain all of the energy services they need for

Table V: Logistic Regression Estimations

(Standard errors in parenthesis)

VARIABLES	A. Informal electricity connection		B. Paraffin use	
	All households *(n=10,261)*	Household with fire experience *(n=3,561)*	All households *(n=10,261)*	Household with fire experience *(n=3,561)*
Female	-0.2650***	-0.0942	-0.3140***	**-0.6470*** **
	(0.0471)	(0.0865)	(0.0443)	(0.0907)
Age	0.1820***	**0.0850***	0.0614***	-0.0276
	(0.0187)	(0.0483)	(0.0119)	(0.0429)
Agesq	-0.0028***	**-0.0015****	-0.0005***	2.47e-05
	(0.0003)	(0.0008)	(0.0002)	(0.0006)
Children	-0.1720***	-0.1210	0.1450***	**0.8680*** **
	(0.0564)	(0.1040)	(0.0537)	(0.1130)
Educ.	0.0222**	**0.1530*** **	0.1150***	**0.3380*** **
	(0.0109)	(0.0229)	(0.0100)	(0.0286)
HHincome	0.0222	**0.9790*** **	0.4110***	**0.3170*** **
	(0.0469)	(0.0838)	(0.0437)	(0.0868)
Unemployed	-0.0648	0.0038	0.8170***	**1.5020*** **
	(0.0478)	(0.0776)	(0.0433)	(0.0834)
Fire_experience	0.2700***	.	-0.4230***	.
	(0.0474)	.	(0.0456)	.
Distance	0.0008	0.0008	-0.0002	-0.0006
	(0.0005)	(0.0008)	(0.0004)	(0.0008)
Constant	-3.7780***	-4.1220***	-3.3800***	-4.7850***
	(0.3640)	(0.8370)	(0.2700)	(0.8260)
LR chi-square (df)	*342.77 (9)*	*221.28 (8)*	*867.11 (9)*	*699.96 (8)*
Pseudo R^2	*0.0280*	*0.0488*	*0.0614*	*0.1477*
Log-likelihood	*-5953.00*	*-2157.37*	*-6627.95*	*-2019.02*

Definition of variables:

„Age"- subjects' age (in years) and it squared; gender (*female*); a binary as to whether or not the household had children aged 0-17 years (*children*) i.e. the presence of children; educational attainment (*educ*) i.e. less than Grade 12 or Standard 10; a binary as to whether or not the household monthly income is less than R2,000 (*hhincome*); employment status (*unemployed*); a binary as to whether or not the household experienced home damaged by fire *(fire_experience);* distance of dwelling from the main road *(distance)*; a binary as to whether or not the household uses paraffin for lighting, cooking and/or heating *(paraffin)*

heating and cooking[51]. It is striking to note that although electricity used for cooking and heating maybe fairly inexpensive, it is sometimes unreliable and this often force people in informal settlement to rely on use of paraffin for heating and cooking despite the dangers it poses to fires. Subjects with previous fire experience and low educational attainment are more likely to use paraffin for lighting, heating and cooking (Table V), and the probability of households with previous fire experience and have children at home engaging in the use of paraffin for lighting, heating and cooking is more than their counterparts[52].

It is worth mentioning that perception of the risk posed by fire in the home varies according to people's subjective assessment of their vulnerability, level of care and protection, the potentially fatal consequences as well as, affective features such as the perceived level of control over risk and its predictability (CLG, 2008). There appeared to be a reasonable level of connotation between people's self-appraisal of these factors and their ability to judge the factors that place them at greater risk of fire. This concern may be associated with people taking precautions and adopting coping strategies that lead them to feel they can manage the risk and therefore are at less risk (CLG, 2008). In this paper, we tests the hypothesis that risk averse individuals will take precautionary measures in as far as possible to mitigate the risk of fire to their household. Our findings seem to suggest that certain low-cost individual-level fire prevention measures that are within the means of the households to effect (e.g. making sure that matches, lighters and paraffin are kept out of reach of children) is correlated with risk aversion.

However, for fire prevention efforts to be effective, the education of the public in fire precautions and prevention needs the resources of modern advertising and high-powered publicity (Bayliss, 1955). Public safety education can be an effective tool for affecting fire safety related to human behaviours, and a robust public education campaign can raise awareness about the dangers associated with fire. However, several factors may limit the

[51] Most residents in informal settlements struggle to access electricity as it is provided only to those residents who have an official address registered with the municipality and those who do not have access are forced to buy electricity (via "electricity tapping") from their neighbours. Burning paraffin fuel for cooking and heating is common throughout the informal settlement. However, when electricity is not available people are often faced to use paraffin as an effective yet slightly more expensive energy source, despite the dangers it poses to fires (Kehrer, Kuhn, Lemay, & Wells, 2008).

[52] See footnote 47

effectiveness of public safety education with regard to fire safety campaigns, some of which are embodied in human behaviours and institutional constraints.

It suffice to note that while smaller less costly behavioural changes are easy to implement and can reduce risk of fire enormously, there are more substantial risks or "structural risks" which falls outside the means of low-income households[53] and therefore outside their realm of their influence. A number of high risk factors fall outside the means of a low-income household (e.g. illegal/informal electricity connections or "electricity tapping") that can increase household fire risk. Several studies have shown that the greater occurrence of fires in informal settlements is due to high density nature of informal settlements (e.g. a study by DiMP (2002) in Joe Slovo informal settlement in Langa, Cape Town). The local authorities have a *„big"* role to facilitate the reduction in fire risk (such as by re-gridding of informal settlements; promoting the use of safer and healthy energy sources) that can drastically reduce household fire risks in informal settlements.

Certain behavioural changes are within the means of households and advertising, campaigns and education can help in reducing fire hazards in the informal settlements. Indeed, community safety campaigns, say through door-to-door fire safety education, can enhance community preparedness of fire disasters and enhance their resilience to such situations.

[53] For example, most fires in several different informal settlements are often linked to behavioural factors such as alcohol abuse, smoking and domestic violence (Pharoah, 2009).

VI. CONCLUDING REMARKS

In conclusion, the current paper has attempted to provide experimental evidence of fire prevention and risk aversion among urban informal dwellers in Cape Town, South Africa, using subjects' choices over lotteries with real monetary prizes. The empirical analysis is performed within the expected utility theory specification, assuming constant relative risk aversion (CRRA) defined over the lottery prize. Overall, this study has shown that subjects are risk neutral and this finding is not consistent with experimental evidence on risk aversion from other studies (e.g. Binswanger, 1980; Brick, Visser, & Burns, 2012; Anderson, Harrison, Lau & Rutström, 2010). However, risk attitudes are found to vary with socio-demographic characteristics and subjects' use of fire safety measures. We tests the hypothesis that risk averse individuals will take precautionary measures in as far as possible to mitigate the risk of fire to their household. Our findings shows that individual-level fire prevention measures that are within the means of the households to effect, such as making sure that matches, lighters and paraffin are kept out of reach of children, is significantly correlated with risk aversion, but measures, such as building of homes at least 3-5 meters from the neighbours, does not seem to be within the choice set of low-income informal dwellers.

We also group the fire prevention measures into two (2) broad categories, namely *"most effort"* and *"least effort"* measures depending on the effort and cost involved in each measure and constructed a binary variable that captures households engaging in these measures. Our results indicate that subjects who engage in fire prevention/fire safety strategies that require the *„most effort"* (that are most effective and costly) are significantly more risk averse relative to subjects engaging in fire safety measures that need *„least effort"*. In terms of demographic variables, there is a significant effect from age, with risk aversion increasing with each year in age of subjects, and risk aversion increases with educational attainment. Contrary to expectation, distance from the main road, informal electricity connection, and the use of paraffin for lighting, heating and cooking are not correlated with risk aversion, indicating that irrespective of the risk profiles of decision makers, low-income households are often forced to make choices that increase their exposure to fire hazards.

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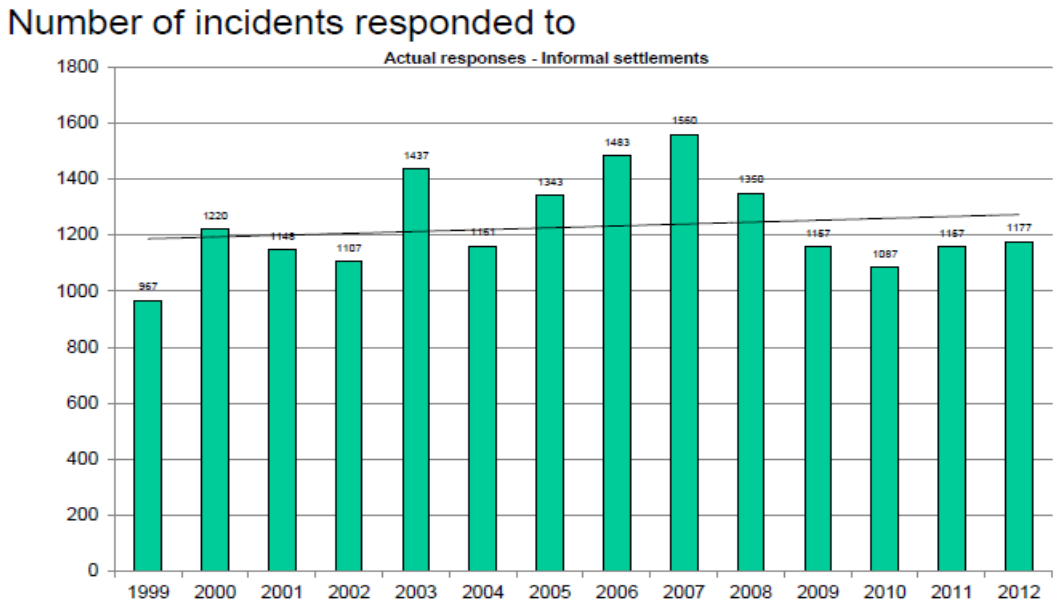
APPENDICES

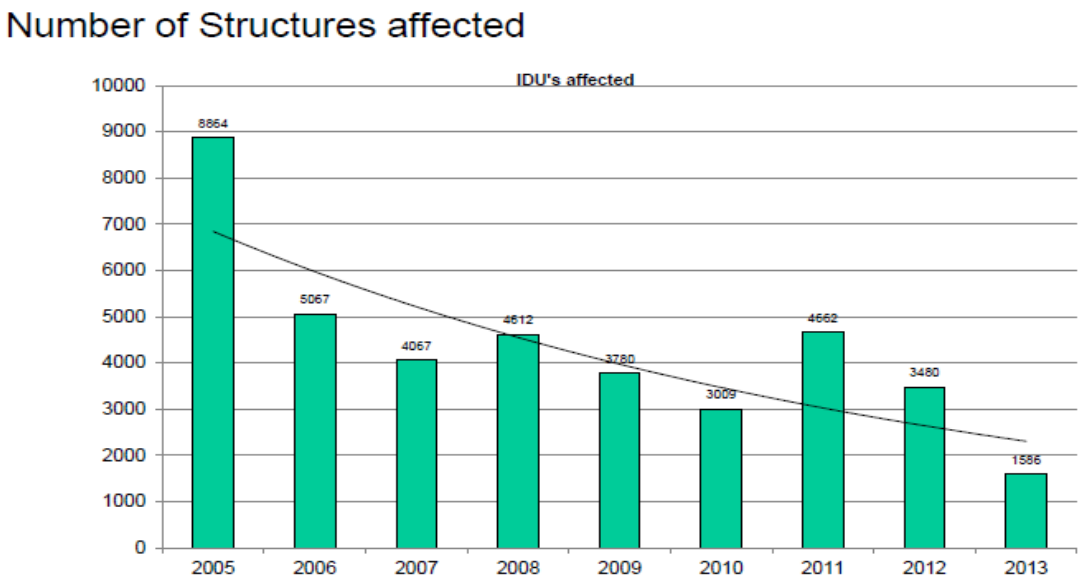
Appendix A: Other Information

Figure A.I: Informal Fire Statistics – Fire incidents in informal settlements in Cape Town, 1999 to 2012



Source: City of Cape Town, 2013

Figure A.II: Informal Fire Statistics – Number of Structures Affected, 2005 to 2013



Source: City of Cape Town, 2013

Selected Previous Related Studies

Table A.I: Summary of Empirical Studies on Risk Aversion

Study	Sample - Study area & experimental design	Finding (s)	Comment (s)
Holt, Charles A & Laury, Susan K (2002)	lottery-choice experiment (involving both the hypothetical and actual payoffs)	This paper presented estimates of a hybrid "power-expo" utility function that exhibits: (1) increasing relative risk aversion, which captures the effects of payoff scale on the frequency of safe choices, and (2) decreasing aboute risk aversion, which avoids absurd amounts of risk aversion for high-stakes gambles. Behaviour across all treatments conformed closely to the predictions of their model	Holt and Laury (2002) assess risk aversion and incentive effects under a simple lottery-choice experiment (involving both the hypothetical and actual payoffs) that elicit risk aversion over a wide range of payoffs (i.e. both low – and high-money payoffs).
Binswanger, Hans P (1980)	▪ 240 households in India ▪ Used two approaches: (i) interview method, & (ii) experimental gambling approach	▪ Experimental measures indicates that, at high payoffs levels, virtually all individuals were moderately risk averse with little variation according to personal characteristics ▪ Wealth tends to reduce risk aversion slightly, but its effect was slightly statistically significant	▪ This study aimed at determining whether or not differences in behaviour between farmers of different wealth levels are the consequence of different attitudes toward risk ▪ Payoffs varied from very low levels to levels exceeding the monthly income of unskilled rural labourers
Brick et al (2010)	▪ Large sample of small-scale fishers (555 subjects) ▪ Used two approaches: (i) interview method, & (ii) experimental gambling approach	▪ Participants exhibited moderate risk aversion and that risk attitudes vary with certain socio-demographic variables, that is, females were found to be more risk averse than their male counterparts; quota holders were more risk loving ▪ Using logistic regression analysis, this study found that a greater degree of risk aversion translated into a reduction in the odds of non-compliance with fisheries regulation	▪ This study found that female fishers and female fisher with fishing rights were more likely to comply with fisheries regulation ▪ These finding shows important implications for the characterization of risk attitudes in fisheries policy applications and for the management of marine resources
Liu, Elaine M (2008)	Survey and field experiment to elicit the risk preferences: of 320 Chinese farmers: Expected utility and	▪ This study found that farmers who are more risk averse or more loss averse adopt Bt cotton ▪ Farmers who overweight small probabilities adopt Bt cotton earlier	This paper examined the role of individual risk attitudes in the decision to adopt a new form of agricultural biotechnology in China

	prospect theory		
Tanaka, Tomoni, Nguyen, Quang, & Camerer, Colin F (2010)	2002 living standard measurement survey *plus* field experiment	▪ Mean village income was related to risk and time preferences ▪ Household income is correlated with patience (lower interest rate) but not with risk preference	This study results suggest people are present biased regardless of their income levels and economic environments
Harrison, Lau & Rutström (2007)	Controlled experiment with 253 subjects aged 19 to 75 years old	Results indicate that the average Dane is risk averse. Risk attitudes vary significantly with respect to several important socio-demographic variables such as age and education. However, the sex effect on risk attitude was not significant	In this study investigated risk attitude were estimated for various individuals differentiated by socio-demographic characteristics

Source: Author's compilation

Figure A.III: Map of Khayelitsha, Cape Town

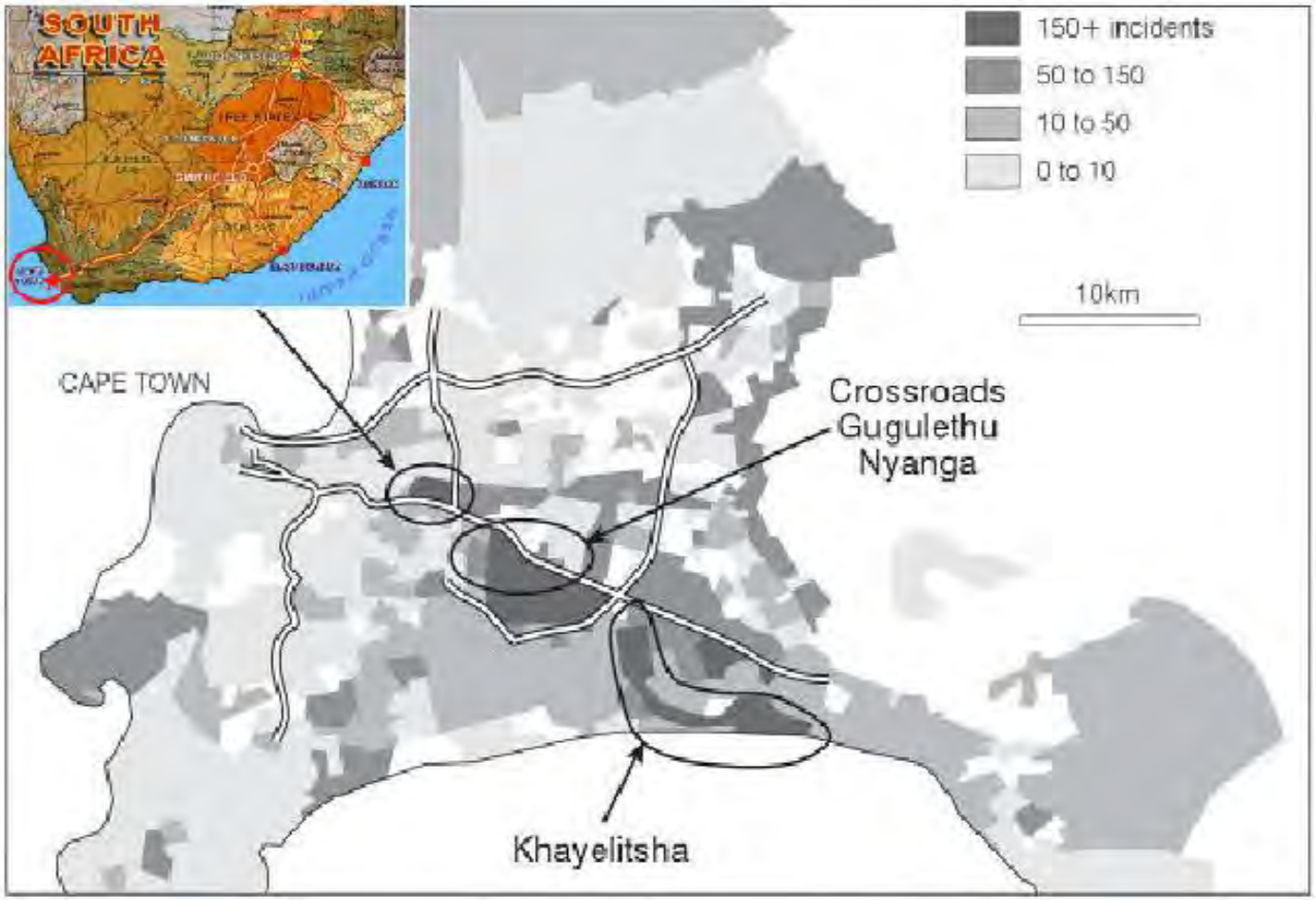


Figure A.III: Total number of informal dwelling fires incidents by suburb, 1990 - 2005

Source: DiMP (2006)

Figure A.IV: Study Site: BM Section, Khayelitsha, Cape Town

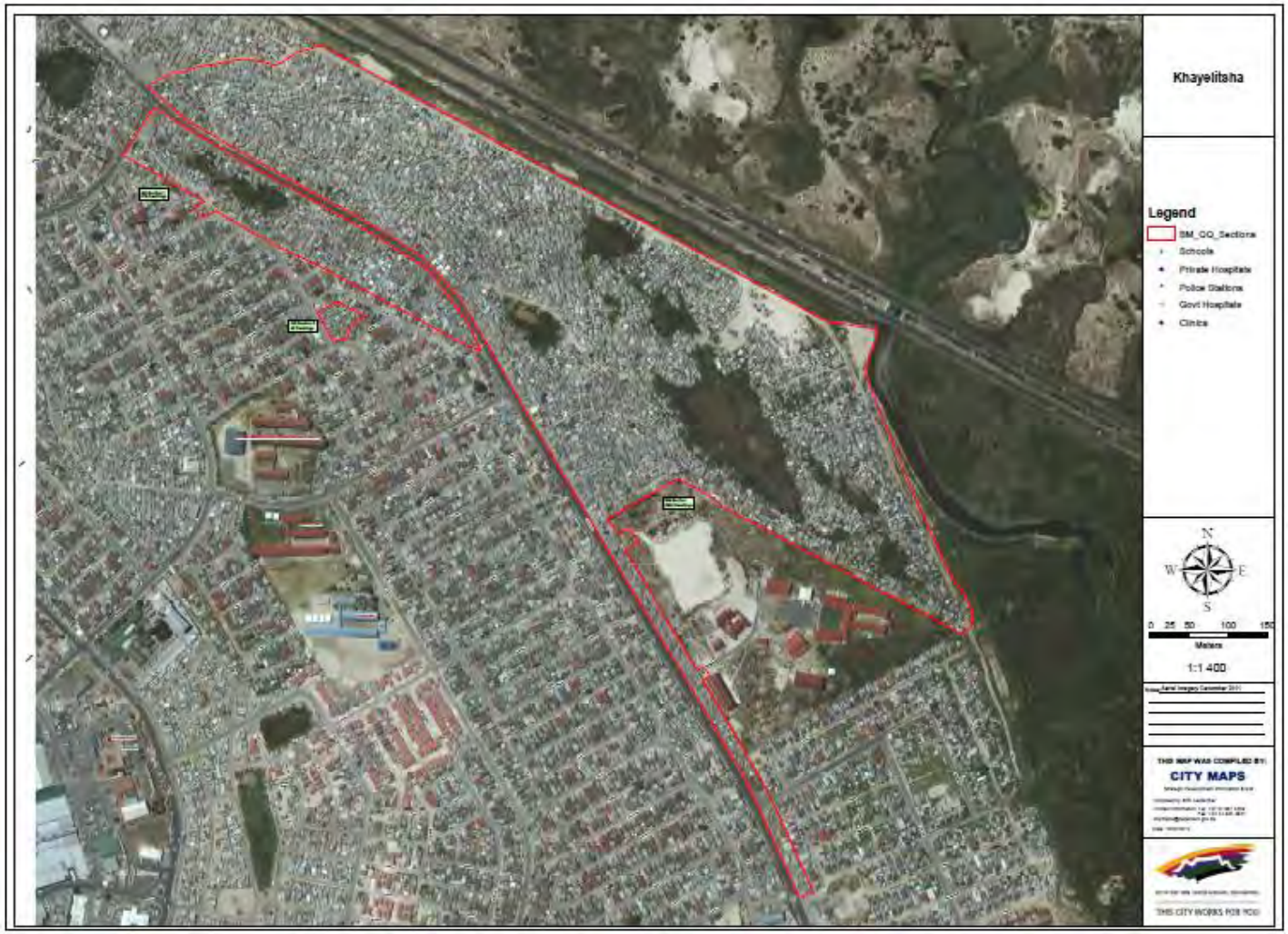
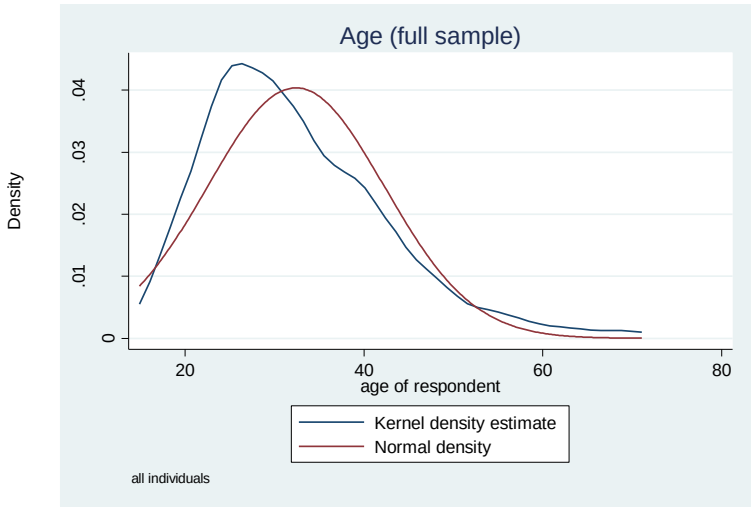


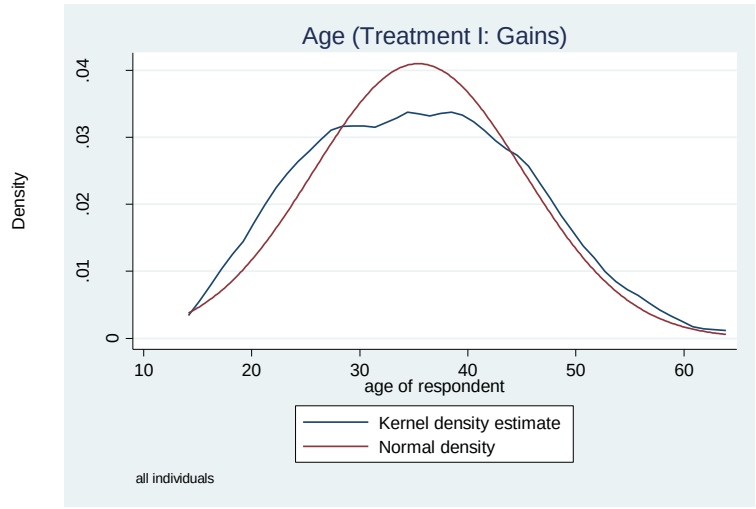
Figure A.IV: Aerial view – Khayelitsha, Cape Town

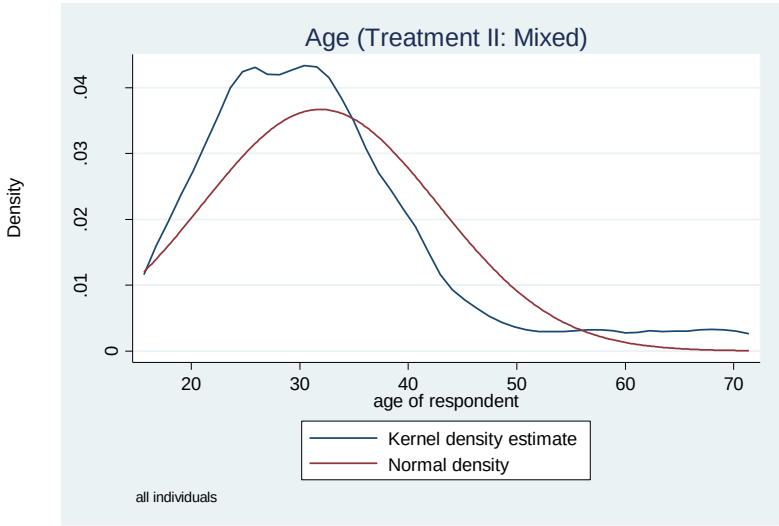
Source: City of Cape Town, 2013

Descriptive Statistics

Figure A.V: Kernel density of distribution of age







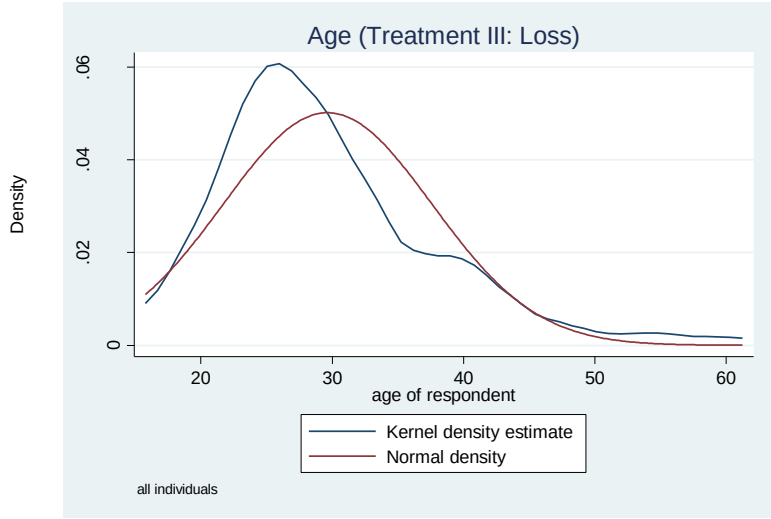


Fig. A.VI: Educational attainment (full sample)

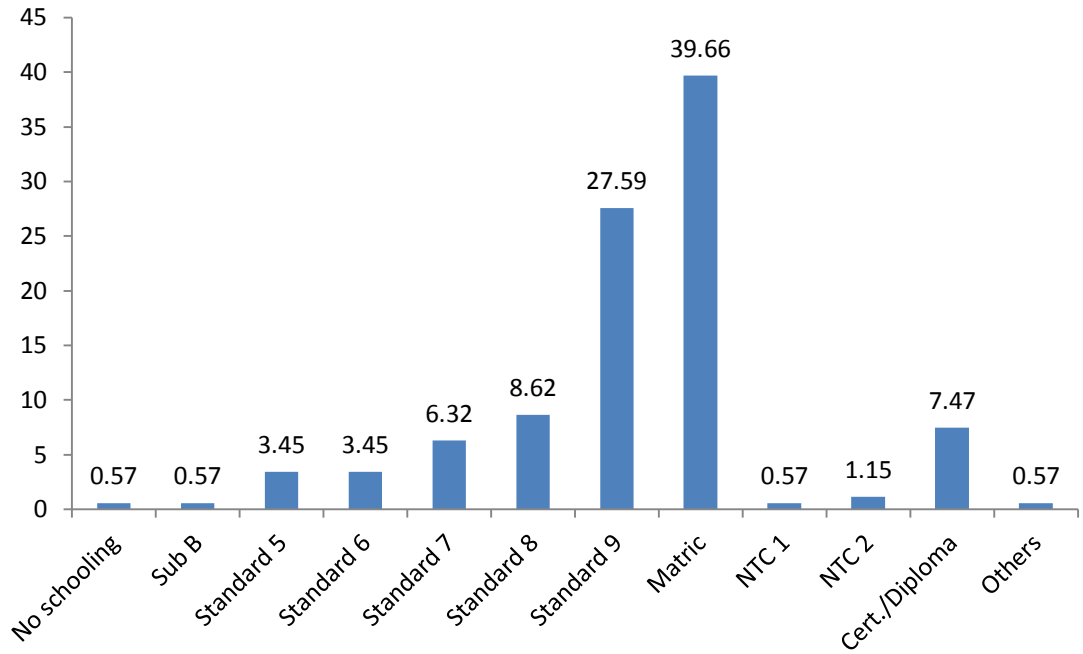


Fig. A.VII: Household income (full sample)

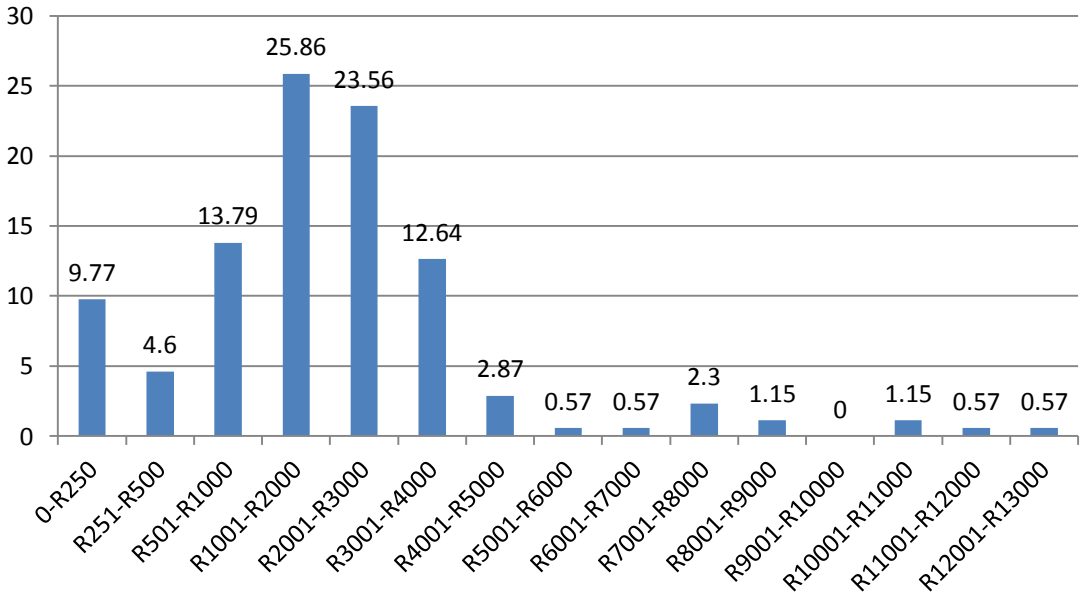


Figure A.VIII: Household's self-reported experiences

(figures are in percentage)

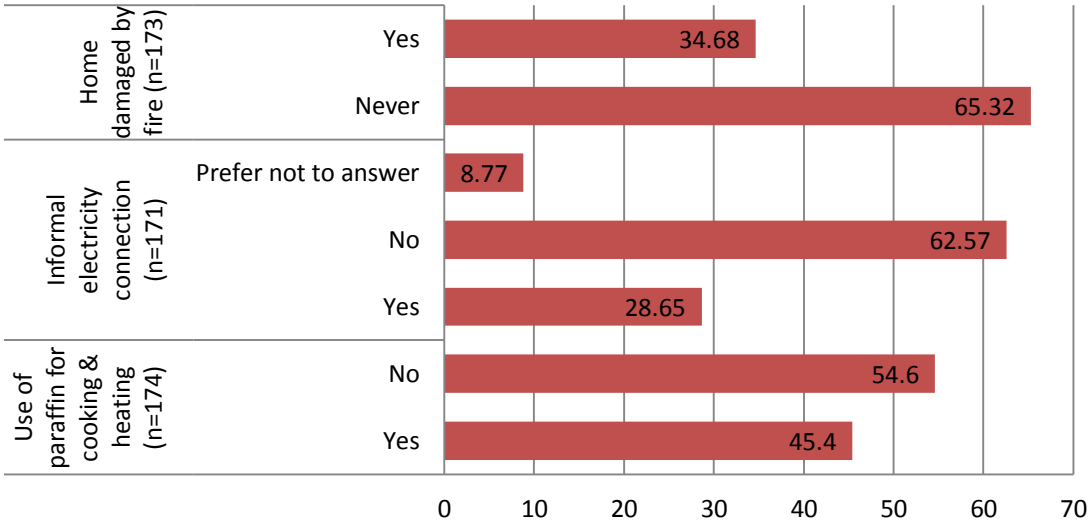


Figure A.IX: Distance of dwellings from the main road

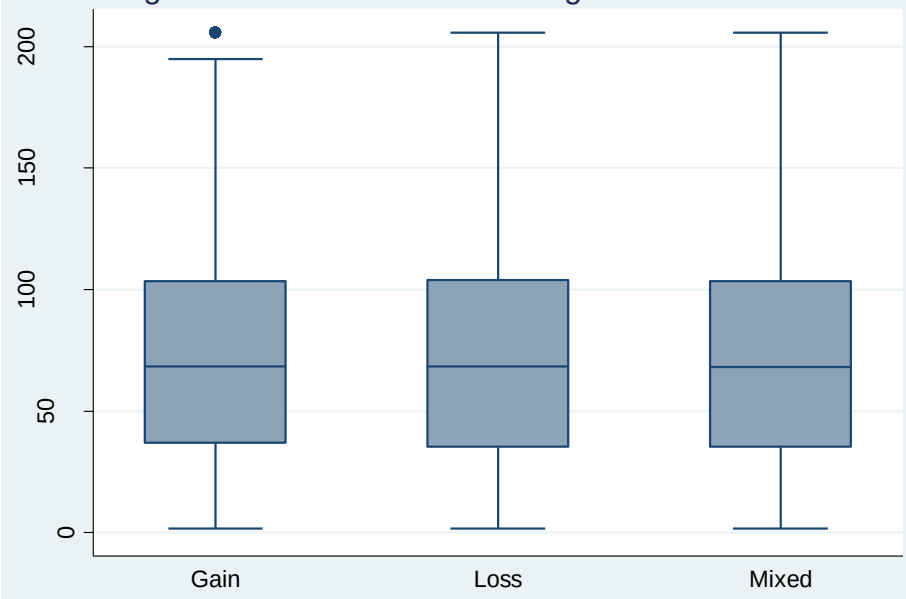
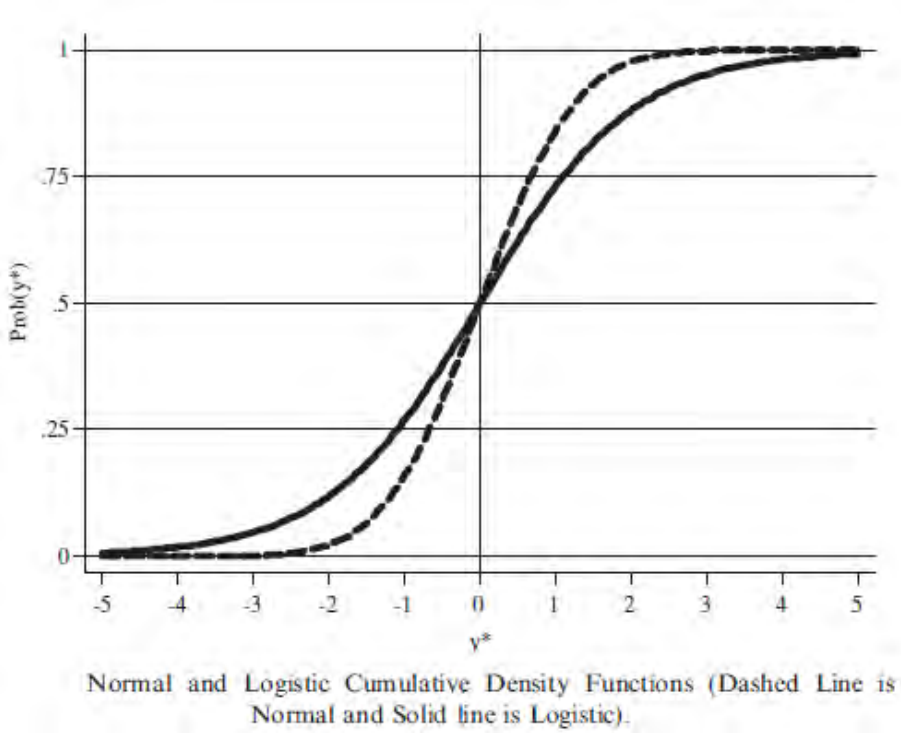


Figure A.X: Normal and Logistic Cumulative Density Function



Normal and Logistic Cumulative Density Functions (Dashed Line is Normal and Solid line is Logistic).

Source: Harrison & Rustrom (2008)

Figure A.X is the standard cumulative normal and logistic distribution function.

Table A.II: Fire Experience & Individual Fire Prevention Strategies

FIRE PREVENTION STRATEGIES	All	Treatment I: Gains	Treatment II: Mixed	Treatment III: Loss
	(n=10,440)	(n=3,600)	(n=3,600)	(n=3,240)
Proportion of household who experienced fire damages	34.68	31.67	40.00	32.08
Panel A: All subjects (Full sample)				
Fire protection strategies *(percent)*:				
Do nothing	18.39	15.00	20.00	20.37
Built the home at least 3 metres apart from the neighbours	21.84	20.00	26.67	18.52
Put out all candles & lamps before sleeping or leaving home	45.40	45.00	40.00	51.85
Made sure that the house has more than one exit	17.82	20.00	20.00	12.96
Keep matches, lighters and paraffin out of reach of children	39.66	41.67	43.33	33.33
Keep stove on flat surface	32.76	40.00	25.00	33.33
Keep a bucket of water and a bucket of sand close-by for fire extinguishing	27.01	31.67	20.00	29.63
Panel B: Only subjects who reported experienced fire damages (Sub-Sample, n = 3,600)				
	All	Treatment I: Gains	Treatment II: Mixed	Treatment III: Loss
	(n=3,600)	(n=1,140)	(n=1,440)	(n=1,020)
Fire protection strategies *(percent):*				
Do nothing	5.00	10.53	4.17	0.00
Built the home at least 3 metres apart from the neighbours	31.67	31.58	41.67	17.65
Put out all candles & lamps before sleeping or leaving home	51.67	31.58	66.67	52.94
Made sure that the house has more than one exit	15.00	15.79	20.83	5.88
Keep matches, lighters and paraffin out of reach of children	43.33	36.84	50.00	41.18
Keep stove on flat surface	41.67	31.58	41.67	52.94
Keep a bucket of water and a bucket of sand close-by for fire extinguishing	38.33	47.37	29.17	41.18

Table A.III: Fire Prevention Strategies Categories

Category	Activities/Fire prevention strategies
(i) Do nothing	Do nothing
(ii) Most effort[a] (Individual "risk" at which the fire originates: Planning & construction)	▪ Built their home at least 3 meters from their neighbours ▪ Homes have more than 1 exit
(v) Least effort[a] (Exposure to risk of fire from most probable causes/origins: Heating & Lighting, House-keeping & Habits)	▪ Put out all candles and lamps before sleeping or leaving home ▪ Keep matches, lighters and paraffin out of reach of children ▪ Keep a bucket of water and/or sand close-by for fire extinguishing ▪ Keep their stove on a flat surface ▪ Do not perform any "most effort" activities

Note: [a]Essentially, we are assuming that these two categories are mutually exclusive. We acknowledge that there are some overlap between these activities listed in each category, for instance, some individuals who perform "most effort" activities will also do "least effort" activities.

Table A.IV: Fire Experience & Grouped Fire Prevention Strategies

(by fire prevention categories)

Fire prevention strategies	All (n=10,440)	Treatment I: Gains (n=3,600)	Treatment II: Mixed (n=3,600)	Treatment III: Loss (n=3,240)
Fire experience[a]	34.68	31.67	40.00	32.08
Panel A: All households (Full sample)				
Fire protection strategies *(percent)*				
Do nothing	18.39	15.00	20.00	20.37
Most effort strategies	8.62	6.67	13.33	5.56
Less effort strategies	72.99	78.33	66.67	74.07
Panel B: Only households who reported experienced home damaged by fire (Sub-sample)				
Fire protection strategies *(percent)*	All (n=3,600)	Treatment I: Gains (n=1,140)	Treatment II: Mixed (n=1,440)	Treatment III: Loss (n=1,020)
Do nothing	5.00	10.53	4.17	0.00
Most effort strategies	10.00	10.53	12.50	5.88
Less effort strategies	85.00	78.95	83.33	94.12

Note:

(i) "*Do nothing*" captures all responses to subjects who reported that they do nothing to mitigate themselves from the risk of fire; "*most effort measures"* this fire prevention category captures individual "risk" at which the fire originates via planning and construction (*see* Table II.A); and *"less effort measures"* this category captures fire prevention strategies that pertains to subjects' exposure to "risk" of fire from most probable causes or origins of fire i.e. heating and lighting, house-keeping and habits (*see* Table II.A).

(ii) [a]Proportion of household who experienced fire damages

Table A.V: Maximum Likelihood Estimation – EUT

(Individual fire prevention strategies)

		A. Homogeneous Preferences	B. Heterogeneous Preferences
Variable(s)	Description	Constant	Constant
r	Constant	-0.0698	-0.3320
		(0.0906)	(0.5520)
Mixed	**Mixed frame**	.	**-0.6060*** **
		.	(0.1730)
Loss	**Loss frame**	.	**-1.0460** **
		.	(0.4320)
Female	Female	.	-0.0382
		.	(0.1480)
Age	**Age (in years)**	.	**0.0547***
		.	(0.0322)
Agesq	Age squared	.	-0.0006
		.	(0.0004)
HHsize	**Household size**	.	**0.0118**
		.	(0.0342)
Children	Presence of children	.	-0.2510
		.	(0.1740)
Matrics	**Grade 12 (or Standard 10)**	.	**0.0398**
		.	(0.1320)
HHincome		.	-0.0240
	Household monthly income (>R2,000)	.	(0.1310)
Unemployed	**Unemployed**	**.**	**0.0784**
		.	(0.1340)
Govt_grant	Government grants	.	-0.1010
		.	(0.1330)
Fire_exp	Fire experience	.	-0.0587
		.	(0.1370)
Close_to_road	**Distance of dwelling from the main road**	.	**0.0223**
		.	(0.0439)
Informal_elect	Informal electricity connection	.	-0.1330
		.	(0.1670)
Paraffin	Use of paraffin for lighting, heating and cooking	.	-0.1530
		.	(0.1490)
Built_home_3m	Home built at least 3-5meters from the neighbours	.	-0.0408
		.	(0.1740)
Home_3exits	**Home has more than one exit**	.	**0.0697**
		.	(0.1620)
Stove_flat_surface	Keep stove on flat surface	.	-0.1380
		.	(0.1680)
Bucket_sand	Keep bucket of sand and/or water	.	-0.3450
		.	(0.2150)
Matches_lighters	**Keep matches, lighters and paraffin away from children**	.	**0.2580**
		.	(0.1670)
Put_candles_out	Put candles/lamps off before sleeping	.	-0.0217
		.	(0.1550)
μ	**Constant**	**-0.1630*** **	**-0.1520*** **
		(0.0151)	(0.0239)
(i) Sample size, n		*10,394*	*10,334*
(ii) Log pseudo-likelihood		*-6889.15*	*-6639.42*
(iii) Wald Chi-square (df)		.	*51.80 (22)*
(iv) Predicted r (at average values)		.	*-0.1683*

(vi) *Standard errors in parentheses; ***Significant at 1%, **Significant at 5%, *Significant at 10%*

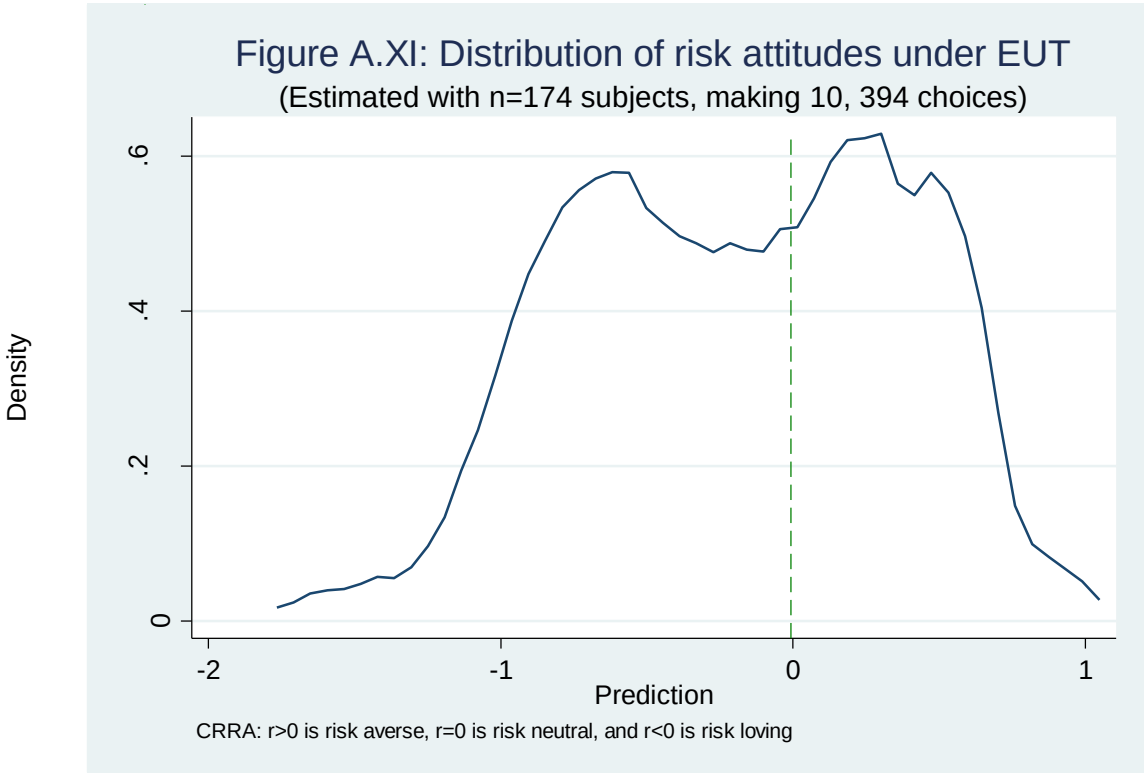


Figure A.XI: Distribution of risk attitudes under EUT
(Estimated with n=174 subjects, making 10, 394 choices)
Density
0
.2
.4
.6
-2
-1
0
1
Prediction
CRRA: r>0 is risk averse, r=0 is risk neutral, and r<0 is risk loving

Table A.VI: Maximum Likelihood Estimation - Expected Utility Theory

		A.Homogeneous Preferences	B. Heterogeneous Preferences						
Variable(s)	Description	Constant	(1)	(2)	(3)	(4)	(5)	(6)	(7)
r	**Constant**	-0.0698	**-1.7550***	**-0.1690**	**-1.7640***	**-1.7680***	**-1.5850***	**-1.5890***	**-1.6080***
		(0.0906)	**(0.9630)**	**(0.5740)**	**(0.9760)**	**(0.9770)**	**(0.9210)**	**(0.9420)**	**(0.9310)**
Mixed	**Mixed frame**	.	**-0.5650*****	**-0.5280*****	**-0.5890*****	**-0.5900*****	**-0.5870*****	**-0.5910*****	**-0.5750*****
		.	**(0.1760)**	**(0.1430)**	**(0.1770)**	**(0.1770)**	**(0.1670)**	**(0.1720)**	**(0.1540)**
Loss	**Loss frame**	.	**-1.3080****	**-1.0500*****	**-1.3610****	**-1.3620****	**-1.2940****	**-1.3350****	**-1.3020****
		.	**(0.6080)**	**(0.3630)**	**(0.6500)**	**(0.6510)**	**(0.5660)**	**(0.5920)**	**(0.5150)**
Female	**Female**	.	0.3390	-0.0113	**0.3640***	**0.3640***	**0.3500***	**0.3560***	**0.3410***
		.	(0.2150)	(0.1330)	**(0.2080)**	**(0.2080)**	**(0.2000)**	**(0.2050)**	**(0.1890)**
Age	**Age (in years)**	.	**0.0842***	0.0393	**0.0808***	**0.0807***	0.0721	0.0718	0.0727
		.	**(0.0485)**	(0.0316)	**(0.0468)**	**(0.0467)**	(0.0450)	(0.0462)	(0.0455)
Agesq	Age squared	.	-0.0009	-0.0004	-0.0008	-0.0008	-0.0007	-0.0007	-0.0007
		.	(0.0006)	(0.0004)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0005)
Children	**Presence of children**	.	-0.2460	-0.1540	-0.2590	-0.2580	-0.2850	**-0.2930***	**-0.2870***
		.	(0.1770)	(0.1500)	(0.1810)	(0.1800)	(0.1740)	**(0.1720)**	**(0.1690)**
Matrics	Grade 12 (or	.	0.0084	0.0783	-0.0071	-0.0072	0.0198	0.0206	0.0169
	Standard 10)	.	(0.1370)	(0.1160)	(0.1390)	(0.1390)	(0.1300)	(0.1310)	(0.1310)
HHincome	Household monthly	.	0.0049	-0.0012	-0.0219	-0.0223	-0.0205	-0.0455	.
	income (>R2,000)	.	(0.1750)	(0.1220)	(0.1580)	(0.1580)	(0.1540)	(0.1560)	.
Unemployed	Unemployed	.	0.1750	0.0439	0.1810	0.1800	0.1780	0.1570	0.1450
		.	(0.1650)	(0.1220)	(0.1690)	(0.1690)	(0.1630)	(0.1600)	(0.1540)
Fire_exp	Fire experience	.	-0.1120	-0.1620	.	.	.	.	.
		.	(0.1850)	(0.1400)	.	.	.	.	.
Fires	**Fire prevention**	.	**0.2210****	.	**0.2430****	**0.2430****	**0.2230****	**0.2190****	**0.2130****
	strategies	.	**(0.1060)**	.	**(0.1050)**	**(0.1050)**	**(0.0892)**	**(0.0901)**	**(0.0838)**
Close_to_road	Distance of dwelling	.	-0.0082	0.0231	-0.0108	.	.	.	.
	from main road	.	(0.0536)	(0.0424)	(0.0546)	.	.	.	.
Informal_elect	Informal electricity	.	-0.1750	-0.1970	-0.1990	-0.2000	.	.	.
	connection	.	(0.1810)	(0.1570)	(0.1810)	(0.1810)	.	.	.
Paraffin	Use of paraffin for	.	-0.0915	-0.1660	-0.0666	-0.0667	-0.0795	.	.
	lighting, heating &								
	cooking	.	(0.1490)	(0.1190)	(0.1490)	(0.1490)	(0.1420)	.	.
μ	**Constant**	**-0.1630*****	**-0.1520*****	**-0.1500*****	**-0.1550*****	**-0.1550*****	**-0.1490*****	**-0.1510*****	**-0.1490*****
		(0.0151)	**(0.0263)**	**(0.0182)**	**(0.0282)**	**(0.0282)**	**(0.0232)**	**(0.0237)**	**(0.0217)**
Notes									
(i) Sample Size, n		10,394	7,290	10,394	7,290	7,290	7,290	7,290	7,290
(ii) Log-pseudo likelihood		.	-4606.94	-6699.09	-4608.30	-4608.32	-4611.66	-4612.43	-4612.68
(iii) Wald Chi-square (df)		.	30.92 (14)	48.23 (13)	30.16 (13)	30.11 (12)	35.97 (11)	34.71 (10)	36.76 (9)
(iv) **Predicted *r* (at average values)**		.	**-0.3167**	**-0.1517**	**-0.3355**	**-0.3357**	**-0.2834**	**-0.2953**	**-0.2830**

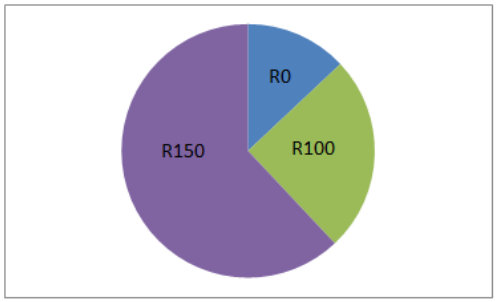
(v) Standard errors in parentheses; ***Significant at 1%; **Significant at 5%; *Significant at 10%

Appendix B: Game Frame (Illustrations)

Illustration D.I: Gain Frame [Game 1]

Option 1:

R0	R50	R100	R150
13%	0%	25%	62%



Option 2:

R0	R50	R100	R150
0%	0%	100%	0%

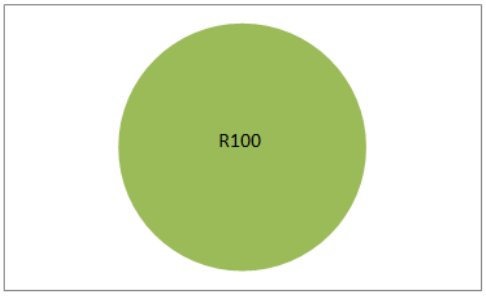
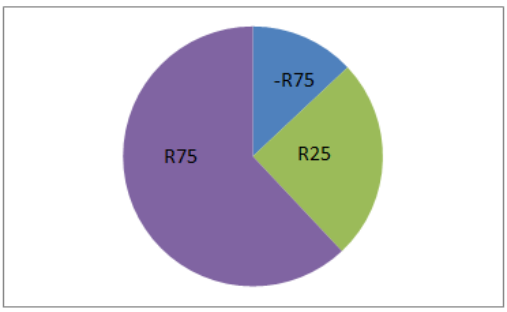


Illustration D.II: Mixed Frame [Game 1]

Option 1:

-R75	-R25	R25	R75
13%	0%	25%	62%



Option 2:

-R75	-R25	R25	R75
0%	0%	100%	0%

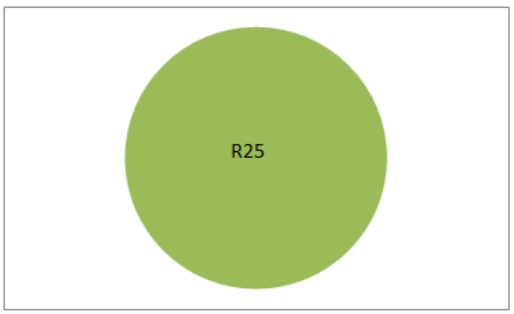
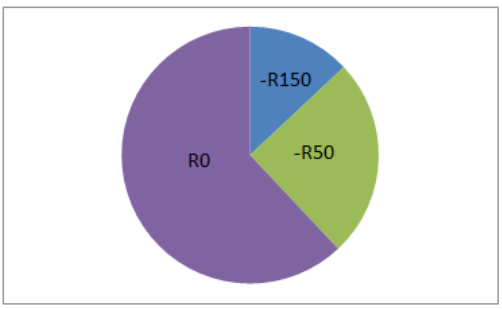


Illustration D.III: Loss Frame [Game 1]

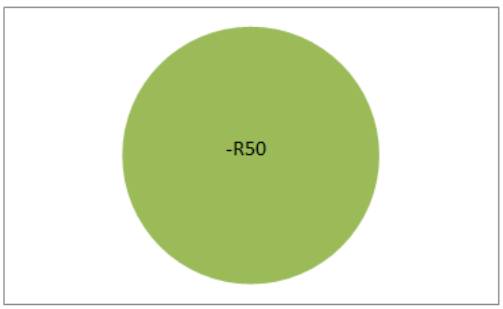
Option 1:

-R150	-R100	-R50	R0
13%	0%	25%	62%



Option 2:

-R150	-R100	-R50	R0
0%	0%	100%	0%



Appendix C: Instructions (Mixed Frame)

INTRODUCTION

Good morning! Thank you for coming. My name is [NAME], and I am a researcher with the University of Cape Town. These are my colleagues [NAMES]. We have invited you here to play some financial games.

You will be paid for participating in this workshop today. For being here today you will earn R50. This is your money to take home.

We are going to start by filling out a short survey. You will earn money for filling in this survey. You will earn R150 for filling in this survey.

Now this is very important. When we play the financial games, you can earn more money or you can lose money. Any money that you earn will be added to this R150. Any money that you lose will be deducted from this R150.

How much money you **earn or lose** depends on the decisions you make during the games. That is why it is very important you understand the rules of the games, which I am going to explain to you as we go along.

The income you earn from today will be paid to you at the end of the day in the form of a cash cheque which you can cash at any branch of ABSA Bank.

You play these games as individuals, not in groups. So please don't talk to anyone while we are playing the games. If you have **ANY** questions at any stage you can just raise your hand and someone will come and answer your question privately.

Participation in these sessions is voluntary. If you decide not to take part, you may leave at any moment, even after you have started playing – but then you will not earn any money. If you prefer to stay we ask that you sign the form that our assistants are bringing around right now.

[HAND OUT THE CONSENT FORMS]

This form says that you understand participation in these games is voluntary and that you can leave whenever you want to. But if you do leave before we have finished playing all the games, you won't receive any money.

Is everyone finished signing the forms? Ok, someone is going to come around and collect the forms from you.

[COLLECT FORMS]

Part 1

Ok. As I said, we are going to start by filling out a short survey…

Remember, you will earn R150 for filling in this survey.

[Hand out the surveys]

[Collect the surveys once everyone has completed them]

Part 2

OK, let's move on to the financial games.

Remember, you can **earn extra money or lose money** by playing these games. **Any money that you earn will be added to the R150 that you have earned for filling in the survey. Any money that you lose will be deducted from the R150 that you have earned for filling in the survey.**

I am now going to explain the rules of the game.

Let's start with the first game in the booklet: Game 1

GAME 1

This poster is a large version of the sheet of paper that is in front of you.

In this game, you must choose between 2 options: Option 1 and Option 2 [REFER TO POSTER].

You must show on the sheet in front of you, whether you choose Option 1 or Option 2.

Now, for both of these options, for Option 1 and Option 2, the amount of money you **earn or lose** depends on these spinning wheels. And, it depends on what colour the arrow lands on.

On this spinning wheel we have option 1. And on this spinning wheel we have option 2.

As you can see, in option 1, the arrow can land on blue, green or purple [rotate the spinning wheel while you talk]

As you can see, in option 2, the arrow can only land on green because the whole area is green [rotate the spinning wheel while you talk]
Let's start with Option 1.

[Point to the poster]
If the arrow lands on blue, you lose R75 – that is why we have written –R75 in the blue area on the sheet [point to where it says –R75].
If the arrow lands on green, you earn R25 – that is why it says R25 inside the green area [point to where it says R25]
If the arrow lands on purple, you earn R75 – that is why it says R75 inside the purple area [point to where it says R75].

These blocks [point to the row of coloured blocks on the poster] **also** tell you how much money you would **earn or lose** if the arrow lands on blue, green or purple:
If the arrow lands on blue, you lose R75
If the arrow lands on red you lose R25 – **but there is no red in this game**
If the arrow lands on green, you earn R25,
And if the arrow lands on purple, you earn R75.

There are two ways you can think about Option 1.

The first way is to use the percentages that are shown in this row [point]. With Option 1, there is a 13 percent chance that you will lose R75. There is a 25 percent chance that you will earn R25. There is a 62 percent chance that you will earn R75.

The other way to think about Option 1 is to look at the different sizes of the coloured areas. **This is the way that we are going to explain the games to you.**

The purple area is VERY big. So if you choose Option 1, there is a very big chance that the arrow will land on purple and you will earn R75. As you can see, the purple area is much bigger than the green and blue areas, so there is a bigger chance of the arrow landing on purple than there is of it landing on green or blue.

But the green area is still quite big – even though it is smaller than the purple area. So there is still a chance that the arrow could land on green and that you could earn R25. The green area is slightly bigger than the blue area. So at least you know there is a slightly bigger chance of the arrow landing on green than there is of the arrow landing on blue. So you have a slightly bigger chance of earning R25 than you do of losing R75.

But even though the blue area is small – it is still there. So there is a small chance the arrow could land on blue and you could lose R75.

Now let's look at Option 2.

With option 2, the whole circle is green.

[Point to the poster]
If the arrow lands on green, you earn R25 – that is why we have written R25 in the green area on the sheet [point to where it says R25].

These blocks [point to the row of coloured blocks on the poster] **also** tell you how much money you would **earn or lose** if the arrow lands on green:
If the arrow lands on blue, you lose R75 – **but there is no blue in this game**
If the arrow lands on red you lose R25 – **but there is no red in this game**
If the arrow lands on green, you earn R25
And if the arrow lands on purple, you earn R75 – **but there is no purple in this game**

So the arrow can only land on green. **That means with Option 2 you are sure to earn R25**.

So now, you have to decide if you want to choose Option 2 and know that you will earn R25 for sure, or if you want to choose Option 1 – where there is a big chance you will earn R75 but a small chance you will lose R75.

Let's do an example. Let's pretend that I am the type of person that wants to pick Option 1. Then I would show this by making a tick next to Option 1 [make a tick next to option 1]. Now that I have chosen Option 1, we spin the wheel so that I can see how much money I would lose. [Spin the wheel]. Ok, so the arrow has landed on [blue, green, purple] which means that I would have [lost R75, earned R25, earned R75].

GAME 2

Ok, let's look at the second game. Once again, you must show on the sheet in front of you, whether you choose Option 1 or Option 2.

Now, for both of these options, for Option 1 and Option 2, the amount of money you **earn or lose** depends on these spinning wheels. And, it depends on what colour the arrow lands on.

On this spinning wheel we have option 1. And on this spinning wheel we have option 2.

As you can see, in option 1, the arrow can land on red, blue or green
[rotate the spinning wheel while you talk]

As you can see, in option 2, the arrow can only land on red because the whole area is red [rotate the spinning wheel while you talk]

Let's start with Option 1.

[Point to the poster]
If the arrow lands on blue, you lose R75 – that is why it says –R75 inside the blue area [point to where it says –R75].
If the arrow lands on red, you lose R25 – that is why it says –R25 inside the red area [point to where it says –R25].
If the arrow lands on green, you earn R25 – that is why it says R25 inside the green area [point to where it says R25]

Remember, these blocks [point to the row of coloured blocks on the poster] **also** tell you how much money you would **earn or lose** if the arrow lands on blue, red or green:
If the arrow lands on blue, you lose R75
If the arrow lands on red you lose R25
If the arrow lands on green, you earn R25
And if the arrow lands on purple, you earn R75 – **but there is no purple in this game**
The green area is a bit bigger than the red area and MUCH bigger than the blue area. So this means that if you choose Option 1, there is a bigger chance of the arrow landing on green and of you earning R25 than there is of the arrow landing on red or blue.

But the red area is still quite big. So there is still a big chance of the arrow landing on red and of you losing R25.

Even though the blue area is very small, there is still a small chance that the arrow could land on blue and then you could lose R75.

Now let's look at Option 2.

With option 2, the whole circle is red.

[Point to the poster]
If the arrow lands on red, you lose R25 – that is why we have written –R25 in the red area on the sheet [point to where it says –R25].

Remember, these blocks [point to the row of coloured blocks on the poster] **also** tell you how much money you would **earn or lose** if the arrow lands on red:
If the arrow lands on blue, you lose R75 – **but there is no blue in this game**
If the arrow lands on red you lose R25
If the arrow lands on green, you earn R25 – **but there is no green in this game**
And if the arrow lands on purple, you earn R75 – **but there is no purple in this game**

So the arrow can only land on red. **That means with Option 2 you are sure to lose R25**.

So now, you have to decide if you want to choose Option 2 and lose R25 for sure, or if you want to choose Option 1 and maybe earn R75. But remember, with Option 1, there is still a small chance of you losing R75.

Let's do an example. Let's pretend that I am the type of person that wants to pick Option 2. Then I would show this by making a tick next to Option 2. I know with Option 2 that I will lose R25 for sure so there is no need to spin the wheel. But let's spin it anyway [spin the wheel]. The arrow landed on red and I lose R25.

GAME 3

Ok, let's look at the third game. Once again, you must show on the sheet in front of you, whether you choose Option 1 or Option 2.

On this spinning wheel we have option 1. And on this spinning wheel we have option 2.

As you can see, in option 1, the arrow can land on green or purple [rotate the spinning wheel while you talk]

As you can see, in option 2, the arrow can only land on purple, green or blue [rotate the spinning wheel while you talk]

Let's start with Option 1.

[Point to the poster]
If the arrow lands on green, you earn R25 – that is why it says R25 inside the green area [point to where it says R25]
If the arrow lands on purple, you earn R75 – that is why it says R75 inside the purple area [point to where it says R75].

The green is quite a bit bigger than the purple, so if you choose this option, there is a bigger chance of you earning R25 than there is of you earning R75. But the purple area is still quite big – so there is still a large chance of you earning R75. The worst you can do in this option is to earn R25.

Let's look at Option 2.

[Point to the poster]
If the arrow lands on purple, you earn R75 – that is why it says R75 inside the purple area [point to where it says R75].
If the arrow lands on green, you earn R25 – that is why it says R25 inside the green area [point to where it says R25]
If the arrow lands on blue, you lose R75 – that is why it says –R75 inside the blue area [point to where it says –R75]

The purple area is very large. So if you choose this option, there is a very large chance that the arrow will land on purple and that you will earn R75. You can see the purple area is much larger than the blue and green areas.

The green area is quite small so there is a small chance the arrow will land on green and you will earn R25.

The blue area is quite small, so there is also a small chance the arrow will land on blue and you will lose R75.

So now, you have to decide if you want to choose Option 1 – where the worst you can do is earn R25, or if you want to choose Option 2, where there is a big chance you will earn R75 but there is a small chance you will lose R75.

Let's do an example. Let's pretend that I am the type of person that wants to pick Option 2. Then I would show this by making a tick next to Option 2. Now that I have chosen Option 2, we spin the wheel so that I can see how much money I would earn. [Spin the wheel]. Ok, so the arrow has landed on [blue, green, purple] which means that I would have [lost R75, earned R25, earned R75].

[Conclude:]

Ok, are there any questions so far?

Ok, soon I am going to ask you to go through the booklet yourself. And on each page, I want you to decide whether you would like to play Option 1 or Option 2.

Before you do that I want to explain one last thing:

In this booklet there are 60 games. You are going to fill in the booklet for all 60 games. But we won't have time to play all 60 games. So at the end of the day, we will choose 2 games to play for money.

But we don't know which of these 60 games we will be playing for money.

I have here 60 pieces of paper – numbered 1-60. I am going to put these pieces of paper in this bag. At the end of the day, 2 of you will each pull a piece of paper out the bag.

Whichever numbers are pulled out the bag – those are the games we will play.

So if number 1 is pulled out the bag, we will play game 1 for money, if number 20 is pulled out the bag, we will play game 20 for money. Let's do a demonstration [pull a number out of the bag]… **so, because we don't know which of the 60 games we will be playing for real money, it is important to act as if every game is being played for real money.**

Ok, now you can go through the booklet yourself. And on each page, I want you to decide whether you would like to play Option 1 or Option 2.

Remember that any money that you earn will be added to the R150 that you have earned for filling out the survey and any money that you lose will be deducted from the R150 that you have earned for filling out the survey.

When everyone is finished, we will use these numbered pieces of paper to decide which 2 games we are going to play for money.

Appendix D: Survey Questionnaire

Experiment number: _____

Please note that you are free to leave out any questions that you prefer not to answer. But it will be very helpful if you can answer as many questions as possible.

BACKGROUND INFORMATION

1. **Age: _____**
2. **Date of Birth: _____**
3. **Gender:**

   [Tick one option only]

   ☐ Male

   ☐ Female

EDUCATION

4. **How well can you read in your home language:**

   [Tick one option only]

   ☐ I cannot read

   ☐ Not well

   ☐ Fair

   ☐ Very well

   ☐ Prefer not to answer

5. What is the highest level of education that you have <u>completed</u>:

[Tick one option only]

☐ No schooling

☐ Sub A

☐ Sub B

☐ Standard 1

☐ Standard 2

☐ Standard 3

☐ Standard 4

☐ Standard 5

☐ Standard 6

☐ Standard 7

☐ Standard 8

☐ Standard 9

☐ Standard 10 (Matric certificate)

☐ NTC 1

☐ NTC 2

☐ NTC 3

☐ Certificate or diploma with less than Standard 10 (Matric certificate)

☐ Certificate or diploma with Standard 10 (Matric certificate)

☐ Bachelors Degree

☐ Higher Degree (Honours, Masters)

☐ Other: please explain: _____

YOUR HOUSEHOLD

Here, you should include all those people who sleep and eat in the same household as you on a regular basis

6. How many people (including you) live in your home? _____

7. What is your relationship to the person that is the head of the household?

[Tick one option only]

☐ I am the household head

☐ Husband/Wife/Partner

☐ Son/Daughter

☐ Son-in-law/Daughter-in-law

☐ Grandson/Granddaughter

☐ Brother/Sister

☐ Brother-in-law/Sister-in-law

☐ Father/Mother

☐ Father-in-law/Mother-in-law

☐ Uncle/ Aunt

☐ Nephew/Niece

☐ Cousin

☐ Friend

☐ Other

8. How many people living in the house are between:

(a) 1 – 17 years: _____

(b) 18 – 64 years: _____

(c) 65 years and older: _____

9. How many people living in your home have regular employment?

_____

10. How many people - inside and outside the home - depend on you financially?

_____

11. What is your monthly HOUSEHOLD income in a typical month?

(This is the TOTAL income from EVERYONE living in the household)

[Tick one option only]

- ☐ R0-R250
- ☐ R251-R500
- ☐ R501-R1000
- ☐ R1001-R2000
- ☐ R2001-R3000
- ☐ R3001-R4000
- ☐ R4001-R5000
- ☐ R5001-R6000
- ☐ R6001-R7000
- ☐ R7001-R8000
- ☐ R8001-R9000
- ☐ R9001-R10000
- ☐ R10001-R11000
- ☐ R11001-R12000
- ☐ R12001-R13000
- ☐ R13001-R14000
- ☐ R41001-R15000
- ☐ More than R15000 per month

HOUSEHOLD EXPENDITURE

12. What is your monthly household expenditure in a typical month?
(This is the TOTAL expenditure from EVERYONE living in the household)
[Tick one option only]

- ☐ R0-R250
- ☐ R251-R500
- ☐ R501-R1000
- ☐ R1001-R2000
- ☐ R2001-R3000
- ☐ R3001-R4000
- ☐ R4001-R5000
- ☐ R5001-R6000
- ☐ R6001-R7000
- ☐ R7001-R8000
- ☐ R8001-R9000
- ☐ R9001-R10000
- ☐ R10001-R11000
- ☐ R11001-R12000
- ☐ R12001-R13000
- ☐ R13001-R14000
- ☐ R41001-R15000
- ☐ More than R15000 per month

INCOME AND EMPLOYMENT

13. (a) Are you employed on a full-time basis?

☐ Yes

☐ No

(b) What is your monthly salary from this job?

☐ R_____

☐ I am not employed on a full-time basis

14. (a) Are you employed on a part-time basis?

☐ Yes

☐ No

(b) What is your monthly salary from this job?

☐ R_____

☐ I am not employed on a part-time basis

15. (a) Are you self-employed? (You work for yourself and not for an employer)

☐ Yes

☐ No

(b) What is your monthly salary from this job?

☐ R_____

☐ I am not self-employed

16. What is YOUR monthly income in a typical month <u>EXCLUDING GOVERNMENT GRANTS?</u>

[Tick one option only]

☐ R0-R250

☐ R251-R500

☐ R501-R1000

☐ R1001-R2000

☐ R2001-R3000

☐ R3001-R4000

☐ R4001-R5000

☐ R5001-R6000

☐ R6001-R7000

☐ R7001-R8000

☐ R8001-R9000

☐ R9001-R10000

☐ More than R10000 per month

17. Are you unemployed?

☐ Yes

☐ No

18. Are you the main breadwinner in your household?

☐ Yes

☐ No

19. Are you able to make financial decisions for your household?

☐ Yes

☐ No

GOVERNMENT GRANTS

20. Do you or any of your household members receive any money from the Government?

☐ Yes

☐ No

21. If yes, what does your household receive this money for? How much does your household receive each month?

[You can tick as many options as you like]

☐ Pension: R_____

☐ Child Care Grant: R_____

☐ Disability Grant: R_____

☐ No one in the household receives a government grant

FLOODING

22. How often do you experience flooding in or around your dwelling?

[Tick one option only]

☐ Every year during the rainy season

☐ Every second year

☐ Every third year

☐ Not for the past 4 years

☐ Not for the past 5 years

☐ Not for more than 5 years

☐ I have never experienced flooding

23. How do you experience flooding?

[You can tick as many options as you like]

☐ I have never experienced flooding

☐ Water coming up through the ground

☐ Water coming in through the roof

24. When there is a flood, how are the contents of your home affected?

[Tick only one option]

☐ I have never experienced flooding

☐ The contents of my home are usually not badly damaged

☐ Some of the contents of my home are damaged

☐ The contents of my home are badly damaged

25. What have you done to reduce the risk of flooding?

[You can tick as many options as you like]

☐ I have not done anything to reduce the risk of flooding

☐ I make sure that my floor is not below ground level

☐ I use pallets to raise my home above ground level

☐ I use stilts to raise my home above ground level

☐ I use bags of sand to raise my home above ground level

☐ I put plastic sheeting on my roof

☐ I put plastic sheeting on my floor

☐ I raise one side of my roof

☐ I perform general maintenance on my roof before the start of the rainy season

☐ I have moved to another area where the risk of flooding is lower

☐ I have dug trenches/channels around my home

☐ I regularly make sure that the drains/trenches around my home are not blocked

☐ I am waiting for the City of Cape Town to move me to another area

☐ I am waiting for the City of Cape Town to give me formal housing

26. When there is a flood, do you KNOW who to report the flood event to (for example to a community leader or to the City of Cape Town)?

☐ I have never experienced flooding, so have not had to report a flood event

☐ Yes, I know who to report the flood event to

☐ No, I don't know who to report the flood event to

27. Do you ALWAYS report the flood event to someone (for example a community leader or to the City of Cape Town)?

☐ I have never experienced flooding, so have not had to report a flood event

☐ Yes, I always report the flood event

☐ I sometimes report the flood event

☐ No, I never report the flood event

28. What is life like for you after a flood?

[You can tick as many options as you like]

☐ I have never experienced flooding

☐ My home has been damaged

☐ The property in my home has been damaged

☐ The floor of my home is wet or underwater

☐ The roads around my home become wet and muddy and it is very difficult for people to drive into or out of the area

☐ The roads around my home become wet and muddy and it is difficult for me to get to the outside toilets

☐ People (especially children) get sick from standing pools of dirty flood water

☐ There are electricity shortages

29. Have you ever stayed in an emergency shelter (for example a community hall) after a flood event?

☐ I have never experienced flooding

☐ Yes

☐ No, I didn't want to leave my belongings because they might have got stolen

30. Do you think that some people settle in areas that are very prone to flooding on purpose, so that they will be given formal housing quicker?

☐ Yes

☐ No

31. Rubbish that is thrown into drains/trenches sometimes increases the risk of flooding. How often do <u>you</u> throw your rubbish into drains/trenches?

☐ Never

☐ Sometimes

☐ Very often

32. Rubbish that is thrown into drains/trenches sometimes increases the risk of flooding. How often <u>do people living in your community</u> throw rubbish into drains/trenches?

☐ Never

☐ Sometimes

☐ Very often

33. Rubbish that is thrown into drains/trenches sometimes increases the risk of flooding. Would you consider being part of a community initiative to keep the drains/trenches clear?

☐ Yes

☐ No

34. Rubbish that is thrown into drains/trenches sometimes increases the risk of flooding. As part of a community initiative to keep the drains/trenches clear, would you report people who you see throwing rubbish into the drains/trenches? The people you report would be given a fine.

☐ I would not participate in a community initiative like this

☐ I would participate, but I would not report someone for throwing rubbish in the drains/trenches

☐ I would participate, and I would report someone for throwing rubbish in the drains/trenches

FIRE

35. How many times has your home been damaged by fire?

☐ My home has never been damaged by fire

☐ My home has been damaged _____ times by fire

36. Does your household have a formal electricity connection?

☐ Yes

☐ No

37. Does your household have an informal electricity connection?

☐ Yes

☐ No

☐ Prefer not to answer

38. Does your household use paraffin for cooking and heat?

☐ Yes

☐ No

39. What have you done to reduce the risk of a fire and protect yourself during a fire?

[You can tick as many options as you like]

☐ I have not done anything to reduce the risk of a fire

☐ I have built my home at least 3 meters apart from my neighbors'

☐ I put out all candles and lamps before I go to sleep or before I leave my home

☐ I have made sure that my house has more than one exit

☐ I don't smoke in bed

☐ I keep matches, lighters and paraffin out of reach of my children

☐ I keep my stove on a flat surface

☐ I keep a bucket of water and a bucket of sand close by to put out small fires that start

EDUCATION

40. The City of Cape Town has tried to educate people about how to protect themselves from floods and fires (for example by handing out brochures). Are you aware of this?

☐ Yes

☐ No

41. **The City of Cape Town has suggested that to protect yourself against floods, you should raise your floor above ground level, keep drains unblocked and dig channels around your home. Which of these suggestions are you aware of?**

[You can tick as many options as you like]

☐ I am not aware of any of these suggestions

☐ Raising my floor above ground level

☐ Not throwing rubbish in the drains and keeping them unblocked

☐ Digging channels around my home

42. **The City of Cape Town has suggested that to protect yourself against floods, you should raise your floor above ground level, keep drains unblocked and dig channels around your home. Have you as a result of this taken any of the actions listed below to protect your home against floods?**

[You can tick as many options as you like]

☐ I have raised my floor above ground level

☐ I don't throw rubbish in the drains and try to keep them unblocked

☐ I have dug channels around my home

☐ I have not taken any of these actions

43. **The City of Cape Town has suggested that protect yourself against fire, you should make sure your home is 3meters away from your neighbor, keep stoves on a flat surface and keep and keep a bucket of water and sand close by. Which of these suggestions are you aware of?**

[You can tick as many options as you like]

☐ I am not aware of any of these suggestions

☐ Making sure my home is 3 meters away from my neighbour

☐ Keeping my stove on a flat surface

☐ Keeping a bucket of water close by

☐ Keeping a bucket of sand close by

44. The City of Cape Town has suggested that protect yourself against fire, you should make sure your home is 3 meters away from your neighbor, keep stoves on a flat surface and keep and keep a bucket of water and sand close by. Have you as a result of this taken any of the actions listed below to protect your home against the outbreak of fire?

[You can tick as many options as you like]

☐ I have made sure that my home is 3 meters away from my neighbour

☐ I keep my stove on a flat surface

☐ I keep a bucket of water close by

☐ I keep a bucket of sand close by

☐ I have not taken any of these actions

SANITATION

45. Which toilets do you use?

☐ Individual toilets within the house

☐ Communal toilets outside the house

46. How often is the rubbish/refuse usually collected?

☐ Never

☐ Once a week

☐ Twice a week

☐ Once a month

☐ Twice a month

47. How often is the rubbish/refuse usually collected during the rainy season?

☐ Never

☐ Once a week

☐ Twice a week

☐ Once a month

☐ Twice a month

SAVINGS

48. Do you have a bank account?

☐ Yes

☐ No

49. If you don't have a bank account, why not?

[You can tick as many options as you like]

☐ I do have a bank account

☐ I have no money

☐ Banks are too far away

☐ The bank charges are too high

☐ I don't have the right documents to get a bank account (FICA)

☐ I prefer to belong to a stokvel

50. Do you belong to a stokvel?

☐ Yes

☐ No

51. If you do not belong to a stokvel, why not?

[You can tick as many options as you like]

☐ I do belong to a stokvel

☐ I save my money in a bank or other financial institution

☐ I have no money to save

☐ There is no stokvel available for me to join

☐ I don't trust people to be honest

☐ I might not have access to the money when I need it

52. If you do belong to a stokvel, how often do you make payments into the stokvel?

[Tick one option only]

☐ I don't belong to a stokvel

☐ Weekly

☐ Every two weeks

☐ Monthly

☐ 6 times a year

☐ 4 times a year

☐ 3 times a year

☐ 2 times a year

☐ 1 time a year

53. If you do belong to a stokvel, how much do you pay into the Stokvel each time?

☐ I don't belong to a stokvel

☐ I pay into the stokvel: **R**_____

CREDIT

54. Have you ever applied for a loan from a bank or any other financial institution?

☐ Yes

☐ No

55. If yes, you have applied for a loan, did the bank give you the loan?

☐ I have never applied for a loan

☐ Yes

☐ No

56. If you have never applied for a loan from a bank or financial institution, why have you not?

[You can tick as many options as you like]

☐ I have applied for a loan

☐ I do not like to borrow money from anyone

☐ I prefer to borrow money from family and friends

☐ I do not know how to apply for a loan

☐ A loan is too expensive and difficult to pay back

☐ I did not think I would be given a loan so I never applied for one

☐ I have not needed to take out a loan

57. Do you personally have any of the loans mentioned below

[You can tick as many options as you like]

☐ Home loan

☐ Personal loan

☐ Study loan

☐ Vehicle finance

☐ Credit card

☐ Store card (for example: Edgars, Clicks, Foschini)

☐ Loan from a friend or family member

☐ I have none of the loans mentioned above

INSURANCE

58. Do you know how buying insurance can protect you against disasters like fire or floods?

☐ Yes

☐ No

59. **(a) Has your property ever been damaged in a flood or fire?**

☐ Yes

☐ No

(b) If yes, would it have helped you if your property had been insured?

☐ My property has never been damaged by a flood or fire

☐ Yes, insurance would have helped

☐ No, insurance would not have helped

60. **If an affordable household insurance product was available <u>today</u>, would you consider buying it?**

☐ Yes

☐ No

61. **Do you think buying insurance COULD BE a useful way to protect yourself against the risk that a negative event (like a fire or flood) might happen?**

☐ Yes, insurance could be very useful

☐ No, I don't think insurance would be very useful

☐ I don't know

62. **Have you ever had an insurance policy?**

☐ Yes

☐ No

63. **If yes (you have had an insurance policy), what type of insurance policy was/is it?**

[You can tick as many options as you like]

☐ I do not have an insurance policy

☐ Crop insurance

☐ Life insurance

☐ Funeral policy

☐ Medical insurance

☐ Disability insurance

☐ Homeowners insurance

☐ Vehicle insurance

64. Which of these insurance policies do you still have?

[You can tick as many options as you like]

☐ I do not have an insurance policy

☐ Crop insurance

☐ Life insurance

☐ Funeral policy

☐ Medical insurance

☐ Disability insurance

☐ Homeowners insurance

☐ Vehicle insurance

65. If you have never bought insurance OR you <u>ONLY have a funeral/burial policy</u>, what is the reason for this?

☐ I have never thought of buying insurance

☐ I don't really understand how buying insurance will help me

☐ I have thought about buying insurance, but don't know how to buy it

☐ I have thought about buying insurance, but find that buying insurance is too complicated and difficult

☐ I have thought about buying insurance, but it is too expensive

☐ I do not want to buy insurance

☐ Insurance companies will not sell insurance to a poor person like me

☐ I have bought insurance

66. (a) Would you join a stokvel where you saved money every month in case a negative event like a fire or flood happened?

☐ Yes, definitely

☐ Yes, possibly

☐ No

(b) If yes, how much money would you be willing to put into the Stokvel every month? _____

ATTITUDES

67. What type of person are you?

[Tick one box only]

☐ A person who **often** takes risks

☐ A person who **sometimes** takes risks

☐ A person who **never** takes risks

68. How often do you buy lottery tickets (lotto or powerball for example)?

☐ Every day

☐ Once a week

☐ Twice a month

☐ Once a month

☐ Every two months

☐ Four times a year

☐ Twice a year

☐ Once a year

☐ I never buy lottery tickets

69. How often do you play Fafi (iChina)?

☐ Every day

☐ Once a week

☐ Twice a month

☐ Once a month

☐ Every two months

☐ Four times a year

☐ Twice a year

☐ Once a year

☐ I never play Fafi (iChina)

70. How often do you play card/dice games for money?

- ☐ Every day
- ☐ Once a week
- ☐ Twice a month
- ☐ Once a month
- ☐ Every two months
- ☐ Four times a year
- ☐ Twice a year
- ☐ Once a year
- ☐ I never play card/dice games for money

71. How often do you bet on animals (for example horse racing, dog racing etc)?

- ☐ Every day
- ☐ Once a week
- ☐ Twice a month
- ☐ Once a month
- ☐ Every two months
- ☐ Four times a year
- ☐ Twice a year
- ☐ Once a year
- ☐ I never bet on animals

72. How often do you go to the casino?

- ☐ Every day
- ☐ Once a week
- ☐ Twice a month
- ☐ Once a month
- ☐ Every two months
- ☐ Four times a year
- ☐ Twice a year
- ☐ Once a year
- ☐ I never go to the casino

73. How do you feel about your life as a whole right now?

☐ Very dissatisfied

☐ Dissatisfied

☐ Neutral

☐ Satisfied

☐ Very satisfied

74. I you compare your life now to your life ten years ago, are you happier, the same or less happy with life?

☐ Happier

☐ The same

☐ Less happy

Thank you for completing the survey!