

Economic Studies 178



Mohammad H. Sepahvand
Essays on Risk Attitudes in Sub-Saharan Africa

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ECONOMICS AT UPPSALA UNIVERSITY

The Department of Economics at Uppsala University has a long history. The first chair in Economics in the Nordic countries was instituted at Uppsala University in 1741.

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-

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Dissertation presented at Uppsala University to be publicly examined in Hörsal 2, Ekonomikum, Kyrkogårdsgatan 10 A, Uppsala, Friday, 8 March 2019 at 13:15 for the degree of Doctor of Philosophy. The examination will be conducted in English. Faculty examiner: Associate Professor Supriya Garikipati (University of Liverpool).

Abstract

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Essay I (submitted): Risk-taking is an important topic in Africa, as access to financial institutions and social security is scarce. Data on risk attitudes in Africa is limited and the available data collected might not be reliable. We investigate the determinants of risk attitudes in different domains and the reliability of survey data in a sub-Saharan African country, Burkina Faso, using a large representative panel survey of 31,677 individuals. Our results show that determinants such as individual's sex and age are significantly associated with willingness to take risk. Reliability differs across determinants of risk taking and risk domains. Women, older individuals or those with high education have more reliable risk measures compared to men, younger individuals or people with low education. Risk taking in traffic has the highest test-retest reliability followed by willingness to take risk in general and financial matters.

Essay II (revise and resubmit): Previous research shows that transmission of attitudes in the family is gendered. However, there are limited findings about the existence of intergenerational transmission of risk attitudes and if it is gendered. By using quantitative data from Burkina Faso in 2014, this study analyzes three different self-reported risk questions. Our results show a strong intergenerational transmission of attitudes from parents to children where positive assortative mating strengthens the parents' transmission of attitudes to her child. Mother's transmission is stronger on their daughters than sons. For fathers the pattern is reverse. Our findings also show that it exist heterogeneity in intergenerational transmission within a male and female dominated risk domain. This gives support for the gender-specific role model hypothesis. Furthermore, we find support for transmission of attitudes from grandparents (and local environment) to their grandchildren (the child), but the strength and significance of this transmission decrease when controlling for parents attitudes.

Essay III (submitted): This study uses sibling correlation to investigate the importance of parental and household characteristics on three different risk domains collected in a nationally representative survey from Burkina Faso. Sibling correlations are between 0.51 and 0.83. The correlations are higher in the general risk domain compared to risk taking in financial matters and traffic. Moreover, the sibling correlation is higher for the younger generation of siblings than the older generation, and for sisters than brothers. We also explore which factors drive these correlations; parents' risk attitudes help explain these correlations, whereas socioeconomic outcomes, family structure, parental health and residential zone have only a limited contribution. We also find that gender is important in explaining the variation in sibling correlations. Mother's have a stronger contribution on daughters than their sons correlation, whereas father's help to explain their sons correlation.

Essay IV (submitted): A popular uprising in 2014, led to a revolution overthrowing the sitting president of Burkina Faso. We investigate if individuals' risk attitudes changed due to this revolution. Specifically, we investigate the impact of the revolution on risk attitudes, by gender, age and level of education. The analysis is based on a unique nationally representative panel Household Budget Survey, which allows us to track the changes in the risk attitudes of the same individuals before, during and after the revolution. Our results suggest that the impact of the revolution is short-term. Individuals become risk averse during the revolution but converge back to the pre-revolution risk attitudes, slightly increasing their risk taking, after the revolution is over. Women are more risk taking than the men after the revolution but are more risk averse during the revolution. In general, older individuals tend to have higher risk aversion than the younger individuals. During the revolution, however, the individuals with higher level of education are less willing to take risk.

Essay V (submitted): This study is an empirical investigation of how individual risk attitudes influence the agricultural productivity of men and women in a sub-Saharan African country, Burkina Faso. By analyzing a large representative panel survey of farmers from 2014 and 2015, the results indicate lower productivity on female-owned plots. Controlling for various socio-economic factors, the results show that as the female farmers' increase risk taking, the productivity of female-owned plots goes down. These results are robust regarding alternative specifications. However, productivity differences vary by the type of crop cultivated, the agro-ecological zone, the share of female farmers in the region, the soil quality, type of seed used, and between consumption quantiles when comparing the poorest to the richest 20 per cent of the farm households. The results indicate that female farmers do not increase their plot yield by taking more risk. It is argued that agricultural policy interventions in Burkina Faso need to be gender sensitized when addressing issues related to credit constraints, improved inputs, and policies that support increase in productivity.

Keywords: Risk attitudes, determinants of risk taking, test-retest reliability, gender, inter and multigenerational transmission, socialization, family background, sibling correlations, exogenous shock, revolution, gender differences, agriculture, productivity, Burkina Faso

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*To Jilla, Mahshid and Tilli, to whom
I wish happiness.*

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we have produced many academic “babies”: four of these featured in this thesis as the journey continues.

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After my second year of PhD studies, in pursuit of a unique data for my thesis, I took on the responsibility as the Chief advisor of the Swedish government’s technical assistance project in statistics in Burkina Faso. I spent several years living permanently in Burkina Faso, collecting data and working with highly intellectual statisticians and demographers at the National Institute of Statistics and Demographics (INSD, *Institut National de la Statistique et de la Démographie*). such as Michel Koné, Namaro Yago, Banza Baya, Hervé J. Louis Guene, Zakaria Koncobo, Jermery Kafando, Placide S. Somé, Chantal Sangaré/Millogo, Mahamadi Ouoba, and many more. My Burkinabé colleagues have turned into an extended family for me, in particular my highly competent colleagues Kadissa Zongo, Nadège Zongo/Kaboré, and also Souleymane Compaoré and Mady Congo. As we say in Burkina, Nous Sommes

Ensemble! The same applies to my colleagues at the Swedish Embassy at Burkina, the Ministry for Foreign Affairs, the Swedish International Development Cooperation Agency, World Bank, Afristat, UEMOA, UNICEF and the EU project in Burkina. With colleagues such as Mats Hårsmar, Richard Bomboma, Aboudoulaye Sanou, Christina Andersson, Ann-Sofie Fofana Rahmqvist, and friends like Tess Ax:son Johnson, Sweden would not forget about the importance of supporting data collection in Burkina Faso.

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So before finishing, I would like to leave future readers of this thesis, maybe those pursuing a dream, with the immortal sentiment of one of the best actors of our time, Robin Williams. There have been other PhD students before you; they believed they were destined for great things, just like you. If you listen, you can hear them whisper their legacy to you, *carpe diem*... Seize the day, make your PhD journey and academic careers extraordinary.

59°51'32.6"N 17°37'16.3"E, Uppsala, January 2019

Mohammad H. Sepahvand

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Introduction

Load the ship and set out. No one knows for certain whether the vessel will sink or reach the harbor. Cautious people say, 'I'll do nothing until I can be sure'. Merchants know better. If you do nothing, you lose. Don't be one of those merchants who won't risk the ocean.

— Excerpt from *Work in the Invisible*, Rumi

Between 2013 and 2017, I lived and worked in Burkina Faso as the Chief Advisor for the Swedish technical assistance project in statistics there. This was a cooperative government project between the National Institute of Statistics and Demography (INSD, Institut National de la Statistique et de la Démographie) of Burkina Faso and Statistics Sweden (SCB).¹ A large part of the technical assistance was dedicated to the development and implementation of a multipurpose Household Budget Survey (HBS) with a panel structure to ensure a sustainable statistical production system. Therefore, before accepting the responsibility of the technical assistance project in statistics in Burkina Faso and, most importantly, taking a long leave of absence from my PhD studies at Uppsala University, I came to an agreement with the authorities at INSD (and Sweden) to include risk questions in the HBS in order to use these questions in my doctoral thesis and future research.² Several senior researchers (e.g., Björklund 2014) claim that seeking to gain experience and knowledge about data collection during the PhD studies creates a comparative advantage for one's future academic career. Using self-collected data for own research has three advantages that are intertwined: (i) the researcher has a better knowledge about issues concerning data limitation, (ii) the researcher can customize the survey in order to answer a well-defined research question and (iii) a large number of articles written by Swedish economists published in top economic journals use data that are collected by themselves (ibid).

In 2013, I was in contact with researchers in the Stockholm-Uppsala area, in particular Magnus Johannesson at Stockholm School of Economics, concerning the operationalization of my research in Burkina Faso. It came to my

¹ The project was financed by the Swedish International Development Cooperation Agency (Sida, or in French: *Agence suédoise de coopération internationale au développement*, Asdi).

² I had also previous experience from working in Burkina Faso with data collection in 2007 under the supervision of Yves René Surry and in collaboration with INERA (*Institut de l'Environnement et du Recherches Agricoles*) in Burkina Faso

knowledge that, with the recent integration of individual-difference psychology into economics (Almlund et al., 2011; Borghans et al., 2008), the argument that risk preferences are domain specific (e.g. Weber et al., 2002) had strengthened. This information was important because, historically, the common assumption in economics has been that a single risk preference governs risk taking in all risk-related domains. However, this reliance on a single-item measurement makes it more prone to measurement error. The standard approach in economics to observe measurement error is to observe changes in risk measures over time.³ So, my research agenda in Burkina Faso now included improving the measurement of risk preferences, not only capturing individual's risk taking. As a result, I started an interdisciplinary collaboration with a sociologist, Roujman Shahbazian, at the Swedish Institute for Social Research (SOFI) in order to adopt other standards for improving the measurement tools for risk preferences. Therefore, I persuaded INSD to include not only measures of risk attitudes into the HBS, but also measure it over time so that it would allow for the possibility to understand the degree of measurement error.

I was well aware that economists have historically recommended experiments as the methodological gold standard for measuring risk preferences since experiments observe real choices with real incentives in well-controlled decision situations that are comparable across individuals. Survey measures were considered to capture only risk perception on top of risk preferences. However, I wanted to collect data on risk preferences because there was a lack of reliable data about sub-Saharan Africa, in particular data with enough statistical power. I had a choice to implement experimental measures to capture risk taking. But at the same time I had the possibility to ask risk questions to all of the individuals aged 18 years and older in the HBS that INSD was planning to implement in 10,800 households across the 13 regions in Burkina Faso. I knew from my previous work at SCB that measures are costly and time consuming when implementing them on a large, nationally representative sample, in particular if the experimental measures would take more time to implement. Moreover, a sub-Saharan country like Burkina Faso does not have access to the same pool of highly educated graduate students that usually participate in risk experiments in laboratories. Access to computers and electricity in the field also made it difficult to implement an experiment in order to capture risk preference on such a large scale. However, I did not want this be a question of cost, so after discussions with my sociologist, we decided to make it into an empirical question. I presented the research idea about measuring risk attitudes at several research seminars, workshops, and conferences, in particular the very constructive group of economists that constitute the Stockholm behavioral network. The vast majority of the input that I received was that there

³ This is because the assumption that preference should not change over time (at least in the short term) has shaped economics for decades (Stigler and Becker, 1997).

is no need to make an experiment for such a large sample size; survey questions that capture risk preference were preferable. This was because the self-reported risk questions that were going to be implemented in the HBS had already been shown to capture individuals' risk preferences by comparing them to incentivized lottery experiments in developed countries (e.g., Dohmen et al., 2011; Lönnqvist et al., 2015), emerging countries (e.g., Hardeweg et al., 2013), developing countries, and comparatively for 30 countries (Vieider et al., 2015). Thus, I got the green light to carry on with measuring risk preferences through self-reported risk questions in Burkina Faso.

My endeavor to measure risk preferences through surveys does not imply that I will never measure risk preferences through experiments. For instance, there are influential researchers, such as Glenn W. Harrison, that still promote experiments as the standard for measuring risk preferences. My aim with the implementation of these risk questions on a large scale is to persuade researchers and practitioners to pay more attention to risk attitudes at the onset survey design rather than post analysis using proxy indicators collected in surveys, such as smoking or drinking, as these proxies for risk attitudes have not been able to capture economic behavior as well as risk preferences. The questions in this thesis to measure risk attitudes have been used in numerous studies and make up a fairly easy and cost-effective risk measurement for researchers and practitioners to implement in other countries repeatedly in panel surveys. This allows for comparison over time and across countries. This is important since replicability and reproducibility of scientific findings have recently reemerged as key factors (Dreber et al., 2015; Camerer et al., 2016) for being able to use and analyze the same measures as previous studies.

While recent research seems to confirm the notion that risk taking is a fundamental mechanism of decision making, very little empirical evidence exists about the stability of risk preferences, individual attitude endowment, and the interaction of risk and gender in agricultural productivity that can be considered as a black box in economics. In this thesis, I explore and improve on the understanding of these processes. To do this, I approach these questions in four ways. The first is to take a more-detailed look at the main methodological requirements for an empirical-research agenda on risk preferences: validated measures of risk preferences and a strict definition of what it means when preferences are stable. The second is to investigate how individuals' attitudes are shaped by their family and role models in the local environment. The third is to return to the question on the stability of (risk) preference, empirically, through a natural experiment to determine the direction of a large national exogenous shock and how it affects risk preferences. The fourth is to analyze gender differences in agricultural productivity by taking individual farmer's level of risk taking under consideration.

Aim, contribution to previous research and research questions

The aim of this thesis is to improve on the understanding of three central aspects of risk taking: stability of risk preferences, individual attitude endowment and the interaction of risk and gender on agricultural productivity. By doing this, I will be able to provide greater insight into one core dimension of individual preferences: attitude towards risk. The empirical contributions are fourfold.

First, by studying the changes in risk measures over time, I test the definition of preference stability in order to answer the question of whether individuals' risk attitudes are constant over time. I also compare individual characteristics determining risk taking in previous research with my findings and examine how well my risk measures explain and predict risky behavior in order to answer the question of how valid these risk measures are in capturing risk preferences. Second, an investigation on the risk attitude transmission process both vertically from parents, grandparents or other roles models to children and horizontally between siblings, will give a more detailed view and endogenize the attitude endowments of individuals. Third, I provide a new perspective on how individuals' risk preferences can be altered by a general large exogenous shock, the 2014 Burkina Faso revolution, and study in detail what direction the impact of a major shock has on individuals' risk taking and, hence, directly addressing the question of stability of risk preferences. Fourth, by studying the role of risk attitudes and gender on the agricultural productivity, I aim to answer the question of whether females' lowered measured productivity is due to their inability to take higher risk. This will give a more-detailed view on the alleviation of gender differences, which is one of the key drivers in reducing poverty and increasing food security in Africa and many other developing countries across the world.

On this basis, in this thesis I answer five questions related to these three central aspects. These are dealt with in each respective article:

STABILITY AND VALIDITY OF RISK PREFERENCES

- I. *What are the determinants and reliability of self-reported risk attitudes in Burkina Faso?*
- II. *How does a revolution change risk attitudes?*

INDIVIDUAL ATTITUDE ENDOWMENT

- III. *Does it exist an intergenerational transmission of risk attitudes? What roles do gender and positive assortative mating play in the individual attitude endowment? Does it exist a transmission of attitudes from grandparents (and the local environment) to their grandchildren?*

- IV. *What is the size of sibling correlation in risk attitudes? What factors, such as parents' risk attitudes, socioeconomic outcomes and family structure, drive these correlations? What role does gender play in explaining the variation in sibling correlations?*

THE INTERACTION OF RISK AND GENDER ON AGRICULTURAL PRODUCTIVITY

- V. *Does an individual's risk attitudes influence gender differences in agricultural productivity in Burkina Faso? How robust is this influence in controlling for different factors? How do productivity differences vary, depending on type of crop cultivated, agro-ecological zone, the share of female farmers in the region, the soil quality, type of seed used, and between consumption quantiles when comparing the poorest to the richest 20 per cent of the farm households?*

Outline of the thesis

The next section provides an overview of the empirical patterns of measuring risk that form the background for the thesis and situates it in the three central aspects of research that each respective article addresses. This is followed by a discussion of the theories and methods that frame the thesis. After this, I present the country of study, Burkina Faso, and the data material, followed by a discussion on the practical experience of collecting data in the field. Finally, I summarize each of the five essays before concluding in the final section with a discussion of the results.

Eliciting risk preferences

This section gives an overview of the different approaches to elicit and assess individual risk preferences and the approach that the thesis argues.

Incentivized experiments and self-reported risk questions

The extent that individuals are willing to take on risk constitutes their risk preferences. Risk is at the heart of decision making. When making a decision, individuals consciously or unconsciously weigh pros and cons and it is domain specific. For instance, when rushing to arrive at a dissertation, one questions is if one should drive on the safer, right-hand side, or go faster and move to the left-hand side? In financial matters, should we take a greater risk and invest our money in emerging markets or go with a safer investment? If we decide to have a sexual encounter with a person we have meet for the first time,

should we use contraceptives, or risk getting an infection or disease? Economists and psychologists have developed a variety of well-established approaches to elicit and assess individual risk attitudes. Choosing which approach to use is dependent on the research question one wants to answer, as well as the characteristics of the sample population. However, among these methods, two approaches prevail: incentivized experiments, and self-reported risk question obtained in surveys. With the experimental approach, individuals usually choose between two-outcome incentivized lotteries, and the higher willingness to take risk is typically captured through individual's choice of higher expected payoffs that come at the cost of higher variance (risk) of payoff. The most-used experimental approaches to capture risk preferences are the Holt and Laury's (2002) price-list method and Binswanger's (1980) or Eckel and Grossman's (2002) choice between different gambles.

The standard example for capturing risk through the self-reported risk question is the corresponding following ordinal-scale question in surveys, such as the German Socio-Economic Panel (SOEP): How do you see yourself: Are you a person who is fully prepared to take risks or do you try to avoid taking risks? On a scale from 1 to 10, where 1 = not at all willing to take risk and 10 = very willing to take risk (Wagner et al., 2007). The question is then adapted to different risk domains, such as risk taking in general, traffic, or financial matters. Notably, this risk measure is qualitative and does not involve an explicit lottery. Rather, it relies on the respondents giving an assessment of willingness to take risks in different domains that could be faced in decision making. This approach is potentially attractive for the purpose of eliciting reliable measures of risk attitudes within domains. As there are no explicit stakes or probabilities in the question, there is the potential that factors other than risk preference could lead to variation in responses across individuals. Specifically, subjective beliefs about the riskiness of the decision environment could affect someone's stated willingness to take risks. For this reason, it is informative to state that the same type of risk measures have been empirically validated through field experiments as being a fruitful way of eliciting a reliable measurement of risk preferences (Dohmen et al., 2011; Hardeweg et al., 2013; Vieider et al., 2015; Lönnqvist et al., 2015; Beauchamp et al., 2017). There is also another approach used previously in financial literature that measures risk taking from for instance investment decisions (Malmendier and Nagel, 2011). However, such an approach to infer willingness does not capture an isolated measure of risk preferences, but instead also simultaneously captures beliefs about the extent of how risky a given behavior is and the opportunity to engage in that behavior.

In economics, experiments have been recommended as the methodological gold standard for measuring risk preferences. By assigning probabilities to each outcome, experimental measures precisely quantify the risks under consideration, while survey measures might capture risk perception on top of risk preferences. However, experimental measures are costly and time-consuming

to implement in large representative samples. For instance, complex ways of eliciting risk—as through the experimental approach—might demand more understanding from the respondents, otherwise their lack of comprehension would make their answers less meaningful. Complex elicitation of risk preferences might work well in a lab experiment with a homogenous sample of respondents consisting of graduate students that have access to computers and a method with multiple trials to implement, where their higher education allows them to obtain a higher level of comprehension of the subject. However, while conducting the survey in the real world in the field for a nationally representative sample with limited access to computers and electricity in a developing country, given how long time an interview takes constituting of a large cost in the survey budget, eliciting risk preferences through a non-incentivized self-reported questionnaire is preferable. This approach also allows differences in individuals' risk preferences to be captured across different risk domains over time in a panel survey and to a lower cost (Charness et al., 2013). Moreover, eliciting risk preferences through incentivized lotteries or hypothetical gambles focuses in particular on the risk domain of financial matters and might not be able to be extended to capture other risk domains. Reflecting on the common assumption in economics that a single risk attitude governs risk taking in all risk-related domains. However, this reliance on a single-item measurement makes this kind of risk measures more prone to measurement error. Moreover, heterogeneity of the individual's financial risk taking elucidated through lottery-based risk questions may also depend on the level of stakes involved. For instance, varying the level of stakes in lotteries changes the level of risk-aversion, where the same individual goes from risk-seeking to becoming risk averse due to the level of the stakes (e.g., Holt and Laury 2002), or more risk averse when faced with a gain but not with a loss (e.g. Viedier et al., 2015). In addition, in Sepahvand and Shahbazian (2017a), my coauthor and I find correlations of between 0.5 and 0.7 across different risk domains, such as in traffic and financial matters, as well as for general risk preferences. This is evidence that risk preferences across risk domains are correlated by far from perfectly, which is in line with recent studies showing that individuals do not have one underlying risk preference, but instead differ in their risk taking in different domains (e.g., Slovic 1972a, 1972b; Weber et al., 2002; Hanoch et al., 2006; Dohmen et al., 2011; Lönnqvist et al., 2015; Beauchamp et al., 2017).

Theoretical framework and methodology

In this section, the theoretical framework that forms the underlying perspective in the thesis is presented. To analyze the relationship between risk attitudes, individual characteristics, attitude endowment and agricultural produc-

tivity, I draw on the main methodological requirements for an empirical research agenda on risk preferences: validated measures of risk preferences and a strict definition of what it means when preferences are stable. This framework is expanded on by including a description of how individuals' risk preference may change, given different possible scenarios. In relation to this, I discuss how my perspective on risk taking can contribute to the literature on the stability of risk preferences.

Validity and stability of risk preferences

In recent years, with the emerging interest in risk taking, economists have started to examine the validity of their measures of risk preferences. This implies that economists no more assume but instead investigate if the commonly used measures of risk preferences are internally valid and have an external or behavioral validity. Risk measurements aiming to capture risk preferences have a behavioral validity if they capture actual risky behaviors. For instance, Dohmen et al. (2011) indicate that their self-reported risk preferences predict risk taking behavior (e.g., self-employment and smoking). Other studies also show that these same types of risk measurements are reliable predictors of actual risk taking in incentivized lottery experiments across the world (e.g., Dohmen et al., 2011; Hardeweg et al., 2013; Lönnqvist et al., 2015; Vieider et al., 2015). Measured risk preferences are internally valid if different ways of measuring risk preferences have the same underlying risk preferences and offer a coherent explanation of the same individual. For instance, recent studies about developed (Dohmen et al., 2011) and developing (Yesuf and Bluffstone 2009) countries indicate that individual characteristics such as gender, parental education, own education, and age are important determinants of risk attitudes, irrespective of ways of measuring risk preferences, such as self-report measures or experimental measures.

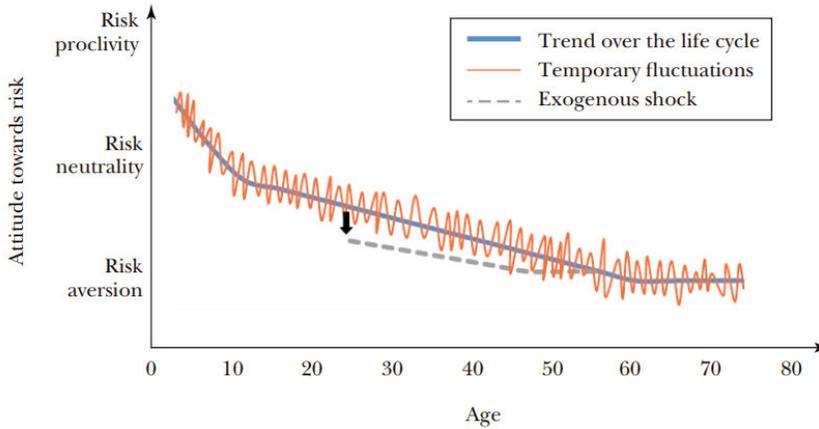
In economics, stability of (risk) preferences is defined as the fact that individual risk preferences are constant over time, as opposed to stability of the distribution of preferences, in a given population. This definition implies that the same willingness to take risk should be observed when measuring an individual's risk preferences repeatedly over time, given that there is no measurement error. Therefore, if one were to observe changes in risk measures over time, the standard approach in economics has been to assume that this is due to measurement error, hence it considers these changes to be nothing more than noise. The common method to test the definition of preference stability is by analyzing the test-retest reliability of the measured risk preferences. If reliability is low, the risk measure does not provide an accurate assessment about the risk preferences we want to capture, which implies that measurement error might be high.

However, with insight from behavioral economics and psychology (Almlund et al., 2011; Borghans et al., 2008), recent empirical economic studies have suggested that individuals' risk preferences can change due to various general large exogenous shocks, such as natural disasters (Eckel et al., 2009), financial crises (Sahm 2012), traumatic events from conflicts (e.g., Voors et al., 2012), and revolution (Sepahvand et al., 2019).⁴ Schildberg-Hörish (2018) presents a detailed and excellent framework of how an individual's risk preference may change given different possible scenarios, such as what happens with risk preferences given an exogenous shock (like a natural disaster), a temporary variation in emotions, and changes over the life-cycle with age. Figure 1 illustrates her framework. The solid line of the figure shows that willingness to take risk decreases, i.e. individuals become more risk averse with age, which also reflects the findings from other previous research (Bishai 2004; Tanaka et al., 2010). The jagged line shows a distribution around the mean, which could be representative by the variance of the distribution of risk taking. This could be an indication of temporary fluctuations in risk attitudes, which Schildberg-Hörish (2018) links to the previous literature on how temporary variation in stress, self-control, or emotions cause temporary fluctuations in risk preferences around a baseline or average level. The dashed line, which aims to illustrate a downward shift of the solid line, indicates a sudden mean-level change in individual risk taking, which Schildberg-Hörish (2018) argues is what would be observed in terms of changes in risk attitudes from an exogenous shock like a natural disaster or violent conflict.

The central aspects studied in the thesis can be inserted into this framework of the stability of risk preferences provided by Schildberg-Hörish (2018). She finds inconsistent and contradictory results from the emerging field of research regarding how risk preferences change due to an exogenous shock. This is where I aim to fill the gap by providing empirical evidence to Schildberg-Hörish's (2018) conceptualization of the dashed line through the use of a large, national representative panel survey capturing how a revolution affects changes in individuals' risk attitudes. Changes in risk preferences have important consequences for economic behavior because an individual's willingness to take risk predicts aspects of occupation (Bonin et al., 2007), self-employment (Cramer et al., 2002), investment in human capital (Guiso and Paiella, 2005), and sexual behaviors (de Walque 2014). For instance, individuals with a lower willingness to take risk (in other words, those who are more risk averse) are less likely to be self-employed and countries with higher aggregate risk aversion have a lower total factor productivity (Dohmen et al., 2011; Falk et al., 2017).

⁴ The psychological literature argues that experiences of an extreme event or strong emotions influence risk preferences (for literature review see Loewenstien et al., 2003). However, the direction of the change in risk attitudes depends on the type of shock. For instance, if the individuals are faced with a high probability of loss, they are more willing to take risk as compared to a situation of a high possible gain (Tversky and Kahneman, 1992).

Figure 1. Schildberg-Hörish (2018) illustration of changes in risk attitudes.



Note: The Figure provides a conceptual framework for understanding why an individual's risk attitude may change due to an exogenous shock. The solid line shows that individuals become less risk taking with age. The dashed line shows a possible shift of the solid line given an exogenous shock. The jagged line shows temporary fluctuations in risk attitudes caused by temporary variation in stress, self-control, or emotions. The figure focuses on a representative individual and ignores the substantial heterogeneity in risk preferences across individuals. The sketched effect sizes are inspired by empirical findings as described in Schildberg-Hörish (2018). Source: Schildberg-Hörish (Figure 1, 2018:142)

Burkina Faso

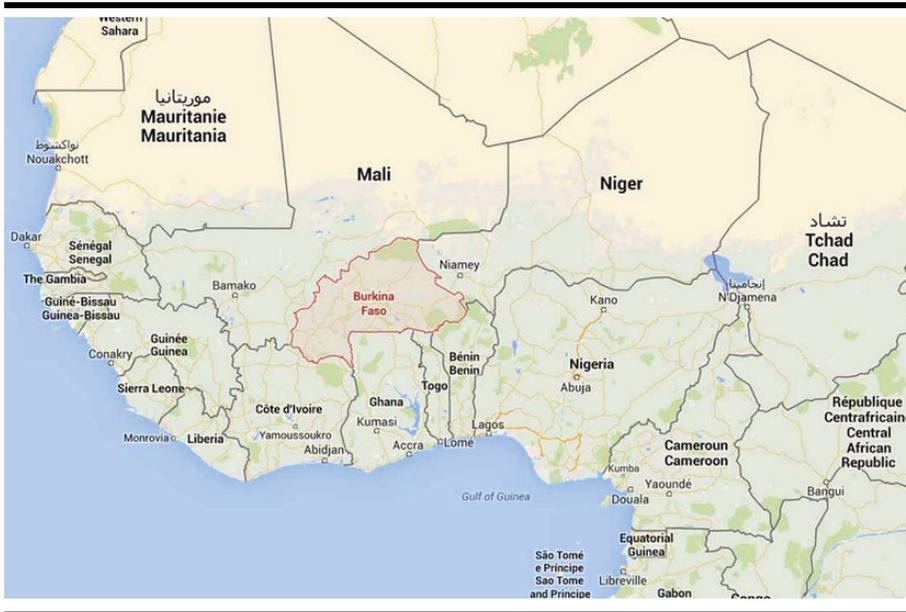
All of the essays in this thesis provide empirical evidence about risk taking in Burkina Faso. Therefore, in this section, I provide an introduction to the country of study, Burkina Faso. This is followed by a description of why the country needed technical assistance in statistics.

The country context

Burkina Faso, as a country of study, is of particular interest as it is one of the most economically underdeveloped countries in the world, with a per capita gross domestic product (GDP) of \$704 USD in 2014 and an overall majority living in rural areas. A low level of education and employment, particularly among women, characterize these rural areas. The national level of literacy of men is twice that for women, whereas female literacy is less than ten per cent in the rural areas. The institutions are still underdeveloped and access to social services is scarce. There are inequalities in terms of who has access to these

scarce services. Those who need social services the most (such as the poor in rural areas) have less access to it (INSD 2015a). This has led to urbanization. The urban areas move towards service and low-level manufacturing, while rural areas continue to be dominated by small-scale subsistence farming. Burkina Faso is a landlocked country in West Africa, as presented by Figure 2.

Figure 2. Excerpt from Map of West Africa.



Source: Google Maps, 2015-09-21.

Irrigation systems for agriculture in the country are lacking, which makes the agricultural sector highly weather dependent. Despite these harsh conditions, the agricultural sector constitutes about one third of its gross domestic product and employs around 80 per cent of the working age population.⁵ The principal subsistence crops cultivated are mainly sorghum, millet, and maize. Maize is also used as cash crop. Otherwise, cotton is the main cash crop followed by peanuts, sesame, cowpeas, and paddy rice (which is cultivated in some restricted areas of the country). In terms of investments, Burkina Faso was ranked as the 111th investment destination in the world,⁶ which makes investments in the country a risky choice. Due to the climate, most of the population of Burkina Faso is concentrated in the center and south of the country, which is also why the northern regions are the poorest (INSD 2015a). The

⁵ Ministry of Agriculture Burkina Faso, found at <http://agriculture-bf.info/> (2018-04-22).

⁶ Euromoney Country Risk, <http://www.euromoneycountryrisk.com> (2018-03-10).

households are credit constrained through the limited access to formal financial services. However, in the households with access to credit, it is usually the heads of the households, mostly men, who have this access. This implies that gender norms are still persistent in the country. On average, there are approximately six children born per woman, with a life expectancy estimated to be between 57 and 59 years old (INSD 2015b). The relatively high amount of births per women in relation to population projections for 2014 of almost 18 million inhabitants (INSD 2017) makes the country's population growth one of the highest in the world. Estimates show that around 50 per cent of the population is under 20 years old (INSD 2015b). This demographic trend, together with the large share of urbanization, will increase the competition for urban jobs, creating challenges for the institutions to create more opportunities in the urban, non-agricultural occupational sector. As the institutions are still underdeveloped, an individual's willingness to take risk in order to seek occupational opportunities increases.

Sub-Saharan African countries have experienced major climate changes in the past decades in terms of very warm periods and droughts. It is estimated that between the 1970s and 2010, there were over 100,000 drought-related deaths in the rural areas of Burkina Faso and its neighboring countries due to reduced rainfall and drought (AEO, 2002; USAID, 2012). If this trend were to continue, in combination with high population growth, it would have a very large economic impact. This includes reduced access to food and water, as well as the potential elimination of ecosystems. Food and water scarcity will also lead to health issues because of the lack of nutrition and sanitation, giving rise to infectious diseases. Estimates from INSD (2014) show that around 43% of the individuals in Burkina Faso suffered some form of food insecurity at certain times in 2014.⁷ It is considered that mothers and children are those with less resilience to shocks; if a mother were obliged to provide for her child through, for example, having access to water, it implies less time put towards labor.

In a coup d'état 1987, Blaise Compaoré became the president of Burkina Faso. The president was re-elected for a second and constitutionally last term in 2010.⁸ However, in the hope of staying in power beyond his second term, he had plans to amend the two-term limit set by Article 37 of the constitution. He remained head of state until the revolution of 2014, resulting in the change of the political regime in Burkina Faso. After the revolution, an interim government was put in place with the mandate to prepare the country for national democratic elections. Dr. Michel Kafando, a former vice-president in the

⁷ These estimates are based on the number of calories individuals in a households get from the consumption of food products. 2,283 kcal per adult equivalent and per day is the standard level.

⁸ Blaise Compaoré had been in power since 1987, however only his last two elections were under the 1991 constitution as amended in 2000–2002, which limits the presidents to two five-years terms.

United Nations General Assembly and Burkina Faso's diplomatic representative to the UN, was appointed as its interim president and Colonel Yacouba Isaac Zida as the interim prime minister. A short military coup dissolved the interim government in September 2015. However, it was not successful in gaining power due to the massive pressure from the Burkinabé people and other regional actors, such as ECOWAS and AU. The general elections were held on November 29, 2015, and Roch Marc Christian Kaboré of the People's Movement for Progress won the elections in the first round of voting and was sworn in as president of Burkina Faso on December 29, 2015, thus bringing greater stability to Burkina Faso. However, political challenges still persist. Burkina Faso, like its surrounding countries, is also affected by the regional instability. The country has experienced terrorist attacks after the revolution in both the capital Ouagadougou and its northern parts.⁹

In summary, these effects could, in the future, cause global migrant flows due to the salient uncertainty disrupting the livelihoods of populations, not just in Burkina Faso but the rest of sub-Saharan Africa as well. Therefore, it is of utmost importance to understand what determines and shapes individual risk preferences and, hence, decision making over time.

Technical aid in statistics

One of the main challenges in Burkina Faso and many other sub-Saharan African countries is the reduction of poverty. In 2002, the government of Burkina Faso implemented the Poverty Reduction Strategy Paper (PRSP), which was a strategic vision to reduce poverty and increase economic development. In 2010, the country adopted a new strategic vision, which was more ambitious than the PRSP to reduce poverty. The Accelerated Growth and Sustainable Development Strategy (SCADD), among others, aimed to develop the backbones of accelerated growth, promote social safety, as well as take into account subsequent priorities in development policies and programs. However, to be able to implement and monitor the strategic areas of SCADD, there was also a need for statistics and a sustainable statistical system. The official statistics in Burkina Faso (and many other sub-Saharan African countries) has historically been limited and not reliable because of small sample size, reduced geographic variation, and lack of panel structure. This is because of the underdeveloped national institutions due to, for example, unpredictable or volatile aid flows. Many donors have inconsistent requirements or the aid is fragmented into many small projects. International institutions also crowd out or

⁹ For more information about the recent political development in Burkina Faso, see Hagberg et al. (2018).

undermine local efforts to collect national statistics or the donors and recipients of national official statistics have different goals.¹⁰ Moreover, an evaluation conducted by Cameroon and Niger in 2009, the peer of the statistical system in Burkina Faso, concluded that highly well-educated and skilled statisticians exist in Burkina Faso, making it one of the best in the region. However, it also stated that there is a lack of development of statistical data because of limited data production, a lack of archiving and security policy of data, and imperfect coordination. So, in an effort to improve its official national statistics, Burkina Faso requested that the Swedish government, as a part of its bilateral aid program, should focus on improving and increasing the capacity and ownership of the National Statistical System (NSS). The argument was that the availability of official statistics is vital for the development of countries like Burkina Faso in monitoring poverty reduction and economic development.

SCB was chosen as a technical partner in a government-to-government agency project to provide technical assistance (i.e., transfer of competence and not cash transfers such as salary to statisticians, etc.). The project's objective was to contribute to the development of a sustainable statistical system in Burkina Faso that facilitates decision making based on relevant and reliable statistical information that meets domestic demands (e.g., being in compliance with the Burkina Faso's national statistical plan), is well-coordinated with other statistical projects (EU, World Bank, UNICEF, etc.), and supports and provides indicators for the implementation and the monitoring of the national development program, such as the Strategy for Accelerated Growth and Sustainable Development (SCADD) and the Millennium Development Goals (MDG). The specific project objectives were to assist in the development of prioritized statistical areas (economics, social and environment statistics); this includes the development of the statistical business register, and the improvement of gender, demographic, and environmental statistics. It was also to reinforce the general statistical capacities in terms of report writing and survey methodology courses, for example, and to reinforce the IT system at INSD and in the rest of the NSS, which will lead to the production of statistics that will satisfy the national and international needs to a greater extent. More specifically, a large part of the assistance was dedicated to the development of a multipurpose Household Budget Survey (HBS) with a panel structure to ensure a sustainable statistical production system. This HBS was a separate project within the technical assistance project.

The main objective of the HBS was to provide indicators on the poverty level and other factors needed to monitor whether Burkina Faso had achieved the goals of the development initiatives (e.g., SCADD and MDGs). However, through the panel structure of the HBS, it was possible to obtain consumption

¹⁰ Other reasons could also be related to level of corruption and realistic government plans. However, it is hard to establish causality in these specific cases, as the evidence is scarce or hard to attain.

and expenditure patterns on a quarterly basis, which was valuable for the construction of national accounts. Since the HBS also collected local price statistics across all the 13 regions of the country for each quarter, it provided input for the consumer price indices. Previous attempts were made by Burkina Faso to implement household surveys. These were undertaken in 1994, 1998, 2005, 2007 and 2009. However these surveys were simplified in terms of data coverage, lacked a panel structure (in other words, being more concentrated on specific reference periods, for example three to six weeks) and were often implemented with some other external actor (e.g., the World Bank) that implied reduced ownership for the NSS. INSD's and the rest of the NSS's ambitions were to have relevant statistical data to enable policy makers to track indicators of national and international development programs over time. To be able to achieve this, they demanded an efficient survey program that reduced time from data collection to publication of official statistics, as well as a sustainable survey coordination that allowed for institutional capacity building within the country. Therefore, SCB's role became assisting INSD in the development and implementation of a HBS. In this development phase of the HBS, some key areas were identified, such as including a panel structure to capture the dynamics of development (SCADD and MDG) indicators over time and a permanent and continuous survey with a core, annual and more-focused questionnaire, combined with rotating modules.¹¹

Data

In the process of writing this thesis, I included three risk questions in a national representative panel survey covering 10,800 households. In this section, an overview of the data used in the thesis is presented and the process involved in collecting them is described. A personal view of my experience of collecting data in the field is also described. I would also share how we solved some of the challenges during this period. When I use the term 'we' I refer to the National Institute of Statistics and Demographics (INSD) in Burkina Faso, Statistics Sweden (SCB), and the rest of the National Statistical System (NSS) in Burkina Faso.

Data description

The data in this thesis are a multipurpose Household Budget Survey (HBS). The HBS is a face-to-face, nationally representative panel survey covering 900 enumeration areas (EA)¹² with twelve households per EA, i.e., 10,800

¹¹ To my help in the development and implementation of the HBS together with INSD and the NNS, I also had access to skilled statisticians such as Thomas Polfeldt, Lars Lundgren and Roujman Shahbazian.

¹² The enumeration area is a statistical defined geographical unit for sampling purpose.

households spread across the 13 regions of Burkina Faso.¹³ The selection of the EAs is a random selection, including both urban and rural areas. A two-stage stratified sampling technique is used. In the first stage, the EAs are drawn from a frame with a probability proportional to the number of households in the EA. The frame constitutes 13,821 mapped EAs defined during the population census of 2006.¹⁴ Then a listing procedure is conducted in each EA in order to update the number of households through the frame of the second stage.¹⁵ In the second stage, twelve households per EA are drawn with equal probability in each EA (INSD 2013).¹⁶

The HBS surveys the head of each household in the sample. It also surveys all other members present in the household at the time of the interview, asking about a wide range of personal and household information. The HBS also collects demographic information for the remaining, non-present household members at the time of the interview.¹⁷ This thesis focuses on three different risk questions in the HBS that directly ask the respondent to assess his or her willingness to take risks in traffic, in financial matters, and in general. These self-reported risk attitude questions were collected in the third (July to September) and fourth (October to December) rounds of 2014 as a separate module for all household members with the age of 18 years and older. These are the same self-reported risk questions as those from the German Socio-Economic Panel. These survey-based risk question are the prototypical examples of a self-reported risk measure and have been used extensively in previous studies, and have also been empirically validated through field experiments (where choices involved paid lotteries with explicit stakes and probabilities) as being a fruitful way of eliciting a reliable measurement of risk preferences (Dohmen et al., 2011; Hardeweg et al., 2013; Lönnqvist et al., 2015; Vieider

¹³ A pilot survey was also conducted during 2013 with 500 households, to test the questionnaires, the fieldwork operations and the data capture.

¹⁴ A number of these EAs were updated in 2008.

¹⁵ This listing procedure is also done in order to update the size of the EA for estimation of sampling weights.

¹⁶ There were 27 permanent interviewing teams, each consisting of a controller, three interviewers and a driver. Each team covers around 33–35 EAs. The overall majority of the interviewers had at least a bachelor's degree, all were university students, and many were graduates. The interviewer teams stayed together during data collection periods and had daily discussions of experiences and problems encountered. The controllers and supervisors kept a tight check during the data collection and corrected for anomalies in the questionnaire. Approximately each week of data collection was followed by a detailed report by the supervisors. The advantage of having face-to-face interviews is that it is superior compared to other interview techniques, such as questionnaires, or/and telephone, as it provides a more accurate screening of the respondents (for instance in terms of sex, age, level of literacy, etc.), efficient interviewing time and quality checks of questions.

¹⁷ The HBS consists of a core module, which is repeated every round, while additional modules are less frequent. The contents of the core module are concentrated around sections on household expenditure and labor force data. In both of these sections, important changes may occur at fairly short notice, hence seasonal variations will be well captured. Besides collecting household information, such as expenditure and consumption data, respondents are also asked to provide a range of personal information through rotating questionnaire modules.

et al., 2015; Beauchamp et al., 2017). The exact English wording of the questions is as follows: “How do you see yourself: Are you a person who is fully prepared to take risks or do you try to avoid taking risks? On a scale from 1 to 10, where 1 = not at all willing to take risk and 10 = very willing to take risk. A. In traffic (driving a car, motorcycle, bike, etc.), B. In financial matters, C. In general?”

The HBS has an overall household response rate of approximately 95 per cent for the third and fourth rounds respectively, which gives a low level of attrition. All respondents who were 18 years and older have answered all three risk questions. However, not all respondents answered at both time points. The number of responses in the third round was 34,494 and 33,066 in fourth round. In both rounds, by the same individuals, there were 31,677 responses for all three of the risk questions. In order to get a more reliable measurement of risk attitudes and decrease measurement error, the analysis in this thesis uses the average of the two periods. However, all analysis was performed with responses separately for the third and fourth rounds and the results are similar.¹⁸ Additionally, an extensive agricultural module (collected between December 2014 and January 2015) exists, making it possible to link to the individual-disaggregated information on demographics, education, health, wage employment, amount of hours worked, non-farm enterprises, income from non-farm income sources, food consumption, food and non-food expenditures, food security, as well as other topics in the HBS. This agricultural module is administered at the plot level, containing questions about ownership and that directly asks individual farmers, for example, to provide answers about their agricultural crop and input choices, land areas and soil characteristics, labor and non-labor input use, crop cultivation, and production at the plot level.

The panel structure of the HBS makes it possible to account both for cross-sectional and time-series variation. In practice, this structure also reduces the measurement error in risk measures by using the average of the measurement over time in the analysis.

Data collection, limitations, and solutions

The main focus in the creation of the HBS was that all the data collected should be linked with indicators required for the national (SCADD) and international (MDG) development programs. This is because previous surveys covered both everything and nothing. Therefore, our main objective became to make sure that the HBS included over 50 per cent of the national and international development indicators. We did this by intensively having meetings

¹⁸ Standardized versions of the risk measurements are used (standardized to mean zero and standard deviation one) in order to have a transparent comparison of coefficients with previous and future studies.

and workshops, including the demands and interest from other users and producers involved in data collection in Burkina Faso. These included but were not limited to the Central Bank, Minister of women's rights, UNICEF, the World Bank, the university, NGOs and other parts of the NSS. For instance, the interest of many actors was that the data collected should capture indicators for the poverty rate, sexual practices, mortality, and other aspects for children under five years old, household expenditure, labor force, health, the informal sector, the agricultural sector, domestic violence, attitudes towards subjective shocks, etc. Therefore, the implementation plan for the HBS had a core module collecting data on household expenditure and labor force each quarter, combined with rotating modules, such as collecting information from the respondents about their sexual practices, degree of involvement in the informal sector, health and medicine expenditures, and farming practices. To be in compliance with the national statistical plan of Burkina Faso, the HBS was also harmonized so that it could be compatible on a national and regional level and make it possible to disaggregate data by sex and urban/rural areas. Moreover, a very important aspect for us was that the HBS should have a low cost so that INSD could take it over or at least not be completely dependent on aid for the implementation of future survey rounds. Furthermore, it was also important that official statistics should be published continuously. Previous survey data was collected but not published accordingly. For instance, other actors conducted the publishing, which was a positive thing in the short run but not sustainable long term, as the question of who was accountable and responsible for the data was ambiguous. Therefore, in the creation of the HBS, we added a budget for analysis and publication of data. One positive outcome was that INSD now, for the first time, became responsible for what was published on its own webpage.

The challenge in creating and implanting a HBS in sub-Saharan African countries is the cost of the survey. Burkina Faso is no exception. The reason that the cost of collecting data becomes an issue is because it is related to the core question when it comes to aid and the sustainability of development. If the costs were not low enough, the national statistical office would never be able to implement the survey itself and instead be dependent on donors and the international community. Given the existence of volatilities in aid flows and other aspects of why aid may not function well, it becomes difficult, if not impossible, to have a longer perspective in terms of data collection. Previously in Burkina Faso, there was a high cost for collecting data through surveys. For example, a survey could cost somewhere around \$1.5 to 2 million USD, and only cover a short period of data collection, which is a couple of weeks. These limitations in the data collection process created an institution that was forced to reinvent the wheel for each survey, which had a devastating effect on the national statistical process. For instance, when a planned data collection was implemented, many vehicles were purchased with the purpose to transport the interviewing team to an EA somewhere in the country. However, after the

survey project was finished, the statistical office could not bear the maintenance cost of these vehicles, which implied that these vehicles were put aside. The same process repeated itself survey after survey as the projects were independent of each other.

For us, it was important to contribute to a sustainable statistical system, as we are using taxpayer money. Therefore, the vehicle issue, for example, was dealt with by repairing the former car pool, implying that instead of having X newly purchased vehicles, we now had X^2 old vehicles that could be reused. As well, instead of buying new motorcycles for interviewers to be used in the data collection process, the cost of gasoline usage was covered. We could have this approach because our plan for the HBS was long-term. The idea was to implement a survey that would be continuous. This also implied that INSD could bear the yearly cost of maintenance of vehicles or handle the cost of gasoline when the survey rounds were carried out.

Other strategies for reducing the cost of the survey were linked to human resources. As previous surveys did not have a long-term perspective, each survey employed a temporary staff of interviewers. After the survey was finished, the employment was terminated. This implied that interviewer quality could be affected, as the best interviewers might not apply for a job that is only temporary, especially in a developing country such as Burkina Faso. This is because the search for obtaining a permanent job is key. Usually, interviewers could have a mixed education background. Additionally, because the contracts were temporary, the knowledge accumulated during the data-collection process disappeared with the loss of the interviewers, as it was uncertain that the same interviewers would be found again for the next survey. Another aspect was that these interviewers received a salary that was relatively high compared to the statistician at the national statistical office. This created a problem because those who were responsible for analyzing the data now became interviewers. However, as the HBS had a panel structure, we could offer interviewers long-term contracts or permanently employ them with regular salaries, which also reduced this problem. Interviewer training, feedback, and workshops in relation to each survey round were occurring features. This increased the quality of the data, but also created an archive of question and answers linked to each survey round and module. The pool of job applications for these interviewing positions was at an all-time high at INSD, which gave us the opportunity to pick the best of the best from the pool; many were university students or graduates. The amount of applicants was so high that the ink on the stamps needed to confirm receiving each application quickly ran out.

Another strategy for reducing the cost was linked to coordination and collaboration with other stakeholders. For instance, as the HBS had different modules, it was possible to add modules in the HBS. This was exactly what was done by the World Bank, for instance, including an agricultural module with the HBS. A positive externality of including the World Bank within the

data-collection process was that it also had a value added in the data collection of consumption and expenditures.

Usually within technical assistance projects, the cost of external consultants constitutes a major part of the budget. These external consultants are an important part of the project, although the importance of their role within a project should always be evaluated. We knew that INSD had one of the best-educated statisticians in the region. We were also aware that INSD had experience from implementing surveys, even though they were often working in collaboration with some other international actor. Therefore, we reached the conclusion to reduce the use of external consultants in the HBS project. For instance, while some technical assistance projects were dependent on frequent visits of consultants (e.g., over 10 visits a year) we reduced the number of visits to between one and two visits a year. This implied that we could put more money towards collecting more data in the HBS (i.e., including the needs of more users and producers) but also implement the HBS with one-third less of an estimated budget in 2014.

Measuring consumption in previous surveys in Burkina Faso was done through the actual consumption approach, trying to measure consumed quantities multiplied by local prices. This way of measuring consumption is considered optimal if the objective is to classify households as rich or poor. The reason this approach was implemented in earlier surveys was because the consumption for each household was only measured for one week. The plan with the HBS was to have a panel structure, thus measuring the consumption in each household four times a year (i.e., four quarters over four weeks). The interviews at the household level were scheduled before each round in the HBS. Therefore, the specific households were not visited at the same time each month. For instance, household A could be visited during the beginning of a month in one survey round and at the end or middle of the month in the next round. Some experts were telling us that measuring consumption through a panel structure may reduce the difference between what a household purchase and what it actually consumes. Therefore, consumption should be measured through acquisition, as it is easier and more cost effective. Others contradicted this argument. In Burkina Faso, we measured consumption both according to the acquisition and the actual consumption principles. We made it into an empirical question. The reason we chose this middle way was because consumption statistics, in particular poverty estimates based on them, can more easily be disputed if they are not following international recommendations.

Essay summaries

This section provides a summary of each of the five independent essays that constitute this thesis. Four of them are coauthored and the final essay is individually authored. This is followed in the next section by a discussion of the main results and conclusions of each essay.

Essay I: Individual's risk attitudes in sub-Saharan Africa: Determinants and reliability of self-reported risk in Burkina Faso

Willingness to take risk is an important factor in almost every economic decision making, as individual risk attitudes are a core determinant of economic behavior. Risk taking is particularly an important topic in sub-Saharan Africa because access to financial institutions and social security is scarce. Data on risk attitudes in sub-Saharan Africa is limited and the available data collected might not be reliable. In this essay, we investigate individual's risk attitudes in a large nationally representative panel survey of 31,677 individuals from Burkina Faso. Our risk measurements are the same as used in previous nationally representative surveys such as the German Socio-Economic Panel.¹⁹ Our findings are in line with previous research about the determinants of risk attitudes (e.g., Dohmen et al., 2011; Hardeweg et al., 2013; Vieider et al., 2015). We find that willingness to take risk is significantly associated with sex and age. Women tend to report to be less risk taking than men. Older respondents responded that they are less risk taking than younger respondents. While other determinants, such as parents' (and own) level of education, economic status, health and/or marital status, are also significantly associated with individuals' risk taking, their contribution as a determinant of risk attitudes is not as large as sex and age. We also find that our risk measures predict risky behavior. Additionally, we find support in this essay for the argument that risk attitudes are domain specific, which is in line with previous literature in economics and psychology (Weber et al., 2002; Vlaev et al., 2010; Highhouse et al., 2016). For instance, women (and older individuals) are less willing than men (and younger individuals) to take risk in traffic than in both general and financial matters.

The estimates of the test-retest reliability of 31,677 individuals' self-reported risk measurements in general, traffic, and financial matters in this essay indicates that our risk measures are quite stable and to a large extent comparable to previous studies from developed countries using the same self-reported risk questions.

¹⁹ The same type of risk measurement has been used in other surveys and countries by previous research, such as in China (Ding et al., 2010; Jin et al., 2017), Germany (Dohmen et al., 2012), Netherlands (Wölbert and Riedl, 2013), Thailand and Vietnam (Liebenehm et al., 2015) and Sweden (Beauchamp et al., 2017).

Essay II: Intergenerational transmission of risk attitudes: The role of gender, parents and grandparents in Burkina Faso

Economists usually assume individual attitude endowments to be exogenous. Until recently, discussions of how and from whom these attitudes are endowed have been limited. The literature focusing on intergenerational transmission assumes the family to be an important institution for the endowment of attitudes, in particular the transmission from parents to children (Bisin and Verdier, 2000). In addition to the role of parents for children's attitudes, there is a growing literature within sociology and economics that investigates the role of grandparents for socio-economic outcomes through a multi-generational approach (for a recent overview on educational outcomes, see Anderson et al., 2018). The argument is that grandparents, who are present in the life of their grandchildren, could also be a source of transmission in shaping individuals' attitudes. This essay provides evidence about whether an intergenerational and multigenerational transmission of risk attitudes exists in a sub-Saharan African country and investigates if risk attitudes are gendered depending on specific risk domains.

The findings in this essay show a positive and strong transmission of risk attitudes between generations. We see that a transmission of attitudes from both mother and father to their child's risk taking exists within different domains. The intergenerational transmission is robust even when including the influence of the local environment. The findings of this essay also indicate a multigenerational transmission of risk attitude in Burkina Faso. However, the magnitude decreases when controlling for parents' risk attitudes, implying a mediating role for the parents between the grandparents and children. Moreover, since there are strong gender roles in Burkina Faso, we find that the transmission of attitudes from mothers have a stronger associative effect on their daughters' risk attitudes compared to their sons. For fathers, we see the reverse effect. Furthermore, the results show that heterogeneity exists in the intergenerational transmission of risk attitudes across risk domains. For instance, in the male-dominated risk domain (traffic), the transmission of risk attitudes from fathers to daughters is relatively stronger than in the female-dominated risk domain (financial matters). Meanwhile, the transmission of risk attitudes from mothers to sons is relatively stronger in the female-dominated risk domain (financial matters) than in the male-dominated risk domain (traffic). This gender heterogeneity in risk domains implies that children are socialized more by the parents in the domain that they are more exposed to.

Essay III: Sibling correlation in risk attitudes: Evidence from Burkina Faso

The family is a focal institution that shapes an individual's preferences. The emphasis is usually placed on the parent-child relationship, as indicated by the

growing empirical literature on the transmission of attitudes between parents and children such as precautionary behavior (Yeung et al., 2000), gender roles (Fernandez et al., 2004), family values (Mason 2007), trust and social capital (Tabellini 2008), non-cognitive abilities (Grönqvist et al., 2016), and time devoted to housework (Gimenez-Nadal et al., 2017). Transmission of risk attitudes has been investigated to a much lesser extent. However, there are some exceptions. Kimball et al. (2009) find a positive association between parents and their adult children's risk taking with hypothetical income gambles questions. Dohmen et al. (2012) and Sepahvand and Shahbazian (2017b) show evidence for the existence of an intergenerational transmission of risk attitudes with self-reported risk questions. Although there is a tradition in economics and sociology of investigating family influences through intergenerational correlation (e.g., Björklund and Jäntti, 1997; Chadwick and Solon, 2002; Black et al., 2005; Mood et al., 2012; Blanden et al., 2013; Mood 2017), parental influence is only one of many ways that individual's preferences are shaped. Besides genetic endowments and parent-child socialization, factors such as neighborhoods, schools, and other institutions may shape the child's choice, such as obtaining higher/lower levels of education, employment, income, or risk. Therefore, sibling correlation has been argued to be a broader measure in capturing the influence of family and community background for outcomes in adult life (e.g., Solon et al., 1991; Conley and Glauber, 2008; Black and Devereux, 2011; Björklund and Jäntti, 2012; Aparicio-Fenoll and Oppedisano, 2016). Sibling correlation has a straightforward interpretation: it is the fraction of the variation in an outcome that can be explained by factors that siblings share. Siblings who have grown up together share the same environment. Thus, sibling correlation is an omnibus measure of the importance of family background and community influence. It thereby captures anything that is shared by siblings both inside and outside the family (such as parental influence but also school, religious institutions, and neighborhood influence), while at the same time capturing anything that is not shared by siblings, (such as genetic traits not shared, different treatment of siblings and changes in neighborhoods, schools, etc.).

The results of this essay indicate that the influences of family and community background are larger than previously shown, based on intergenerational correlation studies on risk attitudes. The results from this essay have also clear policy relevance. The usage of motorized transportation, especially motorcycles in sub-Saharan African countries, has increased in the last decades (e.g., Cervero 2013). However, traffic fatalities have also increased.²⁰ The results from the transmission of attitudes within the family show that the father's risk attitudes in traffic have a larger effect than the mother's, on the size of the sibling correlation of risk attitudes in traffic. Previous campaigns designed to

²⁰ WHO's Road Safety database, estimated number of road traffic deaths by country, income level and type of road user: http://www.who.int/gho/road_safety/mortality/en/

increase traffic safety, such as wearing a helmet, have been shown to be successful in many countries, such as India (Mohan et al., 2016), China (Chang et al., 2016), and Spain (García-Herrero et al., 2017). Therefore, by simple means like the public helmet-wearing campaign in sub-Saharan African countries where fathers influence their children to wear helmets, for example, may decrease the likelihood of serious injury and mortality in traffic.

Essay IV: Does revolution change risk attitudes? Evidence from Burkina Faso

A popular uprising in 2014, led to a revolution that overthrew the sitting president of Burkina Faso, Blaise Compaoré. In this essay, we investigated if individuals' risk attitudes changed by experiencing a large, general exogenous shock—a revolution. Specifically, we investigated the impact that the revolution had on risk attitudes, by gender, age, and level of education. The analysis is based on a unique nationally representative panel Household Budget Survey, which allows us to track the changes in the risk attitudes of the same individuals before, during, and after the revolution. Our results suggest that the impact of the revolution is short term. Individuals become risk averse during the revolution, but converged back to the pre-revolution risk attitudes, slightly increasing their risk taking after the revolution is over. Women exhibited more risk taking behavior than men after the revolution, but were more risk averse during the revolution. In general, older individuals tended to have higher risk-aversion than the younger individuals. During the revolution, however, the individuals with higher levels of education were more risk averse.

Essay V: Agricultural productivity in Burkina Faso: The role of gender and risk attitudes

The sources and consequences of gender differences in agricultural productivity between female and male farmers have attracted a large interest, particularly in sub-Saharan Africa. Because growth in agricultural productivity has been identified as a key driver of poverty reduction and increased food security. Previous studies show that an increase in agricultural productivity in sub-Saharan Africa improves the living standard through increases in income and food security and decreases in poverty (e.g., Irz et al., 2001; Ligon and Sadoulet, 2008). Most recently, the Food and Agriculture Organization of the UN (FAO) (2011) estimated that if female farmers had the same access to productive resources as men, they could increase yields by 20 to 30 per cent, which could increase total agricultural output in developing countries by 2.5 to 4 per cent and lift between 100 to 150 million people out of hunger. However, within the economic literature, it has often been argued that females' lower measured productivity or inability to respond to economic incentives is due to their inability to take higher risk, for instance the gender gap disappears in the

higher-payoff treatments when women express a higher willingness to take risk (e.g., Averett et al., 2018). Thus, through this line of reasoning, female farmers would experience a higher level of productivity if they take higher risk.

In this essay, I provide estimates that indicate lower productivity for female-owned plots as the female farmers' risk taking increase. The findings show lower productivity for female farmers as their risk taking increases. These results have clear policy relevance as policy interventions to reduce the credit constraints for female farmers in sub-Saharan African countries could be encouraged. The findings are robust to alternative specifications. However, findings vary depending on a number of factors: the type of crop cultivated, the share of female farmers in the region, the soil quality, type of seed used and by the poorest and richest consumption quantiles of farm households. The plot-level productivity is lowest among crops that require large quantities of inputs of fertilizer and labor, possibly owing to the lack of credit access. Findings also indicate that agro-ecological zones matter, as the size of gender differences for high risk taking female farmers is lower in the driest regions of the country.

Concluding discussion

In this section, I present a concluding discussion of the results of the five essays in relation to the aim of the thesis. The aim was to improve the understanding of three central aspects of risk taking: stability of risk preferences, individual attitude endowment, and the interaction of risk and gender on agricultural productivity. In the beginning of the thesis, three central themes were formulated that have guided the five studies.

The first theme was related to the stability and validity of risk preferences. In Essay I, I discussed the main methodological requirements for an empirical research agenda on risk preferences: validated measures of risk preferences and a strict definition of what it means when preferences are stable. In economics this definition implies that individual risk attitudes are constant over time. The standard approach to test the definition of preference stability is by analyzing the test-retest reliability of the measurement capturing the preferences. Our results showed that the reliability was satisfactory and to a large extent comparable to other studies using the same risk measurements as ours.²¹ These are the first results so far, focusing on the reliability of self-reported risk attitudes in a developing country. Later on, I also proceeded with

²¹ To the best of our knowledge, there are only three studies that examine the reliability for the same risk measurements as ours (Lönnqvist et al., 2015; Beauchamp et al., 2017; Dohmen et al., 2016). There are other studies that have also attempted to address the reliability of risk question over time with different risk measurements than ours, such as a typical multiple price list (Andersen et al., 2008 [n=97]), gain/loss lotteries (Zeisberger et al., 2012 [n=86]), hypothetical

the concept of preference stability by investigating the impact of a large exogenous shock on individuals risk attitudes. Regarding the validity prerequisite, the risk measurements (self-reported risk questions) used in this thesis, has been proven to capture individuals risk preferences by comparing them to incentivized lottery experiments in developed countries (e.g., Dohmen et al., 2011; Lönngqvist et al., 2015), emerging countries (e.g. Hardeweg et al., 2013), developing countries, and, comparatively, for 30 countries (Vieider et al., 2015). In a further attempt to check the validity of our risk measures, we compared the individual characteristics determining risk taking in previous research with our findings. Previous research in developed (Dohmen et al., 2011) and developing (Yesuf and Bluffstone, 2009) countries indicate that individual characteristics such as gender, parental education, own education, and age are important determinants of risk attitudes. These findings are also in line with the findings of this thesis. We also detected, as a step to determine if our survey risk measurements are useful for explaining and predicating risky behavior, positive correlation between our risk measures and risk taking behavior (e.g. self-employment, drinking, smoking) as one expects, providing further confirmation of their behavioral validity.

In Essay IV, we returned to the question about the stability of (risk) preference, as it is conceptually at the heart of microeconomics. For a long time, the consensus in influential economic models was that individuals have stable preferences over time, which is exogenous and fixed at least in the short term (Stigler and Becker 1977). However, recent empirical economic studies have suggested that individuals risk preferences can be altered by various general large exogenous shocks, such as natural disasters (Eckel et al., 2009), financial crises (Sahm 2012), and traumatic events from conflicts (e.g., Voors et al., 2012) etc. Yet, there is no consensus about the direction of these exogenous shocks and how they affect risk preferences. Some studies find that experiencing a shock makes the individuals more risk tolerant (Voors et al., 2012), others suggest that individuals become risk averse (Cassar et al., 2017), while some find that women do not change their risk level while men become more risk tolerant (Hanaoka et al., 2018).

The unique panel data used in this thesis allowed us to identify the effect of a large national exogenous shock, the 2014 Burkina Faso revolution, on individuals' risk attitudes. This panel structure made it possible to track the changes in risk attitudes of the same individuals before, during, and after the revolution to control for unobserved individual heterogeneity. It also gave us the possibility to examine if individuals were more likely to participate in the

income gambles (Barsky et al., 1997 and Kimball et al., 2008 [n=693]) and different types of self-reported risk question than ours (1-5 scale, with different random ordering of scales) over time (Weber et al., 2002 [n=121]). However, the studies that found reliability results that are more than only moderately stable over time are those that use the same self-reported willingness to take risk question as in this thesis. These findings support the use of this observed risk measure for the underlying objectively measurable risk attitudes.

uprising (risk seeking) rather than staying indoors (risk averse). Our empirical evidence showed that the exposure to the revolution did, in fact, have an impact on the individuals' risk attitudes. Individuals become risk averse during the revolution, but they converged back to their pre-revolution level while slightly increasing their risk taking after the revolution was over. Therefore, we contributed to filling a gap in the literature about what direction the impact of a major shock has on individual's risk taking and hence directly addressed the question of stability of risk preferences. However, is this stability transitory? Our reference period captured the last two quarters of 2014. It is important for future research to understand how a large exogenous shock, a revolution, impacts individuals' risk attitudes in the long term. A long-term impact would imply that the shock might have a persistent impact on risk taking and, hence, decision making. One notable exception is a similar study by Hanaoka et al. (2018), which finds persistent results over a long-term period, where men who live in the areas affected by an earthquake are still risk tolerant five years after the event occurred. This implies that large shocks have the potential to have a persistent impact on individuals risk preferences over time. This may have important policy relevance for several developing countries that are experiencing major political, social and economic changes. Suggesting that a social uprising and a revolution increase risk aversion, which possibly could reduce self-employment, investments and total factor productivity, which in turn can amplify macroeconomic downturns. This would be devastating for developing and sub-Saharan African countries aiming to create sustainable growth.

From my point of view, economic research on measurement of risk preferences (in particular the recently emerging research) has established the fundamentals for investigating stability of risk preferences. However, we economists can still do better in improving the ways of measuring risk preferences. As a result, I started an interdisciplinary collaboration with a sociologist in order to adopt other standards for improving the measurement tools for risk preferences. I believe in a standard that aims for using risk measures with a higher (or highest) test-retest stability (or reliability) in shorter time periods in a panel data, as this will reduce measurement error, given no large exogenous shock.²² We economists should apply these risk measurements more broadly. I believe that in future work, economists should search for understanding if (risk) preference stability is temporary or not, by investigating the changes in risk attitudes over longer panel survey periods.

The second theme was related to individual attitude endowment. Inspired by predictions from the models of Bisin and Verdier (2000) and the limited empirical results regarding the role of the family as a focal institution that

²² Because, the consensus in influential economic models is still that individuals have stable preferences that are exogenous and fixed at least in the short term (Stigler and Becker 1977).

shapes an individual's risk preferences,²³ in Essay II and III we investigated the risk attitude transmission process both vertically from parents, grandparents, or other roles models to children and horizontally between siblings. However, models of transmission of attitudes within the families have typically been abstracted away from aspects such as gender, as the models are adopted for developed countries institutional settings. Therefore, we offered an alternative conceptual framework for understanding the attitude transmission process in a development setting: the role of gender. Social learning theory was our underlying perspective for explaining how transmission of risk attitudes across and between generations can be gendered. The results of this thesis provide evidence regarding the overall importance of family and community background as determinants of risk attitudes by examining an intergenerational and multigenerational transmission of risk attitudes, estimating sibling correlations in risk attitudes, and investigating if risk attitudes are gendered depending on specific risk domains. This is in line with the recent economic literature within the intergenerational transmission of other outcomes where not only father-son transmission is studied, but also the transmission of both parents on their respective son and daughters (e.g., Niknami 2010; Hederos Eriksson 2015). Moreover, our results can be linked to the choice of risky occupations, where Lindquist et al. (2017), for instance, argue that the risk attitudes of parents are likely an important mechanism that contributes to sibling similarities in the choice of risky occupations, and capturing such variation is suggested to be an important avenue for future research.

The final and third theme was related to the interaction of risk and gender on agricultural productivity. In Essay V, I aimed to deal with one of the most important policy questions in Africa and many other developing countries across the world, the existing gender difference in agricultural productivity. The alleviation of gender differences has been one of the key drivers in reducing poverty and increasing food security while simultaneously aiming for individual's livelihoods and promoting gender equality. This is not only a policy advocated by the international donor community and national policymakers but also intertwined with the United Nations 2030 Agenda of a Sustainable Development, which has led to an increased attention on gender analysis in agricultural research in the past decade. However, it has often been argued within the economic literature that females' lower measured productivity or inability to respond to economic incentives is due to their inability to take higher risk. Thus, through this line of reasoning, female farmers would experience a higher level of productivity, if they take higher risk. Essay V offers

²³ A notable exception being Dohmen et al. (2012). Otherwise the emphasis is usually placed on the transmission of attitudes between parents and children in terms of precautionary behaviour (Yeung et al., 2000), gender-roles (Fernandez et al., 2004), family values (Mason 2007), trust and social capital (Tabellini 2008), non-cognitive abilities (Grönqvist et al., 2016) and time devoted to housework (Gimenez-Nadal et al., 2017).

multiple understandings for future research on gender differences in agricultural productivity.

The results showed that the female farmers taking more risk are less productive on average when compared to the male farmers, i.e. the gender differences did not disappear but instead increased when including risk as a possible interaction with gender. Therefore, individual farmer's level of risk taking should be taken under consideration when analyzing gender differences in agricultural productivity, and where possible robustness checks for farmers' risk attitudes should be conducted to provide more credible results. This implies that attention should be paid to risk attitudes at the onset survey design, rather than ex-post analysis using proxy indicators collected in surveys, such as smoking or drinking, as these proxies for risk attitudes have not been able to capture this dimension of gender differences in agricultural productivity. A valid and reliable risk measure is an important input for designing agricultural price and income support instruments, as it exists a lack of a high degree of consensus in the agriculture economics literature regarding the level of farmer's risk taking (e.g., Couture et al., 2010).

The risk questions used in this thesis to measure risk attitudes have been utilized in numerous studies and is a fairly easy and cost-effective risk measurement for researchers and practitioners to implement in other countries and repeatedly in panel surveys. This allows for comparison across time and countries. This is important since replicability and reproducibility of scientific findings have recently reemerged as a salient factor (Dreber et al., 2015; Camerer et al., 2016), by being able to use and analyze the same measures as previous studies.

To summarize, understanding what determines and shapes individual risk preferences over time is key to designing effective policies, as well as improving our understanding of individual decision making in least-developing countries, predominantly dependent on agriculture and vulnerable to climate change.

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